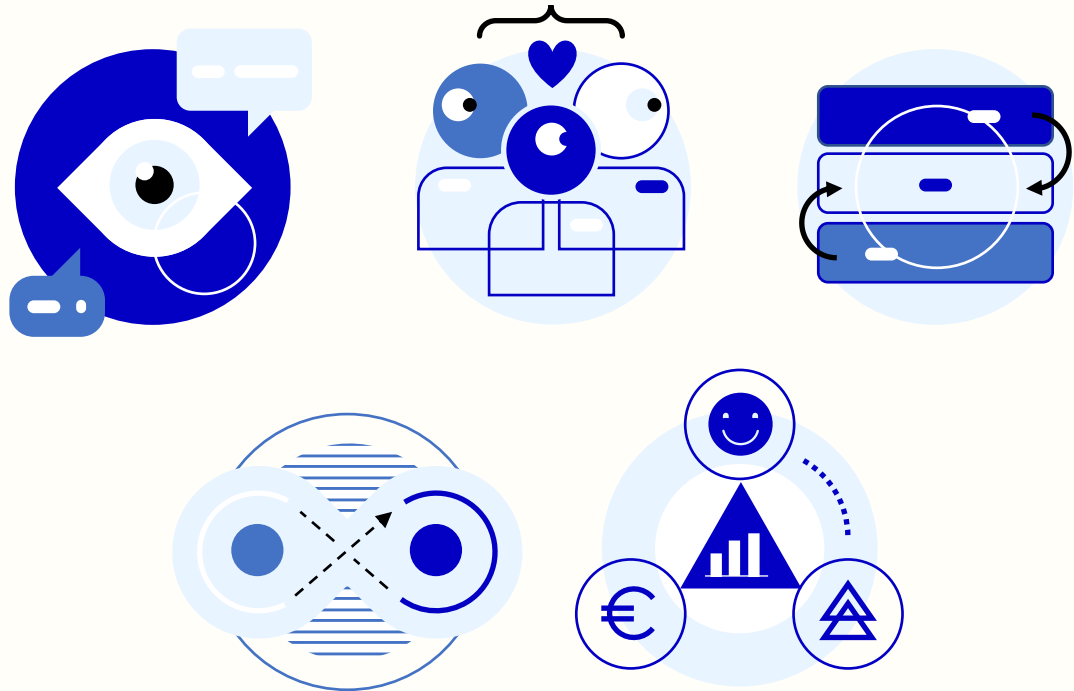


Collaborating for a sustainable future – ecosystem guide



Collaborating for a sustainable future – ecosystem guide

Contents

1. Objective and purpose of the guide	3	5. Development stages and the life cycle of ecosystems	32
2. Why are ecosystems important?	7	Development stages of ecosystems	35
Benefits for individual actors	11	Tasks of ecosystem orchestrator at different stages	37
3. Defining and categorising ecosystems	13	Ecosystem life cycle	38
Knowledge, innovation and business ecosystems	13	Regional, national and international perspectives	39
Different approaches exist to collaboration in ecosystems	20	Roles of public sector actors, the partnership model and funding instruments	39
4. Ecosystem orchestration and collaboration model	22	6. Accelerating and evaluating the impacts of ecosystems	44
Shared vision and objectives	22	Impact indicators and sources of evaluation data	46
Orchestrator and the role of rules	24	Impact evaluation as a management and steering tool	49
Forms of participation and actor roles	26	7. Ecosystem success factors	51
Knowledge and information management practices	28	Key terms and glossary	54
		Further reading and main sources	55

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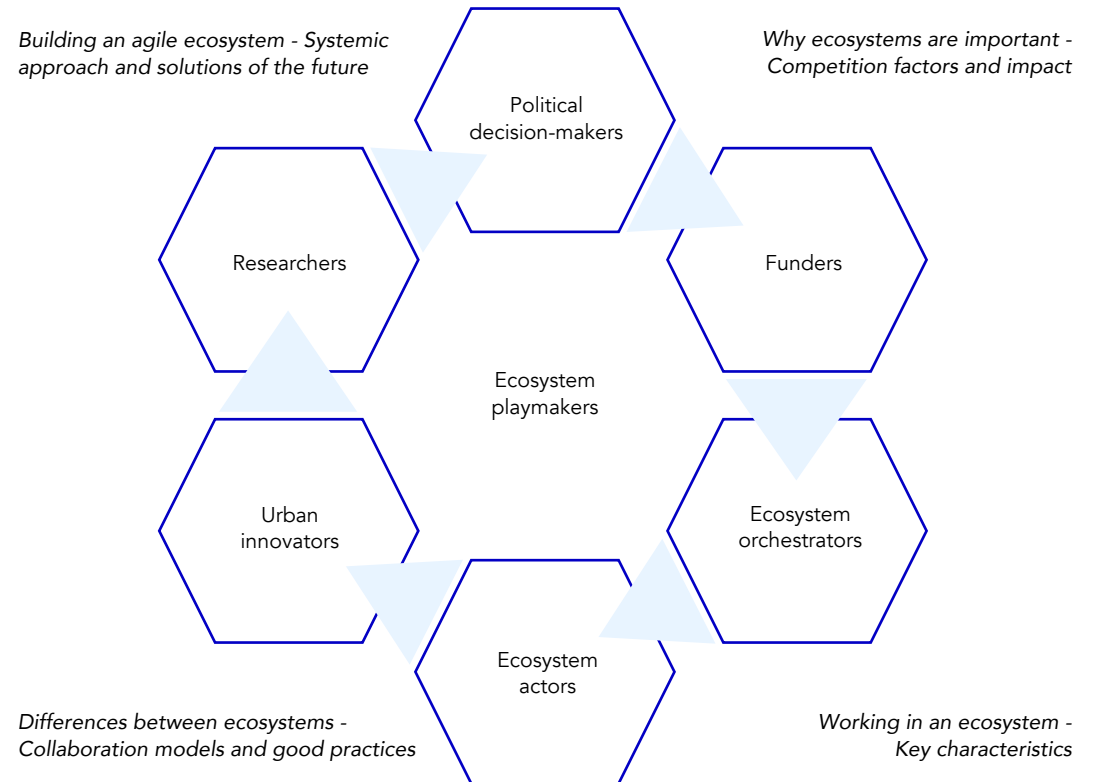
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1. Objective and purpose of the guide

The objective of this guide is, starting from ecosystems and other networked operation models, to better understand their differences and to promote their potential to help build both a sustainable future and business competitiveness - through collaborative innovation (Figure 1).

Business executives, public officials, politicians, consultants and researchers are keen to create new terms to describe the phenomena they are dealing with.¹ The terms become well-established and people start associating them with specific phenomena. The notion of 'ecosystem' is one such concept which remains rather a vague, not yet able to provide a firm basis for building common understanding. The guide outlines a number of practical examples describing various types of ecosystem and their main features, with a focus on innovation ecosystems.



¹ Berger and Luckmann describe this phenomenon as 'social construction of reality'. Thus, linguistic expressions play a key role in the common outlining of reality. Berger, Peter L. & Luckmann, Thomas: Todellisuuden sosiaalinen rakentuminen: Tiedonsosiologinen tutkielma. The social construction of reality: A treatise in the sociology of knowledge, 1966. Suomentanut ja toimittanut Vesa Raiskila. Helsinki: Gaudeamus, 1994 (3. painos 2000).

Figure 1. Target groups and key issues discussed in the guide

This publication is intended for public sector decision-makers tasked with promoting RDI, RDI funders and decision-makers responsible for RDI in private sector companies.

The objectives of the guide are as follows:

- describing and specifying the multifaceted ecosystem concept,
- structuring the factors behind ecosystem successes,
- describing the benefits of ecosystems from the perspective of individual actors, and
- highlighting the new indicators required to improve their impacts.

In this publication, an ecosystem is defined as follows:

Ecosystems are built on interaction between companies, entrepreneurs, research, public administration and third-sector actors. An ecosystem is both a structure and an interactive process, in which actors complementing each other join forces to create value. Ecosystems have a large number of parallel network structures sharing the same vision and same objectives and incorporating an operating model steering the process of implementing the objectives (strategic roadmap).

Table 1. Definition of an ecosystem

Being a networked structure, an ecosystem is in a state of constant change and for this reason it cannot be explicitly specified or categorised. Instead of trying to define the ecosystem as a concept, we should focus on the aspects essential to shared objectives, such as creating a sufficiently ambitious and concrete vision addressing the needs of all ecosystem actors. This guide discusses the key elements of ecosystem activities as follows:

This guide contains background and in-depth information on the topic. It examines ecosystems as a strategic RDI instrument and even though key aspects of orchestration are discussed, development tools are not presented in the publication. Publications discussing practical ecosystem orchestration tools are listed in the literature section of the guide.

Chapter 2:

Describing why ecosystems are important and what the benefits are of ecosystem activities

Chapter 3:

Explaining ecosystems, describing the key features of ecosystems and comparing them with other forms of cooperation

Chapter 4:

Collaborating as a member of an ecosystem and how ecosystems differ from earlier approaches to networking

Chapter 5:

Development stages and life cycle of ecosystems

Chapter 6:

Measuring and evaluating the benefits of ecosystems to different actors

Chapter 7:

Summary - key elements of ecosystems' success

Ecosystems in research and development work

The idea behind ecosystem thinking is that, based on broad-based interactive cooperation, an ecosystem can generate more value by using the same input as individual actors. At the same time, influenced by target-oriented and random decisions by the actors, an ecosystem is constantly developing in tandem with its environment. Understanding these dependencies and interactive relationships is essential for ecosystem steering, the setting of effectiveness objectives and anticipation of the development path.

The objective of the national RDI roadmap outlined by the Research and Innovation Council is to make Finland the most attractive and competent environment for innovation in the world by the year 2030. The aim is to achieve this by creating ecosystems supporting the strong expertise base already available in Finland. The purpose of ecosystems is to solve extensive and complex problems involving a large number of actors.² Understanding the systemic nature and self-organisation of things is essential for the exploitation of new value-system models. The purpose of the ecosystem concept is to make these factors concrete and to operationalise them.

Public administration acts as an ecosystem enabler and is not expected to control or dominate. In practice, this means that ecosystem actors should be identified and brought together, cooperation platforms and processes should be created and a basis for co-creation should be established. Ecosystem policy involves close cooperation between private, public and third-sector actors as well as coordination of the complementary development measures introduced by them.³ Thus, the partnership models used in open innovation activities and public-private cooperation are closely linked to the development of ecosystems.

² Ministry of Economic Affairs and Employment (2019) <https://tem.fi/documents/1410877/2095051/Kansallisen+TKI-tiekartan+tavoitteet+ja+p%C3%A4%C3%A4m%C3%A4%C3%A4r%C3%A4t/1ed3c9bf-30b9-2e74-5612-ae7468456dd9/Kansallisen+TKI-tiekartan+tavoitteet+ja+p%C3%A4%C3%A4m%C3%A4%C3%A4r%C3%A4t.pdf>

³ Ministry of Economic Affairs and Employment (2017) <https://tem.fi/documents/1410877/4429776/Ekosysteemit+uuden+elinkeino-+ja+innovaatiopolitiikan+kohteena/f46d3709-fdcf-4a73-83cf-e84ae24b4196>

2. Why are ecosystems important?

Ecosystems enable continuous renewal and multi-sectoral innovation. Tackling extensive systemic challenges requires multi-sectoral collaboration within an ecosystem. The benefits and impacts of ecosystem activities arise from the vision jointly created by the actors and the roadmap supporting it.

In a rapidly changing competitive business environment, acting alone or relying on slowly changing networks based on long-standing partnerships can no longer guarantee success in global markets. Solving extensive systemic challenges requires problem-solving by a wide range of actors.

In ecosystems, joint action is directed by shared objectives and platforms creating new value in a multilateral network. Ecosystems are not merely instruments for establishing relationships but constantly developing systems that have self-organisation as one of their critical features.

In ecosystems, a large number of networks function and reorganise themselves without any hierarchical control. Ecosystems enable continuous renewal.

Digitalisation and servitisation have already changed and will continue to shape our operating environment and the ways in which cooperation occurs (Figure 2). Digital solutions and the data flows collected by platforms enable simultaneous personalisation and up-scaling as we make a shift from data sharing to joint processing of information. At the same time, servitisation increases the need for combined interfaces so that end users can have access to a seamless service package in a multi-channel operating environment. Digitalisation and servitisation have already shaped the development of co-creation models. In the optimum situation, ecosystems enable constantly developing network structures, continuous joint learning by actors and open innovation.

+ 3. Co-creation

- Supply chain
- Customer is the focus of sales efforts
- In-house R&D

- Strategic partnerships
- Customer as a resource
- Innovation in current network(s)

- Shared-objective ecosystem and platforms
- Customer is a strategic partner
- Open innovation, co-learning and opportunities for growth

+ 2. Servitisation

- One-to-one
- Single-channel approach
- Creating one-off value

- One-to-one
- Multi-channel approach
- Creating continuous value

- Many-to-many
- Target-oriented interaction on a multi-channel basis
- Integrating actors into continuous value-creation processes

1. Digitalisation

- Speed
- Data sharing
- Efficiency through analytics

- Scalability
- Data Processing
- Better customer experience

- Personalisation
- Integration and network impacts
- Synergies, new value and results

Figure 2. Key change drivers in the operating environment

Case example.

Ecosystems as builders of new economic structures and wellbeing

World-class ecosystems as builders of new economic structures and drivers of economic growth⁴

Ecosystems play a key role in the economy because ecosystem actors spur each other on, complementing each others' expertise and capabilities. They can also provide their customers with added value that would not otherwise be available.

In the optimum situation, ecosystems play a major role in the renewal and productivity of the economy and its ability to generate wellbeing, both directly and indirectly. Ecosystems also attract research, development and innovation investments and provide foreign companies with an operating base encouraging them to invest in the development of their activities. There remains however a lack of research on the economic impacts of ecosystems and few statistics covering the topic have been produced. As ecosystems are extensive, complex and constantly developing entities, explicit verification of their economic impact is extremely difficult.

In Finland, creating new 'world-class' business ecosystems is one of the business and innovation policy objectives set out in the Programme of Prime Minister Marin's Government. This also provides companies with an opportunity to boost their own growth by joining the growth ecosystems funded by Business Finland.

Ecosystems as factors boosting business competitiveness

In addition to traditional business and innovation policy, we also need an active and systemic policy geared to the needs of a rapidly changing and open operating environment. In Finland, cooperation between companies is common. Finnish companies are mostly small and do not possess all the required resources. At the same time, open innovation and dynamic ecosystems across sectoral boundaries are still in the process of developing collaboration practices and often have more future-oriented objectives. The ecosystem policy examines the prerequisites for entrepreneurship from the overall systemic perspective, focusing on the unique development needs and development stages of specific ecosystems.⁵

According to a survey published in 2019, some 65% of all Finnish companies are engaged in innovation activities with 40% of them engaged in innovation cooperation with other parties. Most of the innovative companies in Finland report that they belong to more than one innovation ecosystem and that these innovation ecosystems have had a positive impact on their business operations. The survey results are based on the information supplied by 473 companies receiving Business Finland funding (Figure 3).⁶

⁴ Kalle A. Piirainen (ed.), Vesa Salminen, Juha Kettinen (4FRONT), Stijn Zegel (Technopolis Group), Alasdair Read (EFIS Centre) 2020. Maailmanluokan ekosysteemit Business Finlandin asiakkaina (World-class ecosystems as Business Finland customers). <https://www.businessfinland.fi/4aa4e1/globalassets/finnish-customers/news/news/2020/world-class-ecosystems-report-2020.pdf>

⁵ Ministry of Economic Affairs and Employment (2017) <https://tem.fi/documents/1410877/1429776/Ekosysteemit+uuden+elinkeino-+ja+innovaatiopolitiikan+kohteena/f46d3709-fdcf-4a73-83df-e84ae24b4196>

⁶ Mirjam Knockaert, Matthias Deschryvere & Laura Lecluyse et al. (2019). Science and Public Policy, doi: 10.1093/scipol/scz002 and Deschryvere, M., Lehenkari, J., Oksanen, J., Rilla, N., Still, K. 2015. Impact of ecosystems: Key results of the Finnish Entergrow survey. Tekes Policy Brief Ekosysteemit, No. 4, 2015

Based on the survey results, ecosystems are estimated to boost economic growth. The potential for added value has been substantial, especially in digital services and new technology sectors. According to the evaluations,⁷ ecosystem member companies are, on average, more productive than the Finnish private sector in general. This indicates that, on average, individuals employed in ecosystems create more value than private-sector employees generally. Ecosystems produce better operating models and provide a basis for the more multidimensional use of technologies.

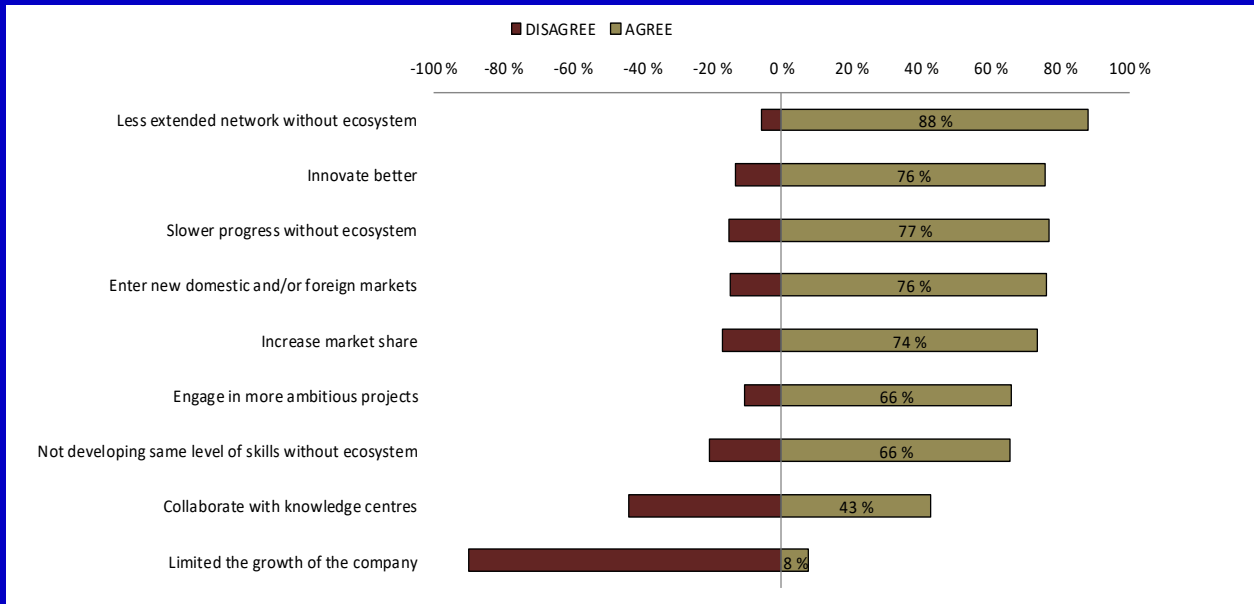


Figure 3. How does participation in ecosystem activities impact business operations? The graph is based on the self-evaluation carried out by the companies in autumn 2004. They were asked to assess the benefits over the next five years by responding to nine statements. The original Likert scale 1 (Strongly disagree) - 7 (Strongly agree) is summarised here into 'Disagree' (1-3) and 'Agree' (5-7).

⁷ Rytter Sunesen et al. (2019) https://www.businessfinland.fi/496a33/globalassets/julkaisut/3_2019-world-class-ecosystems-and-competitive-business-environment.pdf

Benefits to individual actors

An ecosystem brings together a variety of different actors (Figure 4). Coordinating their needs and expectations is critical to the success of the ecosystem. Collaboration in an ecosystem must be based on reciprocity: different types of actor, such as companies of different sizes, research organisations, funders and public sector actors, make their own expertise and networks available to the ecosystems. The benefits of ecosystems to different actors and the value of different actors to ecosystems are described in Table 2. The challenge here is that significant variation exists in the timespans of ecosystem actors' decision-making and thus in the attainment of set objectives.

Ecosystems are important for companies of all sizes. By combining competences and resources, ecosystems generate new ideas, technologies and solutions, which in turn enhance the co-creation of added-value services strengthening the joint offerings. Large companies often act as leaders of value networks within ecosystems, enabling growth platforms for smaller partners and up-scaling new products for international markets. A smoothly functioning ecosystem brings together complementary competences and resources.

Research and development organisations

Universities, research institutes, Universities of applied science, regional development organisations, research and innovation clusters, researchers - *as parties creating and relaying new knowledge*

Funders

Public (national and EU) and private (companies and private equity investors) funders - *as enablers and networkers*

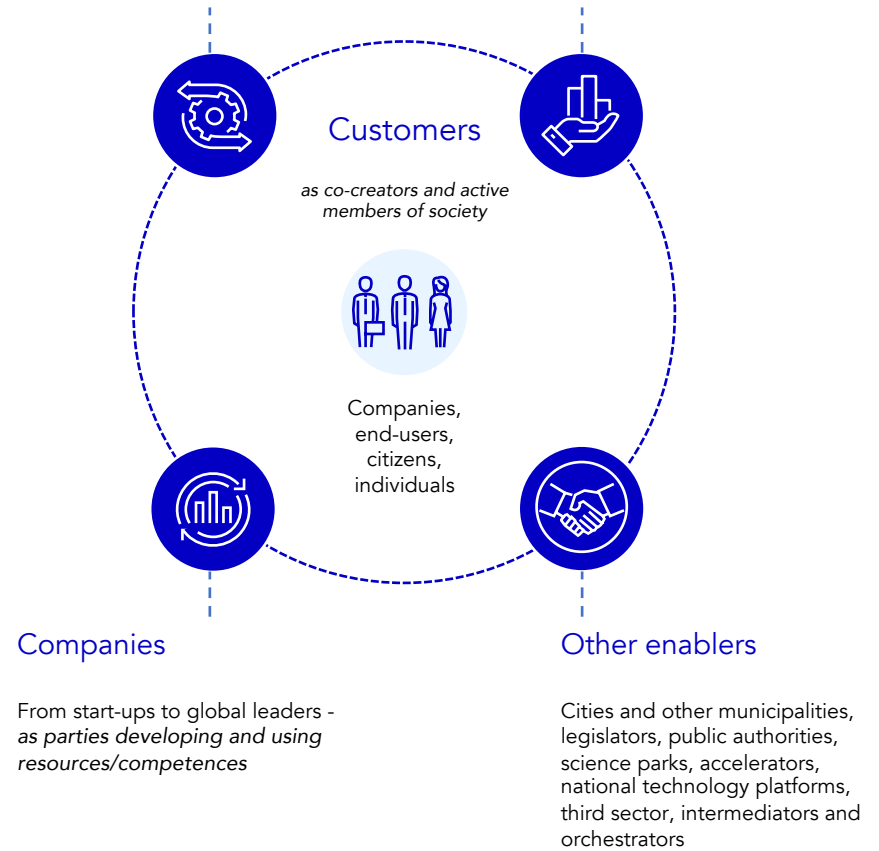


Figure 4. Ecosystem actors

Actors	Benefits generated by ecosystems	Value to ecosystems and other actors
Large companies	<ul style="list-style-type: none"> - New ideas, perspectives and innovations from outside. - Building partnerships or doing acquisition to scale or to expand business - Using complementary expertise of other actors - Sharing technology and business risks 	<ul style="list-style-type: none"> - Business ecosystem drivers with established business networks in the ecosystem focus or related areas. - Connections with customers and ability to scale and commercialise solutions on a wider range of topics. - Possibility to invest time and resources into ecosystem activities. - Setting shorter-term business objectives and development challenges.
Small companies	<ul style="list-style-type: none"> - New ideas, perspectives and innovations from outside. - Expanding business through new partnerships without taking big risks. - Contacts with customers and the ability to scale and commercialise solutions 	<ul style="list-style-type: none"> - Established businesses with deep know-how on specific topics. - Ability to scale and commercialise solutions on specific topics.
Start-ups	<ul style="list-style-type: none"> - New ideas, perspectives and innovations from outside. - Fast-track testing of new ideas and solutions in an ecosystem - Opportunities to scale business through new partnerships. 	<ul style="list-style-type: none"> - Ability to introduce new thinking, solutions and scalable business models. - Opportunity to take risks and try out new solutions and approaches. - Reaching out to (new) customers through new channels and technologies.
Test beds and living labs	<ul style="list-style-type: none"> - Competitive, efficient and compelling business, working and living environment - Monetary or other type of value for providing data and insight - Functioning as a cost-effective platform for co-creation 	<ul style="list-style-type: none"> - Providing test platforms, infrastructure and users for the ecosystem actors - Provide data and insight for research and development purposes - Feedback on the solutions and services being developed
Research organisations	<ul style="list-style-type: none"> - Expanding research portfolio through new partnerships - Building new networks and collaboration in the specific R&D area of interest - Attaining new skills, capabilities and know-how through the ecosystem - Accessing new technologies, tools and data through the ecosystem - Accessing new test environments, infrastructures and users through the ecosystem 	<ul style="list-style-type: none"> - Providing skills, capabilities & know-how for the ecosystem - Providing technologies, tools and data for the ecosystem
Third sector	<ul style="list-style-type: none"> - Creating skills, capabilities and know-how - Opening up new funding sources 	<ul style="list-style-type: none"> - Understanding customer relationships and citizens' needs - Ecosystem test beds and users
Cities	<ul style="list-style-type: none"> - Support and expertise (centres of expertise) strengthening the capabilities of urban communities - Creates the prerequisites for the innovative development of services in urban communities - Making cities more attractive - Using new RDI funding sources 	<ul style="list-style-type: none"> - Enables cooperation within an ecosystem: permits processes, engaging urban dwellers, opening up one's own activities & being a customer - Understanding customer relationships and citizens' needs (incl. customer data for developing innovations) - Active co-creation which functions as a neutral ecosystem orchestrator and coordinator. - Brings together different parties and provides development environments to support cooperation.
Funders and other stakeholder actors	<ul style="list-style-type: none"> - Private funders: short or long-term return of investment through R&D activities. - Competitive, efficient and compelling business and development platform - Advancing local competitive position at the national level, as well as position on the international level. - Opportunities to explore new regulation and policy frameworks in test environments 	<ul style="list-style-type: none"> - Investing in ecosystem R&D activities - Provide favourable ground for R&D&I activities - Public funders: Co-develop and co-create test platforms; Expertise in business scaling and effective commercialisation. - Policymakers and regulators: Contributing to innovation policy making at the national and European levels

Table 2. Different types of actor, benefits accrued to them and their value to the ecosystem and other actors⁸

⁸ Based on Nousiainen & Vienamo (2019). SmartOtoniemi ekosysteemin sidostyöanalyysi (Stakeholder analysis of the SmartOtoniemi ecosystem; internal VTT report) and Kortesoja, A. & al. (2017) New role for cities in promoting innovations. Publications of the Ministry of Economic Affairs and Employment 40/2017. http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160339/TEMjul_40_2017_verkkokulkaisu.pdf https://www.espooli.fi/materiaalit/espooli_kaupunki/verkkolehti/ekosysteemiennonnoaatiojohdantamisen-viitekehys/html5/index.html?page=1&noflash

3. Defining and categorising ecosystems

Ecosystems are constantly developing network structures built around a common vision. New ecosystem features emerge through interaction and dependencies between actors. Using different objectives as a basis, three key types can be identified: knowledge, innovation and business ecosystems. Value chains and networks, clusters and ecosystems serve as complementary cooperation models.

The choice of development and supporting instruments depends on the type of ecosystem and its development stage. The results produced by ecosystems and ecosystem timespans may differ depending on whether new expertise is produced by means of academic research or whether markets are created by constructing networks for international business operations. From the resourcing perspective, it is important to understand the differences between these ecosystem categories.

Knowledge, innovation and business ecosystems

Both business executives and researchers often use the ecosystem concept without defining it. For this reason, most of the partially overlapping concepts, such as industry, business activities, services, entrepreneurship,⁹ innovations and competence-creating ecosystems are used without specifying their differences. Using different ecosystem objectives as a basis, three key types can be identified: knowledge, innovation and business ecosystems (Figure 5).

⁹ Entrepreneur or start-up ecosystems are local ecosystems consisting of start-ups and innovative companies (Silicon Valley and Otaniemi are two examples of such ecosystems). Current, future and former growth-driven entrepreneurs play a key role in them.

Knowledge ecosystems



Built on the same top-expertise base, incremental or disruptive development.



Top-research applications for a broad range of different markets, market acceleration. Potential for disruptive business ecosystems.

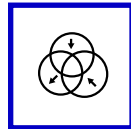


Value network/actor map is changing more slowly but is able to link with new resources and other ecosystems.

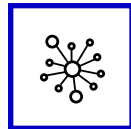
Innovation ecosystems



Development arising from societal challenges and incorporating a broad range of different sectors. Target-oriented focusing.



New markets emerge and existing markets disappear at the sectoral interface. Potential for more compact business ecosystems.

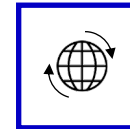


Value network/actor map is broad-based; it is continuously updated as new actors are added.

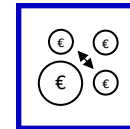
Business ecosystems



Focus on business renewal and development needs (profitability, growth and sustainability).



Quick scaling for new markets and the global marketplace. Building new partnerships.



All partnerships and value-sharing models have been identified; the ecosystem contains closed networks acting as alternatives/competitors.

The aim of knowledge ecosystems is to generate new knowledge or technologies. Their focus is often on networked research carried out on a project basis. In business ecosystems, the actors (such as customers; companies and their subcontractors plus their service providers) focus on generating value for their customers. Innovation ecosystems combine the new knowledge generated by knowledge ecosystems and the customer value arising from business ecosystems when producing new solutions and innovations. (Valkokari 2015). Practical examples of these three ecosystem categories are given below.

In practice, one actor can be a member of more than one ecosystem category. Moreover, each ecosystem is always unique, containing a unique group of actors and interaction and as a result, it develops in a particular direction. In an ecosystem, each of the actors has its own role, interpreting each ecosystem from its own perspective.

Case example.
Knowledge ecosystems¹⁰

The Finnish Center for Artificial Intelligence (FCAI) is a national centre of expertise established by Aalto University, the University of Helsinki and VTT. Its main objective is to strengthen AI-related basic research and education and apply AI-related research expertise across a wide range of scientific fields. The FCAI is supported by top university-developed expertise and serves as the flagship project in the field of artificial intelligence, for which it receives funding from the Academy of Finland. In addition to having a research and education role however, the aim of the FCAI is also to ensure that research-based expertise can be applied and that the benefits are made available to the companies operating in the FCAI's partnership network and their other partners.

¹⁰ Ecosystem websites: <https://fcai.fi/>, <https://smartotaniemi.fi/> and <https://www.luxturrim5g.com/>

Case example.
Innovation ecosystems¹⁰

The common objective of the actors in the **Smart Otaniemi** innovation ecosystem is to slow down climate change with the help of the energy solutions of the future. The ecosystem has developed around the interface between a large number of different sectors including real estate, construction and energy-sector actors as well as companies offering solutions and technologies for data use. Public sector actors, such as cities and research institutes, play an active role in the future solutions-building process. New business opportunities are generated in sectoral interfaces but the work may also lead to the disappearance of existing business models. From the outset, the Smart Otaniemi ecosystem has been open to new actors from all over the world and there are already more than 100 actors in the network. Smart Otaniemi has established cooperation networks with similar network actors in such countries as France, Germany, the Netherlands, India and Japan.

Case example.
Business ecosystems¹⁰

LuxTurrim5G is a business ecosystem driven by Nokia Bell Labs and part-funded by Business Finland. It provides a platform for a multi-sectoral company cluster developing a digital backbone for smart cities based on 5G light poles. The challenges of urban environments (safety, air quality, traffic, housing, etc.,) call for the construction of a novel service infrastructure. As more services become available and more people are using them, the inadequate data transfer capacity of mobile networks has been recognised as a global challenge. The Luxturrim ecosystem is seeking to solve this problem by relying on the smart lighting network. Being a corporate-driven ecosystem, LuxTurrim has made rapid progress from the research stage to the piloting of a variety of different smart city elements. 5G base stations, sensors, cameras and other equipment are integrated into light poles and they provide a platform for new data-based services for smart cities and business opportunities for a wide range of different actors. With these solutions, the participating companies are vying for international markets with a potential totalling billions of euros.

¹⁰ Ecosystem websites: <https://fcai.fi/>, <https://smartotaniemi.fi/> and <https://www.luxturrim5g.com/>

There is now more debate on the role of industrial ecosystems in the European industrial strategy combining digitalisation and sustainable development, in which industrial ecosystems are examined at the macro level, as large entities comprising all sectoral actors.

Case example.
Industrial ecosystems in the European innovation policy¹¹

Increasing emphasis is now placed on the role of industrial ecosystems in European innovation policy. Europe must focus on specific technologies but should also take a closer look at the opportunities offered by industrial ecosystems and the challenges arising from them. All actors along the value chain are members of these industrial ecosystems: from the smallest start-ups to the biggest companies, from higher education institutions and researchers to service providers and suppliers of goods. Each have their specific characteristics.

The following 14 industrial ecosystems have been presented in connection with the European industrial renewal strategy and recovery from COVID-19: tourism, creative and cultural industries, aerospace & defence, textiles, electronics, mobility-automotive, low-carbon energy-intensive industry, renewable energy, agrifood, health, digital, construction, retail and proximity & social economy.

¹¹ <https://euclidnetwork.eu/2020/07/social-and-proximity-economy-recognised-as-key-industrial-ecosystem-in-europe/>

Key research aspects and supplementary ecosystem models¹²

In the social sciences, the ecosystem approach has been utilised for many years to better understand the dynamics of the economy. Ecosystem approaches consider the economy, organisations and individuals as living organisms. The ecosystem concept has been actively discussed in business management for more than two decades. Interest was first prompted by Moore who in 1996 described the business ecosystem as a multi-layer structure.¹³ Different research traditions emphasise different dimensions of the ecosystem concept. Geographical vicinity is emphasised in economic thinking, the focus in innovation management is on the process of joint learning, while strategic management gives priority to the results of joint value creation. In business management, the ecosystem concept is associated with systems thinking and the evolution economy. The features of self-organising natural ecosystems are used in research on ecosystem management. Applying biological allegories to economic research is not however without its problems: the objectives of economic activities pursued by humans do not always have equivalents in biology, where emphasis is placed on survival and reproduction.

The research focus is often placed on a single ecosystem category (such as innovation or entrepreneurship ecosystems). In real-life systems, actors (such as ecosystem member organisations) channel their interests into several different areas simultaneously. Moreover, little research has thus far been conducted on institutional factors such as official and unofficial constraints on participation or structures promoting and preventing interaction. The relationships and interactions between ecosystem categories should therefore be examined at several levels so that we can better understand how ecosystem development paths are, in practice, linked.

¹² The literature summary is based on the articles by Valkokari (2015) (<https://timreview.ca/article/919>) and Ketonen-Oksi & Valkokari (2019) (<https://timreview.ca/article/1216>) published in the Technology Innovation Management Review.

¹³ Moore, J. (1996) *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*. New York: Harper Business. 320 p.

An extensive review¹⁴ of the ecosystem literature provides a better understanding of the various typologies used. On this basis, we can also identify future research needs pertaining to the functioning of ecosystems, of which we still know too little:

- **Knowledge ecosystems** focusing on interaction between knowledge and actors in the pre-competition situation → research questions: exchange of information, obstacles to crossing sectoral boundaries and collecting information from different fields of technology
- **Innovation ecosystems** focusing on the value creation arising from cooperation between actors → research questions: creation and development of innovation ecosystems, merger mechanisms, development paths and the renewal of business operating models
- **Business ecosystems** contributing to value creation and storing value when actors are committed to interaction → research questions: relationship categories, selection of partners, features critical to the strength of ecosystems and interaction between ecosystems

¹⁴ Suominen, A., Seppänen, M. and Dedehayir, O. (2019), "A bibliometric review on innovation systems and ecosystems: a research agenda", European Journal of Innovation Management, Vol. 22 No. 2, pp. 335-360.
<https://doi.org/10.1108/EJIM-12-2017-0188>

Different approaches exist to collaboration in ecosystems

As value chains and systems are becoming increasingly fragmented, many of the situations involving cooperation are multidimensional with the challenge here being to manage several parallel networks and their variations. One ecosystem contains overlapping, parallel and competing cooperation networks. For this reason, it is important to understand the characteristics of value chains and networks, clusters and ecosystems (Table 3).

The process of manufacturing a product or providing a service, from raw material production to the assembly and distribution of the end product are described as a value chain and a value network or a supply chain. In these chains and networks, cooperation is defined and steered by direct contractual relationships between the actors. Typically, clusters and alliances are used to describe sectoral and regional competence or resource sharing networks. Ecosystems bring together a broad range of different actors and functions across sectoral and geographical boundaries.

	Ecosystem	Cluster	Value chain and network
Definition¹⁵	Serves as a co-creation environment in which actors are committed to joint RDI functions and business initiatives.	Brings together companies operating in the same business segment to give the companies more visibility and to highlight common views on development agendas towards the public sector.	A chain built by the focal company in which the tasks of the chain actors, the requirements they must meet and the prices they must pay are specified on a contractual basis. A value network is a cooperation model in which interconnected partners create value for end users (customers).
Participants	A heterogeneous group of participants representing a broad range of different sectors and tackling common challenges that may involve technologies, business operations or wicked problems.	Industrial actors share the same knowledge base and business logic; may be geographically concentrated.	Companies possess mutually supportive expertise, which is required for supplying the product or for offering more extensive packages as a joint effort.
Management and constraints	Decentralised and hybrid; openness contributes to innovation and renewal	Decentralised/shared; sectoral boundaries may place constraints on the creation of new expertise.	Responsibility lies with a centralised spearhead company or group; functions are very similar even though individual actors belong to several different value chains. The value network is steered by shared core functions and interconnected earning models.
Dynamics (competitiveness, sustainability)	Actors are often engaged in competition and cooperation; diversity of actors makes the system more sustainable.	Cooperation may be constrained by the competitive situation between the companies; overlapping expertise areas may slow renewal.	As a rule, cooperation is on a mutual basis and the roles and tasks are well-defined. The value network is a structure combining expertise and arising from interaction between the parties.
Examples	One Sea, Taltioni, Smart Otaniemi, GreenE2 mobile ecosystems (Apple and Microsoft)	Finland's forest industry, regional wine producers and airline alliances.	Supply chains of Nokia and Ikea, project delivery networks and alliances
Theoretical background	Moore 1993 ja 1996, Lansbury & Levien 2004	Porter 1990, Wailes, 2000	Porter 1990, Stabell, Charles B., and Fjeldstad, Ø. 1998

¹⁵ Definition based on ISO 44001 standard (Collaborative business relationship)

Networks for co-creation and joint activities are established within ecosystems. The differences between the types of collaboration can be derived from the degree of openness and the steering model used (Figure 6). The operating model of an ecosystem may be built on a centralised basis around a single actor (often the leader company of the value network) or it may be created under the auspices of a close-knit core group. This coordinating party sets the objectives for the work and is often the key beneficiary of the results. Centrally orchestrated and relatively closed ecosystems are efficient but they may not be so good at adopting new operating practices or creating new initiatives.

Ecosystem cooperation across the boundaries of value networks, such as product development alliances or cooperation forums, often provide a sound basis for critical mass and new expertise combinations. They also provide a basis for significant growth potential but less certainty exists in terms of achieving results. At the same time, in completely open and reconnecting operating models, the focus is on the continuous search for ‘the new’ while the joint agenda of the ecosystem remains relatively vague. Agenda fragmentation is a typical problem in open models and the composition of the entity involved in simultaneously developing components is, generally, ‘fuzzier’ than in more closed models.

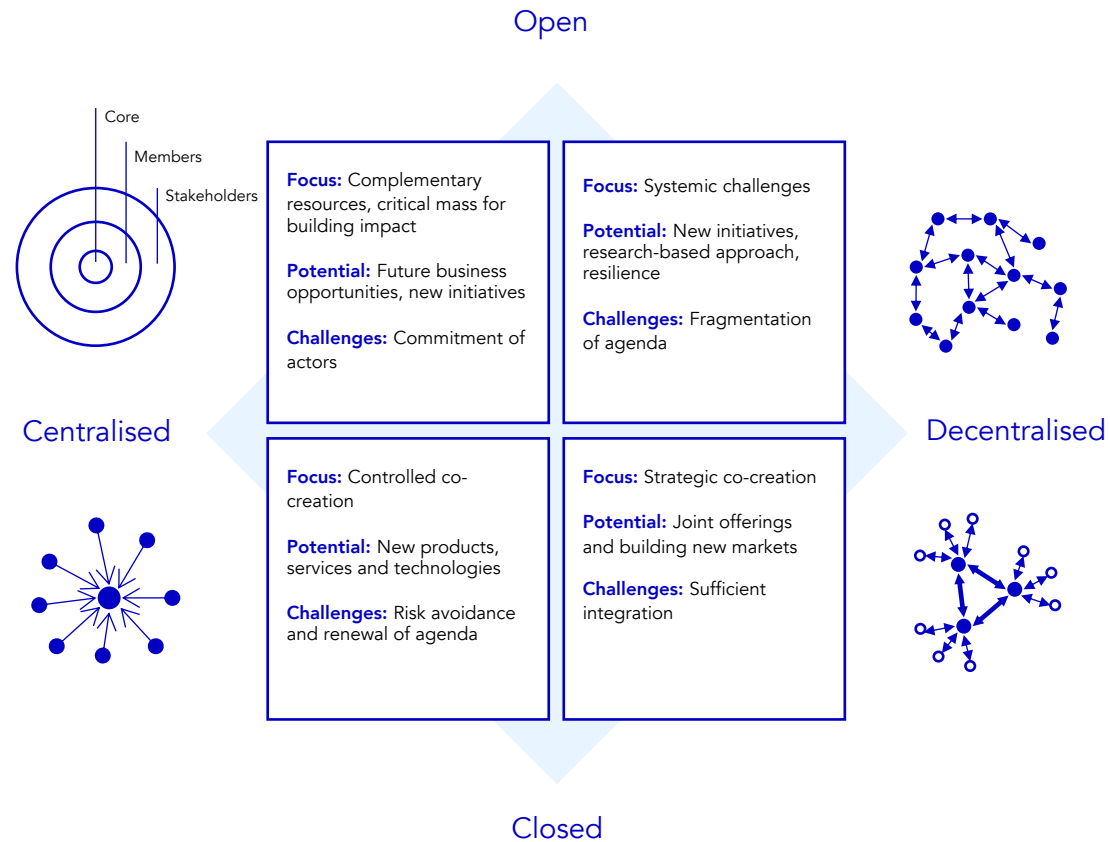


Figure 6. Ecosystem network structures and operating models

4. Ecosystem orchestration and collaboration model

The roles of the ecosystem actors and the practices of co-creation are determined by the ecosystem vision and the joint roadmap. Ecosystems are usually based on a multi-layer operation model. The rules in respect of the ownership of knowledge and results and the actors' roles, jointly built by the ecosystem members, are key to building trust.

The objective of any ecosystem must be sufficiently interesting such that the actors are prepared to remain together and engage in collaboration. Cooperation is also essential to achieve this objective. Understanding and coordinating the timespans of the actors' interests and objectives is a critical factor here. The work is based on shared objectives arising from a common vision, a jointly prepared roadmap and a shared understanding of the manner in which the benefits and costs of the ecosystem are distributed. The key issue then is to find a balance between self-organisation and the construction of long-term benefits for multiple actors.

Shared vision and objectives

Ecosystems rarely have any hierarchical authority but mechanisms steering the cooperation are needed so that results can be achieved. These ecosystems are designed entities relying on two principles: a common objective and a jointly agreed operating logic. It should however be remembered that in an ecosystem, the interests of individual actors and common objectives are parallel factors, rendering the activities a constantly changing process. The activities here consist of motivation (why), the collaboration model (who and what) and operating practices (how). Ecosystems are usually based on a multi-layer management model (Figure 7. Multi-layer structure of an ecosystem).

The intensity of the actors' involvement and their roles vary during the different stages of the ecosystem's development. Using the development path as a basis, we can describe the actors' roles during these stages, ensure that they are committed to the collaboration and support the development of the ecosystem and its objectives.

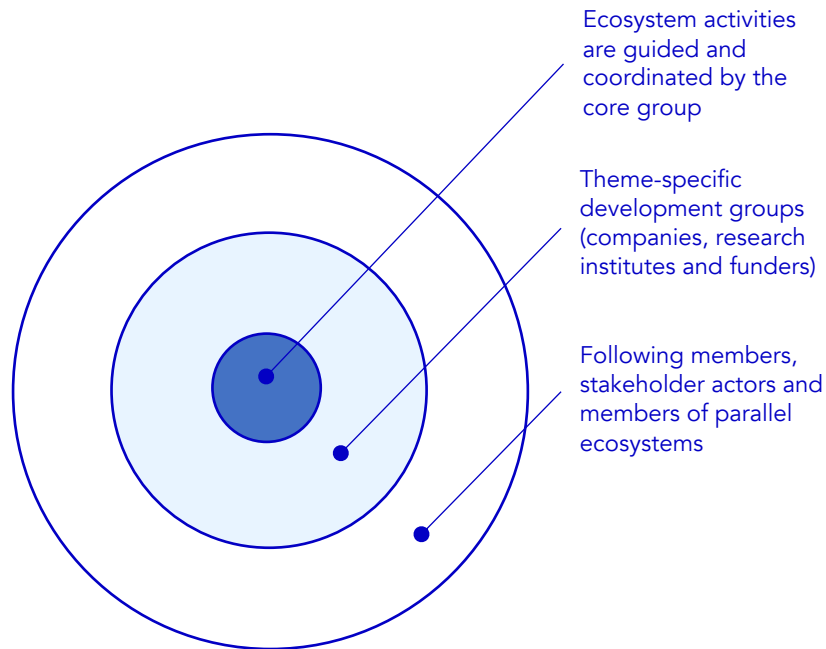


Figure 7. Multi-layered structure of an ecosystem

Identifying the common objective also helps to see the impacts of the ecosystem more clearly as well as the benefits to the actors and the broader societal role played by the ecosystem itself. Setting indicators describing the benefits and value of an ecosystem helps to concretise the impact objectives and the development path. It is essential that the timespan during which the ecosystem work is expected to produce results and the measurable benefits generated for the various actors are made visible. The indicators used to evaluate the ecosystem impacts are discussed in more detail in chapter 6.

Any ecosystem benefits from having actors involved who play a variety of roles and from attracting companies of different sizes and in different stages of development. The core group often includes one or more globally competitive and networked companies acting as leaders. The actors of the core group also possess substantial research and development expertise and resources. One of the core group actors often constructs the finalised solution or is the owner of the problem shared by all ecosystem members. It is clear that the visions of the core group actors and the joint vision of the ecosystem must be sufficiently similar such that the development process can be successfully launched and can produce desirable solutions. Companies joining the development team may be smaller in size or have less resources than the core group companies. Even though the actors have their own research agendas, a significant proportion of their research and development work may be carried out in cooperation with their ecosystem partners. Ecosystem interest groups, such as followers, subcontractors and stakeholders, differ from the abovementioned actors in that, as a rule, they provide ready-made solutions for other ecosystem actors or indirectly contribute to the attainment of the common ecosystem objectives. They do not necessarily have a development agenda of their own in the ecosystem but it does nevertheless provide them with good opportunities for networking and customer references.

Orchestrator and the role of rules¹⁶

An ecosystem is not a closed network as it must constantly renew itself. In order to keep on the jointly chosen path, the ecosystem's actors need orchestration to support the self-organisation process. In practice, orchestration means the enabling of meetings, formation of shared views, follow-up of activities and promotion of diversity. In networking between ecosystems, the orchestrator may represent the network in other networks and in partnership and funding applications.

Who should be responsible for ecosystem orchestration and how can the orchestrator support value creation in the ecosystem?

The orchestrator must possess strategic expertise to construct a target-oriented ecosystem and to commit a broad range of different actors to the cooperation carried out under the auspices of the ecosystem. The orchestrator must create a credible 'big picture' and bring together the best actors to enable co-creation.

It is clear that the orchestrator's role depends, in part, on the objectives set for the ecosystem:

- the emphasis should be on extensive content expertise and strong international research networks if the aim is to build an innovation ecosystem creating new expertise
- an extensive network comprising a variety of stakeholder actors is essential if the purpose is to create markets by impacting regulation and standardisation
- qualified coordination expertise is critical if the ecosystem has reached the piloting stage or the stage where commercial solutions are being developed.

Good orchestration facilitates the launching of development work. At first, the orchestrator often helps actors with different agendas used to different types of cooperation to find the right operating practices, rules and common objectives. Even though an ecosystem is not built like a company or a close-knit network, something more than just self-organisation is required when an ecosystem is launched or when it is renewing itself. A good orchestrator has both a vision and a comprehensive understanding of the 'big picture'. Orchestration is also hard work and resources must be allocated to it.

¹⁶ Apilo, Tiina & Paasi, Jaakko (2019) VTT sisäinen työpäpöri (internal VTT working paper)

The main purpose of the shared ecosystem rules is to highlight the collaboration models supporting the openness of the ecosystem and to ensure that the participants act in accordance with the models. There are two types of openness. The first concerns the manner in which one can join the ecosystem: is it open to all those sharing the same goals or only to invitees and what are the invitation criteria used. Openness in terms of the information available to ecosystem actors constitute the second openness dimension. The rules around openness should be defined such that they support the objectives of the ecosystem; sometimes a more restrictive operating model gives better and quicker results.

Case example.

Ecosystem orchestration and shared rules enhancing collaboration.

The SmartRail ecosystem is chaired by Skoda-Transtech and is partly financed by Business Finland. The goal of this ecosystem containing a multidisciplinary group of companies, research organisations and urban actors is to become the most attractive producer of functions and services integrated into rail transport on the market, thus promoting an overall more sustainable and service-oriented transport system. The technological focus is on creating the best tram in the world and to produce solutions that increase the safety and flexibility of rail transport as we move towards autonomous transport solutions. The SmartRail approach is to aim for international markets and a world-class business.

The key tools required to achieve these common goals are the systematically managed co-creation process and the implementation of a world-class development environment for rail transport connected mobility services. SmartRail is an open, growing shared ecosystem that works according to a mutually agreed set of rules. The rules cover for instance: ecosystem steering and operation practices, ecosystem actors' roles in joint activities, IPR-rules and confidentiality aspects.

Forms of participation and actor roles

In an ecosystem, all actors must be familiar both with each other's roles and the interactive relationships between them. Smooth interaction between the parties ensures that the ecosystem is more than simply the sum of its parts. A fuller understanding of the various interests and roles enables participants to foresee other actors' decisions and thus also the structuration of the ecosystem's non-linear development path. For a company, joining an ecosystem is always a strategic choice, based on their understanding of the logic and benefits of the ecosystem. The ability of the actor to guide its own, other actors' and even its competitors' activities within the ecosystem determines their ability to create and collect value in the ecosystem.

The paradox of an ecosystem arises from the fact that the actors build and maintain a value-creating network without a hierarchical administrative structure while at the same time furthering their own aims. Unlike in value chains or networks, action in an ecosystem is strongly based on a situation where individual actors understand the rules of the ecosystem, their chances of benefiting from the value created by others and their own ability to create value for others.¹⁷

Case example. Diversity of actors

About 100 actors have joined the Smart Otaniemi ecosystem. They represent a broad range of different expertise areas and sectors. The following parties were represented in the core group steering the launching of the initial stages of Smart Otaniemi: VTT, with a focus on research (energy systems, electric transport, real estate, data platforms and connectivity), building and coordination of ecosystems and, with Aalto University as research partner; City of Espoo (regional focus and the carbon neutrality agenda) and Business Finland in the funder role.

The map of actors describes the broad range of different participants, different parties and roles. In practice, most of the companies are linked to the ecosystem through research entities built in stages around the ecosystem pilots.

¹⁷ Based on Arho Suominen (2020). Ketjujen optimoinnin sijaan verkostovaikutusten ymmärtämistä (Understanding the impacts of networks instead of optimising chains).

Case example.
Diversity of actors

The actors are divided into the following four main groups on the basis of their involvement level (cf. Figure 8. Multi-layered structure of an ecosystem):

Partners, who jointly formulate the vision of the ecosystem and make substantial investments in the development and growth of the ecosystem.

Active members, who take part in co-creation, projects and development and contribute to the ecosystem with resources and expertise.

Passive members, who attend events, monitor the activities and seek opportunities but do not actively take part in the development work carried out in the ecosystem.

Potential members, who do not yet take part in the activities of the ecosystem but work with similar topics.

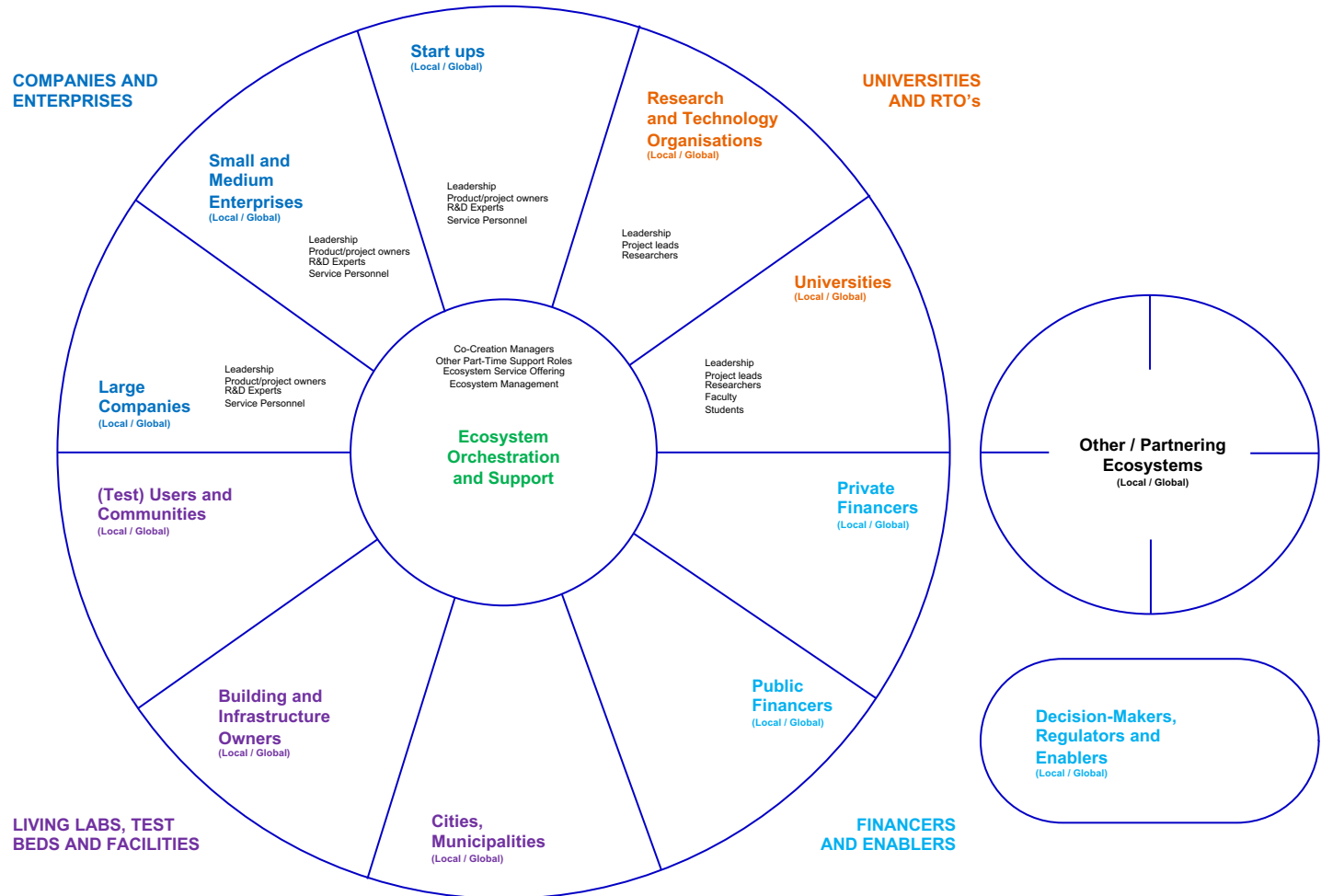


Figure 8. Actor roles in the ecosystem¹⁸

¹⁸ Nousiainen & Vienamo (2019). Smart Otaniemi sidosryhmäanalyysi (VTT sisäinen raportti) (Analysis of Smart Otaniemi stakeholders - internal VTT report)

Ecosystems must have sufficiently concrete objectives such that companies and public sector actors can commit themselves to the partnership on a long-term basis. Activities supporting and implementing the strategies of the companies involved and long-term funding and structures provide a basis for the functioning of ecosystems. In a global operating environment, it is essential to ensure that the development work carried out in an ecosystem is sufficiently international. This guarantees access to the best research expertise in areas that are strategically important to the companies involved and ensures that the parties conducting the research have a good understanding of the companies' business prospects. Launching the cooperation and sharing expertise between the actors is easier if there are clear and transparent rules (such as on agreements, IPR, licence policy and joining and leaving the partnership). Table 4 lists some of the obstacles to joining an ecosystem.

Knowledge and information management practices

Agreement on knowledge and resource sharing depend, in part, on the differing objectives set for ecosystems and the cooperation relationships between the actors. The research knowledge generated in a knowledge ecosystem is often shared openly in academic publications even if the research data itself is protected.

Companies have identified the following factors as obstacles to ecosystem activities:

- Competition between ecosystem actors
- Use of resources (money, people and time)
- The ecosystem is developing too slowly
- Participation in ecosystem activities limits opportunities for other partnerships
- The ecosystem is steered in a decentralised or vague manner
- The ecosystem narrows the focus/scope of business activity
- Actors have differing expectation (they come with different backgrounds and from different industries)

Table 4. Obstacles to joining an ecosystem¹⁹

The results of a knowledge ecosystem may be transferred to companies as intangible capital during the cooperation process or in the form of new employees possessing expertise or patented technologies. In an innovation ecosystem, the joint problem-solving process may require more open sharing of knowledge. In a business ecosystem, it may be possible to build the joint offerings using part-solutions that are already protected through intellectual property rights.

¹⁹ Miriam Knockaert, Matthias Deschryvere & Laura Lecluyse et al. (2019). Science and Public Policy, doi: 10.1093/scipol/scz002

Even though openness and co-creation are integral to the ecosystem-based development process, it must be ensured that the participating companies are able to use the results in their own business operations. For this reason, the parties should conclude a written agreement on the rights of ownership and use of the knowledge created in the ecosystem in different situations. Trust is built on this jointly determined transparency level - from the perspective of the sharing and protection of results and resources.

The ecosystem development path cannot be determined in advance but the parties must agree, in advance, on the forms and principles governing the sharing of knowledge and information. Each participant must understand the fundamental principles: what are they agreeing to, why and with whom. The openness of co-creation and the sharing of knowledge between the actors can be evaluated from the perspective of background knowledge, the co-innovation process and the outcomes (Figure 9).

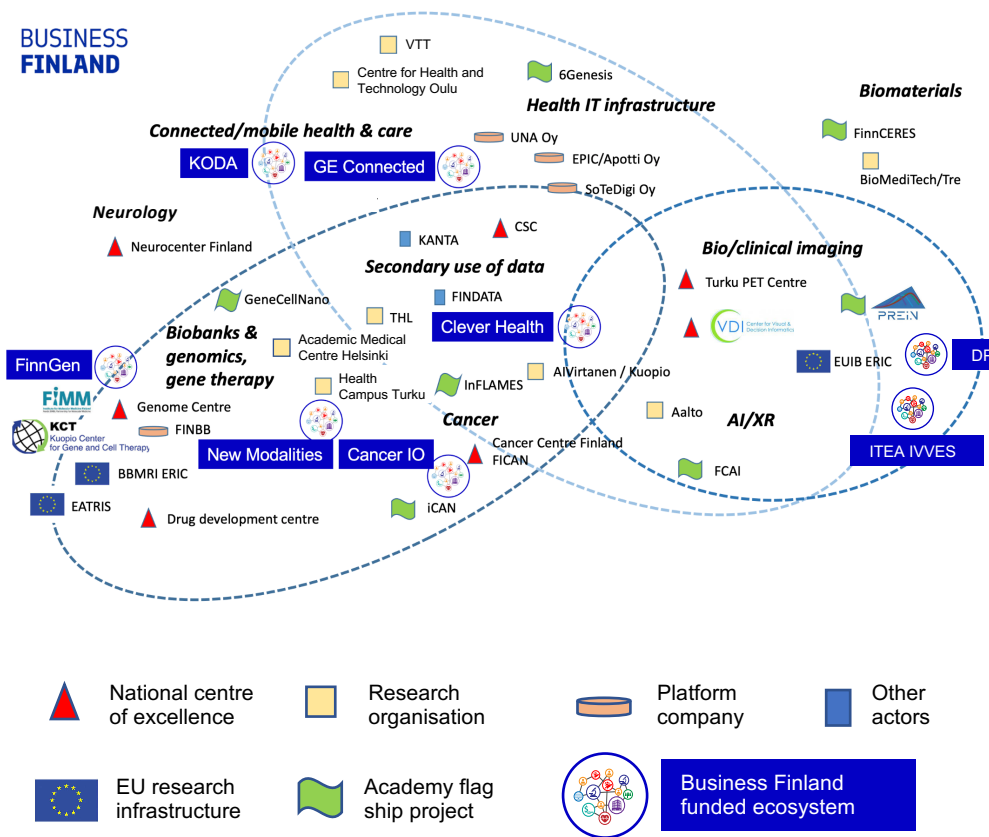
	Closed	Readable	Usable	Modifiable	Public, open
Degree of openness	Limited to transfer of protected information	Open co-creation in closed partnerships	Open co-creation in closed networks		Publicly accessible co-creation
Background material for co-creation	Agreement-based transfer of baseline information between actors only	Sharing background information during co-creation	Free access to background information during co-creation	Can be freely edited by network partners	Public (editable and accessible)
Co-creation process	Closed process	Closed process	Agreement-based co-creation; provision for monitoring development work carried out by other parties	Results of co-creation are shared; parties take part in each other's development work	Open access (controlled if necessary)
Results of co-creation	Exclusive rights held by actors	Exclusive rights held by actors	Ownership and access rights are subject to agreement between the parties	Joint ownership and/or shared access rights	Publicly accessible

²⁰ Based on Paasi et al. 2012. Background information means all expertise and knowledge that can be protected formally or informally. It may refer to data, patents, program codes, secret research information etc. Likewise, the results of co-creation can include public research information, intangible expertise or technology protected with patents. Paasi, J. Valkokari, K. Rantala, T., Nystén-Haarala, S. Lee, N. & Huhtilainen, L. 2012. Bazaar of Opportunities for New Business Development: Bridging Networked Innovation, Intellectual Property and Business: 20 (Series on Technology Management) Imperial College Press.

The following example of health and wellbeing ecosystems describes the different dimensions of knowledge sharing and protection and ecosystems' decisions in respect of different models of knowledge sharing.

Case example.
Health and wellbeing ecosystems²¹

The health and wellbeing sector (especially pertaining to health data) has been identified as a unique national competitiveness factor in Finland. A large number of interconnected ecosystems and networks (some of which compete with each other) have been established to exploit this potential. An evaluation report prepared by Business Finland has identified this area as a sector with huge growth potential, in which a large number of ecosystems combine into mega-class macro ecosystems. The existing map of health and wellbeing ecosystems is already diverse and extensive. In the figure, potential macro-level ecosystems are shown as dotted-line circles with these macro-level ecosystems comprising a large number of centres of expertise, a variety of different actors and ecosystems.²²



²¹ Source. Kalle A. Piirainen (ed.), Vesa Salminen, Juha Kettinen (4FRONT), Stijn Zegel (Technopolis Group), Alasdair Read (EFIS Centre) 2020. Maailmanluokan ekosysteemit Business Finlandin asiakkaana (World-class ecosystems as Business Finland customers) Case descriptions compiled by the University of Vaasa (Helena Rusanen) (CleverHealthFinland network and Watson Health Center) and the ecosystem survey jointly produced by Business Finland and VTT.
²² Description of an ecosystem-based operating environment in the health and wellbeing sector and its key roles, based on the outline of health and wellbeing ecosystem activities produced for Business Finland by Minna Hendolin (11/2020). An ecosystem-based entity is in a state of constant change, which means that new actors and networks are continuously established. For this reason, all parties are not necessarily shown in the figure.

Case Example.
Health and wellbeing ecosystems

Major initiatives require coordinated action by ecosystems and in many cases, joint ecosystem offerings are still developed or markets generated in separate project networks under the auspices of ecosystems each of which have their own rules governing such matters as the sharing of data. It is clear that the use of the unique data collected in the health sector (especially in healthcare) requires extremely clear and transparent rules.

From the perspective of openness and the ecosystem collaboration model, each ecosystem is unique. CleverHealth Finland coordinated by the Hospital District of Helsinki and Uusimaa (HUS) is an example of an ecosystem based on a networked multi-layered model. The steering by Business Finland and the lessons learned by HUS in the first artificial intelligence projects had a substantial impact on the launching of the ecosystem. The projects were considered to have displayed significant potential but it was clear also that the required solutions could not be developed by individual companies operating on their own. In the networks of the CleverHealth Finland ecosystem, co-creation typically occurs on a semi-open basis: the joint knowledge capital may be available to all participants or it can be freely modified by them (Figure 9). Watson Health Center is an extensive partnership network operating under the auspices of IBM. Its operating model is a combination of an open and closed approach.

IBM provides an open space for meetings and for creating effectiveness through events, with the focus being on start-up cooperation. With the help of global (IBM's closed) technology, Finnish companies can be provided with new opportunities, while at the same time, solutions, products, services and innovations can be developed for them. The tendency of large private-sector healthcare actors to acquire the start-ups or conclude exclusive contracts has been identified as a challenge. It will again lead to a closed operating model instead of co-creation. FinnGen, a research-driven ecosystem in which the University of Helsinki coordinates biobank data, is an example of pre-commercial research activities in which the road to commercialisation is long. However, the biomedicine companies, acting as partners in the ecosystem, are developing products and new scalable innovations. This ecosystem is building strong sector-specific expertise in Finland which will have uses in both research organisations and ecosystem operating models. Good examples of this include the FinBB cooperative established by biobanks <https://finbb.fi/fi/> and the Fingenious service <https://finbb.fi/>. The ability of both large companies and public sector actors to collaborate with small innovative enterprises is key to the continuous renewal of the ecosystems and to the creation of new innovations.

5. Development stages and the life cycle of ecosystems

All ecosystems are unique – they consist of actors and the interactive relationships between these actors that develop in parallel but in different ways. Even though the development process and the ecosystem life cycle are guided by common objectives, the process itself is iterative. In the optimum situation, ecosystem-based collaboration generates a large number of interconnected ecosystems and networks. Even though the (eco)systemic process is perpetual, ecosystems are in a state of constant change; ecosystems are set up, restructured and dismantled.

Ecosystems bring together different types of actor that can combine things, ideas, skills and knowledge in order to create something new. It is vital to find partners that can contribute to the development of an ecosystem and to enable cooperation. The ability and readiness to find new partners and use different combinations of resources are important for building ecosystems.

Building and developing ecosystems involves a variety of change drivers; regional strengths and reform visions. Strong industrial leader companies can serve here as the galvanising forces pulling ecosystems together. Legislative changes and public sector support measures may also open up new opportunities for growth. Timing is an important factor in the development of ecosystems: technologies are key in the testing stage while, subsequently, demand and commercial actors must be attracted to the same playing field simultaneously.

Case example.

Mechanisms of ecosystem building - material-circulation ecosystems as an example²³

The shift towards resource-efficiency and circular economy thinking often requires that actors change their business models and for this reason, building ecosystems based on the new circular economy principles is a key factor in this transition. Thus far, material circulations have been at the core of the circular economy and only about three percent of turnover in this sector is derived from product-as-a-service concepts or sharing platform business. Three ecosystem building mechanisms were identified in the structuring of business ecosystems for the material circular economy:

- 1) **ecosystems built around strong industrial leader companies;**
- 2) **ecosystems relying on the circular economy vision; and**
- 3) **ecosystems building on regional strengths.**

Each of these mechanisms has its strengths and weaknesses. Cities and local development agencies often play a key role in ecosystems building on regional strengths. Ecosystems associated with strong industrial driver companies are closely integrated into the international business environment and operations. Ecosystems based on the circular economy vision enable major transitions even though the process of transforming the visions into practical development work may be slow at first. Ecosystems relying on a strong national vision and a development agenda may encounter fragmented decision-making in ministries and continued commitment to the vision a challenge. Ensuring sufficient renewal may present a challenge to ecosystems driven by strong industrial leader companies. Well-established companies in particular may be reluctant to give up their competitive advantages and business operating models.

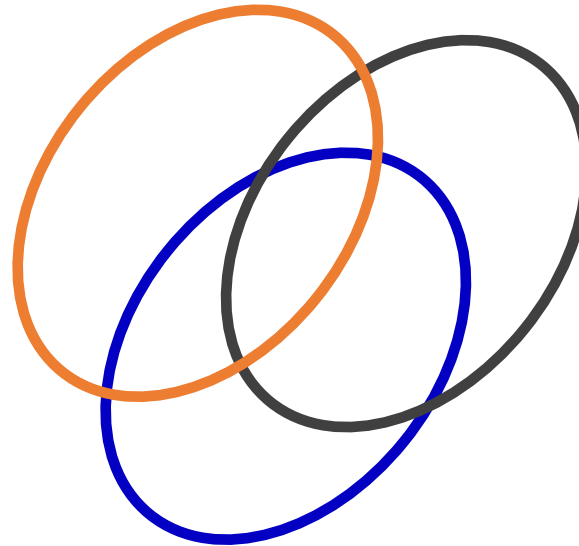
²³ Orko, Inka; Ritschkoff, Anne-Christine; Lantto, Raija (2020) Ecosystems in the circular economy. Publications of the Ministry of Economic Affairs and Employment 2020:13 <http://urn.fi/URN:ISBN:978-952-327-500-3>

Case example.

Mechanisms of ecosystem building - material-circulation ecosystems as an example²³

Ecosystems based on regional strengths

These ecosystems are based on strong regional networks. They are motivated by regional growth targets and access to local side streams and resources. Transforming a regional business into a national and international level provides the challenge.



Ecosystems of strong industrial leaders

These ecosystems are built on the core business of the industrial leader. In circular economy functions, the focus is on the use of side streams and resource-efficiency. Leader companies are strong global players with extensive networks purchasing services from local service providers and cooperating with SMEs and start-ups in areas outside their core business. Renewing traditional business operations and cooperating with SMEs on an equal basis are the challenges faced by these ecosystems.

Ecosystems based on the circular economy vision

Early-stage ecosystems are built on non-hierarchical project activities. Constructing an ecosystem-oriented solution based on the circular economy approach to meet the sustainability challenge provides the motivation. Securing early-stage business funding, ecosystem facilitation, joint operational planning and preparing traditional markets for circular economy thinking are the key challenges during the implementation process.

Development stages of ecosystems

Even though the starting points of ecosystems can be different, they each proceed along similar iterative development paths. A single ecosystem does not necessarily go through all stages as the changes in objectives and actors may also require restructuring of the ecosystem or give rise to more than one ecosystem entity.

In practice, ecosystems evolve by trial and repetition - the choices made by the actors impact each other and the manner in which the ecosystem develops. The following main stages can be identified in the development of an ecosystem:

- 1) **identifying the need and forming a vision (exploration);**
- 2) **clarification of the ecosystem actors and their roles (experiment);**
- 3) **operation of the ecosystem (expansion); and**
- 4) **re-evaluation (established and renewal).**

Renewal and reorganisation are present in all stages of the ecosystem life cycle and not all ecosystems reach the 'established' stage as the development can branch into more than one value network.

Case example. Stages of an ecosystem²⁴

All ecosystems go through the following development stages:

- 1) **exploration stage**, in which future partners are seeking cooperation opportunities, start developing ways to engage in cooperation and launch the joint development process;
- 2) **experiment stage**, in which the collaboration starts to mature and becomes more formal and the testing of co-created solutions is launched;
- 3) **expansion stage**, in which the collaboration is already well-established and some of the ecosystem companies assume leadership and start scaling the business operating model and the solution for world markets; and
- 4) **the established and renewal stage**, in which the new value network emerges as a group of actors aim to stabilise the new markets to its advantage or the ecosystem activities and actors undergo strategic renewal.

The table on the following page describes the main actors in these stages as well as typical funding sources and the business operating potential.

²⁴ Kalle A. Piirainen (ed.), Vesa Salminen, Juha Kettinen (4FRONT), Stijn Zegel (Technopolis Group), Alasdair Read (EFIS Centre) 2020. Maaillanluokan ekosysteemit Business Finlandin asiakkaina (World-class ecosystems as Business Finland customers)

Case example.
Stages of an ecosystem²⁴

	1. Exploration	2. Experiment	3. Expansion	4. Established and renewal
Main actors	Universities, RTOs and intermediators	Start-ups, spin-offs, SMEs (solvers) and broad companies (challenge owners)	Human Growth Foundations (HGFs), scale-ups, corporations, growth-oriented companies	Incumbent corporations, Multinational Enterprise (MNEs) and global platforms
Typical funding sources	RDI funding	RDI, seed, (local) Venture Capitalist (VC)	Growth funding, high-risk investments, acquisitions and cash funding	Net cash flow, Foreign Direct Investment (FDI), Mergers & Acquisitions (M&A) / Buyout
Time to (global) market / (technology readiness levels (TRL))	Very long / not known (TRL 1-4)	5+ years (TRL 5-7 [-8])	2-3 years (TRL [8-] 9)	Present < 2 years Shaping new markets and customer needs
Competition	Very few / no business initiatives	Various competing initiatives Some emerging leading companies	Network's focal companies have a significant role in scale-up	Ecosystem is established and competes with other ecosystems
Strategic focus of innovations	Problem-solution-fit, scoping of emerging markets	Product/solution-market-fit, market creation	Business-model-fit, scale-up and market growth	Market renewal, creation of new solutions Establishing leadership and, maintaining market position

²⁴ Kalle A. Piirainen (ed.), Vesa Salminen, Juha Kettinen (4FRONT), Stijn Zegel (Technopolis Group), Alasdair Read (EFIS Centre) 2020. Maailemanluokan ekosysteemit Business Finlandin asiakkaina (World-class ecosystems as Business Finland customers)

Tasks of ecosystem orchestrator at different stages

The orchestrator can make use of a broad range of co-creation tools and processes during the various stages of ecosystem development. Orchestration is critical during the exploration and launch stages and also in the ecosystem establishment stage. Ecosystem orchestration is prioritised differently at each stage of the process.

Case example

Tasks of ecosystem orchestrator at different stages²⁵

Stage 1: Build attractiveness

- Bring together thought-provoking visionaries and content experts
- Seek shared values and concrete actions
- Be bold, but do not ignore the impacts of value destruction (destruction of business benefits)

Stage 2: Create shared value

- Clarify the vision and communicate it in understandable ways
- Strengthen self-organising and avoid controlling the value co-creation process
- Demonstrate the potential for co-creation and value creation and emphasise the benefits arising from ecosystems to different actors

Stage 3: Analyse impacts

- Conduct a critical analysis of the acquired results and raise the ambition level
- Give priority to co-creation and share the results and benefits of cooperation with others
- Commit to the vision and structures, but be open to new people and ideas

Stage 4: Support diversity

- Strengthen the common vision through active communication
- Look for disruptive business models and for novel ways of value creation and collaboration
- Support the emergence of diversity and agility by matching people and ideas

²⁵ Ketonen-Oksi, Sanna & Valkokari, K (2019). <https://www.talentvectia.com/en/insight/blogs/how-to-build-a-viable-innovation-ecosystem/>

Ecosystem life cycle

Internationally competitive ecosystems match the national (or regional/local) competitive advantage with international demand. Ecosystems cannot be built artificially without close links to the global business environment. The evolution of ecosystems is often based on development trends arising from history and national or local operating environments, the result of which being that a specific geographical region has gained a strong competitive advantage. It may derive from natural resources and natural conditions, existing industries or world-class expertise and research.²⁶

Ecosystems have long life cycles, often measured in years or decades. An ecosystem is not a single project but a networked entity engaged in a continuous process of renewal. We can make a distinction between multi-layer and parallel ecosystems. Long-term regional development work is a key factor enabling ecosystems: The energy cluster in Vaasa is an example of systematic regional development work. At the same time, the OneSea ecosystem was built through significant national RDI inputs and boosted by strategic choices, such as legislative changes providing a basis for testing.

Case example

Long-term regional development work as a factor enabling ecosystems.

The Vaasa-based EnergyVaasa ecosystem has largely arisen from the needs and expectations of the owners of the Merinova Technology Center. The success of the energy technology companies has also strengthened local economies in the cities and the other municipalities involved. Local enterprises and research institutes have joined forces and are also building strategic long-term compatibility in order to maintain the identified strengths. The capacity of the ecosystem to renew itself is also considerable while the operating practices and services are continuously developed (for example, Energyspin and Wärtsilä's Smart Technology Hub). Supported by strategic compatibility, the role of research as a factor boosting and sustaining local innovation capabilities is rapidly expanding but it is hampered by its small resource base while other research institutes must contribute to the work by providing research resources. This serves as the basis for the better linking of regional, national and international research agendas.

²⁶ Ministry of Economic Affairs and Employment (2017) <https://tem.fi/documents/1410877/4429776/Ekosysteemit+uuden+elinkeino-tja+innovaatiopolitiikan+kohteena/f46d3709-fdcf-4a73-83df-e84ae24b4196>

Ecosystem actors often belong to several different ecosystems. Local, regional or national ecosystems cannot exist on their own as they have to find their place in global ecosystems and value networks. It requires specialisation around one's own strengths and continuous anticipation of market needs. A small country like Finland can only possess a limited amount of world-class expertise, thus, efficient use of these limited resources is critical. A dialogue between all levels and actors is required such that the priorities can be set and market needs identified.²⁷

Regional, national and international perspectives

Ecosystems are often tied to a specific location or region even if they compete in global markets. Although the boundaries of ecosystems are not determined by national, city or company boundaries, geographical vicinity nevertheless remains an important factor in the creation of interaction between actors and in the building of cooperation. Ecosystems are often scalable and they may have local (Otanieniemi or Äänekoski), regional (Uusimaa), national (Finland's ICT cluster) or international (gaming industry and platform economy) dimensions. Many ecosystems are both concurrently local players and members of larger ecosystems.

Roles of public sector actors, the partnership model and funding instruments

Ecosystem thinking has already had a major impact on new innovation policy models such as the RDI partnership model (currently under development in Finland) and various funding instruments. New expertise is not only needed in grassroots networks but also across the entire innovation system. In the optimum situation, public funding may support the setting of common objectives and boost the process of renewal. New impact indicators provide a concrete example of the new steering mechanisms supporting co-creation. They are needed to make visible the value obtained by ecosystem actors and broad-based societal impacts. A practical example of systemic governance is the Finnish Growth Programme for Transport, whose measures are designed to serve the development and commercialisation of ecosystems such as the lead company-driven SmartRail²⁸ and the research collaboration platform TransDigi²⁹. A snapshot and metrics were also produced to measure the impact of the programme, providing a basis for systematically measuring and managing change.³⁰

²⁷ Policy Brief, 15/2016 <https://tietokayttoon.fi/documents/1927382/2116852/Mit%C3%A4+innovaatioekosysteemit+ovat+ja+miten+niit%C3%A4+voi+kehitt%C3%A4%C3%A4/feecb2aa-d56e-441d-aa2e-15f5bd18d59b?version=1.0>

²⁸ SmartRail is an innovation ecosystem lead by Skoda-Transtech and partially funded by Business Finland. It aims to build a business ecosystem. <https://smartrailecosystem.com/>

²⁹ In the development of the transport industry, the measures to promote research and education have been the launch of the TransDigi collaboration and innovation platform <https://transdigi.fi/>

³⁰ Transport sector indicators and situational picture. Proposals for growth programme assessment and for monitoring the sector's development. (Liikennealan mittaristo ja tilannekuva: Ehdotukset kasvuohjelman arviointiin ja toimialan kehityksen seurantaan). Metsäranta, Heikki; Rannikko, Heikki; Toivanen, Mia; Rausmaa, Salla; Wennberg, Mikko (2020) <https://iulkaisut.valtioneuvosto.fi/handle/10024/162316>

The most important actors working to develop the system supporting an ecosystem are as follows:

Cities and local development companies

- Local ecosystems play a key role when policy-level visions are put into practice, the required change in thinking is enhanced and challenges are transformed into opportunities for sustainable growth.
- Ambitious objectives and directions are determined for large urban communities so that politicians, public sector actors, companies, research and training centres, citizens, non-governmental organisations and other actors can be encouraged to work together.
- Being natural meeting points, cities play an important role as locations attracting actors and bringing them together and as locations serving as neutral development platforms that bring together a large number of actors in a common problem-solving process.
- Public sector innovative procurement is one way to identify and determine the challenges that must be solved and to build new solutions.

National ministries and programmes

- Implementing national policy decisions often requires the construction of ecosystem development agendas, commitment to testing environments and national test beds, support for learning co-creation and the structuring of the rules of result ownership and funding.

- National and EU-level programmes should link the development environments and the infrastructures of universities and other higher education institutions, companies and cities into a platform for cooperation between ecosystems. Publicly funded programmes and funding are critical to knowledge ecosystems and the research infrastructure. Resources should be primarily focused on research infrastructures and development environments that are internationally important and based on national strengths.
- In the evaluation of the ecosystem impacts, the added value created by ecosystems to different actors should be highlighted and the evaluation should also be used in the targeting and orchestrating of the ecosystems. When impact indicators are set, both the added value to companies and other actors generated by the activities and system-level impacts should be examined.
- Ecosystems can contribute to societal renewal and systemic changes (such as the health and social services reform and transport). Typically, both the factors promoting change and those preventing it are intertwined and uncertain. Change factors affecting society and specific industries must be understood when the opportunities and challenges of ecosystems are structured.

At EU level

- At the European level, cooperation across interfaces provides the process with the required diversity and, in the optimum situation, ecosystem-oriented development may create new markets at both the global level and in the EU. Constructing EU-level synergies between national ecosystem activities is vital.
- Practices and RDI investments supporting ecosystems should be more innovation-centred and business-oriented so that companies of all types and sizes can participate.
- Examining system-level impacts in the EU supports the joint targeting of successful ecosystems, research and technology infrastructures and collaboration. It also helps to strengthen the challenge-based approach to work and the associated decision-making in ecosystems.
- A joint European agenda and European-wide objectives can be made more transparent by means of impact indicators. In the optimum situation, they help to clarify the objectives of the collaboration and concretise the benefits gained by the actors. Important European-level priorities should be set for long-term visionary missions and activities that bring together actors to tackle major challenges.

Case example.

Establishing a test area for an autonomous maritime ecosystem involves many factors³¹

Long-term national inputs in the development of the maritime cluster have been a key factor behind the construction of the One Sea ecosystem. Finnish Maritime Industries, a branch association of the Technology Industries of Finland, has played a key role as a builder of networks between actors and in the establishment of the research agenda. The development agenda has been promoted in the DIMECC's SHOK-programmes preceding the One Sea ecosystem (such as Innovations and Networks (2009-2014), UXUS (2010-2015) and REBUS (2014-2018)).

A clear focus on business operations distinguishes the One Sea ecosystem from previous programmes in which the emphasis was on research and innovation. A vision of the future of the autonomous maritime traffic established and disseminated at the creation of the ecosystem was an important factor in making the ecosystem more attractive. The creation of the test area represents the summation of many interconnected and mutually dependent factors and we should not forget the visionary individuals who have worked tirelessly to take this development work forward.

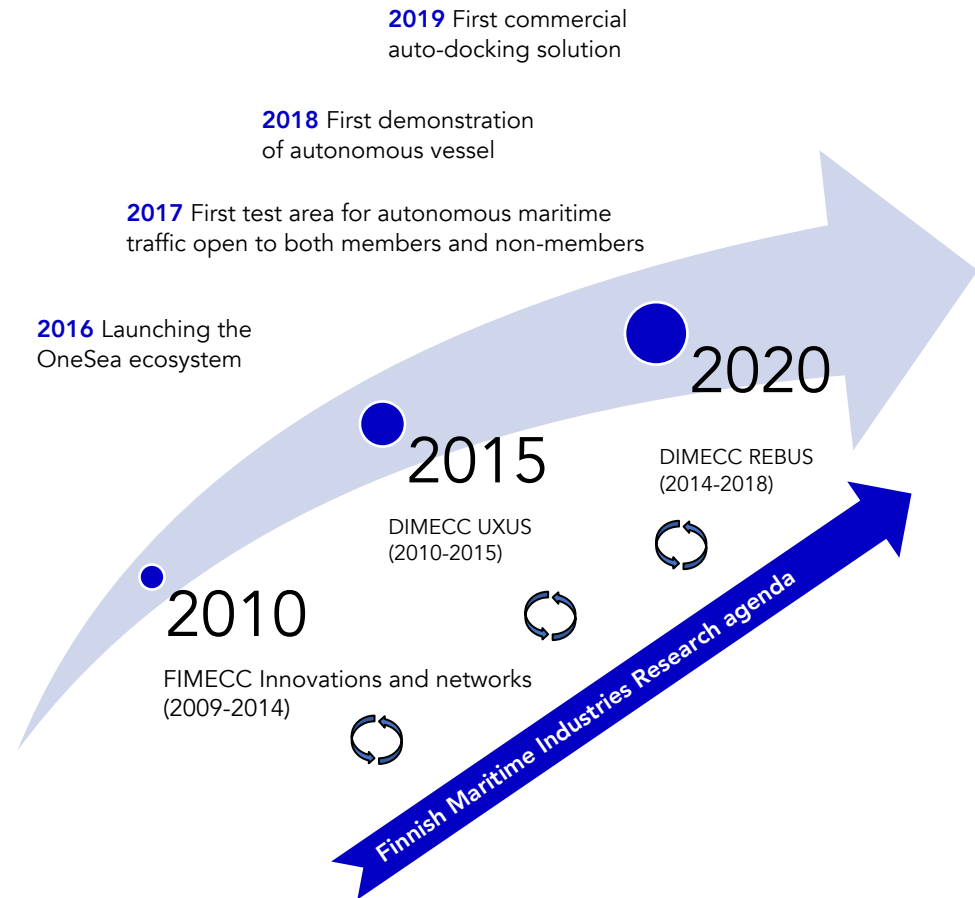
³¹ Presentation by Sauli Eloranta. Website of the DIMECC OneSea ecosystem. <https://www.oneseaecosystem.net/> and YouTube (Rolls Royce plans to deploy fully autonomous cargo ships by 2020, published in 2016, <https://www.youtube.com/watch?v=yRwQ95vXV/mM>)

Case example.

Establishing a test area for an autonomous maritime ecosystem involves many factors³¹

The One Sea - ecosystem, launched in 2016, involves the key maritime companies and operators, providers of digital solutions and parties representing the authorities. The ecosystem has 13 members and DIMECC is responsible for facilitating its activities. In addition to the technological and business development work enabling the autonomous maritime traffic set out in its vision, the One Sea - ecosystem has also invested heavily in the dismantling of legislative restrictions hampering the development work.

The establishment of a joint test area (Jaakonmeri) is one key result of these efforts. In accordance with the open innovation operating model, Jaakonmeri is also available to actors outside the ecosystem on the condition that they accept the rules governing its use and conclude a user agreement. The programmes of the One Sea ecosystem (Design for Value 2017-2019, and the Sea for Value launched in 2020) are also open to non-members.



How should RDI funding instruments be developed and renewed so that they can support ecosystem activities and new partnership models?³²

A better combination of funding instruments so that large project entities can be accelerated (cooperation between the Academy of Finland and Business Finland and a better use of regional funding) would provide a key starting point for the development work. Funding instruments should be pinpointed and modelled as part of the different stages of ecosystem life cycles and the suitability of different instruments for supporting knowledge, innovation and business ecosystems should be highlighted.

The criteria for international research cooperation help to ensure that the research expertise that is globally best-suited for the purpose is available to the companies in strategically important areas. It is also important to ensure that research parties have a good understanding of the companies' business prospects. For example, in the construction of knowledge ecosystems, the views of internationally networked companies could be used more extensively in the renewal of the research network and in the coordination of different aspects of research. The exchange of personnel between companies and research institutes and research training programmes renewing business operations would, in addition, support the formation of common interpretations and the joint construction of the research agenda.

Transparent and predictable terms and conditions for public funding and clear rules (such as agreements, IPR, licence policy and joining/leaving partnerships) would boost the construction of ecosystems. At the same time, they would also enhance the capacity of companies to present major business challenges and improve the manner in which the results can be used. For example, channelling funding towards the joint use of research infrastructures is an issue in which ambiguity remains in the rules governing the use of funding instruments and this may slow the utilisation of test beds. Long-term research collaboration also requires a commitment by public actors (especially political decision-makers) to themes across parliamentary terms. The needs and hopes of companies can be summed up as follows: low participation threshold, lightweight bureaucracy and flexibility for different consortium models.

³² Based on the material of the RDI partnership model working groups arranged in May and June 2020

6. Accelerating and evaluating the impacts of ecosystems

New approaches and indicators are required to assess the benefits and impacts of ecosystems. They must take better account of the added value created by ecosystems for companies and research organisations and more broadly, the added value boosting the renewal of the economy and society more generally. Concrete measurable indicators are required to make visible the business and societal impacts generated by ecosystems. Linking impact evaluation to the target setting of ecosystems helps to clarify the objectives of cooperation and concretise the benefits generated for different actor groups.

In order to ensure the existence of an up-to-date and relevant knowledge base for decision-making, indicators showing ecosystem impacts must be set to capture the systemic nature of the reforms and the direction of change generated by ecosystems. Systemic changes mean changes at the system level intended to tackle major societal challenges. For example, technological solutions are not enough to produce a carbon-neutral urban environment. A multi-sectoral approach and cooperation between researchers, companies, citizens and user communities is essential to promote systemic change. Furthermore, developing the solutions into societal reforms and introducing and disseminating the reforms requires extensive knowledge of the decision-making environment and business alternatives. In other words, solutions promoting systemic change arise from a combination of different technological and service-based novelties, in the collaboration of a variety of actors and as a result of complex, long-term processes.

Making visible broad-based and systemic changes and impacts requires the development of new types of indicators and the acceptance of imperfect information. In addition to traditional metrics including technological and business benefits obtained by companies, there is also a need for supplementary information drawing our attention to the quality of the solutions as well as to services and social value. In addition to quantitative data however qualitative information is also required. Besides backward-looking information there is a real need for information that supports the development of the activities and helps us to look forward. In the worst-case situation, narrowly-based indicators may lead to inaccurate or even erroneous conclusions.

There are two main reasons why information on ecosystem impacts is required. The primary requirement here is to produce understanding to support efficient ecosystem management and steering. Secondly, the information produced in this process allows decision-makers to see the actual and targeted benefits and to check whether the funding channelled to ecosystems produces the expected impacts. Irrespective of the need for information, it is important to understand the successes and the direction of the change produced by impact evaluation and indicators and incorporate them into ecosystem steering and management and the decision-making processes surrounding them.

When new indicators and approaches are developed, the focus should be on the following perspectives³³:

1) We need indicators that genuinely describe the activities and the extensive benefits arising from the ecosystems.

Information on benefits and impacts is currently produced on the basis of technological-economic indicator data. Traditional indicators examine successes from an extremely narrow perspective and do not describe sustainable societal growth or the comprehensive impacts of the innovations boosting wellbeing and growth. We can take here the increasingly important role of the service sector in society as an illustrative example. Digitalisation highlights the role of services as part of smart energy solutions and their scale-up at system level. In services, the impact challenge pertains to indicators that have been set to capture the value of innovations solely from the technological-economic perspective. However, these indicators are unable to describe societal change and growth in a comprehensive manner and do not make visible the immaterial or social value of the solutions. As a result, the role of the solutions concerning overall systemic reform and the benefits gained by customers and citizens remains invisible.

³³ See Katri Vataja & Kirsi Hyytinen, Vaikuttavuusarviointia monimutkaisessa maailmassa (Effectiveness evaluation for challenges of a complex world). Existing effectiveness and productivity indicators are not the right instruments to produce the best solutions for the wicked problems of our time. Kanava, 7/2019.

2) In addition to indicator-based data, we need information on changes and change trends generated via a variety of methods.

It is often hoped that when the right indicators are found, phenomena can be tamed and brought under control. Talk of indicators however rather simplify a complex problem and fails to take into account the generation of impacts as a result of complex and long-term processes. Producing a comprehensive understanding of system level impacts requires quantitative and qualitative information produced via a range of different methods. We also need to adopt new methods such that the multiple impacts of ecosystems can better be demonstrated.

3) Looking forward and focusing on the speed and direction of change.

Monitoring of the benefits and impacts has been typically backward-looking and focused on the extent to which the objectives set for the activities have been achieved. Rather than aiming for results and quick gains, we should determine whether we are going in the right direction and at the right speed. It is also important to understand how effectiveness can be jointly generated by a large number of actors, on what basis the desired changes can be achieved and the desired time span of the changes sought.

4) Making the impact data a systematic part of the decision-making process.

Impact information should be proactive and continuously support development, management and decision-making. The aim is to achieve systemic changes in an environment in which even the goalposts may move during the process, not to mention the actors themselves on the playing field. When the context changes, the objectives and the activities should also be updated. This would enhance the actors' ability to develop solutions that create real value for citizens' wellbeing.

Impact indicators and sources of evaluation data

Expectations and pressures on impact indicators are generated from many different directions. A great deal is also expected of the indicators themselves: they should be simple, comprehensive and quantitatively verifiable. Indicators should also provide a basis for comparisons between the benefits arising from different types of organisation or instrument. As ecosystems are usually different in character, they cannot be steered or their successes cannot be made visible using one-size-fits-all indicators. The indicators must be adjusted to the activities and objectives of different ecosystems. Benefits and impacts must also be examined from the perspective of different ecosystem actors and actor groups.³⁴

³⁴ When ecosystem indicators are set, it should be remembered that development funding instruments may require instrument-specific monitoring information and indicators.

Figure 10 shows an example of an ecosystem impact model in which the added value created by the ecosystem is examined from the perspective of society at large, companies, expertise and the strength of the ecosystems themselves. In addition to providing direct benefits to companies, ecosystems can also contribute to the establishment of new companies and market growth as well as generating wider societal benefits. Furthermore, in order to concretise content-related development targets, the model identifies three impact dimensions:

- 1) ecosystems develop expertise relevant to business operations;
- 2) ecosystems produce solutions to societal challenges; and
- 3) ecosystems strengthen the international nature of research and innovation activities.

Concrete indicators for measuring benefits and value have been identified at the junctures of these perspectives.

	1. Ecosystems develop knowledge for companies and speed up the processing of research results for the benefit of companies and societal actors	2. Ecosystems offer solutions to societal challenges, contribute to systemic changes and create prerequisites for business	3. Ecosystems enhance the international dimension of research and innovation activities and facilitate access to global value networks and ecosystems
Society	<ul style="list-style-type: none"> - Top-class research results provide solutions to challenges facing companies and society at large 	<ul style="list-style-type: none"> - Renewal of markets and industries - Growth in employment 	<ul style="list-style-type: none"> - Attracting new global actors and investments to Finland - New global market initiatives and export growth
Companies	<ul style="list-style-type: none"> - Creating new knowledge in the industrial interface - Boosting competences/RDI capabilities in companies 	<ul style="list-style-type: none"> - Helping companies to expand their international business - Breakthrough innovations - New companies and spin-offs 	<ul style="list-style-type: none"> - Creating new value networks and market initiatives
Knowledge	<ul style="list-style-type: none"> - High-level research portfolio - Opening, sharing and developing research infrastructure - IPR 	<ul style="list-style-type: none"> - Linking research with solutions to societal challenges - Ambitious research and competence roadmap - Integration into research infrastructure and platforms (test beds and living labs) 	<ul style="list-style-type: none"> - Linking ecosystems with global innovation and business ecosystems
Ekosystem strenght: funding base, network of actors, co-creation culture	<ul style="list-style-type: none"> - Broad-based partnership - Commitment and engagement of actors - Culture of co-creation 	<ul style="list-style-type: none"> - RDI investments by private and public sector - Growth in international RDI inputs 	

Figure 10. Examples of ecosystem indicators at different level

The strength of an ecosystem is highlighted as an indicatory factor in creating the prerequisites for impacts. The aim is to emphasise the fact that an ecosystem creates value when the main actors are strong and doing well. There are situations in which an ecosystem can only remain strong if actors or operating models change - or disappear. The strength of an ecosystem can be measured in relation to productivity, resilience and diversity.

Productivity means the ability of an ecosystem to create new products and services from raw materials and technologies at minimum cost. Resilience describes the capacity of an ecosystem to successfully manage transitions (such as the introduction of new technologies). The ability of an ecosystem to self-organise is a key enabler of productivity and resilience. Ecosystems do not have hierarchical management systems. The question of which parties are selected as actors influences the manner in which ecosystems develop and many of the decisions are only partially based on a joint plan. For this reason, ecosystem actors must also tolerate vague objectives and constantly changing operating environments.

Diversity means the ability of the ecosystem to renew itself and to create new start-ups that can later emerge as replacements for the existing ecosystem platforms and technologies. An ecosystem is more diverse than a value network and it brings together many of the networks' members. The ability to structure systemic entities and develop business solutions across sectoral boundaries is seen as a Finnish strength. This expertise should be extensively used.

Tests and piloting of future solutions will best succeed in a networked and transparent operating environment.

Case example.
Ecosystems have multi-dimensional effects

The objective of the Research Alliance for Autonomous Systems (RAAS) knowledge ecosystem is to provide companies and other actors with access to world-class scientific knowledge and expertise in the field of autonomous transport and logistics solutions. The added value and impact of this ecosystem is mainly examined on the basis of three categories: 1) creation of new scientific knowledge and expertise; 2) impact on business operations and society at large; and 3) making Finland more attractive as a development and invest-in location. Each of the categories is divided into three or four impact objectives and one related impact indicator has been set to make them more concrete. At the same time, an annual target has been specified to support the monitoring process. Encouraging international companies to carry out more development work in Finland is one example of the objectives listed in the last category. The number of international companies taking part in test bed activities is a concrete success indicator in this field.

Existing statistics are not well-suited to producing impact data on ecosystems. Traditional statistics provide information on individual sectors whereas in ecosystems, cooperation takes place at sectoral interfaces. Even if data on the main ecosystem sector was available, it would not provide a sufficiently extensive or broad-based picture of the benefits and successes of an ecosystem comprising actors from a wide range of fields. Relying on this information, or on the data provided by individual companies and on indicator data, generates an excessively narrow picture of the success of the ecosystem as a whole.³⁵

Information should be collected from a variety of sources such that the resulting picture is as comprehensive as possible. Indicator data available from national sources and provided by the companies themselves can be supplemented with information based on surveys and qualitative data.

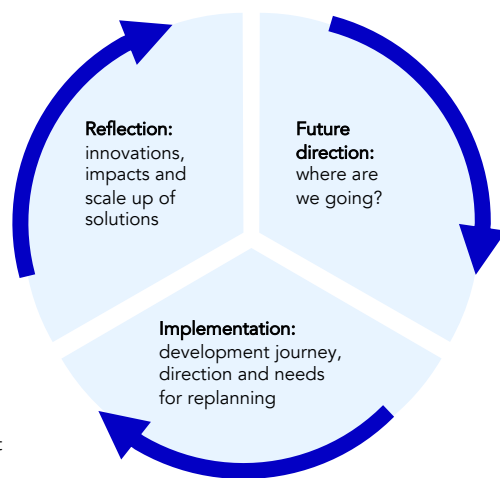


Figure 11. Impact information at different stages of ecosystem management

Impact evaluation as a management and steering tool

A recently published evaluation report³⁶ recommends that in order to gain a better understanding of the benefits and impacts of ecosystems, information and feedback on these matters should be collected on a regular, systematic and centralised basis. For example, funders could collect information each year and as part of the information-gathering process, provide feedback and present proposals in support of the development work on the basis of the information gathered. To support an ecosystem in its own development work and in the focusing of its activities, information would probably be required on a more frequent basis: depending on the ecosystem development stage, the direction and speed of the development should be examined on the basis of the available information on a quarterly or bi-annual basis.

A wide variety of information is needed at different stages of the activities such that the work can be correctly focused. As all ecosystems are different and no universal rules on management and steering can be prepared, we will divide the information supporting steering and management into three different stages: 1) identifying the vision and setting the objective; 2) implementation; and 3) reflection and learning.

³⁵ Kalle A. Piirainen (ed.), Vesa Salminen, Juha Kettinen (4FRONT), Stijn Zegel (Technopolis Group), Alasdair Read (EFIS Centre) 2020. Maa- ja eläinlääkintöalan ekosysteemit Business Finlandin asiakkaana (World-class ecosystems as Business Finland customers)

³⁶ Kalle A. Piirainen (ed.), Vesa Salminen, Juha Kettinen (4FRONT), Stijn Zegel (Technopolis Group), Alasdair Read (EFIS Centre) 2020. Maa- ja eläinlääkintöalan ekosysteemit Business Finlandin asiakkaana (World-class ecosystems as Business Finland customers)

Evaluation of the benefits and impacts of the ecosystem should continue through all stages of the ecosystem development process. Identification of the expected benefits and impacts during the early planning stage will facilitate target-setting and the identification of development paths and stages. When carried out as part of the implementation (during day-to-day activities), the evaluation helps to focus the work and determine the change requirements. In the reflection stage, the evaluation takes into consideration the impacts generated in the ecosystem, produces the platform and identifies the measures required for scalable innovations and solutions.³⁷

Case example.

An international example of measuring and managing effectiveness³⁸

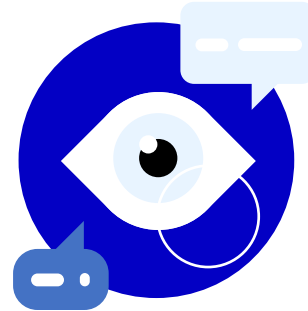
In its capacity as the biggest funder of Make, the Flemish Government of Belgium conducts performance discussions with the organisation each year and has KPIs for monitoring the activities. The indicators cover such matters as publications, participation in EU programmes, business funding and leverage funding. In its monitoring work, Make focuses on the manner in which companies use research results. Make also has KPIs for universities. Depending on the results, Make pays 5% of the funding it has received from the Flemish Government to universities as a gratuity payment. In its self-evaluation, Make shifted its focus from the concept 'good project result' to that of 'project result that can be used'. The aim here being to obtain results that can be used.

³⁷ Hyttinen, K, Saari, E. & Elg, M. (2019). Human-Centered Co-Evaluation Method as a Means for Sustainable Service Innovations, in Human-Centered Digitalization and Services (eds) Toivonen, M and Saari, E. 2019. Springer. <https://www.springer.com/in/book/9789811377242> <https://doi.org/10.1007/978-981-13-7725-9>

³⁸ Gaia- Consulting (2020) Taustaselvitys kansainvälisistä verrokeista

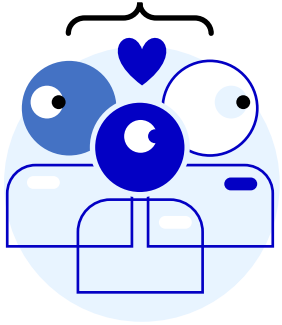
7. Ecosystem success factors

What makes an ecosystem successful? Ecosystems are diverse and continuously developing entities and defining their success is as challenging as defining the ecosystems themselves. This guide sums up five core questions with ecosystems as potential success stories able to provide clear answers to all of them.



1. Clear vision and value proposition: *What is the purpose of an ecosystem?*

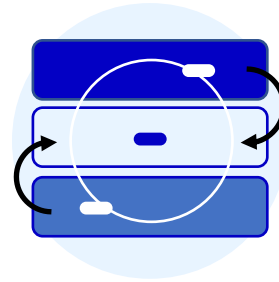
Ecosystem actors are able to create a common vision for long-term impacts. The vision and the joint roadmap serve as tools for guiding the ecosystem and for co-creation. The best way to influence the self-organisation of an ecosystem is to actively disseminate information about its successes and impacts. It is difficult to implement a vision that will only generate business benefits after many years. An innovation ecosystem is not a matter of preserving the existing business ecosystem but of renewing it. A sufficiently ambitious vision can put pressure on the development process and show what kind of a world the ecosystem actors are building. The ecosystem must generate benefits and added value for all actors even if the type of benefit and the timespan of the benefit-generation process varies.



2. Complementary actors and roles:

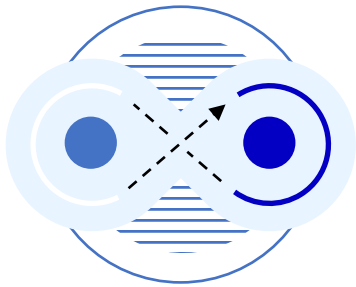
How are ecosystems built and who are their members?

Ecosystem actors are committed to collaboration and assuming at least one role in the ecosystem. In order to understand the functioning of ecosystems and to anticipate their development, we must identify the main actors and stakeholders (as well as the relationships and dynamics between them). The actors may be members of more than one local and/or global ecosystem at the same time. Promoting a variety of actor roles ensures the strength of the ecosystem. In this way, new ecosystem features emerge through interaction and dependencies between the actors. Inviting competitors to join the ecosystem is a typical bottleneck that can be overcome when there is understanding of the complementary roles of the actors and the constraints on their activities.



3. Systematic and open collaboration model (projects and activities, platforms and resources): *How does an ecosystem work?*

Ecosystem actors are able to use multi-sectoral resources and existing research infrastructures or development environments or even create new platforms as a joint effort. There are a variety of different paths available to ecosystem actors wishing to participate in the joint projects and activities carried out under the auspices of the ecosystem. An ecosystem often needs other networks and actors as support. Openness and trust between the actors and in the development work, creates the basis for renewal and broad-based impacts.



4. Continuity - value sharing, commitment and communications: *How does an ecosystem develop?*

An ecosystem develops in an interactive process involving the actors and the environment. Ecosystem actors possess complementary models for value sharing and related contractual practices. An ecosystem possesses uniform collaboration models creating value for all parties. Ecosystem actors complement each other, forming links and dependencies in value networks. An ecosystem builds trust and a willingness to compromise.



5. Impact - value co-creation: *How can ecosystems concretise the impacts and benefits accruing to ecosystem actors?*

In addition to the vision, collaboration is also guided by indicators making the objectives concrete. The indicators can show the benefits gained by the actors. The understanding of successes and the direction of change generated by impact indicators and evaluation facilitate the steering of ecosystems and joint decision-making. This ensures that the ecosystem can develop in the right direction and that corrective action can be taken in a changing business environment.

Key terms and glossary

Based on the publication 'Ekosysteemit ja verkostojen parviäly' (Ecosystems and the swarm intelligence of networks):

<https://www.vttresearch.com/sites/default/files/pdf/technology/2014/T152.pdf>

Alliance = a consortium between companies. The typical aim of an alliance (which is often horizontal and involves two companies) is to acquire and combine resources or expertise and to engage in cooperation in a specific sector

Value system = an entity comprising value chains across corporate interfaces, extending from the production of raw materials to distribution and use

Value chain = a chain comprising the actors and functions creating value for a company. A value chain is a multi-stage entity starting from raw material production and extending to the assembly and distribution of the end product.

Originally, the term 'value chain' referred to the company-internal system of value-creation.

Value network = a structure built on the cooperation and interactive relationships forged between interconnected actors, combining core functions and resources. It creates value for end customers and has its focus on a target-oriented approach, multi-faceted interaction and the need for orchestrated activities (see 'Orchestration')

Ecosystem = (in biology) a functional community of interacting organisms and their environment occurring in an area with uniform natural conditions. As an operating model, ecosystem means a group of interdependent actors combining different types of skill and engaged in interaction in order to achieve common objectives.

Self-organisation = (at a general level) a system characteristic in which the re-organisation of the components produces new characteristics or phenomena; (in sociology) collective action lacking formal or hierarchical coordination or organisation

Cluster = geographical network or group comprising a large number of companies operating in the same sector. In a cluster, the actors both compete with each other and engage in cooperation in order to enhance their competitiveness

Orchestrator = an actor or group activating the network, strengthening the exchange of information, expanding collaboration and developing the activities

Further reading and main sources

<https://teknologiateollisuus.fi/sites/default/files/2020-01/Internationally%20significant%20innovation%20and%20growth%20ecosystems%20in%20Finland.pdf>

<http://4front.fi/userassets/uploads/4F-Ekosysteemiblogisarja-2020-02-10.pdf>

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Handbooks

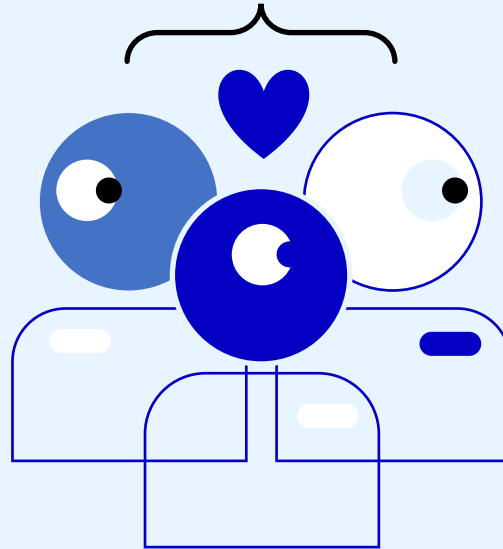
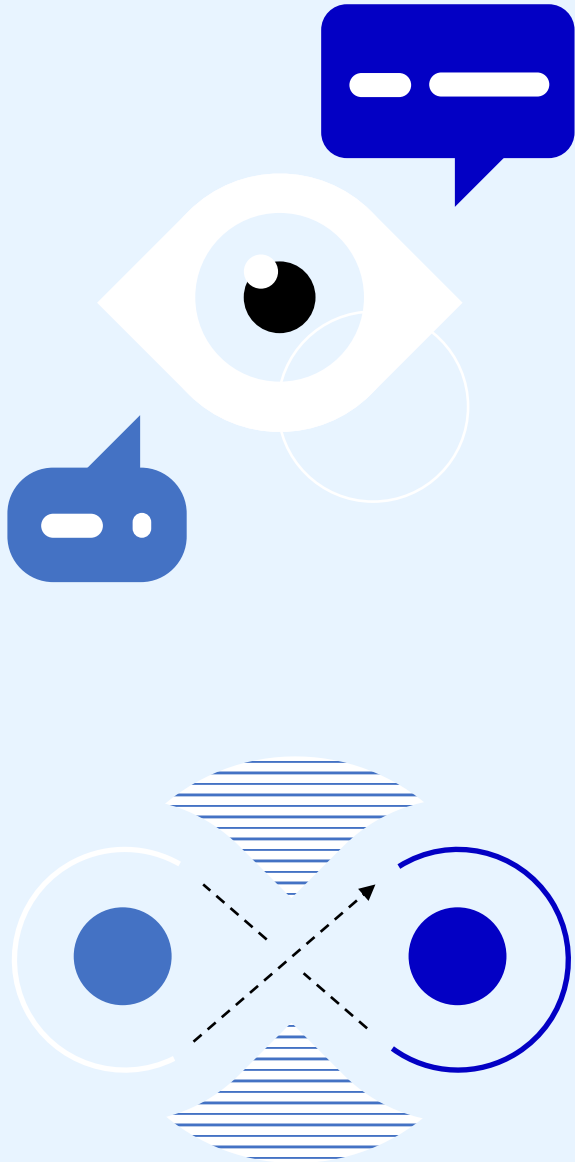
<https://www.theseus.fi/bitstream/handle/10024/344131/LauraPuusaari.pdf?sequence=2&isAllowed=y>

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