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Innovation Ecosystem Orchestration in the water technology context

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Abstract: From the perspective of innovation management, the orchestration of an innovation ecosystem is one of the most essential aspects to ensure the realisation of the value for the ecosystem members within the ecosystem emergence process. However, the current understanding of ecosystem emergence and the role of an orchestrator during the process is relatively limited. Based on the case analysis of an innovation ecosystem, we provide new empirical evidence on the emergence process and the role of an orchestrator and the local innovation policy. In the case study of a water management ecosystem, we will present how it has evolved since the 1980s and what have been the key phases, the key decisions, and the outcomes resulting in its current state. Based on the analysis, we see that both ecosystem orchestration as well as the regional innovation policy can drive value capture during the emergence of an ecosystem.

Keywords: Ecosystem emergence; orchestration; innovation policy; water technologies; governance; dynamics

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1 Introduction

In a continuously changing business environment, an organisation's capability to catalyse the emergence and guide the development of an innovation ecosystem can offer an increasingly potential and a powerful source of competitive advantage (e.g. Pellikka and Ali-Vehmas, 2016). Working cooperatively with other players such as private and public organisations opens new opportunities to use and build complementary assets to further drive the organisation's objectives. This can be done, for example, via novel ways created to facilitate resource mobilisation to develop innovative products and services (Neudert and Kreutzer, 2021). In order to realise these benefits, orchestration of the innovation ecosystem is an essential area to ensure the realisation of the value for the ecosystem members. In this paper, we define the term 'ecosystem orchestration' as 'the set of deliberate and purposeful actions undertaken by the ecosystem orchestrator or a hub organisation to plan, manage, and mobilise resources for co-creating value and to reach the set objectives (see Pellikka et al. 2021; Giudici et al., 2018). In addition, the orchestration of the innovation ecosystems depends on establishing inter-organisational collaborative practices to facilitate knowledge, asset, and information sharing among the ecosystem members. These practices can be planned and executed via a systematic approach including planning and orchestration of the key elements of an ecosystem (see Pellikka et al. 2021).

However, the current understanding of ecosystem orchestration that addresses ecosystem emergence approaches and provides concrete perspectives for the ecosystem orchestrators is relatively limited (see Autio, 2021). The current literature is lacking a theoretical foundation that addresses the development and change of innovation ecosystems over time and does not consider the inherent dynamics of innovation ecosystems that lead to their conceptual design, building, operation, maintenance, and succession. It has been also noted that it is challenging to effectively orchestrate an ecosystem that consists of multiple actors, assets, data, and resources (see Pikkarainen et al. 2017). Therefore, is it essential that an ecosystem must be able to identify in more detail the key value creation elements, drivers, roles, and key constrains (see e.g. Dedehayir, 2018). In addition, we can also see that the life cycle of an ecosystem must be considered as part of the ecosystem orchestration planning and execution (see also Tolstykh et al. 2020). Based on the perspectives described above, this paper introduces a case study of Kuopio Water Cluster (KWC) and its development since the 1980s. Our aim is to answer the following key questions:

1. What are the main phases of an innovation ecosystem emergence process?
2. What is the role of an ecosystem orchestrator in the emergence process?

The paper is organised as follows. Section 2 discusses previous literature related to the key elements of ecosystem orchestration and ecosystem emergence from the multi-layered perspective. Section 3 describes the methodology and the case of KWC and finally, Section 4 discusses its key results and implications for the ecosystem orchestrators and the innovation policymakers.

2 Innovation Ecosystem Orchestration and Ecosystem Emergence

Organisations have developed innovation ecosystem strategies and practices to leverage their own knowledge and data-based resources. In many domains, firms across industries are searching for new synergies, partnerships, and collaboration formats that can secure future competitiveness and profitable business models in an ecosystem setting. In order to be able to define the strategic alternatives, it is essential to gain a deeper understanding of the dynamic nature of an ecosystem and its key characteristics, including structure, phase in its lifecycle, capabilities to create value, and more.

Previous studies have described different perspectives on how ecosystems emerge and how they evolve over time in order to create and capture value for members. In this paper, we define the term 'innovation ecosystem' as follows (see Thomas and Autio, 2020), 'An innovation ecosystem is a community of hierarchically independent, yet interdependent heterogeneous participants who collectively generate a coherent, ecosystem-level output and related value offering targeted at a defined user audience.' Note that although the ecosystem orchestrator often is the 'hub' firm, any participants of the ecosystem may engage in orchestration activity in an effort to shape the functioning of the ecosystem. In this context, 'ecosystem orchestration' relates to where ecosystem leaders persuade others to make voluntary inputs that are consistent with the ecosystem's overarching value offering (see Autio, 2021).

Moving beyond conceptual models, recent scholarship has begun to provide empirical evidence of stages of ecosystem emergence. Many of the previous studies found out that typically ecosystem emergence follows a process including key phases. For example, Sant et al (2020) showed that the main classifications related to the structure of an innovation ecosystem are the ecosystem lifecycle (birth, expansion, leadership, and self-renewal), the classification according to the ecosystem level (macroscopic, medium, and microscopic). Tolstykh et al. (2020) proposed that the ecosystem follows the following main phases: conceptual design; ecosystem building; operation and maintenance; and finally succession. According to Thomas and Autio (2014), the ecosystem emergence process follows the listed phases: conceptual design; ecosystem building; operation and maintenance; succession. After succession, there are two possible reactions to the challenges: self-sustaining growth or retrenchment. From the architectural point of view, Autio (2021) proposed that effective innovation ecosystem orchestration should entail orchestration activities in four dimensions (i.e. multi-layered approach): technological, economic, cultural-behavioural, and institutional.

The technological layer of ecosystems comprised the focal platform, or alternatively, a set of shared technological standards that underpins the ecosystem and around which the ecosystem community is organised. As such, the platform could be digital – e.g., a set of shared algorithmic functionalities accessible through a shared interface. The required coordination could also be achieved without a central platform.

The economic layer of innovation ecosystems comprised of economic assets and policies – such as economic incentives targeted at one side of a multi-sided platform with the intent of mobilising ecosystem participation.

The cultural-behavioural layer of ecosystems comprised participant behaviours and behavioural norms defining desirable and undesirable behaviours.
The institutional layer of innovation ecosystems comprised rules, regulations, and externally facing institutional activities dedicated to enhancing and embedding the ecosystem into its broader societal and economic context.

In addition, based on the previous studies, we can also see a linkage between innovation ecosystem emergence and ecosystem orchestration. Since ecosystems are typified by complex systemic interdependencies (see Adner, 2017), the role of the orchestrator and the decisions of the other key members are essential to manage this entity. From the ecosystem member point of view, they can adopt different forms of collaboration to develop innovations by sharing capabilities, knowledge, and data. For example, companies face a choice between taking an active or a passive role in the innovation ecosystem (see Pellikka and Ali-Vehmas, 2016). If an actor assumes a leadership role in an ecosystem, the actor will have the opportunity to tailor the ecosystem's development in a way that may align closer to its own strengths and gains.

However, although the importance of orchestration has been widely recognised in literature, there has not been much research focusing on tangible actions firms can take to successfully orchestrate an innovation ecosystem from inception to maturity (see Yaghmaie and Vanhaverbeke, 2019; Autio, 2021). Rather than relying on internal resources, firms, ecosystem leaders, orchestrators, and policymakers are increasingly seeking new approaches to create and capture value via other partners in innovation ecosystems. This, however, means that in practice these parties must be able to set and facilitate the key orchestration activities including (e.g.): 1) the definition of a winning strategy for a selected ecosystem (formation and implementation); 2) creation of managerial capabilities and set roles and responsibilities; and 3) external search practices and effective ways of working with the business partners that can provide the complementary assets and resources for further business development and growth.

Therefore, is it essential that an ecosystem must be able to identify in more detail the key value creation elements, drivers, roles, and key constrains (see e.g. Pellikka et al. 2021; Leminen et al. 2012). In addition, as structures of value capture in the innovation ecosystem context requires well-selected efforts with effective execution, innovation ecosystems present a distinctive governance challenge that also underlines the importance of ecosystem orchestration (Autio, 2021). In such multi-actor settings, orchestrating firms play a significant role. It has been argued that both an orchestrator and the local service infrastructure, including innovation policy, should provide a nurturing environment for the innovation ecosystem and, thus, enhance regional economic growth (e.g. Yun et al. 2017). It has been recommended that priority should be given to policies designed to promote co-creation and co-value capture via joint value discovery, collective governance, platform resourcing, and contextual embedding (Thomas et al. 2022).

Through these, ecosystems can be created and establish themselves as functioning organisational collectives. To enable this, significant objectives of economic policies have been to provide suitable infrastructure and enhance the availability of appropriate support for the ecosystems. However, it has been argued that studies should be more focused on identifying effective instruments and their integration within a wider support system and the optimal deployment of public policy to promote entrepreneurship and innovation (OECD, 2018). Thus, there is a need to examine the requirements of ecosystems and the ecosystem orchestrator associated with the emergence process and to identify potential alternatives to help innovation ecosystems to reach their set objectives.

3 Methodology and the case description of Kuopio Water Cluster

As highlighted in the literature review above, concepts and information from a large range of disciplines, such as business economics, organisation theory, industrial relations, and innovation management studies need to be taken into account when examining the innovation ecosystem and its orchestration. Previous authors have reported that case study analyses can improve the relevance of management and innovation studies in the technology sectors; case studies especially can provide valuable insights into innovation particularly from organisational, sociological, and managerial perspectives (see Eisenhardt and Graebner, 2007). In order to meet the objectives of this paper, we conducted the following steps:

1. Definition of the main research questions
2. Selection of the case ecosystem and determination of the data gathering and analysis methods
3. Preparation of the data collection (e.g. semi-structured interview setting)
4. Data collection (e.g. interview plan and facilitation planning)
5. Evaluation of the data
6. Data analysis
7. Results and implications

The conceptual framework and the definition of the research questions were both based on previous literature assumptions regarding small technology firms, relying on theory-bonded observations.

The interviews were based on broad themes following a semi-structured outline, in which each theme to be covered was addressed by detailed questions and related questions were planned in advance. During the interview, substantial flexibility was allowed to provide opportunities for the interviewee to talk about issues they considered important. The outline of the themes was applied flexibly in the interview situation, and the questions were not sent beforehand to the interviewees. At the beginning of each interview, the background of the study was briefly described to the interviewees. Moreover, before each interview, the case ecosystem was examined in order to obtain an overview of the history and the current priorities.

The data were analysed with a three-pronged approach (Miles and Huberman, 1994) comprising the following three main phases:

1. Data reduction. This refers to the process of selecting, clustering, abstracting, and transforming the documented transcriptions into a usable form.

2. Data display. This involves assembling the data to be used in a way that enables (inter alia) conclusions to be drawn. The interview data were organised into time-ordered matrices for this purpose.

3. Conclusion drawing and verification. In this phase, the key results of the study were critically evaluated and documented for reporting usage.

Innovation Ecosystem in the regional context - Kuopio Water Cluster

North Savo is a region located in eastern Finland with a population of 244 236 inhabitants. The region is divided into 18 municipalities with the largest cities and populations as following:

- City of Kuopio: 120 000
- City of Siilinjärvi: 22 000
- City of Iisalmi: 21 500
- City of Varkaus: 21 000

The North Savo region is home to over 200 globally known exporting companies and top-notch international forerunners. These businesses account for approximately 40% of the Finland’s export and 20% of employment in the area. There are 152 education facilities in North Savo, which together have generated an area with one of the highest educated populations in the country. Educational institutions include:

- University of Eastern Finland, Kuopio Campus
- Savonia University of Applied Sciences
- Emergency Services College
- Savo Vocational College
- Ylä-Savo Vocational College

The North Savo region has seven distinct development areas in which strong international know-how and business activities have been identified. Through these areas, the advancement of technological solutions and expertise can be secured, ensuring the vitality of the economy’s competitive advantage. These areas are as follows: 1) Machine and energy technology, 2) Forest industry, 3) Food products, 4) Well-being technology, 5) Tourism, and 6) Intelligent water systems, and 7) Biorefining.

In this study, we will focus on the Intelligent water system area by concentrating on its emergence process since the 1980s. It’s a focused and strategy-lead development process that has lasted for over 30 years, resulting in the high-tech ECCP-certified Kuopio Water Cluster. Kuopio Water Cluster is focusing on the water know-how RDI to support the product development of companies and address water-related challenges. Kuopio Water Cluster facilitates the emergence of new businesses in the water expertise field (i.e. start-ups and new products and services) and strengthens the position and capacity of existing companies to achieve potential growth. Furthermore, KWC attracts new businesses to the region (i.e. spearhead corporations and SME) and supports the access to international markets for companies in the water management sector.

The focus of Kuopio Water Cluster's innovation and product development activities are:

- Processes: Development of water treatment technologies, recovery processes, and closed water cycles
- Environment: Prevention of water and groundwater pollution, agricultural water pollution, and industrial water management
- Smart Solutions: Intelligent water management solutions and wireless technologies (incl. 5G)

In particular, the know-how is applied to the reduction of emissions from water-intensive industries (i.e. the mining industry and the pulp and paper industry), to the water supply of communities, and to the development of comprehensive management of the water impact in agriculture. A special strength of the Kuopio Water Cluster is the ability to develop and test new water technology applications in practice both in laboratory conditions and as pilots on field sites in cooperation with companies operating in the industry. This is a significant advantage in the development of water-related treatment processes as well as new applications in, for example, industry and water supply.

At the regional level, the organisation of the ecosystem is based on the core members and their participation. Savonia University of Applied Sciences coordinates the Kuopio Water Cluster (www.kuopiowatercluster.com) in close collaboration with other key public and private organizations. Founding members include Savonia University of Applied Sciences (Savonia), University of Eastern Finland (UEF), Finnish Institute for Health and Welfare (THL), Geological Survey of Finland (GTK), Finnish Food Safety Authority, and Natural Resources Institute Finland (Luke). These organisations employ a total of nearly 200 water industry experts, mainly located in Kuopio’s Savilahti area. At the core of the cluster are unique laboratory and pilot facilities for the implementation of operations, especially in pilot settings. As of this publication date, 62 organisations have joined the ecosystem as members. On an international scale, Kuopio Water Cluster is actively involved in the EU S3 Smart Specialization platform called Water Smart Territories.

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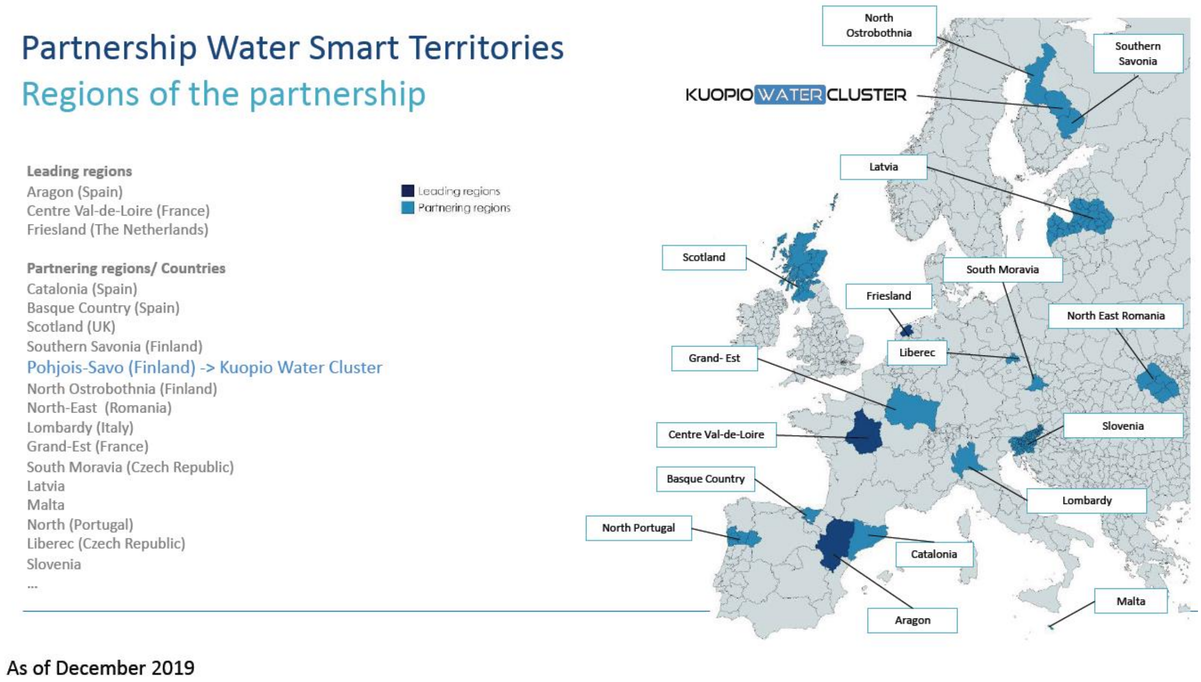

Figure 1. Kuopio Water Cluster as part of the EU-wide Smart Water Territories cluster network. Kuopio Water Cluster was also the first Finnish player to receive official cluster status granted by the EU's ECCP (European Cluster Collaboration Platform) in the spring of 2020.

The following section will describe the development of the ecosystem since its basis was created in the 1980s.

Value discovering in the 1980s - The impetus for cooperation between research institutes. Research collaboration in the water sector can be considered to have started in Kuopio, Finland in the 1980s. The organisation currently known as the Finnish Institute for Health and Welfare (THL) and the University of Kuopio (now UEF) began research into by-products of drinking water disinfection. The research led to international publications as well as e.g. significant updates to the disinfection recommendations for the Finnish water supply sector. In addition to research activities, THL and the university also cooperated in teaching with THL experts acting as visiting lecturers in university courses and supervising students' theses and dissertations. Cooperation projects led by the University of Kuopio related to the implementation of chemical and later microbiological analyses also took place. Joint professorships were established between the organisations to further promote cooperation.

Collective governance in the 1990s. During the 1990s, the city of Kuopio became active in the regional RDI work and Pohjois-Savo University of Applied Sciences (the current Savonia University of Applied Sciences) was established. The first 'wave' of a light governance body, research infrastructures, and buildings supporting research cooperation and entrepreneurship was completed in Kuopio. Finland also joined the European Union on 1 January 1995.

In the mid-1990s, research and teaching cooperation between THL and the university continued, resulting in Pohjois-Savo University of Applied Sciences being founded in 1992. At the same time, the local technology centre Technopolis Kuopio, or the former Teknia Oy, began when its first building, Tietoteknia, was completed in 1990 in the Savilahti area. The second main parts of the RDI buildings were completed in 1994 (Bioteknia 1) and further in 1999 (Bioteknia 2). The new RDI spaces enabled the expansion of the efforts within this comprehensive domain.

The City of Kuopio also took a more active role in developing the infrastructure and innovation support and development services aimed to help science-based businesses and start-ups cooperate with the technology centre. The EU membership (from 1995 onwards) enabled the utilisation of EU structural funds for development activities. The degree programme in Environmental Technology was established at Savonia University of Applied Sciences in 1998. The main content of the degree programme relates to water technology and community technology, supplemented by e.g. air protection technologies and waste management.

At the same time, the design work for the first phase of Microteknia's buildings began. Significant laboratory facilities were planned for the University and the University of Applied Sciences in connection with the properties. The profiling of the research activities of the University and the University of Applied Sciences was agreed in such a way that the focus of the University's laboratories will be on the development of air physics and chemistry and particulate matter combustion and in Savonia the development of laboratory facilities for Environmental Technology and water technology.

Research platform resourcing. Major extension of the technology centre further enhanced water, chemistry, and related RDI efforts. In practice, the first phase of the technology centre expansion was completed in 2001 and Savonia's Water Laboratory started operating in a shared laboratory environment together with the University and THL professionals. At the same time, European Union RDI funding enabled investments in the region and with the new role of the universities (i.e. stronger impact on society including businesses) to drive further RDI collaboration projects across ecosystems. The first joint RDI projects of these three organisations were launched and it formed the basis for future innovation ecosystem performance and RDI project cooperation. At the same time, cooperation with the University regarding the teaching of laboratory courses started at the Savonia Water Laboratory. The practical implementation of the cooperation was facilitated by the appointment of common human resources for laboratory teaching and project cooperation. In addition, the joint laboratory was utilised e.g. for dissertation research and master's theses. The regional development task and applied research activities were recorded as a statutory task for universities alongside teaching activities.

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The EU Structural Funds periods started in full in Finland, divided into the following programme periods: Programme period 2000-2006, 2007-2013, 2014-2020, and 2021-2027. The first programme period in the region included the search for funding for multiple themes and projects without a very strong visible and strategic linkage to the regional strengths. However, the regional level priorities started to change during the second programme period 2007-2013 when the so-called thematic programmes started to emerge. Through the thematic programmes, the aim was to outline a few key areas for the development of the region and the needs of companies, to which the majority of the funding for that programming period was allocated.

Contextual embedding to drive value capture further. The use of Structural Fund programmes became more efficient, and the selected development priorities began to influence and sharpen development activities. The role of the University of Applied Sciences as a regional developer was significantly strengthened alongside the regional association. Regional programmes and development strategies were outlined in extensive cooperation with the North Savo Regional Council. The cooperation concretised regional specialisation, which was steered by the guidelines of the regional programme and strengthened by the channelling of regional development funding. ERDF funding strengthened selected areas of expertise and the capacity to develop them.

The Geological Survey of Finland (GSF) and Natural Resources Institute Finland (Luke) were also more closely involved in cooperation in the water sector. Joint projects were commonplace and some of the projects also involved content aimed at developing networks and developing wider cluster cooperation. This development culminated in 2018 when the application for funding for the Kuopio Water Cluster project was prepared under the coordination of Savonia. It was preceded by the so-called preparatory funding, which enabled e.g. the benchmarking of European and North American water competence centres and visits to selected example sites, e.g. in the Netherlands and Norway. Based on these, the official ecosystem status and structure of the Kuopio Water Cluster and the mission were defined. The Kuopio Water Cluster project received targeted funding in 2019 to foster further ecosystem building. This ecosystem structure was further defined by the relative absence of hierarchical, contract-based governance modes, which made it necessary for participants to discover not only what the consumer-facing value the ecosystem created, but also what value supply-side participants derived from their voluntary involvement in the ecosystem (see also Autio, 2021).

During 2020s, the Kuopio Water Cluster project enabled a systematic and coordinated assembly and further development of a large-scale ecosystem. In addition, on top of the founding ecosystem partners (n=6), the ecosystem was opened also for corporate members to join. The total number of the enterprise members is currently over 60 as of this publication. The investment money of the cluster project used to make strategic equipment investments are driving the further develop of the ecosystem’s capabilities for the implementation of applied research and product development. Testing and piloting activities as well as business cooperation formed the core of the cluster's practical operations. The aim was to serve the needs of companies operating in the field and to solve e.g. water-related challenges arising from water-intensive industries. The cluster was starting to gain visibility and was also becoming an interesting partner in international funding applications. The cluster received European Cluster Collaboration

Platform (ECCP) certification in spring 2021, making KWC the first Finnish water cluster to have official EU-level cluster status. The next step was to secure the functions of the cluster also after the start-up project from September 1, 2022.

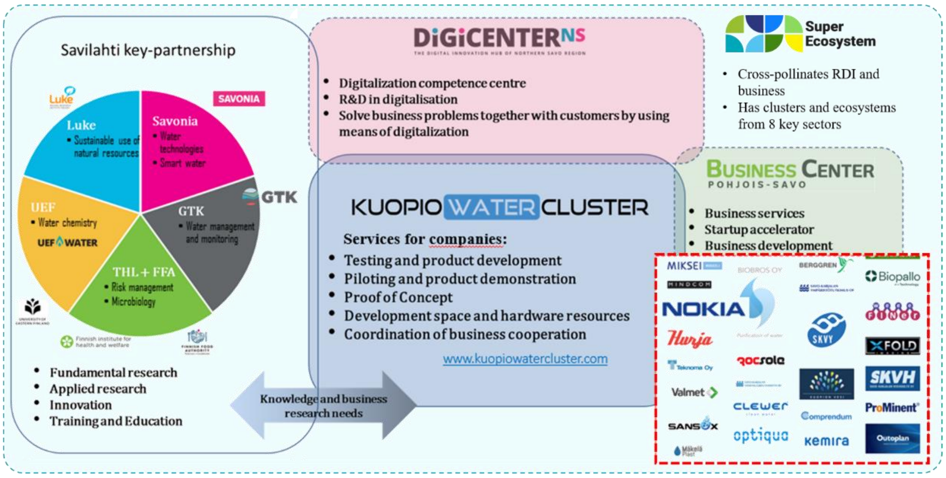

Figure 2. The ecosystem actors and orchestration partners, including governmental organisations, corporate members, facilitating networks (DigiCenterNS and Business Center Pohjois-Savo), and umbrella orchestrator (SuperEcosystem).

4 Results and managerial implications

Our study advances knowledge about innovation ecosystems in several ways. From a managerial perspective, the study provides empirical evidence on the process of ecosystem emergence in where the current understanding has been limited (e.g. Hannah and Eisenhardt, 2018). In addition, we extend and complement recent efforts aimed at increasing the practical rigour and clarity of innovation ecosystems orchestration in the regional context. In this section we focus on the following areas: 1) value creation in the innovation ecosystem, 2) ecosystem emergence, and 3) ecosystem orchestration.

Based on the conducted case, the results support the previous studies (e.g. Thomas and Ritala, 2021; Pellikka and Ali-Vehmas, 2016) that show the importance of the shared ecosystem-level value propositions and related value creation, delivery, and continuous improvement practices. The actual value capturing started to emerge when the leading ecosystem partners started to systematically set mutual targets and initiate joint efforts e.g. on RDI. We also see preliminary indications that the role of an ecosystem orchestrator during the emergence process changes. For example, it can be seen that during the first phases of the Kuopio Water Cluster evolution there was a strong RDI focus among the key ecosystem partners that drove the key activities. During the later phases of the process, more focus was put on the institutional setting and institutional aspects including continuous improvement of the ecosystem level performance. This result is supporting the previous results by Autio (2021) and also indicates that further understanding on ecosystem emergence and orchestration in the multi-layered context is needed.

Our case study provides empirical evidence on the role of the innovation policy both at the local and national level. As pointed out, the local policymakers sharpened the local development strategy and prioritized the key regional public investments based on the modern ecosystem thinking that created a basis also for the joint usage of the RDI infrastructure. Together with the increasing EU funding, these were the key factors to drive the Kuopio Water Cluster’s performance and operational improvement. Our case study supports the view where each ecosystem participant co-evolves with the other members and the investments need to be adjusted over time to maintain their complementarity (also Thomas and Autio, 2020). Orchestration of these investments also needs the decisions among the key ecosystem partners to define the roles that may or may not be agreed by formal contracts. The role of innovation policy underlines the importance of the legitimacy and embeddedness of the ecosystem in the broader economic and social context in which they operate (see Gawer & Phillips, 2013; Thomas and Ritala, 2021). Therefore, these ecosystem-specific characteristics and external drivers may vary significantly across the ecosystems at the regional context, which is an important factor to take into account in the future.

The result of this study shows that via understanding how the frequency of ecosystem processes varies over the different stages of ecosystem emergence, it may be possible to plan and orchestrate innovation ecosystems. All the planned efforts may help to reach the actual objectives of the ecosystem and to capture concrete value for the members (see also Pellikka and Ali-Vehmas, 2016). In addition, with this understanding it is also possible to foresee some challenges that may occur in different phases. As ecosystems evolve, the dominant challenges also shift, meaning managerial attention needs to shift accordingly (see Thomas and Ritala, 2021). Therefore, ecosystem orchestrators need to continuously monitor and proactively react on the potential changes and be prepared to shift their focus of the activities during each phase of the ecosystem evolution. One key activity in KWC has been to define the routines to scout for new opportunities for the ecosystem and its members. Especially after 2019, the leading partners have focused on the formation of the ways of working to scan for opportunities that arise from emerging markets and technologies.

Our results indicate that the governance of the ecosystem supports the orchestration and provides a concrete tool for the ecosystem management. As the case study shows, the documented and executed governance of the ecosystem enabled shared resourcing, joint use of RDI infrastructure (e.g. water laboratories), and the preparation of the joint RDI projects (see also Linde et al. 2021). In addition, the results show that the used governance model became more essential especially when the ecosystem started to grow in terms of the members and the volume of the RDI projects among the ecosystem partners. Based on the case study, we were also able to define that finding an optimal balance for the ecosystem governance model of the different and/or conflicting priorities among the members, including control versus autonomy, is a challenging task for the ecosystem orchestrators.

The results of the case study also show that during the emergence phase, ecosystem orchestrators need to persuade others to make voluntary inputs that are aligned with the ecosystem's mission and value offering (see also Autio, 2021). This has required continuous adaptation of the evolving nature of the market, ecosystem, and its members' needs; scouting of emerging and cross-domain technologies; and the potential new entrants. Thus, having processes and frameworks that enable an adaptable organisation to handle these needs and requirements have been necessary for ecosystem evolvement and performance. Therefore, we recommend that ecosystem orchestrators must be able to define the key areas to orchestrate and understand the key activities to be performed at each stage of the emergence process (also Linde et al. 2021).

The results indicate that the systematic approach to innovation ecosystem management including ecosystem governance can drive value capture in the innovation ecosystem context. Our case study findings indicate that ecosystem emergence is a complex and multilateral process that needs the involvement of a leading organisation ('an orchestrator'), ecosystem partners, customers, and other stakeholders. This suggests that to design a value blueprint, an orchestrator must multilaterally negotiate what is 'valuable' and what the appropriate participant roles and individual-level value offerings are for the delivery of the ecosystem value proposition (see Autio, 2021).

While defining value is easy when a market exists with a properly functioning pricing mechanism, judging value becomes more difficult with offerings that are so novel that a market for trading similar offerings does not yet exist (also Autio and Thomas, 2018). This collective value discovery process is further complicated by the relative absence of hierarchical, contract-based governance modes, making it necessary for participants to discover not only what the consumer-facing value the ecosystem creates, but also what value supply-side participants derive from their voluntary involvement in the ecosystem. From the orchestration point of view, we propose that the ecosystem orchestration strategy (e.g. Aghmaie and Vanhaverbeke, 2019) may be very helpful to define the operational model and the key areas to be orchestrated (also Pellikka et al. 2021).

Finally, based on the analysis of the ecosystem emergence we propose that a previously highlighted multi-layered approach (Autio 2021) together with the other innovation ecosystem development tools (see Pellikka et al. 2021) can create a concrete value for ecosystem orchestrators. Based on the described case study, we see that a multi-layered framework can concretely clarify some key elements of the ecosystem orchestration and it can be further implemented via other ecosystem development tools. Ecosystem members face a choice between taking an active or a passive role in guiding ecosystem development. If an actor assumes a leadership role in an ecosystem, the actor will have the opportunity to tailor the ecosystem's development in a way that may align closer to its own strengths and gains (Iansiti and Levien, 2004). Taking a less ambitious role naturally raises some key questions to answer including e.g.: 1) which ecosystem leadership candidates should be followed, 2) how to create valuable relationships with the selected candidate, and 3) what is the sufficient level of investment into an ecosystem. The questions still require a clear understanding of the full ecosystem, its structure, and dynamics for a successful ecosystem strategy (Adner, 2010; Pellikka and Ali-Vehmas, 2016).

Given the above considerations, policymakers at both national and regional levels should allocate resources at their disposal to innovation ecosystems and their orchestrators. However, in the absence of unlimited resources, it is necessary to make local choices between ecosystems to create the basis for the value capturing across the innovation ecosystems. Further, before decisions regarding the allocation of regional resources can be made, the policymakers need to know how they can efficiently support the emergence of ecosystems during the process directly and indirectly e.g. via ecosystem orchestrators. This requires knowledge of the emergence process, including the identification of activities that orchestrators should and/or must do to drive further development and value capture at the regional as well as the national level.

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