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Impacts and Indicators of Regional Innovation Ecosystems Supporting Sustainable Development

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ABSTRACT

Ecosystems are in a key role in the implementation of EU innovation policies. It is important to assess and measure the impacts of regional innovation ecosystems. A regional strategy targeting smart specialization is implemented also in smaller regions and development results should be measured. The national indicators and level of analysis concentrate and are conducted mostly on a larger or national level and not specifically measuring on a regional level focusing on its special features. This creates challenges for both development and monitoring practices for regional innovation strategies. The objective of this article is to introduce the concept of regional ecosystem assessing and measuring challenges. It introduces early experiences and challenges of the ongoing Häme Goes into Ecosystems HGiE –project. The objective of the project is to enhance sustainable innovation ecosystem development

Keywords: Regional strategy, Ecosystems, Smart specialization, Indicators, Assessing and measuring

INTRODUCTION

Ecosystems are recognized to play an increasingly significant role in the implementation of EU innovation policies. Assessing and measuring the impacts of regional innovation ecosystems is elementary for development. A framework for analysis requires versatile data and ecosystem-specific reviews.

Since 2014, European Union has recommended that European regions enhance their innovation development activities based on Smart Specialisation. Smart Specialisation is a place-based approach characterized by the identification of strategic areas based both on regional strengths and the potential of the economy. It aims to enhance the prosperity of European regions by accelerating research, development, and innovation activities and supporting Entrepreneurial Discovery Process (EDP) with wide stakeholder involvement (EU Commission 2021).

EU's Regional Innovation Scoreboard 2021 assesses the innovation performance of European regions on a limited number of indicators. The most

innovative regions are typically in the most innovative countries. However, in Finland, the indicators and level analysis are conducted at a large area level, and it does not extend to regions. This creates challenges for both development and monitoring practices for both regional innovation strategies and regional innovation ecosystems. The challenge remains on how to enhance, measure, and assess innovation ecosystem development practices at the regional level, especially in the institutionally thin regions with low RDI and EDP performance with moderate innovation capabilities (Asheim et al. 2019, EU 2023, Tukiainen et al. 2020).

ESPON (2022) has studied Entrepreneurial Governance practices to support RDI activities especially related to societal innovation themes - climate, energy, food, health, security, and transportation. In these themes also lagging regions can create enabling conditions for testing new innovative products and services.

This paper shares the early results of the ongoing Häme Goes into Ecosystems HGiE –project which aims to enhance sustainable innovation ecosystem development. The paper introduces a framework for innovation ecosystem measurement and assessment, with selected indicators, and desired impacts of a regional innovation ecosystem. Häme Portfolio management tool is used to support open innovation practices providing an opportunity to measure and evaluate both strategy implementation and regional innovation ecosystem performance.

THEORETICAL FRAMEWORK

The concept of the innovation ecosystem has been used to describe various entities formed around business and innovation activities. The business environment is complex and rapidly changing, and ecosystem development has been perceived to best meet this challenge. Ecosystem innovation and development bring competitiveness and profitability to the participating companies and other stakeholders (Gomes et al. 2018, Salminen et al., 2022).

In the current agricultural digital ecosystem, numerous isolated, often non-interoperable solutions exist. Better management of this data could bring added value through data for various participants in the agriculture business and also measure the change and influence of development work (Kalmar et al., 2022). Making larger volumes of data from ecosystem partners available in a trustworthy way, opens exciting opportunities for that federated data ecosystems that will be the basis for a thriving economy and makes possible value creation for enterprises, citizens alike, and also for societies (Hecker et al., 2022).

Europe has been given guidelines that regional development should concentrate on the development of smart specialization. Smart Specialization in the region has contributed in a positive way to the focus and prioritization of innovation strategies and impacted the innovation performance of the regions. However, it has been recognized that neither inter-regional collaboration, Sustainable Development Goal implementation nor economic transformation are yet a norm in the Baltic Sea Region (Takala & Tukiainen, 2022).

RESEARCH QUESTIONS

The lack of sufficient data, assessment, and available measuring systems create challenges for both development and monitoring practices for regional innovation strategies and regional innovation ecosystems.

The objective of this paper is to analyze challenges and describe experiences in regional ecosystem assessing and measuring systems enabling effective utilization of data and the renewal of business. The main research questions are

1. Is the success of the regional smart specialization strategy dependent on the ecosystem approach?
2. How is the set of indicators constructed and data collected from the region?
3. How is the regional assessment and measuring system built up?

The set of indicators and a way to collect the data and concept for the development of the regional assessment and measuring system is based on literature analysis, previously conducted pilots, and practical work on Häme Region.

In 2020-2021, the OECD assessed the governance system in Finland. They focused on identifying assets, preconditions, and gaps within the wider public sector policy-making and steering system in Finland that may hinder or help implement an anticipatory innovation approach in the Finnish context. One of the agency mechanisms assessed was data and measurement. The study recommended connecting anticipatory data sources in continuous sense-making and framing of issues, integrating alternative data sources into ecosystem steering functions, and providing transparency and dynamic upgrading of indicator development and monitoring practices.

In our study, we seek to apply the innovation ecosystem impact and indicator models to the development of a regional innovation ecosystem.

INDICATOR SYSTEM AND DATA COLLECTION

The Regional Innovation Scoreboard is based on the European Innovation Scoreboard which provides information annually related to innovation performance across Europe. In 2022 European Innovation Scoreboard was based on the indicator framework, which consists of 32 indicators grouped under 12 dimensions such as attractive research systems, firm investment in research and development, and use of information technologies. Between 2015 and 2022, the EU improved its relative position towards all global competitors except China.

However, the EU's innovation divide remains. The performance groups are geographically concentrated, with the Innovation Leaders and Strong Innovators being in Northern and Western Europe, and most of the Moderate and Emerging Innovators in Southern and Eastern Europe. Also, in leading innovation countries there are well-performing areas, as well as so-called thin regions with limited innovation performance (Asheim 2019).

The regional innovation scoreboard (RIS) is a regional extension of the European innovation scoreboard (EIS), assessing the innovation performance

of European regions on a limited number of indicators. The RIS 2021 provided a comparative assessment of the performance of innovation systems across 240 regions of 22 EU countries, Norway, Serbia, Switzerland, and the United Kingdom. The last edition of the scoreboard shows that innovation performance has increased for 225 regions out of the total of 240 regions over the period since 2014. However, the regional innovation scoreboard extends to the NUTS2 level providing from five regions – Helsinki-Uusimaa Region (FI1B), Southern Finland (FI1C), Western Finland (FI19) Northern and Eastern Finland (FI1D), and Åland (FI20). Southern Finland where Häme Region is located next to Helsinki-Uusimaa Region which is Innovation Leader, only second to Stockholm in Sweden.

The Innovation Scoreboard focuses on education, scientific and other publications, RD expenditures, innovators, SME collaboration, patents, trademarks, designs, sales of innovative products, and employment (Figure 1). In the year 2021 new indicators were added to cover individuals who have above basic overall digital skills, innovation expenditures per person employed, employed ICT specialists, and the first climate-related indicator about air emissions in the industry. Statics Finland collects the data. For the Häme Region some of these indicators are inaccessible. Statistics Finland does not provide data at the regional level (NUT3).

Indicators focus on deliverables by universities and research centres. Research and development institutions at Häme Region are Häme University of Applied Science HAMK, Lammi Biological Centre by Helsinki University and two locations – Haapastensyrjä and Jokioinen - of Natural Resources Institute Finland (LUKE). The main technological research centre VTT has no facilities at Kanta-Häme. There are some collaborative projects with other institutions and companies. However, there are no statistics available at the regional level about research centre activities and currently it is impossible to estimate the volume of the collaboration.

Impacts and Indicators of Innovation Ecosystems

The recent study (Laasonen et al. 2022) on impacts and indicators by the INNOVA project has produced information and tools to support the assessment of the impact of innovation ecosystems. Assessing and measuring the impacts of different kinds of ecosystems is challenging and requires a wide range of data and ecosystem-specific reviews. The framework and case studies provide a basis for the impact assessment of innovation ecosystems science/research-driven, business-driven and regionally-rooted innovation ecosystems that were described and analyzed. In addition, ecosystem development and maturity were also considered: 1. early stage, 2. experimental phase, 3. expansion/stabilization phase and 4. renewal phase.

The results of the statistical analysis show a strong link between companies' participation in innovation ecosystems and better firm-level innovation performance. When examining the impacts of innovation ecosystems, special attention should be paid to the extent to which innovation ecosystems increase RDI cooperation between organizations and generate innovations that benefit society more broadly. The recommendations of the study emphasize

Regional Innovation Scoreboard 2021

Etelä-Suomi (FI1C)

	Data	Normalised score	Relative to FI	Relative to EU
Tertiary education	38.2	0.545	86	95
Lifelong learning	26.7	0.994	99	247
International scientific co-publications	2,523	0.814	99	145
Most-cited scientific publications	11.2	0.628	93	116
Above average digital skills	50.5	0.968	101	184
R&D expenditures public sector	0.71	0.477	77	99
R&D expenditures business sector	1.01	0.362	56	70
Non-R&D innovation expenditures	±	0.391	±	±
Innovation expenditures per person employed	±	0.604	±	±
Employed ICT specialists	4.1	0.535	58	107
Product innovators	±	0.674	±	±
Business process innovators	±	0.685	±	±
Innovative SMEs collaborating	±	1.000	±	±
Public-private co-publications	397.8	0.709	99	143
PCT patent applications	4.66	0.724	79	117
Trademark applications	6.24	0.459	74	101
Design applications	4.09	0.582	103	101
Employment knowledge-intensive activities	15.2	0.580	86	97
Employment innovative enterprises	±	0.754	±	±
Sales of innovative products	±	0.628	±	±
Air emissions by fine particulates	6.2	0.855	99	174
Average score	--	0.665	--	--
Country EIS-RIS correction factor	--	0.927	--	--
Regional Innovation Index 2021	--	0.617	--	--
RII 2021 (same year)	--	--	87.2	117.3
RII 2021 (cf. to EU 2014)	--	--	--	132.0
Regional Innovation Index 2014	--	0.531	--	--
RII 2014 (same year)	--	--	87.3	113.5
RII - change between 2014 and 2021	--	18.5	--	--

± Relative-to-EU scores are not shown as these would allow recalculating confidential regional CIS data.

Etelä-Suomi (FI1C) is a Strong Innovator +. Innovation performance has increased over time (18.5%).
The first two data columns in the table on the left show the values and the normalised scores per indicator. The last two data columns show relative performance of the normalised scores compared to Finland and the EU. The last 8 rows show the calculation of the Regional Innovation Index (RII), the RII relative to both Finland (87.2) and the EU (117.3) in 2021, the RII in 2021 relative to the EU in 2014 (132), the RII in 2014 relative to both Finland (87.3) and the EU in 2014 (113.5), and performance change over time between 2014 and 2021 (132 - 113.5 or 18.5).
The radar graph shows relative strengths compared to Finland (orange line) and the EU (blue line), showing relative strengths (e.g. Lifelong learning) and weaknesses (e.g. R&D expenditures business sector).
The table below shows data highlighting possible structural differences, e.g. GDP per capita growth (above average) and Average employed persons per enterprise (below average).

	FI1C	FI	EU
Share of employment in:			
Agriculture & Mining (A-B)	4.0	4.0	4.6
Manufacturing (C)	16.1	13.0	16.4
Utilities & Construction (D-F)	8.9	8.6	8.2
Services (G-N)	66.1	69.5	62.9
Public administration (O-U)	4.7	4.6	7.1
Average number of employed persons per enterprise	3.8	5.0	5.2
GDP per capita (PPS)	31,000	34,700	31,200
GDP per capita growth (PPS)	3.8	3.3	3.2
Population density	37	18	109
Urbanisation	77.8	72.9	75.3
Population size (000s)	1,150	5,530	446,450

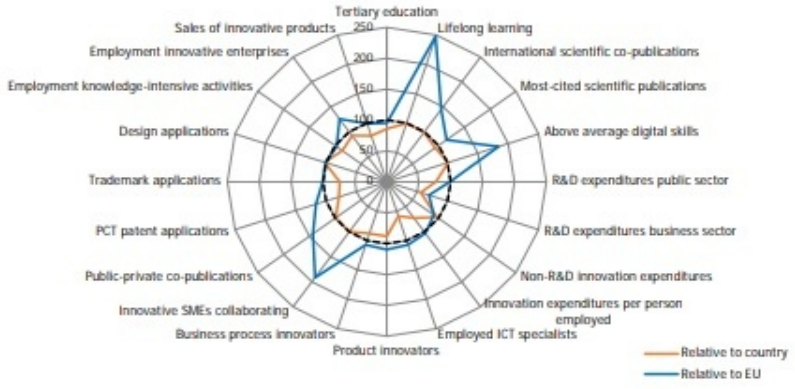

Figure 1: Regional innovation scoreboard southern Finland 2021 (European Commission 2023).

the long-term nature of innovation policy and its monitoring, and the importance of cooperation between RDI funders, as well as impact-oriented policy formulation and implementation (Laasonen et al. 2022).

The ecosystem assessment framework consists of resources/inputs, actions, direct outputs/results of action, outcomes to the wider ecosystem, and social impacts. And it consists of qualitative and descriptive data (See Figure 2). The case studies did not provide many straightforward indicators. The diversity of indicators and the existence of different indicators at different stages of the life cycle must be taken into account: from the preconditions of the

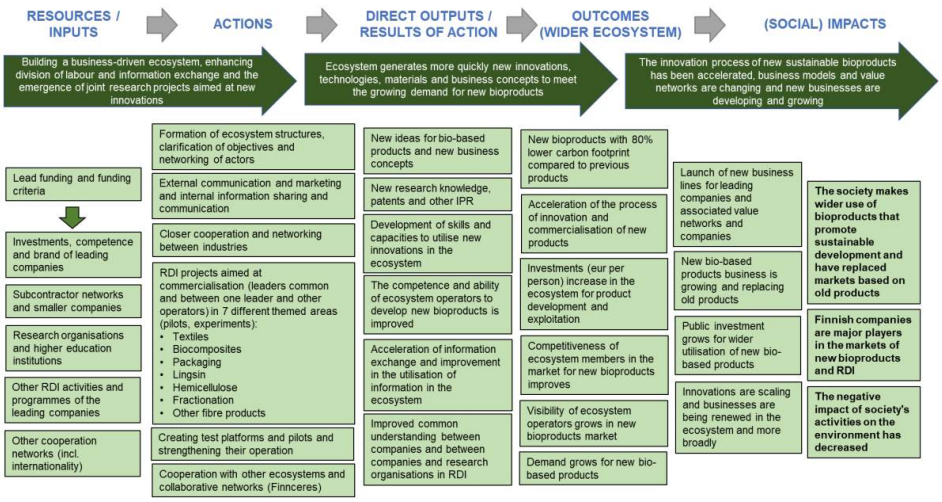

Figure 2: Expand fibers impact logic and ecosystem model based on case study data (Laasonen et al. 2022).

ecosystem to the competitiveness of the national economy. The potential list of indicators identified in the study is presented in Figure 3.

The main observations of the INNOVA study (Laasonen et al. 2022) were the following

- Innovation policy, both nationally in Finland and at the EU level, is increasingly motivated by large-scale societal changes and their acceleration (so-called mission-based and transformative innovation policy) which

	INPUTS	ACTIVITIES	OUTPUTS AND RESULTS	OUTCOMES AND EFFECTS	IMPACTS
What should be measured?	Extensive utilisation of resources: • Financial and personnel • Available networks of expertise and competences (extensive collaboration, diversity) • Collaborative platforms and other support structures • Competences	Bringing together, developing and fostering a network of actors, designing a distribution of labour and clarifying roles (formulating and clarifying a shared vision) Opening up of innovation activities (including changing modes of operating, co-creating and innovating)	Enhancing internal and external co-operation and the use of information in the ecosystem Enhancing the movement of intangible and tangible capital within the ecosystem Increasing the attractiveness and importance of the ecosystem	Strengthening of capacities benefits innovation outcomes in business Scaling up and expanding the utilisation of innovation	Strengthening competitiveness The importance of ecosystems in social and societal transitions, such as improving sustainability and wellbeing (contribution made to national or international objectives, policy goals and missions)
Examples of indicators	Participants and their diversity (as to industry, size, sectors, international partners etc.) New resources / investments to development The utilisation of diverse funding instruments and sources for ecosystem development	Shared strategies (the identification of common themes in organisation strategies), roadmaps and connections to societal changes (recognised areas for RDI-cooperation) Performance indicators (new actors involved in RDI cooperation, projects, facilitated opportunities and participation and commitment to co-development, etc.) Expectations of RDI cooperation vs. experimental value, participation Activity and reporting on ecosystem cooperation within one's own organisation	Sharing and disseminating knowledge in ecosystems The increase in RDI-collaboration and its qualitative changes (diversification and deepening) The recognised improvement of relevance and visibility of the ecosystem Change / growth of ecosystem: the supply of value, internationalisation of networks, international recruitments Increase in RDI inputs and intensity (funding, personnel) Repatriation of RDI funding from international and national sources New joint investments, demonstrations, pilots, innovation outputs etc. Value added to diverse stakeholders (learning), direction of RDI and prioritisation (clarification of strategy and recognition of business potential Reduction of risk	Improved innovation capacity Acceleration of development cycles New innovations Increase in the taking into use of innovations Expansion to new reference markets (indicators including procurement volumes)	The share of RDI inputs of GDP, Economic and productivity growth, Diversity of economic structure (When assessing the impact, continuous monitoring, qualitative review and assessment of the role of the ecosystem in question to international competitiveness is very important)

Figure 3: Common measurement perspectives identified for ecosystems (Laasonen et al 2022).

also changes the focus of examining and evaluating the effectiveness of innovation policy.
- The assessment of innovation ecosystems must be based on the impact paths set by each ecosystem itself. From the perspective of innovation policy, the impact paths should be viewed from the perspective of the wider societal impacts they generate.
- The systematic and long-term monitoring of ecosystems is required in to support instruments to develop the credibility, transparency, and development of innovation ecosystems in national innovation policies.
- Instruments aimed at strengthening and developing ecosystems can be justified, especially from the perspective of transformative innovation policy. The new 'ecosystem policy' does not however provide a complete solution nor does it eliminate the need for other innovation policy instruments.
- The ecosystem perspective in the broad sense then is still evolving. Finland has the opportunity to strengthen cooperation in the implementation of mission-based and transformative innovation policies with other EU countries from the perspective of examining effectiveness.

The main recommendations of the INNOVA study (Laasonen et al. 2022) are

- Recommendation 1: Innovation ecosystems take a long time to emerge and they need to be nurtured and supported by adopting a long-term approach to innovation policy.
- Recommendation 2: Achieving broad societal impacts requires innovation policy instruments that strengthen innovation ecosystems based on different impact paths and starting points (science, business, and regionally-rooted innovation ecosystems).
- Recommendation 3: Innovation ecosystems receiving public funding should be expected to formulate their expected impacts and impact paths (including the impacts and key results and their possible causal connections).
- Recommendation 4: Verification of the effectiveness of innovation ecosystems requires cooperation between RDI funders and the development of nationally harmonized monitoring methods.
- Recommendation 5: Finnish RDI funders and ecosystem actors should intensify international cooperation to improve the impacts of innovation ecosystems.

Entrepreneurial Governance and Use of Regional Data

ESPON, an EU-funded program, conducted a recent study on Entrepreneurial Regional Governance: societal innovation beyond spatial frontiers (ESPON 2022). Based on the study they recognized that some regional public authorities demonstrate entrepreneurial behavior when pursuing social and environmental benefits for their communities. Addressing especially societal innovation opportunities related to climate, energy, health, food, security, and mobility. In an innovation-scarce environment, regional authorities

connected temporarily with private-sector innovators from regions with higher potential for societal know-how flow, adopt external know-how, and 'pollinate' their regional markets with new opportunities. These opportunities are discovered by local firms, who in turn respond with actions adding societal value in regional markets.

Regional public authorities assemble and synthesize information distributed across space, time, and types of legal entities to extract social, economic, and environmental value for their communities. This is a crucial difference from traditional innovation policies. Every region is capable to tap into the existing societal innovation flows and repurpose acquired know-how for the benefit of local communities, adjusting to spatial and structural conditions. This is the nature of the entrepreneurial action: creating a self-reinforcing societal value out of undervalued and/or unrecognized resources through access to spatially external know-how with societal value. (ESPON 2022)

The Häme Region was one of the entrepreneurial regions identified in the ESPON study. We were invited to share our experiences related to Häme Portfolio management practices were shared at the EU Regions Week in October 2022.

EXPERIENCES FROM HÄME REGION

SmartHäme 2025 – smart specialization strategy for the Häme Region was approved by Regional Council in November 2021. Strategy is implemented via several development projects. Häme Goes into Ecosystem -project started in January 2023 and it aims to enhance the implementation of the regional development program Sustainable Growth in Häme 2022-2025, strengthen both research, development, and innovation (RDI) and Entrepreneurial Discovery Process (EDP) activities across Häme Region. The aim is also to increase RDI activities and innovation ecosystem collaboration among stakeholders (corporate, entrepreneur, university, government, and 3rd sector) and funding. The aim is also to accelerate support for new innovative products and services, strengthen capabilities, and creation of new jobs and entrepreneurial regional development practices together with regional, national, and international stakeholders. Activities consist of experimenting with new open/hybrid ways of working with innovation camps, Fast Expert Teams sessions, demos, and pilots, coaching for RDI/EDP funding, benchmarking, and reports on innovation ecosystem development.

The project is conducted in four work packages. The first work package focuses on the creation of a systemic operational model for the regional innovation ecosystem. The second work package provides support and facilitation of ecosystem activities. The third work package develops anticipatory steering practices for RDI supported by indicators and measurement. This paper focuses on the third work package. The fourth work package includes project management and communication.

The Häme Portfolio can be used to support SmartHäme 2025 strategy work and regional ecosystem development. It provides information on companies, public and private RDI organizations, and associations thus supporting networking and partnerships. The tool is open to all interested people,

based on open innovation principles. The Häme Portfolio can be used for evaluation and assessment, and it provides long-term data for indicators and measurement. Reporting and monitoring practices are very flexible, and they can be further developed to support decided actions. It is also possible to link development projects to strategies to follow up on implementation. Projects can be linked to each other, and the aim is to encourage innovative activities. (Takala et al. 2022)

There is ongoing data collection from multiple sources to provide better visibility to available RDI data and the innovation ecosystem framework will be used to assess and analyze the related activities. The aim is also to test various digital solutions for data sharing.

DISCUSSION AND CONCLUSION

We should measure what we value. Elke de Ouden (2012) shares her views of value. According to Ouden, it is important to distinguish the level at which value is perceived. Four distinct levels of value are relevant in the context of innovation: value for users, value for organizations, value for ecosystems, and value for society.

Transformational innovation addresses value for all four levels at the same time. Understanding the issues in society also provides a basis for many new transformational innovations. We should also address value from economical, social, psychological, and ecological perspectives. There is a growing awareness of the business opportunities in 'doing good'. Social responsibility is no longer only about charity and philanthropy, but about creating value for people, organizations, and society at the same time (Ouden 2012). This needs to reflect in indicators and impact assessments.

Sustainability will be an even more important theme in the future (Stankova 2021). Recently published Dasgupta Report and Policy Brief for Finland (Pouta et al. 2023) challenges us to rethink previously used indicators and impact assessment practices. A climate indicator among the European innovation Scoreboard gives a good example of this shift toward sustainability.

For Finland to develop and act on anticipatory strategies for carbon neutrality, the pilot case study on carbon neutrality highlighted the need to prioritize creating responsibility and urgency to act, collaboration and coherence, capacity development, and integration of green fiscal practices into the mainstream.

In the study, we will use the innovation ecosystem framework for indicators and impact, as a tool to design, describe, manage, and assess the regional innovation ecosystem measurement system. The application of the model allows us to apply lessons learned and recommendations from the INNOVA and ESPON studies.

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