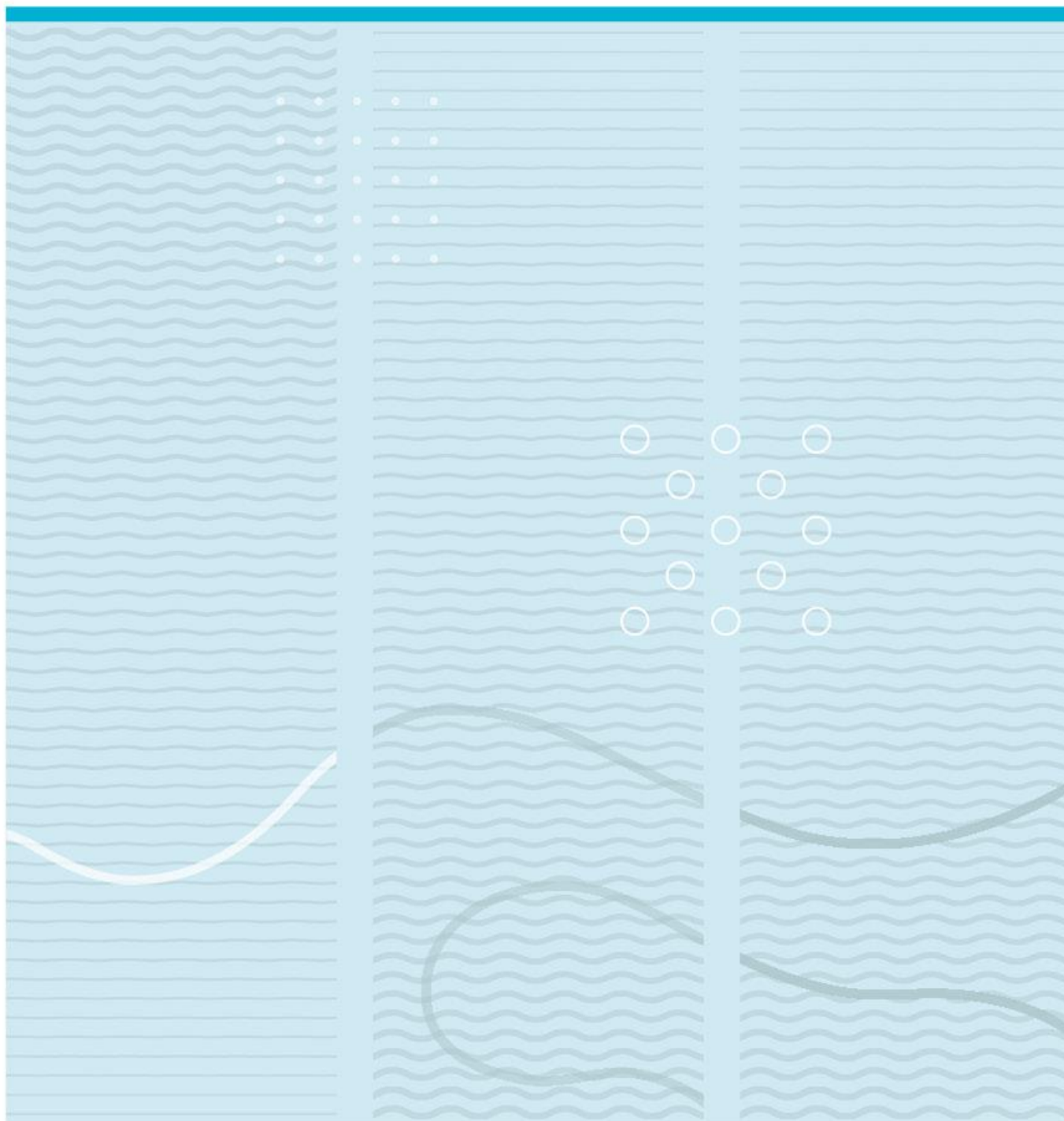




Trine Moa

Exploring the complexity, role and functions of innovation brokers in system innovation and sociotechnical system change

A study of a Nordic intergovernmental innovation intermediary organisation



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This thesis is worth 30 study points

Abstract

It is increasingly acknowledged that, to achieve sustainability, there is an urgent need for radical and transformative restructuring of socio-technical systems, referred to as system innovations for sustainability or transitions. The aim of the study was to investigate the contribution of innovation intermediaries in sociotechnical transitions and how the complexity of the transition context influences the innovation intermediary role and activities. Particularly, the study provides input in the lack of practical knowledge on how systems can be changed deliberately by intermediary activities.

The conceptual framework is built on the multilevel perspective (MLP) and strategic niche management (SNM) to explore the roles and functions innovation intermediaries can play at each transition management level, here with a particular focus on sustainability transitions and the three processes of SNM. The study presents an embedded single case study of an intergovernmental Nordic innovation intermediary organisation that acts as an innovation broker', where intermediation is the organisation's core function. Here, I seek to identify examples of intermediating that have created the momentum for system change and that can illustrate the role that intermediaries can take.

The findings reveal that sustainability transitions need systemic intermediaries because they play a role in voicing new visions and in piloting and testing niche solutions; as convenors, they can bring together the different people involved in acting to change a system. Yet it is difficult to demonstrate their effect on sociotechnical transitions because of attributability challenges and the intangibility of some of their inputs, as well as the long-term picture of system innovations and transitions and the restricted engagement period of the intermediary activities.

Keywords: sociotechnical transitions, system innovation, innovation intermediaries, transformative outcomes, strategic niche management, multilevel perspective, sustainability transitions

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Foreword

The thesis marks the end of my master's degree in Innovation and Leadership at the University of South-Eastern Norway. The Master programme is designed to give expertise for practicing management at both a strategic and an operational level, and to give a sound understanding of how individuals and groups work together with the environment, and functions that involve leadership, organisation and innovation processes in practice.

First and foremost, I would like to express my gratitude to my supervisor Kristin Bentsen, who has kindly and patiently supported me with valuable and constructive supervision throughout the whole process. I would also like to thank all fellow students in this master's program for sharing professional and personal thoughts. Special thanks to fellow student Mozhd Mir, for the memorable road-trips to campus, the friendship, motivation and good input during the program and assignment. A big thank you goes to my employer for its support and to colleagues for their time and effort and for openly sharing their experiences and knowledge in my interviews.

Last but not least, huge thanks to Andy, Max and Lucy and the rest of my family and friends. Their love, support and company have been and will always be my motivation to keep going forward.

Trine Moa

A handwritten signature in black ink, appearing to read 'Trine Moa', with a stylized, cursive script.

Oslo 10/06-2021

1 Introduction

It has increasingly been acknowledged that addressing the key challenges currently facing our societies, there is a need for transformative restructuring of current sociotechnical systems (Schot & Steinmuller, 2017). Sociotechnical transitions, such as the ongoing shift from fossil fuels to renewable energy, are dynamic processes, incorporating not only technological change, but also changes in user practices and institutional structures (Loorbach, 2007). As such, the need for sociotechnical transitions contributes to a wider outlook at innovation, moving beyond product and process innovation to focus on change within and to a system. Hence, to achieve sustainability, joint activities and problem solving between a variety of actors have been seen as crucial to create innovation facilitating these transformations.

The wider outlook on innovation and interaction between different actors has led to considerable attention being placed on organisations that fulfil an intermediary role; these intermediaries are defined as *'an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties'* (Howells, 2006, p. 720). Moving towards a systemic view of innovation and the type of act needed for cocreation, the notion of systemic intermediaries has been introduced. Rather than acting bilaterally and being focused on a single product, these specific types of innovation intermediaries connect multiple actors and navigate across the various innovation system elements (Van Lente et al., 2003).

Kivimaa et al. (2019, p. 1072) describe system intermediaries as *'actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes to create momentum for sociotechnical system change, to create new collaborations within and across niche technologies, ideas and markets, and to disrupt dominant unsustainable sociotechnical configurations'*. Thus, system intermediaries need to operate in highly complex environments (Manders et al., 2020) and deal with the long-term characteristics of the change process while coping with uncertainties, interdependencies and diverging interests. System intermediaries also need to involve a variety of different actors with different interests to build and manage networks that can support the transition. Because the roles of actors constantly change, the intermediary roles are also subject to change, as are the whole ecologies of the intermediaries

in the various phases of a transition (Kivimaa et al., 2019). Therefore, system intermediaries must be explicit about their position and credibility because they depend on other actors.

The literature on sociotechnical transitions acknowledges that the intermediaries are important actors in accelerating sociotechnical transitions, particularly in the creation of 'niche innovations' and regime transitions (Geels, 2012). However, the explicit roles and functions of intermediaries have seldom been addressed (Kivimaa, 2014). Combining theories on innovation intermediaries and sociotechnical change lays the theoretical foundation for forming the analytical framework to explore the activities and roles that innovation intermediaries can play in sociotechnical transitions, here with a particular focus on sustainability transitions and strategic niche management (SNM) (Schot & Geels, 2008). As such, the current study provides inputs into the lack of practical knowledge on how systems can be changed deliberately by intermediary activities and how new systems can be brought into being.

The present study presents an embedded single case study of an intergovernmental innovation intermediary organisation acting as an 'innovation broker' (Klerkx & Leeuwis, 2009; Winch & Courtney, 2007), where intermediation is the organisation's core function. The innovation intermediary organisation describes itself as an organisation acting as an innovation broker at the system level, converting political visions to action as a Nordic innovation policy instrument, serving the interests of both regime and niche actors. As such the organisation takes on a wide variety of intermediary roles in the transition context. Three 4-year innovation programmes with sustainability aims were selected as the embedded units of analyses, and through in-depth interviews of the programme staff, I sought to find examples of intermediate activities and roles. Hence, the idea was to develop a better understanding of how intermediaries are operating and their intermediary structures, such as their position and role, including their neutrality, biases, dependencies and capabilities and intermediary activities that can be found in the complexity of sustainability transitions.

The findings imply that sustainability transitions need systemic intermediaries because they have a role in voicing new visions; they are also needed in piloting and testing niche solutions, and as convenors, they can bring together the different people involved to change a system. Yet it is difficult to demonstrate the impact of the intermediary activities on sociotechnical transition

because of attributability challenges and the intangibility of some of their inputs, as well as the temporal dimension of the activities and the long-term perspective required for transitions. As such, further research is needed to explore the systemic innovation management process of system intermediaries, which could contribute to a better understanding of how to monitor and measure the impact of system intermediaries in sociotechnical transitions.

1.1 Research questions

Drawing on the abovementioned literature, the current study will attempt to answer the following research questions:

RQ1: How does the complexity of the transition context influence the intermediary's roles and activities?

RQ2: What are the main contributions of innovation intermediaries when it comes to accelerating sociotechnical transitions, particularly in SNM?

In the context of sociotechnical innovation systems, I focus on the innovation activities, as facilitated by technological niches, by defining innovation systems around societal problems.

1.2 Background and context

The present thesis was conducted within the context of a Nordic intergovernmental innovation intermediary organisation for innovation and sustainable growth in the Nordic region. The organisation is funded through a Nordic cooperation programme. The cooperation programme describes the primary challenges and areas for cooperation, setting a clear direction for Nordic cooperation on business policy.

Thus, the cooperation programmes highlight the many societal challenges that the Nordic countries face. Climate change and increasing pressure on the world's natural resources mean that the Nordic region must undergo a green transition if they are to continue to have sustainable growth and a welfare society that benefits both present and future generations. The Nordic countries also share the demographic challenge of an increasing and ageing population; this will result in increased demand, increased pressure on resources and a challenge to the Nordic welfare states.

At the same time, globalisation and technological development present Nordic companies with both challenges and opportunities, including digitalisation, automation and new business models, as well as the challenge of a more volatile and unpredictable economy. Volatility and unpredictability require Nordic companies to be capable of changing the way they run their businesses at short notice and adapting ever more rapidly to, for example, the green transition, if they are to remain competitive.

Nordic countries are small players in the global arena, but together, the Nordic region has the strength of its 26 million inhabitants; according to real per capita GDP, it is one of the world's richest regions (State of the Nordic Region, 2020). This strength is reinforced by the region's concentration of expertise, innovation, and knowledge-intensive companies. Moreover, the region has a long tradition of cooperation and intraregional trade, as well as many shared values, such as equality, transparency and rule of law.

Building on strongholds identified by the national innovation and trade promotion organizations and where the Nordic countries have complementary advantages, the organisation developed three comprehensive programmes which contribute to fulfilling the sustainability goals of the cooperation program. The programmes were all cross-sectoral, open and wide-ranging and allowed for final concretisation and delimitation to take place at the project level. Simultaneously, the programmes indicated direction and Nordic positions of strength in response to Nordic and global challenges. By using broad definitions, the programmes consider technological development, innovation and changes that cannot be predicted currently while also taking into consideration stimulating innovation and cooperation across sectors and ecosystems.

1.3 Boundaries of the thesis

Because sociotechnical systems are complex, it is wise to limit one's ambitions. I have limited my study to the perspective of one intergovernmental innovation broker and the Nordic context. The empirical focus has been limited to three innovation programmes in the operationalisation of a Nordic cooperation programme. The empirical research will focus on the innovation broker organisation as an innovation intermediary in system innovation. As such, the study does not evaluate the programme results because the focus is on intermediary role and functions within the complexity of sociotechnical transitions.

2 Theoretical Framework—The Concept of Innovation Intermediaries: System Innovation and Sociotechnical Change

This section introduces the theories used in the current study. On the one hand, they are the sources of research interest and founding framework for the research questions, while on the other hand, they contain the elements and insights used in building the analytical framework. The relevant theories lie in three academic fields: the concept of innovation intermediaries, system innovation and sociotechnical change. In the field of sociotechnical change, two theories have contributed to the understanding and conceptualisation used in the present study: the multilevel perspective (MLP) and SNM. The theories lay the theoretical foundation for the formation of the analytical framework to explore the roles and functions that innovation intermediaries can play at each transition management level.

2.1 System innovation and sociotechnical change

2.1.1 System innovations for sustainability

Society faces both deeply entrenched and growing challenges that are outpacing the systems we have. These are interconnected social, economic, and ecological challenges. We also have opportunities to create new, alternative systems as new knowledge, values and technologies emerge, from artificial intelligence to circular and renewable systems of production (Freeman & Perez, 1988, pp. 46–47). A persistent systemic challenge makes the search for systemic opportunities more pressing, and the emergence of an alternative system makes it easier to reduce our reliance on what is in place now. An example is COVID-19 because the pandemic has exposed underlying strains in current systems, accelerated change and created the urgency for a collaborative effort to find better solutions. As such, taking action to change systems depends on new ways of seeing both the challenge and opportunities in the problem–solution space (Wanzenböck et al., 2020), including how new systems form and what and who is part of initiating and driving the transition. Hence, to act more deliberately and effectively to change, the involved system actors need to see and think about the systems in different ways to understand both the depth of the challenge and the scale of the opportunity, as well as the dynamic, collaborative processes of system innovation.

To respond to the societal challenges, in order to achieve sustainability, it is increasingly acknowledged that there is an urgent need for radical and transformative restructuring of socio-technical systems that meet our needs (Schot & Kanger, 2018, p. 1045) These transformations cover institutional, social/cultural, organisational as well as technological change (Loorbach, 2007), and hence need to take place at the societal level. The process of societal transformation needed to achieve sustainability is defined as system innovation and described as ‘a transition from one sociotechnical system to another’ (Geels, 2005, p. 2), and understood as multi-phase, multi-level dynamic and long-time processes that result in mainstream practices getting outdated and replaced by a set of new practices (Geels F. W., 2005; Loorbach, 2007). Because system innovation is a transformation that takes place in the wider societal context, it covers not only product and process innovations, but also the changes in user practices, markets, policy, regulations, culture, infrastructure, lifestyle and management of firms (Geels, 2005, p. 1); it also involves social innovation because the focus is on many social elements and their relations with technological opportunities (Schot & Steinmuller, 2017, p. 15). In other words, system innovation occurs when the societal system functions differently and, thus, when there is a requirement for a fundamental structural change (Frantzeskaki & de Haan, 2009, p. 598)

2.1.2 Multilevel perspective (MLP)

Geels (2002, 2005) has developed one of the most researched models for understanding the dynamics of large-scale sociotechnical system transition, particularly when it comes to transitions towards sustainability and resilience (Geels, 2010). The MLP illustrates how change comes about through a combination of developments at three levels of system change: the macro, meso and micro levels. A basic premise of the MLP is that transitions are nonlinear processes and innovating across a system or creating a new system means engaging with each of these levels at the same time (Geels, 2012, p. 472). To understand what drives the process of transition, it is useful to see how the actions at these three levels work together, as illustrated in Figure 1.

Increasing structuration
of activities in local practices

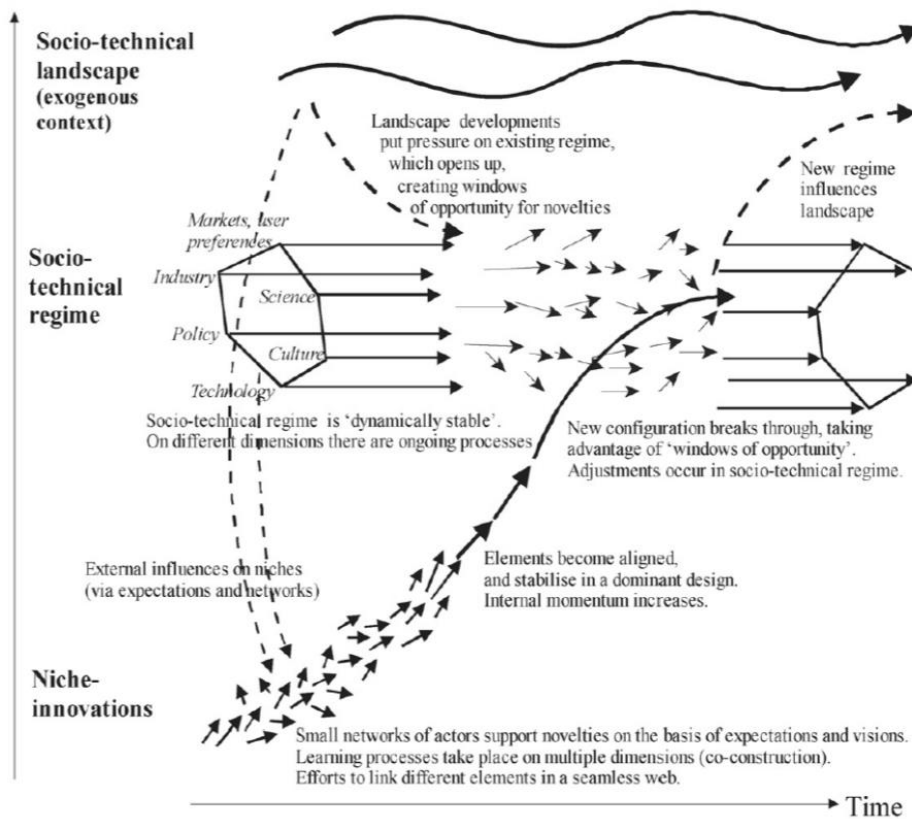


Figure 1. Multilevel perspective on transitions (Source: Geels & Schot, 2007)

Niche innovations

Change at the **micro** level starts through innovation, entrepreneurship and creativity in 'niches', where people start to develop radical new solutions, habits and ways of life that deviate from existing regimes (Geels, 2006). Niches are protected spaces that allow experimentation with the co-evolution of technology, user practices and regulatory structures (Schot & Geels, 2008, s. 537). The purpose of these niche innovations is not necessarily to change entire systems but to respond to local needs and opportunities. Because the performance of radical novelties is low, niches then function as protected spaces that act as incubation rooms, allowing for research and experimentation (Geels, 2006, p. 171). Niche actors hope that their promising novelties will eventually be used in the regime or even replace it. This is not easy, however, because the existing regime is stabilised by many lock-in mechanisms and because niche innovations may display a mismatch with existing regime dimensions (e.g., the lack of appropriate infrastructure, regulations or consumer practices). However, niches are crucial for transitions because they provide the seeds for systemic change (Geels, 2011).

Sociotechnical regime

Change is most powerful when it affects the **meso** level, what Geels (2002) calls 'the regime'. Hoogma et al. (2002, p. 19) define a regime as *'the whole complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, institutions and infrastructures'*. The 'structuration' of this facility is high, providing stable rules and coordinating effects on the actors designated by the regime, such as shared beliefs, competence, lifestyles and user practices. Thus, the regime is the engine room of the system and a combination of institutions, technologies, markets and organisations that give a system its structure. Because of lock-in mechanisms and path dependency, innovation is mainly incremental in existing regimes (Geels F. W., 2005, s. 13)

Sociotechnical regimes are composed of three types of semi coherent rules: regulative rules, which 'constrain behaviour and regulate interactions', normative rules, which are related to 'values, norms, role expectations, duties, rights, responsibilities', and cognitive rules, which 'constitute the nature of reality and the frames through which meaning or sense is made' (Geels F. W., 2011). These rules guide the actions of the actors in the sociotechnical regime while being shaped through their actions at the same time. As a result, regimes and regime actors together contribute to the stability of existing sociotechnical systems because of the actors are embedded in existing system structures and social networks, and their actions are influenced by and reinforces the existing rules, in turn making the actors, their organisations and the systems resistant to radical changes (Geels, 2005; Geels & Schot, 2007). The implication is that the quality of incremental innovations that are subsequently generated within a new regime will be radically different from those under the preceding regime; hence, system transition happens when one regime gives way to the emergence of the next.

Sociotechnical landscape

Entrepreneurial ventures, creating nice innovations, are critical to forming a new system, however they are more likely to take off when they give concrete expression to big shifts in values and needs, because this is when they can catch a wave of change to take them forward (Geels & Schot, 2007). This occurs when niches connect to broad changes at the **macro** level, which is referred to as the 'landscape' (Geels, 2005). The sociotechnical landscape is the exogenous environment serving

as ‘the technical, physical and material backdrop that sustains society’ (Geels & Schot, 2007, s. 403). Key elements at this meta level include macro-economics, deep cultural patterns and macro-political developments (Geels, 2005b; Geels & Schot, 2007). The exogeneous context includes both slow-changing secular trends such as societal values and political ideologies, demographic trends and economic patterns and shocks, for example, recessions, wars and pandemics, all of which lay beyond the control of individual actors.

System innovation must engage with all three levels at the same time because transitions in the multilevel perspective occur through interactions between the processes at all three levels. Niche innovations build internal momentum, changes at the landscape level create pressure on the regime and destabilisation of the regime creates ‘*windows of opportunity*’ (Geels, 2012, p. 473) for niche innovations to provide possible alternatives. Actors working in new niches must be attentive to changes in the landscape as new demographics, values, demands and possibilities take shape; they need to work with policymakers and regulators who might help open the market for their solutions while finding ways to collaborate with innovators inside the ‘regime’ who want to adapt to these changes.

Although the MLP has become a core notion in the field of transition dynamics, it has been criticised from several aspects by scholars such as Smith et al. (2005), who argue that the description of the process of regime transformation overlooks contextual factors and is excessively functionalist. For example, the discussion about ‘agents’ in transformations is overlooked, and the process of how niches link up to regimes and initiate a regime shift is still not clear. Further, Smith et al. (2005) want more of an emphasis on a governance perspective of transitions, one that incorporates the concepts of context, agency and power into the overarching multilevel perspective. This line of research interest is related to another subfield of system innovation and transition studies, which is introduced in the next section.

2.1.3 Strategic niche management

Perspectives on innovation such as SNM address the above-mentioned problem of the complexity and dynamics of systems (Schot & Geels, 2008, p. 538), building on the multilevel perspective of sociotechnical change. SNM appeared in the context of broadening the focus of research technology from a narrow focus on technological innovation process towards a more inclusive

perspective on technological development as a result of interaction between technology and end-user or society. Based on insights from evolutionary economics, SNM emerged in the 1990s to address the problem of why sustainability-oriented innovations would not be able to bridge this gap between the R&D market and market introduction (Kemp et al., 1998). SNM scholars have argued that sustainability-oriented innovations do not diffuse because of the existing practices and rules in the 'sociotechnical regime' (Geels, 2002). The reason for this lack of diffusion is that sociotechnical regimes provide stability to the activities of different social groups but become locked in, thus 'path-breaking innovations' do not diffuse (Kemp et al., 1998).

A core assumption of SNM is that sustainable innovation journeys can be facilitated by technological niches; these are protected spaces that allow nurturing and experimentation with the coevolution of technology, user practices, new markets and regulatory structure and that shield them from mainstream market selection (Geels & Schot, 2007, s. 538). Thus, new technologies are a social process that is neither an unavoidable deterministic result of an internal scientific and technological logic nor a simple outcome of the operation of the market mechanisms. In other terms, SNM aims to align the technical and social. Consequently, new, more sustainable patterns can emerge, and they are partly embodied in the new technologies and practices based on new experiences as ideas. Experimentation gives space for actors, including policy actors, businesses, civil society, users and private funders who are working together on a variety of concrete pathways. The creation of pathways is an important matter for sustainable development because sustainable development requires fundamental change, both technical and social (Hoogma et al., 2002, p. 180).

The literature on SNM proposes three important processes for successful niche management, as follows (Geels & Schot, 2007, s. 540):

1. *The articulation of expectations and visions.* This provides the grounds for interaction and gives direction to learning processes and technical development activities (Geels & Schot, 2007, s. 540).
2. *The building of social networks.* This creates platforms for interaction between related actors and facilitates learning while also developing a constituency behind the new

technology, facilitating interactions between relevant stakeholders and providing the necessary funding and expertise (Geels & Schot, 2007, s. 540).

3. *Learning processes at multiple dimensions.* This sustains the impact of niche experiments and changes the routines related to the sociotechnical system subject to transitions. Knowledge learned here includes technical aspects, user preferences, business models, cultural meaning, regulations and government policy, societal and environmental effects and infrastructure and industry networks (Geels & Schot, 2007, s. 540). The purpose is to overcome the barriers that prevent an innovation from functioning properly. Learning in multiple dimensions should not be limited to accumulating facts and data in relation to innovation inside the network, which is referred to as first-order learning. In addition, learning should guide the development of the innovation so that it can be reshaped and stimulate change in the current system. This is called second-order learning (Schot & Geels, 2008).

Niche innovation gains momentum as the network, its own user group and its own infrastructure becomes larger and when the objectives of the niche are precise and learning processes have succeeded. Eventually, these niche innovations start to coalesce, forming the kernel of an alternative system. This leads to the replacement of the current regime, that is, the transition of an unsustainable system to a sustainable one (Geels, 2011).

In the early work of SNM, the emphasis was often on individual projects, where the three aspects of niche internal processes were used to explain success and failure. The reasons for failure could be that expectations were insufficiently clear, leading to divergence between the actors involved; the local project network was fragmented and not broad enough; or the learning processes were focused too narrowly on technical aspects (Geels & Raven, 2006, p. 377). Later 'scale up' is introduced as a concept (Kemp et al., 1998). Scaling-up of niches is understood as the process of niche building from local projects to global niches, from experimentation to mainstream, which emerges with the accumulation of local experiments over time that start to interact and share cognitive rules (Geels & Deuten, 2006). Scale up allows for local projects to expand their local network directly involved in the project to an emerging field or community in a global network, hence giving access to further technical expertise, funding and political support (Geels & Raven,

2006, p. 378). The distinction between the two analytical levels—the concrete local projects and the global level—enables niche development to be conceptualised as sequences of projects that stimulate continuous rounds of learning, network building and visioning, as illustrated in Figure 2.

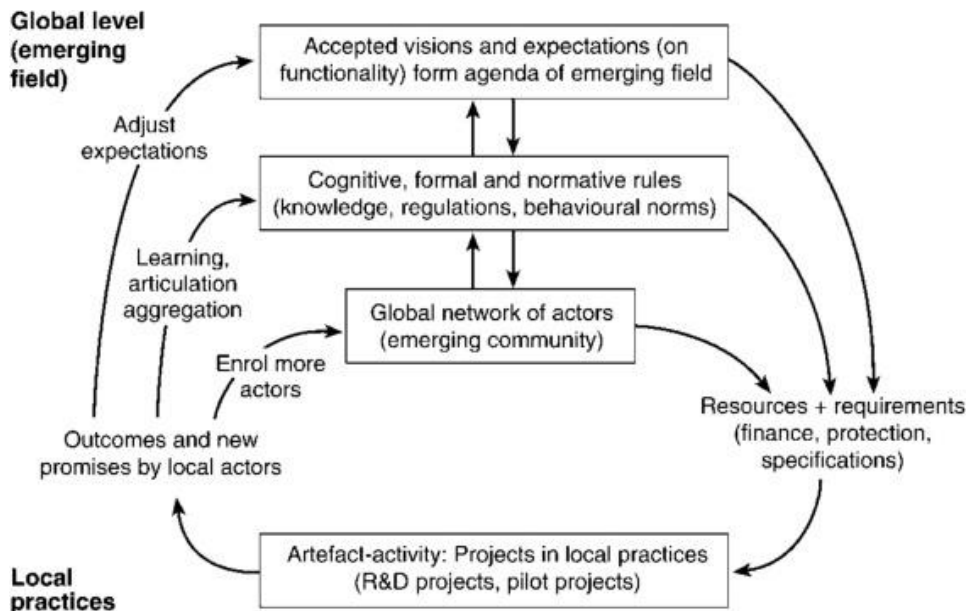


Figure 2. The dynamics of niche development trajectories (Source: Geels & Raven, 2006)

In recent SNM literature, attention has also shifted from the emergence of radical innovation to diffusion as a way to get a better understanding of how innovations can escape their protective space. This requires attention to both niche internal processes and the external context, suggesting that existing regimes also face pressures from externally oriented activities by niche actors (Turnheim & Geels, 2019). An example is the attention given to ‘niche empowerment’ activities (Smith & Raven, 2012), such as creating powerful narratives that can be used as political devices. The aim of the empowerment activities is to change regime-level selection environments, such as regulations, thus facilitating the diffusion of niche innovations. Turnheim and Geels (2019, p. 1425) propose that scholars—in addition to analysing nice-to-regime activities—should include regime-to-nice activities. This may uncover a greater variety in the patterns in niche development, such as coalitions, and between new entrants and incumbents. As such, incumbent actors can play a leading role in the development of radical alternatives.

Geels and Deuten (2006, p. 266) observe that the interaction between projects necessary to form a global niche requires ‘dedicated sociocognitive work’ undertaken by intermediary actors. The role of intermediary organisations is to facilitate the learning process for the aggregation of knowledge and

in the network building and forming of expectations. Because of their strategic position, intermediaries can reveal the increasing number of structural challenges that the community is facing, which will determine the potential of the niche to create a transition.

2.2 Innovation intermediaries in sociotechnical system transitions

2.2.1 The role and function of innovation intermediaries

The move away from viewing the innovation process as a closed and linear process to being more nonlinear is also seen more as an open process (Chesbrough, 2003), where an important element of the competitiveness of a firm is its ability to identify, internalise and use external knowledge. This implies that most innovation processes involve multiple actors from different parts of an innovation system performing different activities and functions (Borras & Edquist, 2019). The emphasis on the interactions between different actors has led to considerable attention being paid to organisations that fulfil an intermediary role, thus strengthening their role within innovation systems.

Such intermediaries are defined as *'an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties'* (Howells, 2006, p. 720). Thus, innovation intermediation involves giving support to firms in the innovation process to access resources or knowledge through various activities, facilitating the formation of networks and partnerships and creating arenas for meetings, knowledge exchange and learning (Geels & Deuten, 2006). Furthermore, intermediaries can advocate for new incentive policies or regulations (Kivimaa, 2014).

In the literature, a large number of functions have been given to intermediaries. Klerkx and Leeuwis (2009, p. 851) summarise the different functions as: *1) demand articulation: articulating innovation needs and corresponding demands in terms of technology, knowledge, funding and policy; 2) network formation: facilitation of linkages between relevant actors; and 3) innovation process management: enhancing alignment and learning of multiactor network.* Application of the different functions varies according to the different system aggregation levels, here depending on the scope and complexity of the network (Howells, 2006). Hence, intermediary activities can be targeted at individual firms, clusters or networks of firms or at higher system aggregation levels in innovation

systems that involve complex installations of firms, governments and societal actors dealing with complex problems (Klerkx & Leeuwis, 2009, p. 851).

The nature of their intermediary activities affects whether they support the supply side (knowledge-intensive business services (KIBS) and R&D providers) or demand side (intermediate and end users of innovations, such as firms) of innovation (Mignon & Wisdom, 2018, p. 103). Intermediaries supporting the supply side provide services supporting commercialisation or creating legitimacy and awareness of a new technology or practice (Van Lente et al., 2003; Kanda et al., 2018), whereas intermediaries supporting the demand side are often referred to as user-side intermediaries and provide users with advice about different technologies or support them in coping with the challenges related to the articulation of their innovation needs and to the design and implementation of their innovation project (Klerkx & Leeuwis, 2009).

In the literature, actors acting as intermediaries are very diverse, and the concept of an intermediary is interchangeable between contexts. Examples of entities identified as assuming intermediary roles include innovation centres, universities, incubators, science parks, business development organisations, funding agencies and consultants (Howells, 2006). Mignon and Wisdom (2018) refer to three main characteristics in their comparison of intermediaries: *their source of income*, *scope of action* and the *target recipients* of their services. Furthermore, Mignon and Wisdom (2018) argue that the differences between intermediaries cannot be overlooked because there is a risk for a mismatch between what is expected from an intermediary and what the intermediary can actually achieve.

Furthermore, intermediaries are often described as neutral or honest, without clear interests beyond the goal of the innovation occurring (Klerkx & Leeuwis, 2009). However, there are certain aspects where intermediaries' sources of income will affect the activities they undertake, as well as their neutrality and legitimacy (Mignon & Wisdom, 2018, p. 108). Sources of income can be divided into two groups: public and private, where publicly funded intermediaries typically have their funding coming from governmental budgets (Mignon & Wisdom, 2018, p. 101). For instance, publicly funded intermediaries are often mandated to implement political decisions and, thus, need to fulfil requirements regarding technology neutrality. Yet they can be perceived as not neutral

because they always practice a certain degree of steering through the selection of actors they connect and are involved in the networking activities with.

Regarding the scope of action, some intermediaries operate on a system level through networks with a focus on the strategic levels of systems, while others focus on direct project support to individual organisations through bilateral relations (Mignon & Wisdom, 2018, p. 102). Kivimaa et al. (2019) follow a similar logic and differentiate between intermediaries acting at the niche and regime level. For instance, niche-level intermediaries may support firms in their growth and diffusion of innovative solutions (Hargreaves et al., 2013). At the regime level, intermediaries can either legitimise or destabilise current practices and standards (Kivimaa, 2014). However, the research of Mignon and Wisdom (2018) illustrates that it is often difficult to draw a strict line between the actor and system levels. For example, intermediaries focusing on the projects all tend to work towards the standardisation of some services.

2.2.2 System intermediaries

Moving towards a systemic view on innovation and the need to include multiple types of actors for cocreation, the notion of system intermediaries was introduced. Rather than acting bilaterally and being focused on a single product, these specific types of innovation intermediaries connect multiple actors and navigate across the various innovation system elements (Van Lente et al., 2003). Hence, system intermediaries focus on the strategic level in relation to systemic instruments, such as the articulation of options and demand, alignment of actors and possibilities and support of learning processes (Kivimaa, 2014).

Thus, system intermediaries have emerged as potentially powerful actors who can speed up transitions and be defined as *'actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes in order to create a momentum for sociotechnical system change, to create new collaborations with and within nice technologies, ideas and markets, and to disrupt dominant unsustainable sociotechnical configurations'* (Kivimaa et al., 2019, p. 1072).

Extensive attention has been given to the different roles intermediaries take on in facilitating sociotechnical transitions. Kivimaa et al. (2019) classify system intermediaries as either regime-based, systemic, process niche or user intermediaries. *Regime based* are often established by regime actors with a special mandate to follow and operate at the different levels in the interest of the regime yet while facilitating multiple niches (Kivimaa et al., 2019, p. 185). *Systemic intermediaries* serve the intermediaries of both the regime and niche actors, and without specifying an interest in any specific niche, they serve the emergence of multiple niches. Whereas regime-based intermediaries steer towards incremental changes, systemic intermediaries aim for fundamental changes in the entire system (Kivimaa et al., 2019, p. 185). *Process intermediaries* support projects and processes without having any interest in a niche or transition, whereas *niche intermediaries* are focused on a specific experiment and a specific niche (Kivimaa et al., 2019, p. 185). Finally, *user intermediaries* serve the interest of the end users in the transition developments. As such, Kivimaa et al. (2019, p. 1068) elaborate on the concept of system intermediation in the transition context as '*operating on all levels (niche, regime, landscape), promoting an explicit transition agenda and taking the lead in aiming for change in the whole system level*'.

Operating in a transition context involves struggle, difficulties and boundaries because it incorporates complexity, tensions and uncertainties. Because the roles of actors constantly change, the intermediary roles are also subject to change, as are the whole ecologies of intermediaries in the various phases of transitions (Kivimaa et al., 2019). Because system intermediaries depend on other actors, they must also be explicit about their position and credibility. This is especially the case when they wish to accelerate transitions because conflicts and tensions may become stronger when the sociotechnical system faces more disruptive forces (Kivimaa et al., 2020, p. 375). Therefore, neutrality is crucial for gaining trust, gathering different parties into new networks and maintaining the personal relationships and informal contacts fundamental for intermediation (Klerkx & Leeuwis, 2009).

In a transition context, intermediaries must therefore operate in highly complex environments. They must deal with the long-term character of the change process and cope with both uncertainties and diverging interests; their dependency on the involvement and actions of others also makes it difficult to demonstrate their impact because it can be difficult to justify the value addition of intermediaries to innovation processes because of attributional challenges and the

intangibility of some of their input (Klerx & Leeuws, 2006; Kanda et al., 2018). Therefore, the complexity, tensions and uncertainties can have implications for the funding situation, which means a long-term perspective is necessary in sustainably transitions; this can lead to intermediaries complementing and competing with each other for resources, mandate and relevance (Kanda et al., 2020).

2.2.3 Intermediaries in niche development

Within the literature on niches, intermediaries are identified as playing several important roles in helping niches develop and become more robust (Geels & Deuten, 2006). Hargreaves et al. (2013, p. 870) broadly define intermediaries in niche processes as ‘*organisations or individuals engaging in work that involves connecting local projects with one another, with the wider world and through this, helping to generate a shared institutional infrastructure and to support the development of niche in question*’. For instance, through their relational work, intermediaries can identify common issues and problems found across multiple local projects. Thus, they can support niche development and diffusion by sharing this knowledge more widely, helping local projects benefit from accumulated experiences and connecting local innovation projects with another and the wider world (Figure 3).

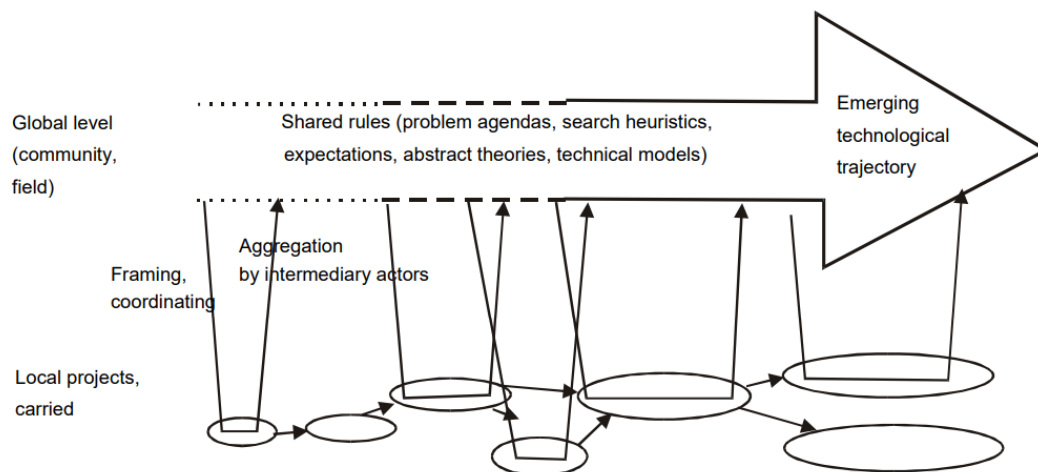


Figure 3. Local projects and emerging technical trajectories (Source: Geels & Deuten, 2006)

Hargreaves et al. (2013) refer to Geels and Deuten (2006) in identifying the three key roles for intermediary actors in niche development, each of which involves managing the flows of knowledge between local projects and the emerging global niche level (Figure 3). The first role relates to the ‘*aggregation*’ of knowledge from local projects. The activities of intermediaries in aggregation do

not revolve around finding technological solutions for local, specific problems but around the creation and distribution of generic, abstracted knowledge (Geels & Deuten, 2006 , p. 267). In the aggregation process, intermediaries are involved in making the local project knowledge context free for it to circulate throughout the global niche. Typically, activities include model building, writing handbooks, formulation of best practices and so forth. The second, *'institutional infrastructure'*, serves as a source and forum for the storage, exchange and circulation of this aggregated global knowledge. According to Geels and Deuten (2006 , pp. 267–268) *'such infrastructure consists of forums that enable the gathering and interaction of actors, the exchange of experience and the organisation of collective action'*. The third role is seen as a *'reversal'* in the relationship between the local projects and emerging global niche, where the global level becomes guiding for the local level activities (2006 , p. 268). In the *'reverse'* situation, the role of intermediaries is to frame and coordinate the development of local activities by using aggregated global knowledge. As such, intermediaries are critical in the development of robust and successful niches that can be capable of surviving in the longer term and of diffusing and scaling up more widely.

Kivimaa (2014) argues that intermediaries are significant when an innovation is entering the market, and her research on how government-affiliated intermediaries execute multiple different functions reveals that intermediaries speed up the niche process. The central intermediary functions in the niche process are the articulation of *expectations and visions, building of social networks and learning processes and exploration* at multiple dimensions (Kivimaa, 2014, p. 1373), which are key elements in the literature within niche innovation (Geels & Schot, 2007; Geels, 2012). The sharing of visions and expectations with multiple other actors promotes the niche, thus increasing its influence. Intermediaries aim to enlarge the niche network, which is essential for a successful transition. Learning processes contribute to niche management by reshaping and shielding the niche and improving its capabilities in its environment. All of these are functions that may speed up the diffusion and adoption of the niche innovation, thus accelerating a sustainable regime shift.

2.3 Conceptual framework; multilevel perspective (MLP) and strategic niche management (SNM)

Based on the analysis and theorisation process, an analytical framework has been built on the framework of MLP and SNM to explore how innovation intermediaries operate in a sociotechnical system and what role intermediaries take in the transition process, particularly regarding sustainability transitions. The framework for analysis, as visualised in Figure 4, has been created by combining intermediary literature, reviewed in section 2.2, and niche processes described in section 2.1. The bottom left column indicates the three important processes for successful niche management and the different roles of systemic intermediaries required to contribute to the accomplishment of sociotechnical transitions. The bottom right column illustrates how change comes about through a combination of developments at three levels of system change: the macro, meso and micro levels. The bottom column indicate that such an analytical framework can be used for the analysis of the empirical case of sociotechnical transition in which systemic intermediaries are involved.

The framework was tested in the context of a Nordic intergovernmental intermediary organisation, acting as an innovation broker. In the study, the organisation is defined as a system intermediary (Van Lente et al., 2003; Kivimaa, 2014). Based on the framework, the case provided examples of intermediary role and activities under the three processes of niche management and contributions in sociotechnical transitions. Three thematic programmes were selected as embedded units of analysis because of their vision of transformative change and because their positioning gives the organisation good possibilities to intermediate between various system actors at multiple levels.

System intermediators:

"actors and platforms that positively influence sustainability transition processes by linking actors and activities , and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes in order to create momentum for socio-technical system change, to create new collaborations within and across niche technologies, ideas and markets, and to disrupt dominant unsustainable socio technological configurations" (Kiviima, 2014)

CASE: Nordic intergovernmental innovation intermediary

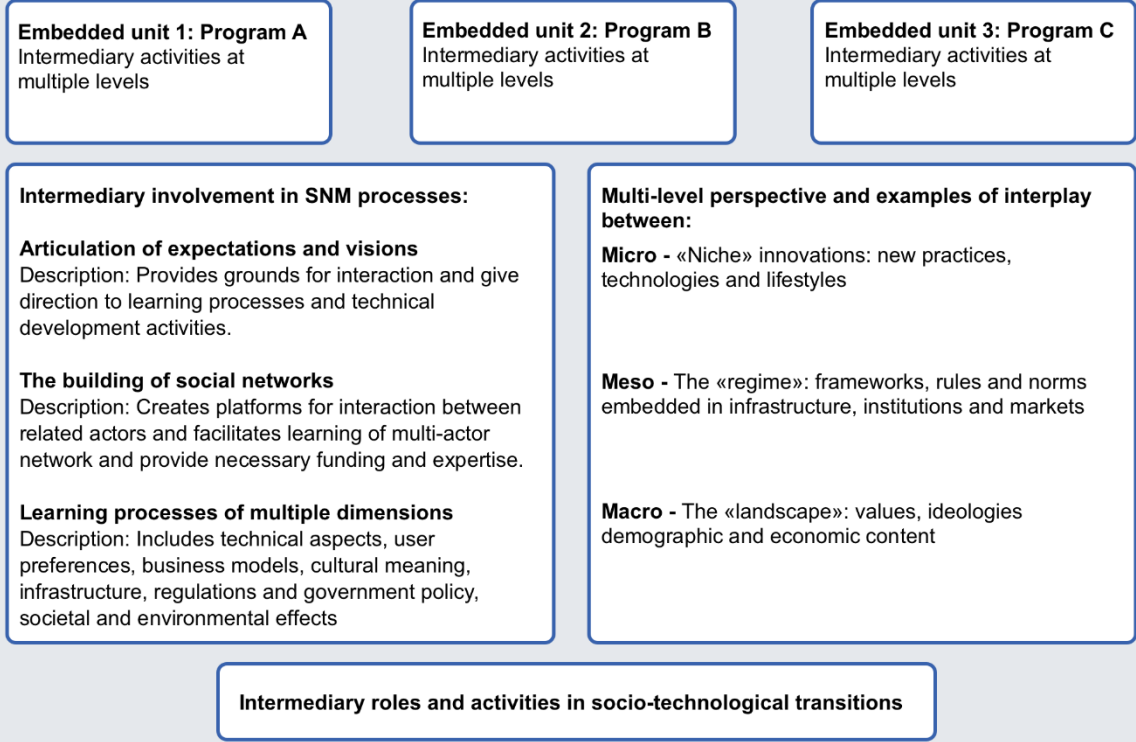


Figure 4. Analytical framework based on related hypotheses presented in the literature (based on Schot & Geels, 2008; Geels, 2014; Kivimaa, 2014)

3 Methods

The main purpose of this section is to present the methods used to gather the empirical evidence, which incorporates the research questions, research strategy and data collection methods. Section 3.1 describes how the research interests generate the main research question and how the case study as the research strategy supports answering these questions. Section 3.2 shines light on why interviews were used as the data collection method. Section 3.3 explains how the study considered reliability and validity.

3.1 Rationale for choice of research design

The current research consists of a qualitative research design with an exploratory nature. A qualitative research design enables the exploration of the whole pattern rather than mapping the statistical causal relationship of the variables. By means of an in-depth qualitative analysis, I sought to identify examples of intermediating that have created a momentum for system change, that is, cases that can illustrate the role that intermediaries can take. Alternatively, examples of intermediating that have not been successful in creating the momentum for change illustrate the complexity of intermediating within system innovation, hence contributing to a better understanding of how intermediaries are operating, their intermediary structures such as position and role, including their neutrality, biases, dependencies and capabilities and intermediary activities in the complexity of sustainability transitions.

A case study was well suited for gaining a good understanding of the context of the contemporary phenomenon that was investigated, especially when the connection between the phenomenon and the context is not clear, which was the case here (Yin, 2018, p. 15). Because qualitative studies allow for an open approach, case studies are well suited to study complex phenomena in a real-life context containing many interacting variables (Ragin & Amoroso, 2011). The study adopted an exploratory embedded single case design. An embedded case study is a case study containing more than one subunit of analysis (Yin, 2018, p. 52) and is suitable to facilitate the exploration of the richness of a single case because identification of subunits allows for a more detailed level of study. The embedded case study approach is particularly relevant for learning conditions when the boundaries between the phenomenon of interest and context are not obvious. To define the focus of the study and the boundaries of the methodological context, three embedded subunits were selected, as illustrated in Figure 5. The rationale that guided the selection of the embedded single

case design was to avoid an unduly abstract level that lacked sufficiently clear measures, which is a typical problem with the holistic design of a single case (Yin, 2018, p. 52). Subunits allowed for more of a focus, though it is important to be aware not to lose track of the larger unit of analysis: the original case.

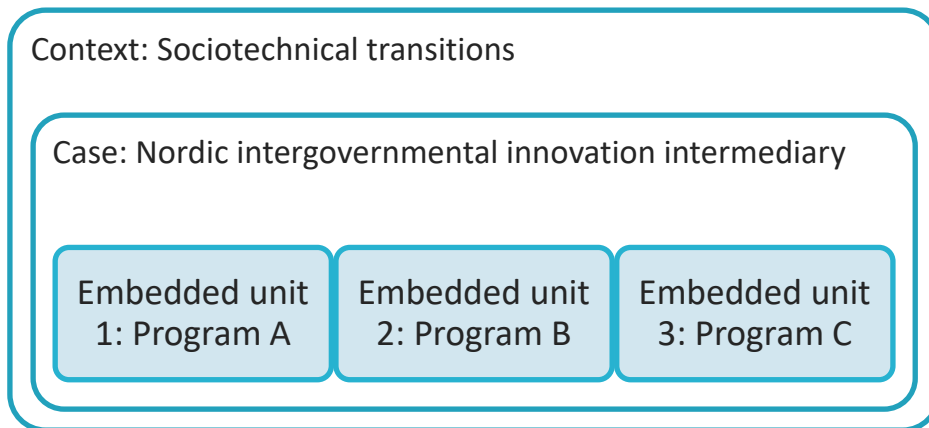


Figure 5. Embedded case study based on Yin (2018)

3.1.1 The role of the researcher

As an employee in the organisation being studied, I needed to be particularly aware of how this could impact the empirical findings. To limit the constraints, I decided to research a part of the organisation where I was not directly involved. Maintaining distance and impartiality is always a problem in qualitative studies, but the problem is put at the forefront if the researchers have a personal relationship with the environment being explored (Repstad, 2014). Therefore, it is important to be aware and make the reader aware of our own backgrounds and personal orientations because they serve as the starting point of any research process (Piekkari & Welch, 2006, p. 572). Researchers need to acknowledge their own interpretative work as they analyse the social worlds they are researching and recognise that in making sense of an actor's sense-making, they themselves impose a second level of interpretation that is subject to the understanding of the empirical findings (Creswell & Creswell, 2018). As such, the researcher's involvement creates insights and barriers (Jaobsen, 2015). Being an employee in the organisation gave me access to information otherwise not approachable, as well as an understanding of the context. Yet it was important to avoid the trap of preconceived notions and to keep a critical distance. Rather than trying to eliminate these biases and predispositions, I have monitored them regarding how they may shape the collection and interpretation of data via triangulation strategies used to promote qualitative research validity. Examples are discussed in detail in the sections below.

3.2 Data collection

3.2.1 Sampling strategy

According to Yin (2018, p. 3), it is important to have a general analytic strategy rather than hoping that patterns will emerge simply through studying and experimenting with the data. The research process is about definition, not only the research question but also the unit of analysis, which is the actual object or entity being studied. Also, the unit must be at the same level as the object of the proposition (Gerring & McDermott, 2007). A Nordic intergovernmental innovation intermediary and three of its innovation programmes have been chosen as the sample for the current research, and the object of the proposition was to examine the main contributions of intermediaries in sociotechnical transitions. Being an employee in the organisation, even though not directly involved with the programmes, I also had access to other data that are not easily accessible. To arrive at a coherent analysis, qualitative data generated through interviews, strategic documents and programme reports have been integrated.

The innovation programmes, which were selected as the embedded unit of analysis, are all part of implementing the same strategy of the intergovernmental intermediary organisation object of the case study. As illustrated in Table 1, the programmes represent three different thematic areas, transformative visions and instruments for intermediary action, and as such, they vary in their approach. Therefore, reflecting on the intermediary roles of the activities in the programmes is of scientific value.

PROGRAM	THEMATIC AREA	EXAMPLE INSTRUMENTS
A	Circular economy and business models Transformative vision: A transition towards carbon neutrality and green circular biobased societies	<ul style="list-style-type: none">- New solutions- Competence building- Ecosystem platforms- Call for proposals
B	Green mobility and connectivity Transformative vision: A transition to more sustainable and connected Nordic mobility solutions for enhanced quality of life	<ul style="list-style-type: none">- Mission- Call for proposal- Cluster collaboration

C	Preventive and personalised health Transformative vision: To make the Nordic the most sustainable and integrated health region in the world, providing the best possible personalised health care for its citizens	<ul style="list-style-type: none"> - Scenario process - Hackathons - Legal obstacles - Interoperability case - Business case
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Table 1. Overview of the programmes selected as embedded units of analysis

As depicted in Table 2, eight open semistructured interviews were conducted with (2) innovation advisers and (6) senior advisers who were part of the teams responsible for implementing the innovation programmes (A, B and C) and were selected from the embedded units 1, 2 and 3 (Figure 5). An open interview with the COO was also conducted. The main criterion for joining the sample was that the researcher believed that the informants had relevant information for the project’s problem, whether it be knowledge, attitudes, opinions or experiences (Repstad, 2014, p. 81). As such, the informants were selected based on their participation in the three transformative programmes. Hence, a strategic selection approach was used in which the informants were chosen to display a particular context and perspective on intermediation.

Interviewee	Programme	Position	Gender	Nationality
1	A	Senior Adviser	F	Norwegian
2	A	Senior Adviser	M	Icelandic
3	A	Adviser	F	Finnish
4	B	Senior Adviser	F	Norwegian
5	B	Senior Adviser	M	Swedish
6	B	Adviser	M	Åland
7	C	Senior Adviser	M	Danish
8	C	Senior Adviser	M	Icelandic
9	None	COO	F	Finnish

Table 2. Overview of the informants

Based on the time limit and scope of this task, a limit of nine informants was set. This number should be sufficient to obtain good empirical evidence and a basis for analysis, discussion and conclusion. Repstad (2014, p. 84) mentions that there is no standard answer as to how many

interviews a qualitative study must have. It must be decided at the discretion of each individual case. The informants in this survey consisted of employees with different genders, nationalities, ages, educational backgrounds and seniority in the organisation. It has been positive and interesting to have informants with different backgrounds in the current study because this strengthens the empirical data through different opinions, experiences and perceptions.

3.2.2 Approach and operationalisation

Great emphasis has been placed on interviews as a method within qualitative research (Kvale & Brinkmann, 2014). Research interviews go deeper than the spontaneous exchange of opinions that takes place in everyday life. In the current study, I chose interviews as I wanted to bring out individual views, interpretations and perceptions about various aspects of intermediation in the organisation. Nine interviews were conducted face to face, which is the most common type of interview technique in the field of qualitative research (Opendakker, 2006); this enables synchronous communication of both time and place, the main advantages of which include the visibility of social cues and an interview atmosphere that is relatively free of unexpected disruptions (Opendakker, 2006). Because of the COVID-19 pandemic, the interviews were conducted through the online platform Microsoft Teams. An online interview is considered as authentic as face-to-face interviews (Sullivan, 2012). However, because of its dependency on the internet, the availability of speedy internet connection and the level of digital literacy of both the interview and interviewees can have a significant impact on the efficiency and effectiveness of the interviews (Sullivan, 2012). Each informant was interviewed individually because of their personal preferences. Thus, the choice of semistructured and individual interview style fit the research need of detailed information and in-depth discussion about the case at hand.

The informants were my colleagues, who worked in different parts of the organisation. The interviews were not characterised by an artificial atmosphere, but the mood was still different because I was not in my usual role as a colleague but as a researcher. In research settings where there are acquaintances, such as colleagues, loyalty ties, dependency ties and the like can disrupt the research (Repstad, 2014, p. 82). Because of the relationship between the researcher and informants, it was particularly important to build trust with the informants so that they would volunteer and give truthful answers. Before the interviews, a consent letter was shared where the interviewees were informed of full anonymity, that the interview was voluntary and that the

interviewee could withdraw at any time without giving a reason. During the interview, I emphasised the importance of open, honest answers and discussions. Studying colleagues was deemed ethically justifiable, largely because the study was conducted openly and transparently, where the informants volunteered to participate.

A set of questions guided the interviews, which helped collect the appropriate information required to answer the research questions. I followed a semi-structured interview guide (Appendix A) based on the dimensions of the conceptual framework (Figure 4) and theories on the MLP and SNM.

Hence, the interview guide covered the following key areas:

- Managing expectations and visions
- Building social networks
- Learning processes, replication and scaling
- Innovation intermediary capabilities

To achieve a more in-depth and complete understanding, I asked several follow-up questions in relation to the main questions. I did not change the interview guide (Appendix A) during the data collection period but rather used it as a guide and adapted it in the interviews as needed. An open interview was conducted with the COO after the interviews with the innovation programme staff. The purpose of this interview was to further elaborate on the initial findings.

Each interview lasted for about 45 minutes. The interviews were tape recorded and fully transcribed to capture subtleties in the data, and the information was then coded and mapped using NVivo. With audio recordings, I could concentrate on asking questions, listening to the respondent's answers and asking follow-up questions, as needed. Vocabulary, tone of voice and the like were recorded and gave me the possibility to go back and listen repeatedly.

The interviews were conducted in multiple languages, both Scandinavian and English. As part of retaining the meaning in the data, data analysis was conducted using the transcription of the original language. The findings will subsequently be presented in English. The reason for allowing the interviewee to choose the interview language was to gain better insights and a higher quality of data. Language use shapes the identity and power of the researcher, alongside several other personal factors that affect the interview situation (Piekkari & Welch, 2006, p. 571). Language issues can also have implications for the accuracy and authenticity of data and for the construction

of shared meaning (Piekkari & Welch, 2006, p. 571). Therefore, the analysis of the data requires a high tolerance of initial ambiguity.

3.3 Data analysis

Because it was necessary to structure the interview (Kvale & Brinkmann, 2014, p. 222), an analytical framework (Figure 4) was applied as a model to build a structure as a basis for the analysis. In the process of structuring, NVivo was used to capture quotes and pieces of data that fell into a certain category. I gathered related material in a container called a node. When opening a node, it is possible to see all the references in the project coded to the node. In NVivo, as illustrated in table 3, I created four nodes according to the research model (Figure 4). Further, I used the structure from the interview guide to create subnodes to sort out the different statements from the transcriptions. The interpretation-based approach also influenced the analysis of the empirical data in the sense that the interpretation of the various statements constituted a new understanding of the whole. Such a continuous process is described as the hermeneutic circle (Kvale & Brinkmann, 2014, p. 237).

NODE	SUBNODE	DESCRIPTION
Building of social network		Creation of platforms for interaction between related actors that facilitates learning, necessary funding and expertise
Contribution		Concrete examples of intermediary contributions in accelerating sociotechnical transition
	Internal capabilities	Intermediary skill, knowledge and competences
Learning processes		Impact of niche experiments and changes to the routines/ barriers related to the sociotechnical landscape
	First order	Accumulating of facts and data in relation to innovation inside the network
	Second order	Examples of learning that guide the development of the innovation so that the innovation can be reshaped and stimulate change in the current system
	Scale up	Examples of niche building from local projects to global niche

	Policy Impact	The programme impact on innovation policy
Vision and expectations		Ground for interaction and direction for technical development activities and learning processes
	Program development and implementation process	Process of selection of innovation instruments and activities
	Articulation of vision	The development of vision narrative

Table 3. Overview of nodes and subnodes used to categorise the data.

3.4 Research quality

3.4.1 Reliability

Reliability is how precise and good the measuring instruments are, how reliable and precise the information is and whether we have carried out the analysis without errors and shortcomings (Repstad, 2014, pp. 134–135). Reliability also refers to the degree to which a study can be replicated. The stability of results over time indicates reliability (Kvale & Brinkmann, 2014, p. 250). This implies that specific results or answers will not differ at different time periods when the same method of data gathering is performed.

The interview guide and questions were prepared based on the theoretical and conceptual framework. I was also conscious of not asking leading questions. Therefore, there are reasons to believe that the same informants would answer similarly if asked again. Because the research is based on interviews and the data highly depend on the input from the interviewees, it is unlikely that identical data were extracted at different points in time.

3.4.2 Validity

Validity is about whether we have actually measured what we wanted to measure. There must be a connection between our research questions and the desired conclusion drawn from the data material collected (Repstad, 2014, p. 134). Internal validity concerns whether there is a good match

between the observations of a researcher and the theoretical ideas that are developed (Jacobsen, 2015, p. 237). The informants were selected based on relevance to the subject of study and the ability to give relevant information to my research questions. Because the interview was semistructured, follow-up questions may result in skewed data. During the coding process, summarising and analysing for similarity and regularity were sensitive to the subjectiveness of the researcher. Additionally, it is key that the message of the qualitative data be preserved because the primary outcome of this research relies on what is being said, not so much on how many say it.

To ensure internal validity, observations were triangulated two times: 1) by conducting multiple interviews per unit of analysis and 2) by an open interview with the COO after the interviews with the innovation program staff to further elaborate the initial findings.

External validity considers the degree to which the findings can be generalised (Jacobsen, 2015, p. 237). Because this was a single case study, the external validity of the present research is limited. However, three subunits of analysis have increased the richness of the single case and allowed for a more detailed level of study. The study had a small sample. To increase its internal validity, it would have been beneficial to extend the research to include more innovation intermediary organisations. In the process of asking a question to analyse the answer, various moments can result in bias. As such a research team of 2 or more persons would decrease the bias and thus the validity of the research.

4 Findings and Analysis

In this section, I present the findings from the research, analysing each embedded unit of analysis (programmes A, B and C) by applying the conceptual framework and searching for similarities and variation. I examine the three processes for successful SNM (Geels & Schot, 2007) and the key roles of the system intermediaries (Kivimaa, 2014) in niche development (Geels & Deuten, 2006; Kivimaa, 2014). This is done to understand the potential main contributions of innovation intermediaries in accelerating sociotechnical transitions and how the complexity of the transition context may influence the intermediary's roles and activities. The research is based on nine interviews with staff in an Nordic innovation intermediary organisation (the case) involved in three innovation programmes (A, B and C). In the next section, I elaborate on the meaning of the findings and whether the findings answer the problem definition and research questions.

4.1 Case overview

The case object is an intergovernmental Nordic organisation acting as an intermediary with the mandate to support ecosystems and enable cross-border collaboration for sustainable growth and promote the entrepreneurship, innovation and competitiveness of Nordic business. The organisation is funded through a cooperation programme decided by the Nordic Ministers for Business and Innovation. As such, the company is acting as innovation brokers at the system level and converting political visions to action, serving the interests of both regime and niche actors. The organisation has 22 employees and a budget of approximately NOK 90 million.

The cooperation programme describes the primary challenges and areas for cooperation and sets a clear direction for Nordic cooperation on innovation policy. Hence, the cooperation programme highlights the many societal challenges that the Nordic countries faces. Climate change and increasing pressure on the world's natural resources mean that the Nordic region must undergo a green transition if the Nordic countries are to continue to have sustainable growth and a welfare society that benefits both present and future generations. The Nordic countries also share the demographic challenge of an increasing and ageing population; this will result in increased demand, increased pressure on resources and a challenge to the Nordic welfare states. At the same time, globalisation and technological development present Nordic companies with both challenges and opportunities. These include digitalisation, automation and new business models, as well as a more volatile and unpredictable economy. Volatility and unpredictability require Nordic companies to be

capable of changing the way they run their businesses in short notice and adapting ever more rapidly to, for example, the green transition, if they are to remain competitive.

The organisation takes on a wide variety of intermediary roles related to the three embedded subunits of analysis. The programmes are three 4-year thematic programmes developed as part of the operationalisation of the Nordic cooperation programme. The programmes are all cross-sectoral. They are open, wide-ranging and allow for final concretisation and delimitation to take place at the activity level. The programme development and implementation process include multiple relevant actors, from business environments and policy makers, in the codesign, co-implementation and co-evaluation of the activities. The activities facilitate the exchange and building of new knowledge, create opportunities for experimentation, help the emergence of standards and common goals and form partnerships.

4.1.1 Embedded unit of analysis—Programme A

The articulation of expectations and visions

The aim of programme A is to accelerate the transition to a circular economy in the Nordic countries and to develop the Nordic countries further as agile frontrunners within circular economy and circular business models; this can be done through increased competence, new solutions and ecosystem building. The programme challenges individual companies to change their business models for improved resource efficiency by providing them with tools and networks that allow for new collaborations and pilots. All the informants in programme A stated that change happens throughout the value chains the companies are operating and throughout the ecosystems, hence creating need the need for collaboration, as stated by one informant:

Because in circular economy you can start the change process within your own company, but you cannot become circular alone' (Informant 3, 09.04.2021).

As such, the intention is to engage the whole value chain and ecosystem for the transition; therefore, this is the focus of the programme.

Programme A illustrates that the exploration phase is a nonlinear process because new options and varieties emerge throughout the programme. The findings also indicate that obtaining the right tools or portfolio needed to be an iterative and involving process is key, as one informant explained:

It is not us driving this transition, we work with the companies and it is the companies that take it into practice. So, I see that our role needs to be very practical and provide actually tools that the companies can use. (Informant 3, 09.04.2021)

This means they need to leave space for key stakeholders and actors to decide what was needed and to engage with the companies. The findings imply that the programme sketches relevant futures through vision and objectives but gives freedom to what informants describe as a cocreation process with key players in the Nordic region. The informants explained that input was gathered from actors at all levels in the Nordic region, as well as a market and stakeholder analysis, to ensure the programme received the necessary legitimacy, acceptance and relevance. Thus, in the exploration phase, different instruments were tested with the aim of bringing different actors together. This mix gave the possibility to approach the system from different angles, to bring a lot of different actors together and to explore various markets.

The building of social networks

In the interviews, it was made clear that the programme has a wide spectrum of stakeholders and that the facilitation and creation of new networks is an implicit part of this, as described by one informant:

We can break this down into all companies. But further for us, it is the most polluting sectors. That is why we have four to five sectors that benefit the most. Then there are those who are the largest consumers of raw materials, that is the part of the business community where we can achieve the most impact and therefore most important to us. You have interest organisations, industry organisations.... Then, you have the civil society organisations... (Informant 2, 17.03.2021)

The programme targets different companies from different industries, circular maturities and roles in the transition. Hence, the informants stated that these actors have different experiences and

knowledge but share same goals, interests and vision. In the programme, through ecosystem building, the intermediary organisation aims for companies to find 'circular-partners' to enhance collaboration, exchange knowledge and start building and implementing pilots together. As such, the informants described their role as an enabler to facilitate change.

The informants all emphasised the need for mobilising to create increased interest and understanding of the circular economy, as well as creating visibility for the organisations working in the area. In the interviews, examples were given on how the organisation strengthened its role as a key player in the circular economy, as an ecosystem builder and as a change agent in the Nordic region and internationally. By attending events and collaborating with many ecosystem partners, The organisation through the program become enablers, facilitating innovation projects for increased Nordic cooperation, as exemplified by one informant:

...We are being pretty good at getting ambassadors out there. We are very aware of that. And somehow created opportunities for collaboration and that is where it all starts, and it turns out that many of the companies that have participated in, for example manufacturing workshop, have begun their journey or we have contributed to them getting on or even faster with their plans. (Informant 1, 26.03.2021)

All the informants mentioned a particular component with a special focus on stimulating the building of Nordic innovation systems in the circular economy through projects that support meeting places and the interconnection of companies, organisations and individuals. In the programme, the organisation also worked with international organisations for the purpose specified by an informant:

It is important, both to understand what is happening in the wider world and to link the Nordic region to this, but also to put the organisation on the map as an actor that is recognised, important and reliable. (Informant 2, 17.03.2021)

Furthermore, the informants implied that through international forums, they could highlight the need for transition and bring key policy actors together, and as such, they have had a positive push towards policy change.

Programme A reveals that the organisation also builds networks for collaboration with other intermediaries. All three informants stated that collaboration with other intermediaries is particularly important for the recruitment of companies to the projects and for learning purposes because they have better access to companies throughout the Nordics, as described by one informant:

So, we need them for recruiting. We need them for feedback from companies to understand what the need in a specific theme or specific time is. I think it is also important for us to be directly involved with companies so that we also get that feedback ourselves. But we cannot have contact with all the companies, we can just have that dialogue whenever possible, when we are discussing with companies and meeting them at specific events, for example. (Informant 1, 26.03.2021)

Similarly, the informants stated that collaborating intermediaries depended on the programme, both for legitimacy and for funding and for their support in linking the intermediaries to initiatives of national authorities and other national actors.

Learning process of multiple dimensions

The findings suggest that through the programme activities, the organisation has contributed to companies and other players in the Nordic region becoming more aware of the circular economy as a concept, the opportunities in circular business models and increased knowledge on how to become circular. In addition, through the programme, pilot ideas have been developed and implemented. The programme activities had the aim of creating a basis for cooperation, platforms and help to support ecosystems and ecosystems within value chains. However, on the political level, as illustrated by an informant, there have been fewer examples of activities:

...We have focused a lot on the opportunities for the companies, and little on the barriers that can be solved at the political level. But now I think it is important that we highlight the barriers we have discovered in our work and bring these to the political level. (Informant 1, 26.03.2021)

Access to a Nordic network was mentioned by all the informants as giving project participants access to more learning, to a much bigger pool of potential partners in their ecosystem and value chains to develop pilots with and to scale. One informant mentioned that by using best practices and learning from the other Nordic countries, *'They can help the industry to develop their focus further when they can benchmark themselves with the other Nordic countries, and beyond the Nordics as well'* (Informant 3, 09.04.2021).

An example mentioned was a project focusing on metal waste from Tinsmith workshops throughout the Nordic region. The project aimed for the whole industry to change and develop best practices for reducing metal waste and to scale these practices throughout the Nordic region. Metal waste was mentioned as a good example because it was possible to see the whole niche that needed change but that just needed that final push. They needed finance to set up a project and save time. The project was funded through a call for proposal, a funding instrument used in the programme. As such, an intermediary role was found as serving local companies with a Nordic network and gain access to a larger market.

The informants described dissemination of knowledge as a key activity, for example, in the form of guidebooks and manuals, as an important tool for stimulating change in the current system. One example is a project where a circular economy playbook was developed to help build competence on circular business models and to be a practical tool for Nordic companies. Further, through workshops within the manufacturing industry, based on the playbook, pilots were developed with the aim to show how circular business models can work in practice and to produce information for future activity.

4.1.2 Embedded unit of analysis—Programme B

The articulation of expectations and visions

The overall ambition of the programme is to: change the way people and goods are moved and increase the pace of transition to more sustainable mobility solutions. Transport is viewed as a function or an activity within a wider mobility system that consist of many interlinked and interdependent components, making it possible to move people and goods around. Sustainable mobility refers to 'emission-free', carbon-neutral and environmentally friendly mobility, with decarbonising as a first step. The Nordic region has specific mobility challenges in terms of the

pattern of settlements dispersed across a large area complicated by natural geographical and weather conditions. This requires a broad network of land se and air transports to maintain vital connections.

In the process, the programme adjusted to a clearer use of terms, which, for example, resulted in the programme being structured around two main themes. One theme (individual level) promotes quality of life, accessibility, flexibility and benefit for individuals, with a reduction in the negative effects of the current mobility system, not least on people's health, as a significant factor. The other main theme (societal level) is sustainable, safe, energy-efficient and emission-free mobility solutions, where the purpose is to reduce—and in the long run remove—the negative environmental and climate effects of the mobility systems. The reason for the two levels was expressed by an informant as follows:

...It is not possible to focus just on the one, because they are very intertwined, but we have set it up so that we can have perhaps more focus on either system change or solutions that are aimed at individuals themselves and how to simplify their lives according to mobility and sustainable mobility. (Informant 4, 19.04.2021)

The programme illustrates that the subject itself is where one could find this common interest, as stated by one informant:

'Mobility is relevant for all countries, and thereby, you have a pretty good platform already' (Informant 6, 21.03.2021).

An example mentioned in the interviews was mapping done early in the process that looked at the priorities and strongholds in the different Nordic countries, in Nordic innovation organisation, at the EU level and in the Nordic business community. The informants made it clear that when it comes to mobility, a lot is happening in all the Nordic countries:

We saw this quite early in the process. There was a lot of innovation going on; there were large investments in all countries. It is visible when it comes to the big environment and climate agenda if you can put it that way. Then you see that

transport is a very big part of the problem and you talk about transport becoming part of the solution, precisely because you cannot do without mobility or transport.
(Informant 4, 19.04.2021)

Further the informants expressed that across the Nordics there is also a trend towards policy driving the development of system wide solutions that are based on cross-technological and cross-sectoral partnerships and collaboration.

The findings suggest that the program design process enabled a form of co-design by stakeholders following a process of taking stock (learning), analysis, data collection and analysis and consultations in the Nordic region. The co-design was viewed from the organisations perspective as a 'tool' to gather ideas for the program, but also as a means to mobilise cooperation and interest with a view to receiving high-quality project proposals. The involvement of actors has also been considered necessary because of the complexity of the topic and the huge number of actors, as explained by an informant:

We tried to figure out how to narrow it down. What is the common denominator in mobility, you get into that, when you sharpen your strategy and the programme a little further? So, we thought, ok it is very difficult for an organisation like ours to have a clear picture of what is most important in five countries, because you get different answers depending on who you ask and there are extremely many actors involved in mobility in one way or another and it overlaps with many other society functions and other areas of technology. In that sense, you cannot isolate mobility completely either, you know it interferes with so many things. So how do you go about choosing the most important ones? (Informant 4, 19.04.2021)

Hence, the programme developed a framework based on numerous talks with stakeholders at multiple levels, which stated that the program activities must focus on sustainability transition and concerning mobility and based on Nordic strength positions. The framework gave direction to a two-stage process, with the purpose of getting input for the programme and determining which concrete areas to build on. The first call for a proposal was used to get an understanding of the market interest and gaps in the Nordic systems. The programme was further designed based on the

input and projects in stage two. The input also helped identify areas where things were already ongoing to then build on these. This meant they could set the ground because the framework described the challenge and scenario to help move away from the traditional setting. However, it would be up to the market to decide what is relevant to work on at the Nordic level, meaning there would be the need for adjustments as the programme received feedback and developed.

The building of social networks

The informants indicated that to change or transform the mobility system, a systems approach with actors from the whole system had to be adopted. As such, project partners range from small digital companies to some of the largest companies in the mobility field in the Nordic region; and from specialised business associations, cluster organisations to research institutes and university teams. In the projects, it was important to promote consortia that have a larger mindset on how to solve the challenges outlined in the framework, as stated by one informant:

...We want a little bigger vision and impact with the funds we have and then create this Nordic added value with actors from different types of sectors and across the ecosystem. (Informant 5, 04.04.2021)

A number of the projects seek to contribute to system innovation with interviewees stressing that in many cases 'technology is not the issue' rather bringing together relevant group of players covering different elements of an emerging value chain to share knowledge openly, build trust and prove the business is important. The informants explained that with the systems approach, as such they were not trying to promote a specific technology but more connecting different actors for creating new markets and facilitating the speed of transformation. An example mentioned in all the interviews is an aviation project that was about the electrification of aircraft and with actors from the entire value chain involved in operating aviation, from airport operators such as Avinor and similar companies in other countries, the airlines such as SAS and Finnair, Icelandair to the type of players working with the infrastructure and to those who will develop the aircraft. As such, everyone was involved in the operation and development of electric planes as if being part of an entire system. This allowed for setting common goals and a common plan for progress.

In the interviews, references were made to activities related to networking, cocreation, matchmaking, learning and experience exchange. The findings imply that by this enabling or facilitation role, the organisation created a platform where actors could build project consortia across sectors and build larger Nordic solutions together. However, the need for funding incentives was raised in several instances. Funding was mentioned as attracting companies, minimising the risk and allowing for experimentation, as stated by one of the informants:

We felt that we must also have the opportunity to further develop the good concepts, as such we must also have some kind of opportunity for further financing or development of the projects, as a further construction of the larger process of system change. (Informant 4, 19.04.2021)

In addition, the informants mentioned that the political anchoring and assurance of it being on the political agenda also helped attract players to the programme activities.

The findings indicate that it was difficult to maintain the wide group of stakeholders involved in the cocreation in the early strategy process as the programme got more operational. The strategy process gave the programme a good positioning, as mentioned by one informant:

In the pre-process, there were many interviews and meetings with relevant actors who make sure that it is diverse, meaning that there are not only business actors but cities and research institutes, etc., as well as to gather input on what is actually important for the market, what is important for the Nordic region, where do we have the opportunity to make a difference, at the same time as what we do is relevant and interesting for those who participate. (Informant 6, 21.03.2021)

However, the findings imply that it was challenging to keep up with the involvement of all stakeholder groups during implementation. Building more on the established network from the strategy process would have enhanced the cooperation within and across value-chains in order to bring together a critical mass of actors that can drive the transition.

Learning process of multiple dimensions

The findings suggest that the programme was seen as representing arenas for strengthening and building trust around the vision, for sharing ideas and for exchanging partly business-sensitive information. This is because the actors, even with several of them being competitors, saw that openness and cooperation could strengthen their competitiveness, as mentioned by one informant:

This openness will increase the speed of innovation. Building upon what each country does best, this project is strengthening the Nordic countries' ability to compete in the future of more energy-efficient and green transportation. (Informant 4, 19.04.2021)

In most cases, the projects are not generating radically new technological advances. A common theme across the projects is mentioned by the informants to use funding to prove and communicate to a broad set of actors on what can be done today to move towards and contribute to the transition. As expressed by one informant:

'We want to see market ready and near-market ready solutions. We decide to work in what can be done right now which means using available technology, test it and align it and combine knowledge from the portfolios of each partner and see how far we can go with today's technology' (Informant 4, 19.04.2021),

stating that they were not looking for projects that provide the final answer but looking for those projects that can take a step closer to such an ideal future of sustainable mobility systems. This also can provide prototypes that can illustrate the possibilities for the market, thus contributing to the creation of new markets.

The informant further explained that working together allows for moving faster and to take a position internationally. The project funding is seen as critical in providing means to 'oil' the cooperation amongst Nordic actors who individually have elements of the required solution. Therefore, by bringing Nordic actors together the program helps foster a process of co-creation and to some extent 'platform' building. Hence, the findings illustrate that the programme can help extend the home market and allow for testing out in a larger market, helping position the Nordic countries as frontrunners in particular parts of the mobility field:

The projects under the programme exist because collaborating gives each of the partners value and the opportunity to achieve something more and something different than they would otherwise do. It is about bringing together different expertise, technology, networks and knowledge, about highlighting the best from each country and putting together new 'state-of-the-art' mobility solutions.

(Informant 4, 19.04.2021)

However, all the informants mentioned that one aspect of the project is that it should create value for other actors besides the individual projects:

It does not prevent other actors from taking part in the result that has emerged, and this was very important to point out to the participants and is something that everyone has been very open about, as the ambition for all is movement towards a more sustainable and integrated mobility system. And they all know that you do not do it yourself; you cannot do it as an individual actor or as a small collaboration within a project, but what you want to do is to move the pillars further forward to be able to be part of the movement that transforms the mobility system. (Informant 6, 21.03.2021)

There was a view that more could be done to give the project results visibility and share methodology and ways of working, for example to use the learning in other sectors such as agriculture or electrification of construction equipment. The informants also stressed that the organisation should further seek to capitalise on the knowledge generated through the program to make sure that business and public authority work together on regulations and decisions needed at both Nordic and national levels.

4.1.3 Embedded unit of analysis—Programme C

The articulation of expectations and visions

The program emphasises the increasing need to change the way Nordic healthcare systems think about priorities, deliver quality health services and provide opportunities for improvement to meet

the future challenges facing the Nordic healthcare system. The findings in programme C indicate that having a clear vision is an important tool to demonstrate a desired future and in communicating and pointing out the possibilities in order to anchor the vision, both among industry and politically. The vision demonstrates a need for a radical design of how to deliver, practice and think about healthcare in the Nordics. Changing demographics and new demands from citizens, private actors and public institutions indicate that a shift towards preventive and proactive care is crucial, as described by one informant:

There are in fact several things you want to see, so you want to first of all change public health systems in the Nordics or the classic Nordic model to also be able to handle challenges we will face in 2030. (Informant 7, 22.03.2021).

Because there are a broad range of issues that need to be solved, the findings imply that to drive the vision, they would need the engagement of numerous stakeholders. Hence, the vision was used as a tool to provide the grounds for interaction and align the various interests of a great number of stakeholders.

The informants from programme C explained that through numerous discussions both internally and externally, health data was brought to focus as an important part in reaching the set vision for the program. According to the programme vision, health data have the potential to improve and democratise healthcare by providing a personalised and preventive approach that could inform all health-related activities. At the same time, it provides interesting opportunities for the development of new solutions and innovations, thus supporting Nordic companies in growing and strengthening their competitive advantage. However, one informant stated the following:

If you look at data, we need standardisation, a secure platform, a regulative framework, and we need to ensure high quality capture of data, as well as the way we use the data, it's a very complicated entity I would say. (Informant 7, 22.03.2021)

Further, the informant stated that the Nordic countries have invaluable health-related data that remain underutilised, and if legal, ethical and technological challenges can be met, these vast datasets, in combination with data generated by individuals, present significant opportunities for

radical innovation for the benefit of people across the Nordics and beyond, as well as developing a competitive advantage for the regional health and life science industry. As such the topic of health data, its flow and use are complex and such require discussions with and within different stakeholder groups, both nationally and regionally, and also spanning outside the direct area of the organisation.

The informants from programme C explained that to implement the program a combination of instruments has been tested. These stand from stand-alone projects to joint Nordic health events ranging in size, from activities involving a handful of stakeholders to hackathons bringing large number of teams and participants. In addition, the activities provide opportunities and arenas for stakeholders to engage. The selection of instrument was both strategic and opportunity based keeping in mind the diversity of stakeholders and the different attitudes in the Nordic countries on how to handle data, as described by an informant:

'So, they all develop their own system or at least Norway, Denmark and Sweden. Iceland and Finland have completely different attitudes to this. Finland has already come a long way and has generally started to use data and has liberal attitudes. And in Iceland, you are used to Iceland being so small. Icelandic health authorities, they cannot invent the wheel; they are just too small. They are just used to shopping. Usually, it's from the USA.' (Informant 8, 16.04.2021)

It was critical for the organisation to pair up closed silos, widen the breadth of the involved stakeholders and allow for experimentation. The underlying logic was that innovation needs other groups to be involved rather than classic silo present in the current health system. As such, the informants claimed that in the programme, they got close to the industry and one of the great achievements so far was that it has managed to get the Nordic health tech industry to gather around the vision, making it easier to obtain political support.

The building of social networks

The findings suggest that the health system shift demands a consortium of stakeholders across the entire healthcare value chain, capturing health institutions, small and large companies, patient

groups, regulators, cities, as well as individual citizens. As pointed by an informant, the consortiums need to be capable of both innovation and implementation in public health systems:

'Not only businesses and politicians, but also hospitals and those who offer health services'
(Informant 7, 22.03.2021).

With such diversity, interest groups are involved in the program for different reasons, and subsequently have different expectations. This implies that motivation of different players in the system needs to adjust over time and regulators need to be ready to embrace the preventive nature of the health system. The role of the organisation in bringing showcases and pilot activities can offer needed evidence to allow for the changes to happen.

All informants emphasised that healthcare is perhaps the one thing that everyone in the Nordics have in common because they all depend on it. Yet this is also a system under strain, confronted by a perfect storm of challenges, and how they address these challenges together as a region rather than as separate nations could prove to be the real test of the Nordic welfare model. As such, the informants believed that by supporting value chain collaborations and helping ecosystems engage with different actors from the public and private sectors, they could drive system-level changes faster. Hence, the informants express that to achieve a shift to prevention an involvement of a broader ecosystem than those stakeholders which are classically considered as part of a healthcare system is crucial. This implies a needed effort to work across stakeholders and silos through connecting these stakeholders and helping them to reach a common understanding of the vision.

The programme conducted various activities to engage the different stakeholders or target groups, and in the process of defining the activities, interacting with external parties was important. In relation to the intergovernmental context, it was also important to ensure that the process considered the priorities of all countries. The findings imply that the inclusion of a wide spectrum of stakeholders, from large multinational companies to smaller Nordic players, was done to avoid silos and allow for the technical industrial base outside the health sector to take part. How they included stakeholders in the programme development process was noted by one informant:

We have tried to have some reference groups, for example, with a relatively broadly composition of selected Nordic stakeholders, split by gender, some from the industry, some from the public, some from Think Thanks. The idea has been to get a more balanced picture of what should be part of this programme. (Informant 7, 22.03.2021)

Further, the informants mentioned the importance of bringing actors together in new constellations and the role of them as intermediaries in creating platforms for collaborating:

We have quite a few smaller activities that focus on being innovative, being quick to get some things connected. One of the first workshops we had in Iceland, for the first-time people from the Ministry of Health and Welfare got together with Icelandic Medtech companies. They had never sat down together before. So it was an example of getting those links and where we facilitate the interaction. (Informant 7, 22.03.2021)

In this way, the strength of the intermediary organisation was also highlighted through the network they built, both in the public systems, such as research institutions and boards, and other public organisations and in the private sector.

Learning process of multiple dimensions

The informants stated that for the effective use of healthcare data, scalability matters. This requires cross-border collaboration on larger datasets. There was also great interest from Nordic companies in working across the Nordic countries and to share data. However, regulations put an end to this desire. One informant stated, *'We cannot change the regulations, but we can show that there is a need for changes'* (Informant 8, 16.04.2021).

The key aim of many of the activities was to have user cases to be able to showcase possible solutions and piloted examples. It was also important to test identified ideas in practice to get a practical understanding in terms of possible results and as well as possible obstacles. This include a feedback loop, which is crucial for better understanding of the user groups and further

development of set ideas. As such the activities needed to be performed in an iterative manner, involving trying out, testing and moving forward.

Hence, as part of the programme, they made an overview of the main legal obstacles for using and sharing health data for innovation purposes across the Nordic countries. The purpose was explained by one informant as follows:

Now, I can just say to politicians we have found 10 things that are low hanging fruits, and if you fix these four legal obstacles, then there are big gains if we manage to make this happen. (Informant 8, 16.04.2021)

Further, the report will form the basis for a use case and business case. The use case will simulate and showcase how the programme vision, if realised, will impact Nordic business in various sectors, whereas the business case will be an assessment of the fiscal value to be gained. In addition, Hackathons were also used to gather innovation talent across the region and to create awareness of the benefits of collaboration and data sharing. As such, the findings indicate that overcoming the barriers that prevent innovation is an important intermediary action in the programme by highlighting the potential of the region becoming a world-leading health innovation hub.

4.2 Summary of findings

The findings demonstrate the *variety of roles and activities* intermediaries in sociotechnical transitions involves. Although all the programmes were engaged in some way under all three internal processes of SNM, there are variations in the programme portfolios of the projects and activities. However, there are some common elements related to the overall role and function of the organisation and strategy process in which they all took part of. For example, in the strategy process, the articulation of vision and sustainability aim was a core part of the process. Through the programme cocreation, the programmes took different directions and implemented multiple tools to fulfil their intermediary role towards the vision of sociotechnical change.

The *importance of the articulation of the vision process* was articulated by the informants in all three programmes. The vision was described as having an essential function in congregating the various stakeholders. As such, in several interviews, developing the programme narrative and

clearly communicating the vision and expected change was mentioned as a critical intermediary action. In the development of the vision narrative, the informant interviews emphasised the early strategy process where the mapping of ecosystems and strongholds took place to identify synergies with the potential for Nordic added value, areas where the Nordics can take a lead and opportunities for collaboration with leading global initiatives within the programme areas. Some informants mentioned that it has been crucial to use broad definitions in the vision to consider technological development, innovation and changes that cannot be predicted currently. As such, the findings suggest that a vision can stimulate innovation and cooperation across sectors and ecosystems because it helps visualise the desired future and communicate and point out new possibilities, bringing up new discourses and ways of thinking and challenging old structures.

Cocreation with stakeholders at all levels in a nonlinear process is a clear function in programme development, as found in all the interviews. The informants stated this was vital to become relevant, create trust and engage stakeholders. This was emphasised by one informant in programme A:

.... we must have confidence that we know what we are doing because if we do not believe in ourselves, and we should do so, then we cannot argue for others to put their resources into our processes or activities. We do this in part by having a continuous dialogue with the stakeholders. Both to see and present what is the benefit and value in the collaboration and in the programmes and activities that we do, and at the same time check that we stay relevant to those we collaborate with...
(Informant 1, 26.03.2021)

As such, the findings indicate that a lot of flexibility is added to the programmes, along with room for experimentation, allowing for adjustments to take place during the programme.

The findings suggest that a **multiple tools approach** is necessary because the aim of all three programmes was to increase awareness and accelerate the application of new concepts and technology, hence engaging numerous target groups. Through the programmes, the intermediary organisation developed a portfolio of a range of projects and multiple tools (figure 1), such as a call for proposals (Program A and B), challenge competition (Program B), competence building

(Program A), piloting new solutions (Program A and B), matchmaking (Program A, B and C) overview of legal obstacles (Program C) and scenario building (Program C). The idea was to encourage actors across levels and sectors to take an active role in achieving the systemic change. Although the role of the intermediary organisation was limited in the projects themselves, it was active in processing, gathering, generating and communicating knowledge and creating arenas for knowledge dissemination and for sharing and providing advice on how to engage in the projects.

The target groups and partners of the projects included a **wide spectrum of stakeholders**, such as small- and medium-sized companies, anchor companies, public authorities, municipalities, national innovation and trade promotion organisations and research organisations. In several interviews, the need to engage with the whole value chain and ecosystems to enable the vision transition was mentioned. Thus, the immense network at all levels of the intermediary organisation was highlighted as a strength by the informants, as stated by an informant in programme C:

Because we actually have the network that runs in both the public systems, research institutions and agencies and other public and then in the private world. So, then I think we have some very large comparative advantage from pretty much all other organisations in the Nordics. (Informant 7, 22.03.2021)

Network governance, such as the creation of models for collaboration with the surrounding ecosystem of actors was seen as an implicit innovation intermediary activity in the programmes. This includes cooperation with other intermediaries, as mentioned by the informants as a way of getting access to a wider network and was considered necessary because a wide spectrum of stakeholders is important to change systems. However, the findings indicate that network governance is a very demanding activity requiring constant communication and engagement. The co-creation in the early strategy process included a lot of stakeholder involvement, giving the programmes a good positioning for multiple stakeholder involvement. As the programmes developed, the findings imply that some programs managed to develop the network organically, while other narrowed their scope of actors.

The findings suggest that **building knowledge** was a key element in the programmes through both articulation of the vision and learnings created through projects. In the collection of knowledge, the

programmes referred to activities such as pilot projects, test facilities, background studies, foresights, challenge competitions, use and business cases and workshops. These proceeded differently in the programmes. For example, in programme C, the informants referred to the need for a legal overview that could portray the legal obstacles and possibilities for using and sharing health data for innovation and, as such, a need legislative change. Whereas in programme B, prototyping and piloting were used to show how the vision can work in practice and produce information for future activities. Seminars, workshops and conferences, guidebooks and manuals, competence building and consortium building in project applications were brought up as examples of activities for facilitating the exchange of experience and knowledge. The findings suggest that in the *dissemination and communication of knowledge*, the aim was also to create value for other actors besides the individual participants, as stated by one informant in programme B:

One aspect of the projects we have done is that it will create value for other actors besides the project....as transformative change is not something you can do as an individual actor or as a small collaboration within a project, but what you want to do is move the pillars further forward to be able to be part of the movement that transforms the mobility system... (Informant 3, 21.03.2021)

Impartial and neutral were brought up in several interviews across the programmes as a way that the organisations are technological neutral, nonbiased and not favouring any Nordic country. As one informant in programme A illustrates, *'That we work for everyone and with everyone gives us a certain status and strength and makes people trust us'* (Informant 2, 17.03.2021).

Trust and legitimacy were referred to in the interviews as necessary to attract companies and for stakeholders to invest their resources in the programme activities. Technology neutral was mentioned in the interviews as important to allow for out-of-the-box thinking and to look ahead without the limitations of technology that already exist in the current regime. However, in some interviews, the lack of independence was brought up because of the organisation being an intergovernmental organisation. Hence, the organisation was not financially independent, and elements in the programmes can be predefined orders as part of political priorities. A challenge can be to link political priorities to the ongoing reality of the companies. As mentioned in one interview, this could present some limitations in relation to the process of programme development:

...I think it is important that we also give the freedom to those who put it into practice and involve the Nordic organisations or the Nordic companies, that we leave it also up to them partly. But of course, it is important that we listen to the Nordic priorities and political decisions as well, but it can somehow restrict our freedom we have in implementing the innovation processes... (Informant 3, 09.04.2021)

As such, as expressed through the findings, emphasising the importance of involving the stakeholders in the co-design of the program in an iterative manner to ensure the legitimacy and relevance of the intermediary activities.

5 Discussion and Conclusion

The aim of the study has been to investigate the contribution of innovation intermediaries in sociotechnical transitions, as well as their role and activities in the complexity of these transition contexts. The conceptual framework was formed utilising the literature on sociotechnical transitions and innovation intermediaries. This chapter discusses the main findings of the study in light of earlier research to discuss the two research questions. I begin by examining the different intermediary roles and activities (research question 1) made visible in the innovation programmes, after which I discuss the findings in relation to the processes of successful SNM. I then scrutinise the possible main contributions of innovation intermediaries based on the empirical findings in system innovation and acceleration of sociotechnical transition (research question 2).

5.1 Discussion

5.1.1 Innovation intermediary roles and activities in the transition context

The theoretical framework used in the current study illustrates that addressing the key challenges currently facing Nordic society requires profound changes in the current sociotechnical systems. To leverage such ‘sociotechnical transitions’ calls for a wider outlook on innovation, moving beyond product or process innovation to a focus on systemic change and system innovation. Because system innovation transforms the wider societal context, there is a prerequisite to address the different interconnected system elements and deal with the changes needed in rules and policy regulations, markets, institutions, user practices and culture required for technological change to be implemented (Geels, 2005). Thus, innovation is not just seen as a technological process but as a process that has social and ecological features built into the design of each technological trajectory (Molas-Gallart et al., 2020). This implies that the objectives—and as such the role and activities of intermediaries operating in system innovation—must be defined in the complexity of the transition context and linked to the transformative outcome.

A systemic intermediary operates at levels (niche, regime, landscape), promoting an explicit transition agenda and taking the lead in aiming for change on the whole system level (Kivimaa et al., 2019, s. 1068). Transformative outcomes were a strong force behind the promotion of activities in all three innovation programmes. The programmes responded to a Nordic intergovernmental cooperation programme that highlighted the many societal challenges that the Nordic countries are

facing. This gave the programmes a transformative focus and need for a system-level approach to innovation, implying that the programmes had the objectives of stimulating innovation and cooperation across a range of sectors and ecosystems. The empirical findings imply that with the systems approach, in many cases 'technology' was not the issue but rather bringing together relevant group of players covering different elements of an emerging value chain to share knowledge openly, build trust and prove the business case. As the transition topic is complex and require discussions with and within different stakeholder groups and spanning outside the direct area of the intermediary action, this meant pair up closed silos, widen the breadth of involved stakeholders and allow for experimentation. Hence, the intermediary act as broker between various priorities, interests and knowledge pools for creating a shared vision and activities to facilitate transition.

To ensure that the innovation programmes had the necessary legitimacy, acceptance and relevance, the programme development and implementation process included all relevant actors in the codesign, co-implementation and co-evaluation of the activities. System intermediary proved to be a lot about engaging and building a broader ecosystem than those stakeholders which are classically considered part of the system. This implies the need to work across stakeholders and silos and helping them to reach a common understanding. Kivimaa et. al (2019) argue that operating in a transition context, the roles of actors change, so are the role of intermediaries also subject to change, along with the whole ecologies of the intermediaries in the various phases of transitions. The nonlinear process approach gave space for experimentation and a more diverse group of stakeholders working together on a variety of pathways, with the possibility to approach the system from different angles and to adjust when needed. As such the non-linear and iterative approach allowed for the intermediary action to appear differently in different stages of the transformative change. Hence, the innovation process proceeded differently in the three programmes. This indicate that due to the complexity of the transition there is a need to constantly innovate the way we innovate, implicitly looking for new innovation tools, capabilities and cultures. This involves a lot of engagement with actors across the system, both inside and outside, to figure out what kind of innovation capabilities and adaptations are needed.

Intermediaries are often described as neutral or honest brokers without clear normative interest beyond that innovation occurs (Klerkx & Leeuwis, 2009). The importance of being *impartial and*

neutral was brought up in several interviews across the programmes. When it came to neutrality, the informants referred to technological neutral, nonbiased politics. The aim of technological neutrality is to allow for out-of-the-box thinking and look ahead without the limitations of the technology that already exist in the current regime. As a system intermediary working in networks instead of one-to-one mediation (Klerkx & Leeuwis, 2009), their reliance on building network highlights neutrality as crucial for gaining trust, gathering different parties into new networks and maintaining personal relationships and informal contacts. To enable the transition, the studied programs needed to engage with the whole value chain and ecosystems. The dependency on other actors and the tension and conflict may become stronger as the system faces more disruptive forces (Kivimaa et al., 2020), emphasising the need to be explicit about the organisation's intermediary position and credibility, as expressed in a interview, *'it is important that the stakeholders feel that we work for everyone and with everyone'* (Informant 2, 17.03.2021).

Despite seeking neutrality, an intermediary organisation may be forced to take some positioning and be biased to cooperating with some parties and not others (Klerkx & Leeuwis, 2009). In the current case, being an intergovernmental organisation, the programmes were, for example, influenced by the political priorities defined in the cooperation programme. This limited the organisation's freedom to set its agenda and can potentially give a degree of lock-in to existing regime. The interviews indicate that the partial detachment from the political administration of *'a political organisation without political discourse'* (Informant 6, 21.03.2021), as well as involving businesses in a co-creation process, built trust. Despite being influenced by political priorities, the studied intermediary had a large degree of independence on how to use the allocated funds to advance systemic change the way they saw best, thus enabling politically more radical opinions and actions, as such appearing politically, technological and financially neutral (Klerkx & Leeuwis, 2009; Kivimaa, 2014) and gaining a certain level of trust from other actors.

The intermediary in the current case takes an active role in the aggregation and dissemination of knowledge. Building knowledge and facilitating learning processes were highlighted in all the interviews as key elements of the innovation programmes. In many activities funded the aim was to showcase possible solutions and piloted examples. Allowing to test ideas in practice, both in terms of understanding possible results as well as obstacles, ensures a feedback loop that is crucial for better understanding of user groups and further development of the niche. As such, the

programmes represented arenas for strengthening and building trust around the vision, for sharing ideas and for exchanging business-sensitive information. This is because the actors, even though several of them were competitors, saw that openness and cooperation could strengthen their competitiveness. In the interviews, it was also emphasised that the learnings and value that was created was not limited for those directly involved in the programme or projects '*...as transformative change is not something you can do as an individual actor or as a small collaboration within a project*' (Informant 3, 09.04.2021). Hence, in the interviews the programs were explained as open and transparent, allowing for the niche innovations to 'scale up' (Kemp et al., 1998) and to give access to further technical expertise, funding and political support (Geels & Raven, 2006, s. 378).

5.1.2 Potential contributions to sociotechnical transitions

The case analysis proposes that intermediary organisations are likely to play a role in all three processes of SNM. However, it can be difficult to justify the value addition of intermediaries to system change because of the attributability challenges and intangibility of some of their inputs (Klerkx & Leeuwis, 2009). This difficulty in demonstrating the added value of intermediaries is especially distinct for intermediation roles, such as those in facilitating networking and partnerships, information gathering and dissemination, because they are based on complex social processes with indirect outcomes because of contingency effects (Kanda et al., 2018). With a limited engagement period, it will also be difficult to see the final impact of the innovation programme activities because the innovation programmes and its activities are too temporary in their nature to influence a regime and, thus, create system change.

Moving beyond the programmes, as an 'innovation broker' (Klerkx & Leeuwis, 2009; Winch & Courtney, 2007) innovation intermediation was found to be the organisation's core functions, and hence, there are possibilities for dealing with the long-term character of the change process. Yet the complexity, tensions and uncertainties can have implications for the funding situation and long-term perspective necessary in sustainably transitions, leading to intermediaries complementing and competing with each other for resources and relevance (Kanda et al., 2020). As a public actor, diverging interests, expectations and policy agendas may also negatively influence the broker's performance. As such, the intermediary activities they carry out in the systemic innovation

management processes should be made more distinctive, and their added value should become more explicit.

Working on transformative outcomes and challenges that require restructuring at the system level places extra great demands on how one performs one's work. System transitions require coalition and movements, and the process of system innovation involves multiple actors negotiating alternative pathways that have the potential to achieve system change (Schot & Steinmuller, 2017, p. 17). The importance of consensus and visions and working methods emphasises the need for systemic innovation management. As such, there is a need to understand how the activities and innovation tools can trigger transformation at multiple levels and to look into devices that can monitor and evaluate innovation experiments with a narrow geographical and temporal scope when the final objective is ambitiously systemic and when there is a vision of systemic transformation.

Examples in the findings illustrate that actions that can be measured, and where a clear change can be illustrated, activities are easily justified. As such, the transformative power of more complex and difficult-to-grasp activities can remain underutilised. Transformative change cannot be implemented or controlled but requires the development of conditions that allow for change to unfold in a desired direction (Gosh et al., 2020). The findings suggest that more research is needed on systemic innovation management processes of intermediaries and on how they can reflect on learning points and adapt the interventions to obtain a better understanding of their contribution, thus strengthening their contributions to the acceleration of sociotechnical transitions. Hence, the paradigm of systemic innovation management should be challenged, both as a practice and as a mindset, to make it effective in the face of complicated issues, as there is the need for an open understanding of the problem, working with stakeholders as equals and experimenting on what works in a given context and time.

5.2 Conclusion

Combining theories on innovation intermediaries and in the field of sociotechnical change, the current study has contributed to insights into both literature streams. The present study also presented an embedded single case study of an intergovernmental innovation intermediary organisation acting as an 'innovation broker' (Klerkx & Leeuwis, 2009; Winch & Courtney, 2007), where intermediation is the organisation's core function. The theories lay the theoretical foundation for the formation of the analytical framework to explore the complexity, roles and functions innovation intermediaries can play at each transition management level, here with a particular focus on sustainability transitions and the three processes of SNM. As such, the current study has provided input to the lack of practical knowledge on how systems can be changed deliberately by intermediary activities and how new systems can be brought into being (Kivimaa, 2014). The framework was designed to be applied to 'system intermediaries' (Kivimaa et al., 2019) in particular, but not exclusively to government-affiliated intermediaries.

The empirical analyses of the intergovernmental intermediary organisation demonstrate the variety of activities that intermediation involves. All three innovation programmes used as an embedded unit of analysis in the single case engaged in some roles under the three internal processes of SNM (articulation of expectations and visions, building of social networks and learning process). Although as an innovation broker, there were some common intermediary activities and roles in all programmes; they also differed in their portfolio of projects and activities because the innovation programme process involved actors in codesign and co-implementations of the projects and activities. Operating within the complexity of the transition context, the intermediary role and activities were found to be subject to change, so the intermediary must continuously innovate the way it innovates, adapting to the various phases of the transitions and stakeholder needs.

The current study implies that sustainability transitions need systemic intermediaries because they particularly have a role in voicing new visions to pilot and test niche solutions, and as convenors they can bring together the different people involved to change a system. Yet it is difficult to demonstrate their effect on a sociotechnical transition because of attributability challenges and the intangibility of some of their inputs, as well as the restricted engagement period of the innovation programmes. As such, the intermediary activities they carried out in the systematic innovation management processes need to be made more distinctive to demonstrate their added value to

sustainability transitions. Hence, there is a need to better understand how the intermediary innovation process can trigger transformation and investigate devices for monitoring, evaluation and learning processes to evaluate innovation experiments with a narrow geographical and temporal scope.

5.3 Further research

There are contextual and temporal limitations. Considering the complex environment in which intermediaries operate, multiple cases and a wider spectrum of informants would allow for a more in-depth empirical basis for better understanding how intermediaries are operating in system transitions. In addition, research is needed to further explore the systemic innovation management process of system intermediaries. Such research could contribute to a better understanding of how to monitor and measure the impact of system intermediaries in sociotechnical transitions, as well as how an innovation intermediary process and its instruments and tools can be designed to intervene in all levels of a system.

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8 Annexes

8.1 Annex 1 Interview guide

RQ1: How does the complexity of the transition context influence the intermediary's roles and activities?

RQ2: What are the main contributions of innovation intermediaries when it comes to accelerating sociotechnical transitions, particularly in SNM?

I begin the interview by thanking for the opportunity to conduct an interview and its great importance for the research and the quality of the master's thesis.

Furthermore, I give a brief introduction to the topic and the research questions, how a typical interview can proceed and how I will ask questions to get as detailed answers as possible.

I inform and ask for consent to record the conversation on a digital recorder that facilitates transcription and analysis after the interview.

I also emphasise the importance of open, honest answers / discussions during the interview and remind again of full anonymity, that the interview is voluntary, and that the interviewee can withdraw at any time without giving a reason.

MANAGING EXPECTATIONS AND VISIONS

Question	Follow-up question
<ul style="list-style-type: none">- Can you give a brief introduction to the program, its purpose and what changes you expect to see as a result of the program?	<ul style="list-style-type: none">- What role do different actors play in the design of the instruments/activities?
<ul style="list-style-type: none">- Where did the idea for the program originate from and how did you further develop the idea?	<ul style="list-style-type: none">- How was the process of articulating the goals and vision of the program?- How did the program develop over time?
<ul style="list-style-type: none">- How do you balance conflicting interests?	<ul style="list-style-type: none">- How did you create consensus?- What have been the biggest challenges in the program design phase?

BUILDING OF SOCIAL NETWORKS

Question	Follow-up question
<ul style="list-style-type: none"> - What are relevant stakeholder groups and how does the program involve these? - How does the program connect different actors participating in the programs? 	<ul style="list-style-type: none"> - Explain who are the most important stakeholders in the program and why? - How do you maintain the network of actors? - How do you create models for collaboration with the surrounding eco-system of actors?

LEARNING PROCESSES – REPLICATION AND SCALING

Question	Follow-up question
<ul style="list-style-type: none"> - How can the program catalyse change - e.g., results of established networks / ecosystems? - How does the program contribute to creating synergies between the activities and the actors and between actors? Example? 	<ul style="list-style-type: none"> - How has the program contributed to increase the visibility for the need for change? - What are the practical outcomes of the established networks and ecosystems? - Can you give an example of real-life impact?

INNOVATION INTERMEDIARY CAPABILITIES

Question	Follow-up question
<ul style="list-style-type: none"> - How do you think XX must appear as an organisation to create trust as an innovation intermediary? 	<ul style="list-style-type: none"> - What is good "intermediation" practice? - What qualities are important in employees? - What are the strengths of XX as an innovation intermediary in system innovation and sustainability transitions? - What challenges does XX have as an innovation intermediary in transformation processes?

Finish the interview and thank you