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To cite this article: Valtteri Laasonen (25 Sep 2023): Building dynamic capabilities in the transition toward a knowledge-based bioeconomy: a case study of three Finnish regions, Regional Studies, DOI: [10.1080/00343404.2023.2249499](https://doi.org/10.1080/00343404.2023.2249499)

To link to this article: <https://doi.org/10.1080/00343404.2023.2249499>



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Building dynamic capabilities in the transition toward a knowledge-based bioeconomy: a case study of three Finnish regions

Valtteri Laasonen^a 

ABSTRACT

This paper analyses the role of various organisations' dynamic capabilities in regional transitions toward a knowledge-based bioeconomy. It offers a more nuanced understanding of regional path development and agency by elucidating the concept of dynamic capabilities in regional contexts and analysing the roles and types of the dynamic capabilities of various organisations. This empirical research is based on case studies conducted in three Finnish regions using a combination of interviews, documents and statistical data. The paper argues that it is important to take a systemic perspective in analysing dynamic capabilities and look at simultaneous changes in different types of organisations.

KEYWORDS

dynamic capabilities; path development; agency; bioeconomy; Finland

JEL O10, O30, R11

HISTORY Received 25 August 2022; in revised form 12 August 2023

1. INTRODUCTION

The literature on regional studies and evolutionary economic geography (EEG) has enhanced our understanding of how regions embark on new development paths (e.g., Boschma, 2017; Hassink et al., 2019) and how different policies promote new path development and adaptation to societal challenges (Labory & Bianchi, 2021; Sjøtun & Njøs, 2019; Tödtling et al., 2021; Tödtling & Trippel, 2005). However, EEG has paid less attention to the role of agency (Grillitsch & Sotarauta, 2020; Hassink et al., 2019; Isaksen et al., 2019), defined as the capability of an actor (individual, group or organisation) bound to time and context to act and produce observable consequences (cf. Emirbayer & Mische, 1998). Consequently, recent contributions have begun to focus on agency and a multi-actor perspective and actors other than firms in new path development and regional economic restructuring. New development paths are shaped by different economic actors and their capabilities. This approach has helped explain why new growth paths emerge in some regions but not in others, despite similar preconditions (Boschma, 2017) and 'how heterogeneous actors reconfigure the organisational and institutional set-up of innovation systems' (Hassink et al., 2019, p. 1642). Moreover, the academic interest in sustainable


development transitions has led researchers to examine why transitions occur in one place and not in another (e.g., Gibbs & O'Neill, 2017; Hansen & Coenen, 2015).

Companies and other organisations need to develop and leverage dynamic capabilities to enable change (Labory & Bianchi, 2021). Especially in turbulent operating environments and systemic, complex societal transitions, such as the transition toward a bioeconomy, the ability of organisations to adapt to change becomes especially important. Moreover, the dynamic capabilities of regional actors, defined as the 'ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments' (Teece et al., 1997, p. 516), are at the core of regional transition toward bioeconomy.

Previous research highlights the different starting points and capabilities of regions, organisations, industries and clusters in the green transition (e.g., Cappellano et al., 2021; Grillitsch & Hansen, 2019; Sjøtun & Njøs, 2019) and the importance of external research and development (R&D) cooperation in companies' successful innovation activities (De Marchi, 2012). The rise of the bioeconomy has become a key driver of economic renewal. It is seen as one avenue for green transitions in regions across Europe even though it is accompanied by concerns and criticism (Scordato et al., 2021, pp. 4–5; Töller et al., 2021). There are many different definitions and interpretations

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/00343404.2023.2249499>.

of the bioeconomy, and quite narrow and even contradictory agendas have ultimately been veiled behind the broad and partly abstract transition (Birner, 2017; Töller et al., 2021). Generally, bioeconomy can be defined as a collection of sectors and subsectors that rely on renewable biological resources to deliver food, energy, products and services (Birch & Tyfield, 2012; European Commission, 2012). Bioeconomy is also a key area in European Union and Finnish research and innovation policies (e.g., European Commission, 2020). In this respect, the focus is particularly on knowledge-based bioeconomy in which the role of new (scientific) knowledge, technology and innovation activities is fundamental (Birner, 2017). Exploiting the economic potential of and fostering innovation in the bioeconomy requires pooling different organisations' resources and capabilities (van Lancker et al., 2016).

These recent theoretical and practical notions suggest investigating the dynamic capabilities of different actors to sense change, seize opportunities, and restructure organisations and examining the coherence of regional dynamic capabilities in creating new development paths (Labory & Bianchi, 2021). Moreover, capabilities themselves are often defined broadly and referred to loosely, and we still do not know much about the multilayered nature of these capabilities (see also Boschma, 2017).

The aim of this paper is to elucidate the concept of dynamic capabilities in regional contexts by analysing the role of companies' and other regional actors' dynamic capabilities in facilitating innovation in bioeconomy. By analysing dynamic capabilities and providing a taxonomy for different types of organisations this paper contributes to a more nuanced understanding of regional path development. The following two research questions are posed:

- What kinds of resources and dynamic capabilities are identified and deployed at the regional level in various organisations when adapting to a knowledge-based bioeconomy?
- What is the role of different organisations' dynamic capabilities in regional transitions to a knowledge- and innovation-driven bioeconomy?

The present study seeks to answer these questions through case studies of three Finnish regions. The case of Finland is particularly useful for examining the role of dynamic capabilities as bioeconomy is a very important sector in Finland (see Table A2 in Appendix A in the supplemental data online). Bioeconomy corresponds to 13% of the value added in the national economy and the transition towards a bioeconomy has become a strong national mission in Finland. Great expectations have been placed both nationally and in the case regions on the growth of bioeconomy sectors. Despite the favourable starting points in Finland, the transition has been challenging.

The article is structured as follows. The next section seeks to clarify the theoretical discussion on dynamic capabilities and their role in regional context. The research design and methods are introduced in the third section, and the fourth section introduces the context of this

study. The fifth section presents the findings on the role of dynamic capabilities in three different regional contexts which is followed by a discussion section. The seventh section concludes.

2. THEORETICAL DISCUSSION

2.1. The nature of organisational dynamic capabilities

According to the resource-based theory (Barney, 1991; Penrose, 1959; Wernerfelt, 1984) and its extension, the dynamic capabilities perspective (Eisenhardt & Martin, 2000; Teece, 2007; Teece et al., 1997), companies should focus on building dynamic capabilities, particularly in turbulent environments, to achieve a sustainable competitive advantage. While many companies possess valuable resources, they may lose competitiveness without the ability to use these resources efficiently and adjust as the operating environment changes. The term *dynamic* refers to the continuous evolution of a company's environment due to factors like changes in consumer needs, the institutional framework, and competitors' actions. *Capability*¹ refers to organisational routines and the importance of strategic management in building, integrating, leveraging, and adapting internal and external resources and capabilities (Teece et al., 1997, p. 515).

In the hierarchical capability architecture (Wang & Ahmed, 2007), resources are the foundation of an organisation, and capabilities are needed to deploy resources. Resources can be divided into tangible (economic and physical), intangible (e.g., technology, reputation, culture) and human resources (e.g., skills, knowledge, motivation). Given that capability is a higher order term, it refers to both the exploitation of bundles of distinct collective resources and to a collaborative process developed through routines to undertake actions successfully and efficiently (Amit & Schoemaker, 1993, p. 35; Vesalainen & Hakala, 2014, p. 939). Wang and Ahmed (2007) regard dynamic capabilities as the 'highest level' in the capability hierarchy, affecting long-term competitiveness. Dynamic capabilities are manifested in an organisation's continuous efforts to renew its resources and capabilities (including developing and learning) in a changing environment.

Teece (2007) divides dynamic capabilities into three categories: sensing change, seizing opportunities and transforming organisations. *Sensing change* refers to identifying and shaping opportunities, the capability to constantly scan, search and explore the operating environment, and accumulating, filtering and interpreting available information. These activities involve not only sensing customer needs and technological possibilities but also understanding the evolution of entire industries and markets. Companies should invest in exploration to detect existing and impending changes before their competitors, and this exploration should not be solely intra-organisational. Firms need to gather information from external sources and develop knowledge links with a wide range of third parties to identify innovative and

profitable solutions, especially regarding sustainable innovation (Mousavi et al., 2018).

For Teece (2007, pp. 1326–1334), *seizing opportunities* refers to the mobilisation of resources to act on identified opportunities; that is, the capability to make appropriate choices about structures, practices, models, and incentives and implement these measures to seize emerging opportunities. Simply identifying possibilities without making timely choices and investments is insufficient. Strategic choices can also mean maintaining flexibility in turbulent situations and making quick decisions and strong investments when the appropriate direction is clear. Seizing opportunities also involves choosing the boundaries of the organisation and thus exploiting the necessary complementary capabilities from outside the organisation. Dynamic capabilities related to seizing opportunities are reflected in R&D investments and new skills based on identified needs. Activities also relate to changing and coordinating structures and interactions, along with building commitment and trust in the organisation.

Transforming organisations refers to the systematic, continuous renewal of an entire organisation's resources and capabilities to match a changing environment (Helfat et al., 2007; Teece, 2007, p. 1334). Changes in the operational environment may require organisations to establish entirely new practices and routines, which may call for perseverance in implementing change processes and taking actions to prevent unfavourable path dependencies. Teece (2007, pp. 1334–1340) also notes the importance of modifying organisational leadership practices by emphasising decentralised decision-making, open innovation, flexibility, responsiveness, and continuous learning, experimentation and effective knowledge management.

2.2. Dynamic capabilities in the regional contexts

The resource-based view and dynamic capabilities approach to firm competitiveness have made important contributions to EEG by emphasising the evolutionary and embedded dynamics and role of firms' and other actors' capabilities (e.g., Lawson & Lorenz, 1999; Maskell & Malmberg, 1999; Uyarra, 2010). Lawson (1999) states that it is the regional set of capabilities within which companies' activities need to be understood and that both firms and regions have capabilities that emerge from social activity. According to Isaksen et al. (2019) the region's economic renewal or adaptation and the creation of new development paths can be seen as a combination of firm and system level agency. The main idea is that new path development requires industry actors that initiate new firms or innovation activities in existing firms, which is firm-level agency, and actors operating in the regional support system, which is system-level agency.

As noted by Labory and Bianchi (2021, p. 1832), 'a region's dynamic capabilities are primarily those of its industries, but the success of the region's evolution also depends on the adaptation and change of all the elements that constitute its ecosystem'. Although the local environment's role should not be overestimated in innovation

processes, regions provide resources and access to local and non-local information and influence the accumulation, reproduction, and recombination of resources (especially tacit knowledge) and capabilities through the actions and interactions of local agents (Boschma, 2004, p. 1006).

Thus, dynamic capabilities should be understood in a systemic context. Labory and Bianchi (2021) suggest that dynamic capabilities can be built in regions, especially in the face of major changes in the operating environment. Companies may have difficulties exploiting dynamic capabilities if they operate within rigid institutional structures. This means that reconfiguring, reshaping, and pooling other organisations' resources and capabilities might be needed in adaptation processes (Hassink et al., 2019).

Green innovations are often more complex than purely traditional innovations, as they typically require a wider range of actors and are more ambiguous in nature, with many stakeholders having contradictory demands (Hall & Vredenburg, 2003). In order to exploit the innovation potential of green transition and sustainability, companies need to collaborate with external partners and manage a network of actors in the value chain (De Marchi, 2012). The diversity of partnerships allows sustainable innovators to pool the resources and expertise needed from a variety of sources. The variety and number of partners might also affect the likelihood of companies to innovate effectively to promote sustainable development (Dangelico et al., 2013; Mousavi et al., 2018).

The literature suggests that the coherence of regional adaptation processes and various organisations' dynamic capabilities must also be considered (Labory & Bianchi, 2021, p. 1883). Besides adaptation at the firm level, the transition toward a bioeconomy demands capabilities such as new, greener solutions and ensuring that innovation moves in a certain (i.e., green) direction. Complex societal transitions may also require capabilities to influence the institutional setting (e.g., formal and informal rules and regulations, political agendas) and interaction and network dynamics or behavioural change to ensure the broad legitimacy of, supply of, and demand for new bioeconomy solutions. Educational institutions should evolve to provide the skills required for new business opportunities, and public organisations need to reform the institutions and procedures that support new business operations.

Several studies have used the capability perspective to study dynamic capabilities of various kinds of both public and semi-public organisations (Bryson et al., 2007; Laasonen, 2022; Pablo et al., 2007; Peteraf & Barney, 2003) and higher education institutions (Leischnig & Geigenmüller, 2020). Due to the increasing attention to strategic approaches in the public sector, the use of dynamic capabilities has been identified as one important approach. Hansen and Ferlie (2016, p. 12) suggest that many public organisations have to adapt, adjust or reconfigure their resources and capabilities in response to changing environmental conditions.

However, the applicability of the dynamic capability perspective beyond firms is not without limitations, especially as to an organisation's nature and degree of autonomy (Hansen & Ferlie, 2016). Compared with firms primarily driven by competitive advantage, the drivers for renewal and adaptation in the public sector are to achieve widespread improvements to increase public value (Moore, 1995). Nonetheless, the capability perspective focuses on value creation and the efficient deployment of resources, which are both relevant aspects in many other organisation types. It is important for public organisations to build, organise and use resources efficiently to create public value.

3. RESEARCH DESIGN, DATA AND METHODS

The paper follows a descriptive case study approach (Yin, 2017), with empirical analysis based on triangulating diverse data. The approach is largely qualitative, and the empirical portion involves case studies conducted in three Finnish regions and a combination of interviews, documents, and statistical data. The main data were gathered through 40 in-depth, semi-structured interviews with individuals at companies, municipalities, and regional and business development agencies (RDAs) and research and education organisations (REOs) promoting the transition toward a bioeconomy (see Table A1 in Appendix A in the supplemental data online). Documents and statistical data on the development of and R&D activities related to bioeconomy funded by Business Finland were used as complementary data.

The selected case regions are South Ostrobothnia, Central Finland and North Karelia. The interviews were focused on the regions' central urban areas: Seinäjoki in South Ostrobothnia, Jyväskylä in Central Finland and Joensuu in North Karelia, all of which were part of a nationwide Innovative Cities programme between 2014 and 2017 and were chosen as the leaders in the bioeconomy context. The programme's aim was to generate new business and new companies based on high-quality competence. The case study regions are not used for comparative purposes as such. Rather, they are used analytically to provide three different contexts, regional innovation systems, and realisations of bioeconomy to study the role of dynamic capabilities. Moreover, selection of several case regions is used to strengthen the research design.

The interviewees were those who work actively to promote a knowledge- and innovation-driven bioeconomy (cf. Bennett & Checkel, 2014). The idea was to identify the actors that several people and actors in the case regions named as central in terms of promotion of the bioeconomy. The interviewed public or semi-public organisations have purposefully established a strategic approach to develop bioeconomy and improve their efforts to fulfil their mandates. Thus, it also became relevant to address their dynamic capabilities (Pablo et al., 2007). The interviews were conducted between October 2015 and January 2016.

The research approach was abductive, with the theoretical framework guiding the empirical research and supporting the analysis of the results. The interviews moved from broad, open-ended questions to more specific queries. The idea was not to impose prior theories or constructs on the interviewees. The interviews were organised into three parts. First, interviewees were asked to describe the most important developments in their organisation's operational environment and regional context related to the bioeconomy transition. Second, they were asked to describe the most crucial elements in their organisation's long-term success in respect of the contemporary operational environment and the need to adapt. As a follow-up, they were asked to detail these crucial elements, citing examples of practical use, based on the evolution of their organisation's resource allocations, knowledge or skills, and/or activities to mobilise, manage, and reconfigure both internal and external resources. Third, the interviewees were asked to assess their organisational capabilities in systemic context.

The observations were built into matrices reflecting interviewees' perceptions of their organisations' capabilities and to identify the mechanisms by which dynamic capabilities are manifested in different organisations. In the analysis, broader second-order themes and third-order dimensions were formed from those individual observations. The idea was to follow the method used by Gioia et al. (2013) to improve the interpretation logic behind the results and find reasoning for each observation through resources and/or specific organisational functions and processes. After this data-driven analysis phase, emergent patterns were reflected upon in terms of the theoretical framework and analysis. Thus, data and theories were considered together.

Statistical data came from three sources. The first two are Statistics Finland's statistics on R&D expenditure and personnel and a separate dataset on bioeconomy indicators (employed persons, output, value added, investment and exports) in key sectors at the national and regional level. These statistics supplement the broader picture on developments and offer insights into what has happened in the bioeconomy sectors and R&D activities in Finland and case regions.

The third data source is R&D project data from Business Finland and include companies' R&D projects promoting bioeconomy and/or environmentally sustainable development funded by Business Finland during the 2010s (see Table A3 in Appendix A in the supplemental data online). The data are used to analyse which companies received external competitive R&D funding and thus seized and invested in bioeconomy opportunities. The data also provide background for the interview data. The reference period for all statistical data in this paper is 2010–19. Supplementary regional and organisation-specific material like websites and relevant regional innovation policy documents were also used to gain insights into the contexts in which these organisations operate.

4. PREMISES FOR THE DEVELOPMENT OF A KNOWLEDGE-BASED BIOECONOMY IN FINLAND AND THE CASE REGIONS

Bioeconomy² is a significant economic sector in Finland, especially in the case regions (see Table A2 in Appendix A in the supplemental data online).³ Finland's bioeconomy strategy was first laid out in 2014 and updated between 2020 and 2022. The transition toward a bioeconomy is regarded as vital to meeting global societal challenges like climate change and the sustainable use of natural resources (Government of Finland, 2022). Above all, the strategy has been defined as a 'growth strategy' and bioeconomy described as a new wave of economic development. The original and update strategy have sought a new common direction for Finland's economic development. The rise of bioeconomy has also been recognised in innovation policy. During the 2010s, societal missions, such as the transition towards a bioeconomy, have become increasingly visible in the innovation policy agenda. Systemic approach and innovation system approach has been present and widely adopted in the implementation of Finnish policy and its instruments (Veugelers et al., 2009). However, recent studies suggest that implemented policy instruments in Finland are still significantly less transformative (Scordato et al., 2021).

In the 2010s, the Finnish bioeconomy did not achieve the high growth targets envisioned in the 2014 bioeconomy strategy. Overall, the country's transition toward a bioeconomy has been challenging (see Table A2 in Appendix A in the supplemental data online). Moreover, there have been challenges in developing R&D in Finland, with the country seeking a new direction for its innovation policy (Laasonen et al., 2020). Consequently, great expectations are placed on bioeconomy development, and attention has increasingly focused on improving the value added and strengthening R&D activities in the Finnish bioeconomy.

All case regions have different premises, resources, and knowledge bases; each has its own specialty in bioeconomy. South Ostrobothnia is heavily focused on agro-bioeconomy and has significant expertise in that sector and related manufacturing and technology. The region is very SME-intensive and has a strong entrepreneurship tradition, though the region's R&D expenditures are quite low. South Ostrobothnia has a university of applied sciences (UAS) but does not have its own traditional research-driven university. Instead, the University Consortium of Seinäjoki brings together the education, research, and development activities of five different universities.

Central Finland boasts a diverse economic structure and expertise in different sectors and knowledge institutions of the bioeconomy. The region has a strong forestry sector, especially in terms of expertise in bioenergy and the paper, pulp and processing industries. It has large, export-oriented companies in the forestry industry and a diversified SME sector. Higher education plays a significant role in the region's R&D investments.

North Karelia is heavily specialised in forestry-related bioeconomy, with a concentration of actors in the forestry industry, forestry research, and educational organisations. An extensive concentration of expertise has accumulated around teaching and research in forestry. The region's business sector is SME-dominated and focuses on forestry, bioenergy, and machinery and technology supporting the forestry sector.

Even though these regions have strong expertise and resources, the value added of bioeconomy has been similar to the national average (see Figure A1 in Appendix A in the supplemental data online), with no particularly strong development in any bioeconomy sectors. However, in Central Finland, bioeconomy investments in 2016–17 were exceptionally high because of the significant €1.2 billion expenditure by the Metsä Group on a new bioproduct mill. At the same time, output and value added have grown more in Central Finland than in North Karelia and South Ostrobothnia. Interestingly, however, investments returned to pre-2016 levels by 2019, and those significant investments in bioeconomy have not been reflected in employment growth.

In terms of R&D expenditures and number of employees, Central Finland and North Karelia are at the average among the Finnish regions, with South Ostrobothnia in the bottom quartile. Compared with nationwide figures, R&D expenditures grew more in the case areas in the 2010s (see Figure A2 in Appendix A in the supplemental data online). In all case regions, total R&D investments of companies are significantly lower than the leading regions. In South Ostrobothnia, the business enterprise sector accounts for the largest share (i.e., two thirds) (see Figure A3 in Appendix A online) of R&D activities. By contrast, well over half of North Karelia's R&D expenditures are made by higher education institutions, and the proportion of corporate R&D expenditures is the lowest in the country.

5. THE ROLE OF DYNAMIC CAPABILITIES IN THE DEVELOPMENT OF A KNOWLEDGE-BASED BIOECONOMY

5.1. South Ostrobothnia: struggling to balance the complementarity of public and private sector dynamic capabilities

In South Ostrobothnia, the development of a knowledge-based bioeconomy has been characterised by a struggle to combine and balance public sector capability building with firm-level dynamic capabilities. The role and dynamic capabilities of REOs and RDAs and intermediary organisations are emphasised, especially in sensing change and shaping opportunities related to bioeconomy.

5.1.1. Sensing change

In the region's companies, innovation activities are often pragmatic and applied in nature, and companies do not necessarily have a research unit dedicated to developing new products or processes. Thus, company interviewees emphasised investing in deep dialogue with customers

across their operations to scan for changes in the operational environment. The companies also developed their capability to operate in networks and leverage external resources to identify and obtain the latest relevant knowledge. For instance, one food sector company actively invested in its own training system and acquiring targeted training for new production methods. Companies have also financed research professorships related to regional food systems. The results indicate that many interviewed companies have sought to broaden and deepen their capabilities.

These firm-level activities have been supported by the REOs and intermediary organisations in the region. REOs have developed dynamic capabilities by launching projects and working groups that involve scanning the operating environment related to bioeconomy, trying to sense opportunities, and retrieving and filtering information to meet the needs of the region's companies. Agro-bioeconomy has been made the region's common higher education strategy, with food safety, traceability, and consumer orientation strongly reflected in the REOs' R&D activities. These organisations have enhanced their expertise throughout the food chain and dialogue with local companies, and strengthened human resources to enable this dialogue. For instance, Seinäjoki UAS joined with other R&D organisations to build an agro-bioeconomy innovation community in the region, which undertook efforts to collect and disseminate information, particularly in the food sector, and to provide area businesses, researchers and developers with the opportunity to network and identify bioeconomy-related business opportunities.

Public organisations, especially the Regional Council of South Ostrobothnia and the City of Seinäjoki, directed resources to find new bioeconomy-related regional development paths and raised strategic awareness of these themes during the 2010s by preparing and executing a regional development initiative and a national innovation policy programme. The capabilities and role of RDAs, especially the business development company Into Seinäjoki, have been important in guiding the direction of development with companies, which has entailed playing an active role in national and international networks. Moreover, Foodwest, which coordinated a national center of expertise programme in food development in the 2000s and early 2010s, has since further strengthened its expert role as an intermediary for new information in the reform of food businesses. First-hand information about market developments and research is passed to companies through Foodwest's extensive customer interface.

5.1.2. Seizing opportunities

As a key dimension of dynamic capabilities is mobilising resources to act on recognised opportunities, the company interviewees emphasised their entrepreneurial culture and flexibility in areas such as technology and responding with agility to changing situations. Tighter restrictions on greenhouse gas emissions in production and products have demanded rapid actions and a customer-driven

approach to quickly reorient operations. In these situations, the emphasis is on timely response, updating skills, and taking risks. One agricultural machinery manufacturer noted that it had to make a timely strategic choice to move toward providing system solutions instead of individual products, which has meant building more extensive vertical and horizontal partnerships. Many companies highlighted the principle of continuous improvement in their capabilities, which means actively seeking and refining better practices and encouraging organisational experimentation.

The complementarity of the dynamic capabilities of firms, REOs, and RDAs is also visible in seizing opportunities and reconfiguring organisations. REOs in South Ostrobothnia are focused on providing new knowledge and skills needed for the transition toward a knowledge-based bioeconomy. Seinäjoki UAS and the University Consortium of Seinäjoki have made substantial investments in training and research infrastructure and practical interaction with companies related to food system expertise. The regional council of South Ostrobothnia has built trust among regional actors, coordinated joint strategy processes, staged forums, and made strategic choices to direct funding to the knowledge-based bioeconomy. Meanwhile, Into Seinäjoki has played an important role in developing expertise and networks to obtain new financial resources to promote bioeconomy and to start projects arising from companies' needs. In addition, the regional agri-food industry has benefited from Foodwest's and ProAgria's capabilities and the continuous renewal of their expertise in supporting the strategic choices of entrepreneurs and their R&D initiatives.

5.1.3. Transforming organisations

However, according to the interviewees, there have been difficulties in synchronising public-driven capability building and development activities such as innovative procurement and demonstration and R&D projects and development platforms with business interests and investment. There are considerable challenges in actually establishing and scaling new business in the bioeconomy from single projects and experiments, which is at least partly due to the lack of significant private bioeconomy investments in the region. The growth of the knowledge-intensive bioeconomy in the region has been slow.

This development is also visible in companies' R&D investment, especially in obtaining external competitive R&D funding from Business Finland. Companies in South Ostrobothnia have not been particularly active in seizing bioeconomy opportunities and investing in R&D; projects are relatively small in financial terms, and only a few environmentally themed and especially bioeconomy-related R&D projects have been undertaken in the region (see Table A3 in Appendix A in the supplemental data online). Based on the R&D projects funded by Business Finland, there are only a few new companies developing bio-based products in the region, with R&D investments focused on the food industry and related technologies. The interviewees also pointed out

that especially in the traditional food sector, large companies face significant challenges in changing their business models, reconfiguring their organisations, and building completely new capabilities. The food industry has long focused on streamlining production, and the shift toward a knowledge-based bioeconomy requires increasing the value added and building new business models that make more and better use of biological resources and diversified production.

5.2. Central Finland: building dynamic capabilities through significant private investment

Dynamic capabilities in Central Finland have been developed primarily as a result of one significant private bioeconomy investment in the region.

5.2.1. Sensing change

When discussing sensing change in Central Finland, the interviewees emphasised the importance of a joint exploration process related to the investment in the Äänekoski bioproduct mill in 2016–17. Even during the planning and construction phase, Metsä Group developed its capabilities for open innovation and made clear that it was looking for new partnerships – companies to develop bioproducts from byproducts and benefit from material flows – and thus underlined the emerging opportunities for open innovation and co-innovation. This led to the establishment of forums designed to couple investment with new bioeconomy opportunities. The investment triggered a meaningful renewal of the region's business, university, and public sectors and created a positive spiral to rearrange assets and orient various organisations' dynamic capabilities toward a knowledge-based bioeconomy. R&D expenditures in the region increased in both the business and higher education sectors in the second half of the 2010s. At the same time, companies have also been active in launching their own R&D projects.

The company interviewees reported that firms actively scanned their operational environment and participated in joint exploration processes. Thus, the use of biological resources to create biomaterials and bioproducts has emerged as a new opportunity to diversify in the face of changes in the operational environment. In terms of external competitive R&D funding from Business Finland, Central Finland has more diverse and stronger R&D activities in bioeconomy and the circular economy than the other case regions. In addition to the traditional forest sector, R&D has been dedicated to information and communication technology, energy, and new textile and fibre products. Bioeconomy-related R&D projects are also more diverse in knowledge-intensive sectors. Several significant Business Finland-funded projects explicitly or implicitly related to the investment in the bioproduct mill in Äänekoski and the development of wood-based textile fibres also emerged between 2016 and 2019.

Although the bioproduct mill was viewed as a significant accelerator for the development of dynamic capabilities, the search for new directions for bioeconomy has long

been underway. The interviews revealed that the Regional Council of Central Finland and REOs, particularly Jyväskylä UAS and Technical Research Centre of Finland VTT's unit in Jyväskylä, have been key actors in identifying and highlighting bioeconomy's potential. The Regional Council had already emphasised bioeconomy's importance in preparing the regional strategy before the 2010s, when a new direction for economic renewal was sought in the region after the financial crisis. Bioeconomy was viewed as playing a crucial role in the renewal and especially the diversification of the region's economy.

5.2.2. Seizing opportunities

Consequently, REOs have been active in generating new information and educating experts relevant to the transition toward bioeconomy, as well as effectively disseminating information on R&D projects through active dialogue with the region's companies. Jyväskylä UAS has played an active role in building international networks and projects related to bioeconomy, which has brought new information to companies in the region. The Institute of Bioeconomy has encouraged its employees to interact closely with the business sector to seek and collate signals about the demands of and changes in bioeconomy to improve its strategy and the impact of its R&D work with companies.

The results show that broadening capabilities is emphasised in Central Finland. Especially in companies this indicated diversification strategies and building of general-purpose capabilities which they can use in new markets. Seizing opportunities related to bioeconomy and building dynamic capabilities were highlighted in many ways in the REO interviews. VTT and Jyväskylä UAS identified significant new R&D opportunities in wood fibre and bioenergy and have invested in pilot and demonstration projects in bioeconomy. VTT has joined companies in launching major R&D projects related to bioenergy and fibre products and processing. The region's educational institutions have also developed their capabilities to respond to the growing need for bioeconomy expertise, launched new training programmes related to bioeconomy, and invested in further strengthening cooperation and trust with companies. Moreover, at the same time publicly owned companies, such as waste management company Mustankorkea Ltd, have been very active and made important investments in R&D related to bioenergy and new circular economy solutions.

5.2.3. Transforming organisations

Significant bioeconomy investments have also meant that dynamic capabilities have had to be developed in regional and local governments. The dynamic capability creation process is manifested in activities such as the continuous development of permitting processes for bioeconomy businesses and acquiring needed skills, along with changing routines to accelerate these processes and make them more flexible. The interviews also revealed that the city of Jyväskylä had set ambitious goals and changed its strategy to support bioeconomy and the circular economy.

Significant amounts of city funds were invested in development platforms, while the procurement unit supported the transition toward bioeconomy and the circular economy, as in the use of biogas in the city's public transportation. Moreover, efforts were made to increase cooperation between different administrative sectors and to strengthen the dialogue with entrepreneurs, as through innovative public procurement. The city of Jyväskylä, together with Sitra, the Finnish Innovation Fund, also launched extensive experiments regarding resource wisdom in the urban environment, where Sitra enhanced the expertise of city employees in experimenting and supported the city administration in changing the way it operates.

However, the interviewees pointed out that these ongoing changes and reforms in the RDAs and intermediary organisations have caused fragmentation in bioeconomy development activities and hindered regional cooperation and the continuity of development actions. Consequently, a regional development organisation specialising in bioeconomy does not exist, so the ability to implement jointly prepared development plans and measures has been hindered.

5.3. North Karelia: public actors at the forefront of developing dynamic capabilities

In North Karelia, the role of public actors and RDAs and REOs is emphasised in sensing change and revealing bioeconomy opportunities.

5.3.1. Sensing change

The Regional Council of North Karelia has been a major initiator of discussions on bioeconomy in the region, producing and compiling information on the subject. Bioeconomy was a key priority of regional programmes in the 2010s, with the regional council exerting considerable efforts to bring in new perspectives and approaches. The council and the City of Joensuu have identified opportunities, built trust among regional organisations to strengthen and diversify bioeconomy efforts, and sought additional funding to promote the regional bioeconomy. The council has also played an important role in integrating various knowledge bases and areas of expertise and bringing together the views of companies and expert organisations to consider regional bioeconomy development priorities.

The business development company Business Joensuu Ltd has also been important in developing capabilities to strengthen regional coordination, improve information flow, and identify new bioeconomy-related opportunities. It also established a regional innovation director position to coordinate R&D activities and support and intensify open innovation cooperation between companies, REOs, and the public sector. Business Joensuu has coordinated regional bioeconomy cluster groups and strengthened the representation of the business sector to direct new R&D projects. As an intermediary organisation, Business Joensuu has also promoted cooperation between researchers and businesses by organising research group visits to

companies, providing local businesses with access to the latest scientific advances.

5.3.2. Seizing opportunities

The role and capabilities of the REOs are pivotal in sensing change and seizing bioeconomy opportunities. Only some forest bioeconomy companies have their own R&D units in the region or at all, and the interviewees stressed that companies make intensive and effective use of universities and research institutes to access the latest scientific information. Company interviewees emphasised the ability to operate in networks and leverage external resources to identify the latest knowledge. Several interviewees pointed out that their companies had built international networks through projects with the region's universities or research institutes and used those networks to seek new knowledge. The companies also show dynamic capabilities to seize emerging opportunities, use the REOs' significant expertise, and tap into the knowledge in different industries, such as biomass processing and materials manufacturing, to develop new technologies and products.

The University of Eastern Finland has undertaken substantial efforts to strengthen bioeconomy research, promote multidisciplinary research groups and R&D projects, and seek new research initiatives. A new professorship in forest bioeconomy was established in 2015, with an emphasis on strengthening foresight activities and partnerships with companies and other key stakeholders. In addition, the interviewees highlighted that educational institutions had tried to strengthen bioeconomy education and to build strong support for the business community at all levels of education in North Karelia.

5.3.3. Transforming organisations

The City of Joensuu and the RDAs have also invested in accelerating bioeconomy R&D, especially through experiments and public procurement. The coordination of innovative public procurement and development platforms from the bioeconomy perspective has been placed at the center of urban development strategy, so that public development projects can also boost the transition toward bioeconomy. Moreover, the strategy of Joensuun Yrityskiinteistöt, which is owned by the City of Joensuu and develops business parks in the region, was repositioned in the mid-2010s. As a result, the organisation has transformed from a traditional builder and broker of factory properties and industrial sites to an economic development organisation. This has required the acquisition of new expertise in the organisation and capabilities to build a new kind of bioeconomy business park concept, which offers customer companies a competitive advantage in terms of location, business cooperation, joint energy solutions, and use of material flows.

However, based on the interviews and the supplementary data, publicly driven R&D projects, the R&D activities of universities and, more generally, the region's very significant forest bioeconomy expertise and capabilities have not yet led to the widespread emergence of R&D-

intensive businesses. The transition toward a knowledge-based bioeconomy is led by public sector development activities. The renewal of bioeconomy companies appears to be quite narrow and to involve the gradual refinement of processes in traditional forestry and similar sectors rather than a broad renewal of business models. Although the R&D expenditures of the North Karelian business sector has increased, only a few area firms have carried out bioeconomy-related R&D projects involving external competitive R&D funding from Business Finland.

From a bioeconomy perspective, companies' R&D activities rely on narrow business lines and a few driving companies in the region's forest and energy sectors. These companies have played an important role in initiating broader change processes in the region and gathering the R&D activities of various organisations around their own investments in the Joensuu area. John Deere has actively promoted bioeconomy and an ecosystem around their investments in the GreenPark business, park and Fortum invested in a bio-oil plant in 2013 in the Joensuu region, along with research into and commercialisation of related new technology.

6. DISCUSSION

The analysis has shown that although the study included different regions, different bioeconomies, and thus different premises, the transition toward a bioeconomy requires very similar types of dynamic capabilities in different organisations; namely, sensing change, seizing opportunities and organisational restructuring. These findings are in line with previous research that has emphasised the importance of intertwining capabilities and agency at both the firm and system levels (Isaksen et al., 2019) to achieve systemic changes and regional transformation. Firms might face difficulties adapting in order to capture the value in the transition toward bioeconomy unless other organisations in the region deploy their own dynamic capabilities (Labory & Bianchi, 2021). The empirical observations from South Ostrobothnia and North Karelia show that even considerable accumulated bioeconomy resources and expertise in a region and the dynamic capabilities of its REOs and RDAs do not guarantee growth in bioeconomy and research, development and innovation activity (RDI) activity if the region's companies do not have the necessary dynamic capabilities to adapt to changes in their operating environments.

The findings suggest that the dynamic capabilities of various organisations play different roles in regions' adaptation processes in the transition toward a knowledge-based bioeconomy. In all case regions, the dynamic capabilities of REOs were very important, especially in sensing change and seizing opportunities in cooperation with companies. Knowledge institutions have reoriented their research and education efforts to support the transition toward a bioeconomy and the skills that companies will require as that transition moves along. At the same time, RDAs have actively developed their processes and skills

and sought new ways to facilitate the transition toward a bioeconomy.

The results show in all case regions that the RDAs and REOs have employed their dynamic capabilities, seized the opportunities of the transition towards a bioeconomy, and developed regional innovation policy decisions. For example, in North Karelia, business development company and the regional council have developed and deployed their dynamic capabilities and strived for broadening regional capabilities in the bioeconomy. This has required extension of knowledge base and the search for novel capabilities through diversification strategy in regional innovation policy and networking. Important activities have been the efforts to expand and diversify the capabilities of the bioeconomy through enabling technologies such as photonics. Couple of new companies have emerged in North Karelia specialising in information and communication technology (ICT) and photonics promoting the digitalisation of the forest sector and the development of natural fibre composites and products. Based on the interviews, these companies show dynamic capabilities to seize emerging opportunities and utilise different knowledge bases and new technologies developed in the region.

As previous studies suggest (Labory & Bianchi, 2021; Teece, 2007), it is evident that dynamic capabilities are costly and difficult to implement. Firms and other organisation face barriers to change and difficulties in implementing dynamic capabilities. Both statistical analysis and empirical insights from interviewed organisations suggest that the large-scale and systemic transition toward a knowledge-driven bioeconomy has only begun and that the dynamic capabilities for reconfiguring organisations and renewing entire business models is still emerging in all regions. In South Ostrobothnia and especially North Karelia, that transition and the increase in related R&D activities are primarily driven by and emphasise the dynamic capabilities of public organisations. In Central Finland, bioeconomy-related R&D is more extensive and diversified, with significant private investments having accelerated the development of bioeconomy and serves as a significant impetus to the development of dynamic capabilities across all sectors in the region.

The findings support previous research concerning challenge-oriented complex innovation processes that emphasise the need to mobilise a variety of actors, including those beyond industry and research, and their capabilities (Gibbs & O'Neill, 2017; Mousavi et al., 2018; Tödtling et al., 2021). It is very important to draw attention to different scales, possible failures in both organisational-level capabilities and activities and the ways in which regional networks of organisations jointly exploit and renew regional resources and capabilities (Laasonen & Kolehmainen, 2017). Moreover, struggles and conflicts between different actors, their capabilities and 'bioeconomies' need to be investigated (Hansen & Coenen, 2015).

7. CONCLUSIONS

Overall, the present study has elucidated the concept of dynamic capabilities in regional contexts, providing a

taxonomy of such capabilities for different types of organisations. The paper analysed the role of the dynamic capabilities of various organisations in regional transitions to a knowledge- and innovation-driven bioeconomy.

This study has important implications for both academics and policymakers. The paper argues that research on path development and agency would benefit from deeper analysis of dynamic capabilities and showing their role in the transition (cf. Hassink et al., 2019). The analysis of such capabilities leads to a more nuanced understanding of regional path development. Thus, the analytical framework and the empirical findings complement earlier studies and theoretical approaches that have called for a better understanding and analysis of capabilities in different regional contexts (e.g., Boschma, 2017; Isaksen et al., 2019; Labory & Bianchi, 2021).

When changing an operational environment, particularly major shifts such as the transition toward a bioeconomy, it is important to take a systemic perspective on dynamic capabilities and look at simultaneous change in different types of organisations and the coherence of these capabilities: What kinds of intra- and inter-organisational change processes are emerging, how do these various organisations actively drive change, and what kind of resources are used and dynamic capabilities developed?

The study's practical implications offer a more analytical understanding of the premises of and capabilities in development paths and supporting policies at the regional level. It shows that the dynamic capabilities of various organisations – like the organisations themselves – actively play different roles in regional path development and adaptation processes (cf. Grillitsch & Sotarauta, 2020). Capabilities for sensing change, seizing opportunities, and organisational restructuring must also be actively built in different organisations and regions (cf. Isaksen et al., 2019; Labory & Bianchi, 2021) but should be viewed holistically, particularly when designing and implementing innovation policy (cf. Hassink et al., 2019; Tödtling et al., 2021).

In any organisation, dynamic capabilities have highly nuanced qualities and are embedded in complex regional and extra-regional dynamics. Thus, it was not possible to assess every aspect of the dynamic capabilities at play in the transition toward bioeconomy in the three case regions. Rather, the paper provides an informed overview of the ultimate impact of those capabilities on regional renewal and the performance of these organisations. Future research could analyse the complex relationship between organisations' capabilities, value co-creation, and the performance and adaptation processes in different regions. This study focused on organisations operating in the case areas. It is also necessary to recognise that the capabilities of national organisations, such as Business Finland, which appeared in the results, have important role in regional development paths. Innovation policy directs various actors in society to develop certain types of abilities and/or to develop their abilities in a certain direction.

ACKNOWLEDGEMENTS

I acknowledge the support of Research Director Jari Kolehmainen and Professor Markku Sotarauta for their valuable comments on earlier drafts of this article. I am also thankful to the anonymous reviewers of a previous version of this paper for their valuable comments, which helped to refine the arguments presented.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

ETHICS STATEMENT

Good scientific practices were followed in this study. Participation was voluntary, and permission to use the interview material in this study was asked from all those invited. The interviewees were informed in advance and during the interview about the purpose of the study. The material was treated confidentially.

FUNDING

This study was part of the ITU research programme (ITU, Local and Regional Innovation Environments) funded by Tampere University, the Regional Council of South Ostrobothnia, the City of Seinäjoki, Into Seinäjoki Ltd, the University Consortium of Seinäjoki and the Higher Education Fund of South Ostrobothnia.

NOTES

1. In definitions in earlier studies, the term 'capability' is closely related to 'competence' and often used as its synonym. Thus, capability embodies terms such as 'ability', 'capacity' and 'power', as in 'the power or ability to do something' (*Oxford English Dictionary*).
2. In Finland, a bioeconomy refers to an economy that relies on using renewable, biological natural resources in a resource-efficient manner to produce food, energy, products and services. In statistics, bioeconomy calculations refer to seven sectors: (1) food, (2) forests, (3) other industries (such as the chemical, pharmaceutical, furniture and clothing industries), (4) energy, (5) construction, (6) water treatment and supply, and (7) bioeconomy services.
3. The transition toward bioeconomy might also be a valuable opportunity in the regions for industries that are closely related to bioeconomy, but whose activities are not directly reflected in bioeconomy indicators. For example, the manufacture of machinery and equipment related to the food and forest industries, as well as information and communication technology companies, are important sectors in all case regions that are not visible in the statistics related to bioeconomy.

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