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Innovation for Agro-Food Clusters

A Guide on Innovation Management for Agro-Food Clusters in the Danube Region

Interreg
Danube Transnational Programme
Danube S3 Cluster

STEINBEIS 2i

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Executive Summary

With a great number of challenges including climate change and resource scarcity but also increasingly complex interdependencies in agro-food ecosystems in the European Union and worldwide, come great opportunities for organisations to create new, adapt or improve their existing products, processes and business models, and find new ways to collaborate with various other organisations along their value and supply chains.

The need for a more responsible economic, social and environmental behaviour to protect future generations and the soils that will feed them is imposing diverse challenges on producers, processors and consumers. Transparent supply chains, circular economy models, eco labels and digitalisation are good and important concepts, but require many efforts and resources, especially from the production and processing companies. Yet, these challenges can boost local food production and consumption, increased sustainability efforts and new technological advancements, which help strengthening agricultural regions and stakeholders. To stay ahead and contribute to the future ways of working, agro-food organisations need to focus their innovation efforts and pool resources for joint success.

Clusters often provide an environment that promotes innovation and joint knowledge creation because the physical proximity of the organisations allows for fast and easy sharing of information, tacit capabilities, specialised know-how and personnel, and other resources. The cluster itself needs to promote innovation and know-how to support cluster members in implementing their own projects. Innovation needs the right environment to thrive and organisations that want to innovate need the appropriate capabilities to manage innovation internally and in relation to their environment. Clusters and their member organisations should follow a structured approach for innovation and innovation performance measurement. This guide will present a selection of pertinent innovation management tools, including theoretical backgrounds, reference literature and useful examples (green boxes) that can support agro-food organisations in their innovation activities. The structure of the guide will follow A.T. Kearney's five innovation management dimensions and complement these with relevant principles of open innovation and knowledge sharing which can enhance innovation processes along the way.

1 Innovation in Agro-food Clusters: An Introduction

The agro-food sector, including agriculture and food processing, is an important economic driver for many European regions and has become one of the most prominent domains within the smart specialization strategies of EU regions. In many European countries, agriculture and food contribute to achieving shared prosperity, providing employment and development opportunities for the labour force.[1] At same time, the stronger growth in demand and constant productivity and market pressures, force organisations in the agro-food sector to enhance their competitiveness and innovation capacities. In that, even though agriculture is often seen as a traditional sector, it is now speeding up developments and innovations towards higher efficiency and value in production and distribution.

The agro-food sector, just like all other sectors, is facing new industrial, demographic, ecological and political challenges, which demand for change. Global commodity price trends shifted fundamentally since 2000: after having declined by an average of 0.7 percent per year over the 20th century, nominal food prices rose at an average of 6 percent annually between 2000 and 2013.[2] Although many factors influence these price fluctuations, we see that with today's global demand to satisfy growing populations, quantities of agro-food products and services needed in the market can exceed the capacity of farmers and agribusinesses to respond.

Agro-food Clusters

One possible solution to these pressures and new challenges is the creation of clusters as they bring together the innovation potential of various organisations within the agricultural value chain, supporting relationships between them, and with other facilitating organisations (such as research institutions and local governments). The Food and Agriculture Organization of the United Nations (FAO)

1 Ketels, C., Protsiv, S. 2017. Priority Sector Report: Agrofood, p. 1. European Cluster Observatory Report. Center for Strategy and Competitiveness Stockholm School of Economics. https://www.clustercollaboration.eu/sites/default/files/eu_initiatives/psr_agrofood_sp_20170707.pdf. Based on the Presentation about the Agri-Food Platform by Katerina Ciampi Stancova, DG JRC.

2 Richard Dobbs et al. 2013. Resource Revolution: Tracking global commodity markets, p. 25. McKinsey Global Institute. https://www.mckinsey.com/business-functions/sustainability/our-insights/resource-revolution-tracking-global-commodity-markets.

defines agro-based clusters as "concentration of producers, agro-industries, traders and other private and public actors engaged in the same industry and inter-connecting and building value networks, either formally or informally, when addressing common challenges and pursuing common opportunities". [3] Clusters often create an enabling environment for interorganisational cooperation and facilitate access to information and markets. These are good conditions to foster innovation among a cluster's organisations.

For the purpose of this guide, a distinction is made between "clusters" *as phenomena* that exist within regional economies and "cluster policies" which include policy interventions, practices and processes that are based on the concept of clusters. This guide will focus on "clusters" as *phenomena in economic regions* and depict how agro-food clusters can improve their innovation management knowledge and capabilities. From an economic or business perspective, clusters can further be defined as geographic concentrations or "groups of industries closely related by skill, technology, supply, demand, and/or other linkage" and driven by "input-output linkages, labour market pooling, and knowledge spill overs, which are associated with cost or productivity advantages".[4]

The Potential for Innovation in Agro-food Clusters

A broad view of innovation includes the technological, organisational or marketing changes that improve economic productivity, increase the value of products and services or improve other attributes, such as environmental sustainability.

An innovative cluster can be seen as a **community of organisations** (including businesses, associations, research and policy institutions) within which the "co-location of the various stakeholders accelerates knowledge sharing and development of new products and services."[5] Joint research and development (R&D) initiatives and the sharing of information, tacit capabilities, specialised know-how

3 Gálvez-Nogales, E. 2010. Agro-based clusters in developing countries: staying competitive in a globalized economy. Agricultural Management, Marketing and Finance Occasional Paper, 25. Food and Agriculture Organization of the United Nations (FAO), Rome.

4 Delgado, M., Porter, M. E., Stern, S. 2013. Defining Clusters of Related Industries, p. 2. Working Paper 20375 of the National Bureau of Economic Research. www.nber.org/papers/w20375.

5 Radjou, N. 2011. Cited in: Fostering innovation-led clusters: A review of leading global practices, p. 6. The Economist Intelligence Unit, London.

and personnel, and other resources between organisations simply become easier if they are located in the same region and therefore closer to each other.

The agricultural value chain includes "the entire flow of inputs and outputs that enables agricultural enterprises to realise the value of their unique capital base by meeting the needs of final consumers". The agro-food sector of Europe comprises various fields such as food processing and manufacturing (e.g. processing of fruit and vegetables, manufacture of confectionery and manufacture of beer, manufacture of feed for farm animals, operation of dairies and cheese making), livestock processing (e.g. production of meat and poultry products, processing and preserving of meat), agricultural inputs and services (e.g. post-harvest crop activities) and other important local activities and services (e.g. plant propagation, growing of cereals, manufacture of bread or mixed farming).[6] The winners of current and future developments will be those who proactively are **facilitating cross-sectoral and smart value chains, fostering internationalisation and international cooperation, and advancing digital production, environmental protection and circular economy.**[7] As a special community of organisations with great networks and knowledge-sharing practices, clusters can have a huge advantage in driving innovations in all of these areas. They can tap into their networks and joint activities, drawing on a much broader information and knowledge basis and combining capabilities, know-how and resources to achieve a greater impact.

Agro-food in the Danube Region

The Danube region stretches from the Black Forest (Germany) to the Black Sea (Romania-Ukraine-Moldova) and is home to 115 million inhabitants. Many countries in the Danube region have identified the most promising areas for innovation based on their respective local strengths. Comparing Smart Specialization Strategies (S3) priorities, most of the countries and regions have decided on **agro-food related priorities**, often relating this area to health, environment, bioeconomy, or sustainability. Within the frame of the Danube S3 Cluster project for example,

6 For a detailed composition of the agro-food industry in Europe in relation to industry employment see: Ketels, C. and Protsiv, S. 2017. Priority Sector Report: Agrofood, p. 3. European Cluster Observatory Report. Center for Strategy and Competitiveness Stock-holm School of Economics.

7 Raupelienė, A. 2019. Innovative and Cross-sectoral Clusters as Facilitators of Value-Added Chains in Agriculture – Smart Agro Clusters in Romania, p. 1. Proceedings of the 9th International Scientific Conference Rural Development.

Danube clusters have "set emphasis on promoting organic farming and bioeconomy and will aim at increasing links between food, farming and health on the one hand side and strengthening sustainable practices and circular economy on the other." [8] The project addresses the **unbalanced distribution of innovation performances** between the Western part of the region indicating a high level of development and the Eastern part lagging behind with 17 % of enterprises producing only 3 % of added value. Based on the need for improved innovation management knowledge and capabilities, this guide aggregates knowledge and tools to support to the innovation management in agro-food organisation and complements the innovation management trainings foreseen in this project. Reaching the aims of their S3 will require clusters and cluster organisations to innovate their products and services, and to innovate within their own organisations to stay relevant in the markets of this increasingly globalised and competitive world.

Within the region of the Danube S3 Cluster project, which involves clusters from most countries in the Danube region, namely Bosnia and Herzegovina, Bulgaria, Croatia, Germany, Hungary, Moldova, Romania, Serbia, Slovakia, Slovenia, Ukraine, a total of 37 clusters active in the agro-food sector are registered on the European Cluster Collaboration Platform (ECCP) as of January 2020.[9] Many of these clusters however, have rather informal structures and are organised in associations, cooperatives, groups or communities of producers (see nominal and active clusters).[10] In total, 69 active cluster have been identified in the Danube region, catering to the following main categories in the agro-food sector: bioeconomy; wood processing; digitalization in agriculture; food processing; advanced packaging; crop and animal production; biofuels and energy efficiency; food additives, functional food, biopharmaceuticals; organic food; sustainable lifestyle, local products, tourism, circular economy; agriculture machinery.

Within the Danube region, innovation governance shows a range from very weak to remarkably strong political support for research, development and innovation. Most regions have defined R&D as a political priority, setting up support schemes and functions, such as financial and counselling services or individual support

8 Danube S3 Cluster project. 2020. Transnational analysis of Danube regional context and cluster innovation potential, p. 17. Transnational Cluster Cooperation active on Agro-Food, based on Smart Specialization Approach in the Danube region.

9 Ibid, p. 21.

10 Ibid, p. 20.

mechanisms, implemented by public agencies and intermediaries. However, for many of the regions, challenges of the current innovation systems include insufficient public R&D funding (Baden-Württemberg, Bulgaria, Hungary, Romania, Serbia, Slovenia, Ukraine) and innovation infrastructures (Bosnia-Herzegovina, Croatia, Hungary, Ukraine), shortcomings in building long-term and regionally adapted R&D strategies (Bulgaria, Hungary, Slovenia, Slovakia, Ukraine), fluctuations in R&D government responsible personnel (Slovakia, Slovenia), legal environments unfavourable to business innovation (Bosnia-Herzegovina, Croatia, Moldova, Ukraine), and a misguided focus in public R&D support towards scientific rather than marketable results.[11]

This guide provides practical tools for innovation activities in agro-food clusters and their member organisations, and useful examples around digitalisation and technology in the field. Each chapter of this guide seeks to deliver a good understanding of the theoretical foundations of innovation management and applicable tools for designing and implementing structured and targeted innovation processes within the own organisation, while providing relevant examples for agro-food cluster. The content of this guide derives from the outcomes of the Report on Innovation Audits on Agro-Food Clusters performed within the Danube S3 Cluster project and is based on the same model of innovation management dimensions of Kearney (see Figure 5, chapter 3) used in the Innovation Audits. Following this introduction, chapter 2 lays the foundations for a common understanding of innovation by outlining terms used in innovation management and related disciplines. Throughout chapter 3, this guide presents tools to support the creation, implementation and continuous improvement of processes and activities within organisations looking to develop their innovation management capabilities to achieve the intended outcomes. Chapter 4 provides useful information on external innovation support for policy makers with interest in improved support programs targeting the innovation capabilities and competitiveness of organisations, before summarising the main themes of this guide in chapter 5. This guide will also serve as manual for the innovation management trainings organised within the Danube S3 Cluster project in 2020/2021.

11 Danube S3 Cluster project. 2020. Transnational analysis of Danube regional context and cluster innovation potential, p. 11. Transnational Cluster Cooperation active on Agro-Food, based on Smart Specialization Approach in the Danube region.

2 Definitions of Innovation and Frames of References

"Creativity is thinking up new things. Innovation is doing new things."
Theodore Levitt

The term "innovation" is broadly used in various contexts. This can lead to confusions with respect to the meaning and interpretation of the term within a respective context. Creating a shared understanding of the subject matter should be the first step in the process of change related to an organisation set out on a path to innovation. This chapter will introduce relevant definitions and distinctions of the term "innovation".

2.1 Definitions of Innovation

The International Organization for Standardization (ISO) defines innovation as the "search for and the discovery, experimentation, development, implementation and adoption of new products or services".[12] It is important to stress the fact that innovation cannot only be the coming up or development of a new or ground-breaking idea. There is a distinction between a "discovery" or "invention" and an innovation which includes some form of implementation of that idea, discovery or invention into **applicable and marketable products, services, processes, or systems for users**. An innovation needs to create new value for its users' existing problems and unmet needs, and it involves commercialisation processes.

An **innovation** includes some form of **implementation of that idea, discovery or invention** into applicable and marketable products, services, processes, or systems for users.

The Oslo Manual of the Organisation for European Co-operation and Development (OECD) specifies that an innovation must have "one or more characteristics that are significantly different from those contained in the products or business processes previously offered [or used by the organisation and] which must be rel-

12 International Organization for Standardization (ISO). 2014. ISO 37500:2014: Guidance on outsourcing, 3.6.

evant to the [organisation] or to external users".[13] Yet, innovation can also come from several minor changes made over a period of time that lead to a significant difference in the final product, service, process, or system.[14] In both cases, the implementation of the innovation is key:

> *"Implementation requires organisations to make systematic efforts to ensure that the innovation is accessible to potential users, either for the organisation's own processes and procedures, or to external users for its products."*[15]

The Oslo Manual further distinguishes between the term *"innovation"* referring to outcomes and the term "innovation activities" referring to *processes* performed to achieve these outcomes:[16]

- **Innovation:** a new or improved product or process (or combination thereof) that differs significantly from the [organisation's] previous products or processes and that has been introduced on the market or brought into use by the organisation
- **Innovation activities:** all developmental, financial and commercial activities undertaken by the organisation that are intended to result in an innovation

The following paragraphs picture a categorisation of types of innovation based on the Oslo Manual and a description of types of innovation by Keeley, Pikkel, Quinn and Walters, as well as a distinction between incremental and radical innovation based on Schumpeter's view.

Types of Innovation based on the Oslo Manual 2018

In this fast-paced world, it is crucial for any type of organisation to innovate to improve the organisation's performance and achieve a market advantage or con-

13 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 69. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.
14 Ibid, p. 69.
15 Ibid, p. 47.
16 Ibid, p. 68.

stantly ensure that its products and services still cater to the users' needs. The objectives of the innovation can include, for example, the creation of productivity-enhancing process innovations, where the organisation gains a cost advantage over its competitors, increasing mark-up at the prevailing market price or, combining lower price with higher mark-up to gain market share or increase profits. With a product innovation, the organisation can obtain a competitive advantage by introducing a new product, which allows it to increase demand and mark-ups.[17]

One of the first distinctions of innovation types was suggested by Schumpeter as follows[18]:

- Introduction of a new product or a qualitative change in an existing product
- Process innovation new to an industry
- Opening of a new market
- Development of new sources of supply for raw materials or other inputs
- Changes in industrial organisation

A very common categorisation of innovation types comprises **product, process, organisational and marketing innovations** as described in the Oslo Manual of 2018 and depicted in Figure 1 below:[19]

17 Organisation for European Co-operation and Development and Statistical Office of the European Communities. 2005. Oslo Manual 2005: Guidelines for Collecting and Interpreting Innovation Data, p. 29. 3rd Edition. Organisation for Economic Co-operation and Development, Paris.

18 Schumpeter, J. 1934. The Theory of Economic Development, p. 66. Harvard University Press, Cambridge, Massachusetts.

19 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, pp. 70–73. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

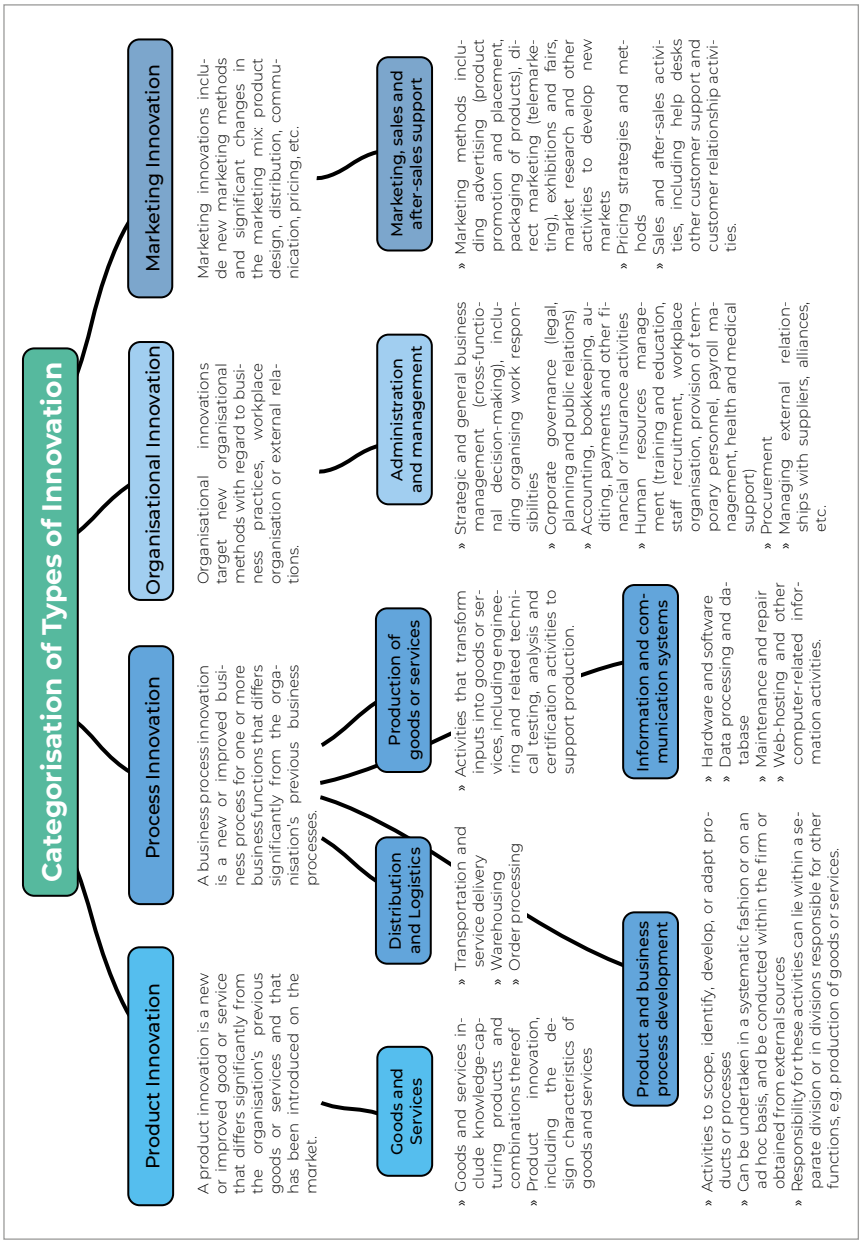

Figure 1: Categorisation of Types of Innovation (Source: Steinbeis 2i GmbH adapted from the Oslo Manual 2018)

Agro-food innovations are manifold, from new feeding systems and digitised precision farming to new types of packaging or conservation, new additives and flavours, or new consumer products and new types of logistics. Not all innovations in the agro-food sector are easily assigned to the traditional conceptual and empirical classifications of innovation.[20] An alternative to the four types of innovation is the paradigm of the Ten Types of Innovation described in the next chapter.

10 Types of Innovation by Keeley, Pikkel, Quinn and Walters

Moving beyond the four standard types of innovation, the Ten Types of Innovation[21] of Keeley, Pikkel, Quinn and Walters provide a different way to identify new opportunities for innovations describing a greater number of organisation processes and activities. In Figure 2 below, the types of innovation under the **configuration** category focus on the innermost workings of the organisation and its system: the profit or non-profit model, network, structure and the process. This includes strategic questions on how to make money and how to connect with others to create value, or how to align talent and assets.

The innovation types under **offering** focus on the organisation's core products or services: product performance and product system. They investigate how to develop distinguishing features and functionalities or complementary products and services. The innovation types under the **experience** category focus on the customer-facing elements of an organisation and its business system: service, channel, brand, customer engagement. This is related to how an organisation is delivering offerings to its customers and users or how it can support and amplify the value of its offerings. It is important to know where to innovate in order to constantly adapt the innovation strategy, processes and activities and check them against the organisation's goals.

20 Finco, A., Bentivoglio, D., Bucci, G. 2018. Lessons of Innovation in the Agrifood Sector: Drivers of Innovativeness Performances, p. 182. ECONOMIA AGRO-ALIMENTARE, FrancoAngeli Editore, vol. 20(2), pp. 181–192.

21 Keeley, L., Pikkel, R., Quinn, B., Walters, H. 2013. Ten Types of Innovation: The discipline of building breakthroughs, pp. 16–61. John Wiley & Sons Inc, New York, United States.

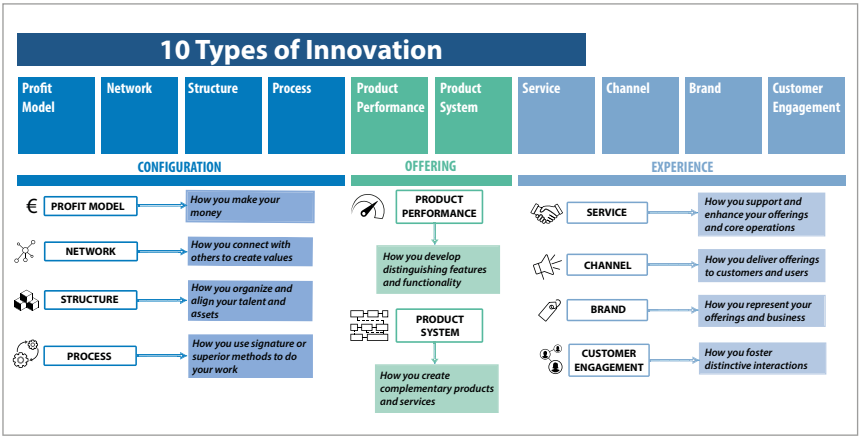

Figure 2: Overview of Ten Types of Innovation (Source: Steinbeis 2i GmbH adapted from Keeley, Pikkel, Quinn, Walters 2013)

One example of a **profit model innovation** in the agro-food sector involves a water management software platform which helps farmers use water in a more efficient and sustainable way. The organisation is experimenting with different revenue models, e.g. a fee-for-service model, charged per acre of land, a revenue-share model, where farmers can monetise the water that is conserved by transferring their lease to another farmer or municipality, and leasing water management equipment through a subsidiary. Another strategy related to **network innovation** is an open-source, easily accessible precision farming system developed by a start-up to empower everyone to grow food. This approach is allowing everyone to contribute and further **develop and scale the automated farming technology while attracting valuable resources and partners from the entire B2C customer segment.**

Incremental and Radical Innovation by Schumpeter

Another relevant differentiation within the sphere of innovation was established in the 1930s by Schumpeter[22] who framed the notions of "radical" and "incremental" innovation. The concept of radical or disruptive innovation focuses on the impact of innovations as opposed to their novelty. However, the first and most widely used approach is to determine the novelty of an organisation's innovations in compar-

22 Schumpeter, J. 1934. The Theory of Economic Development, p. 66. Harvard University Press, Cambridge, Massachusetts.

ison with the state of the art in the market or industry in which the organisation operates.[23]

Incremental innovations stimulate **continuous change processes** (often within the organisation). They seek to improve existing products, services, processes and systems, in terms of quality, costs or features, or performance. This can mean that a simple product may be improved in terms of advanced performance or lower cost through use of higher performance components or materials, or a complex product comprising several integrated technical subsystems may be improved by partial changes to one of the subsystems.

An example for an **incremental innovation** is the conversion of an irrigation sub-system from overhead sprinkler to drip irrigation where most components in the irrigation system (e.g. pump, valve, timer, etc.) and the architectural principles of the sub-system are not affected. Only the sprinklers are replaced by drippers that emit water at lower levels than the sprinklers.

Radical innovations which provoke **major disruptive changes**. They are discontinuous events with high economic impact and can trigger growth of new markets and completely replace existing solutions and 'ways of doing things'. They are focused on the development of revolutionary new technologies, markets or business models.

A **radical innovation** would be a conversion from furrow irrigation, where water moves through the system from high to low elevation under the influence of gravity, to mini-sprinkler irrigation with a pump that moves the water from high to low pressure. All old components (gate, furrow, siphon) are replaced by new ones (pump, valve, mini-sprinklers, pipes, filter, etc.). The core design concepts change and much of the knowledge of the furrow irrigation is not relevant to the operation of mini-sprinkler irrigation.

Innovation differs by sector. Some sectors, like the high-technology sectors, are characterised by rapid change and radical innovations; others like the low- and medium-technology industries, including rather traditional fields such as the agricultural sector, mainly see incremental innovations and adopt existing knowledge and technology. Within these sectors, innovation activities are often focused on production efficiency, product differentiation and marketing. However, the

23 Organisation for European Co-operation and Development, European Union. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 77. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/ Eurostat, Luxembourg.

food-processing industry is becoming more market-driven and technology-focussed, engaging for example in food microbiology or genetic modification and drawing on knowledge and technologies from the biotechnology, pharmaceuticals, smart materials or packaging fields.[24]

Another example is the innovation activity in services which also tends to be a continuous process of a series of incremental changes in products and processes. These innovations can be difficult to identify because they cannot be linked to single events and are often spread over time. Nonetheless, both types of innovation are important for the competitive edge of an organisation and they help to advance an organisation's economic, cultural and social processes.

2.2 Innovation Management

"An organization's ability to innovate is recognized as a key factor for sustained growth, economic viability, increased well-being, and the development of society."[25] But innovation needs structure and commitment. It needs the right leadership and all relevant resources – including the creative resources, i.e. the people of an organisation holding transferable expertise and know-how, and the time and financial resources needed for its implementation. The best way to capture the creative resources is to establish structures and processes inside the organisation that support innovation and innovation activities and, if possible, allow everyone in the organisation to develop innovative competencies.

Innovation management is the leadership, administration and controlling of innovation processes and activities across the previously defined definitions and types of innovation. It provides tools to create a common understanding of processes and goals and implement structures and processes to realise innovation. ISO defines innovation management as follows:

Innovation management is the leadership, administration and controlling of innovation processes and activities.

24 Von Tunzelmann, N. and Acha, V. 2005. Innovation in 'low tech' industries, pp. 426–427. Chapter 15 in Fagerberg. J., Mowery, D. and Nelson, R. R. The Oxford Handbook of Innovation. Oxford University Press, Oxford, UK. pp. 407–432.

25 International Organization for Standardization (ISO). 2019. ISO 56002:2019: Innovation management – Innovation management system – Guidance. https://www.iso.org/obp/ui#iso:std:iso:56002:ed-1:v1:en

"Innovation management can include establishing an innovation vision, innovation strategy, innovation policy and innovation objectives, and organizational structures and innovation processes to achieve those objectives through planning, support, operations, performance evaluation and improvement."[26] This description gives a glimpse at the vast expanse of the field of innovation management, which is why the upcoming chapters of this guide present practical advice for organisations in the agro-food or any other sector on how to set up and implement systematic innovation processes.

Before diving into the different dimensions of innovation management in chapter 3, the following paragraphs briefly present two important concepts which are eminently shaping current and future innovation efforts: open innovation and social innovation.

Open Innovation as Mindset and Strategy

"After years of telling corporate citizens to 'trust the system', many companies must relearn instead to trust their people – and encourage their people to use neglected creative capacities in order to tap the most potent economic stimulus of all: idea power."
Rosabeth Moss Kanter

Open innovation is a mindset that encourages organisations to also **use external knowledge and resources to innovate**, contrary to a secrecy or silo mentality which used to be common practice in traditional corporate research laboratories. The term was coined by Henry William in 2003 describing open innovation as „a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology".[27]

26 International Organization for Standardization (ISO). 2020. ISO 56000:2020: Innovation management – Fundamentals and vocabulary. https://www.iso.org/obp/ui#iso:std:iso:56000:ed-1:v1:en:term:3.1.2.1

27 Chesbrough, H. W. 2003. Open Innovation: The new imperative for creating and profiting from technology, p. 183. Boston, Harvard Business School Press.

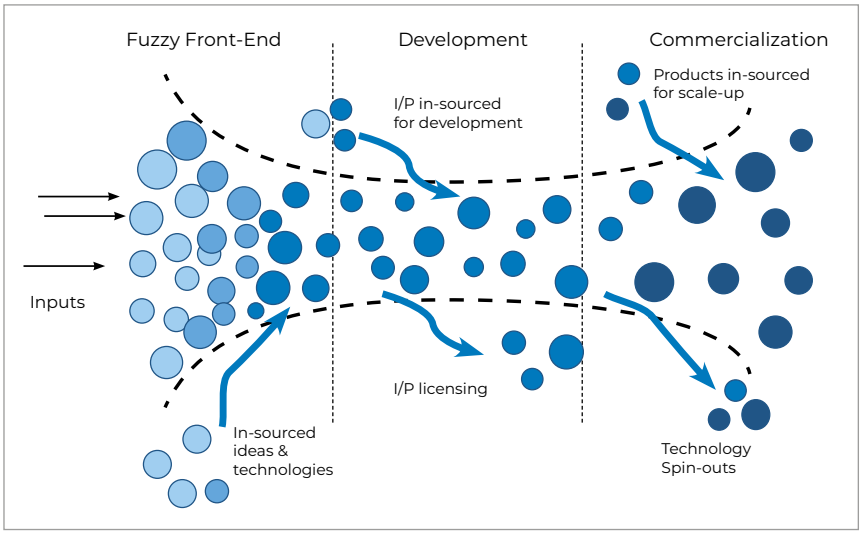

Figure 3: Open Innovation (Source: Steinbeis 2i GmbH adapted from Chesbrough, 2003)

Keeping up with the pace of today's technological and resulting social and political changes is hard for large organisations, and often impossible for smaller and medium scale organisations – if they decide to fight for themselves. Knowledge gaps risk to arise anywhere. The need for horizontal and vertical cooperation between organisations is vital for their success. These types of "external cooperation" become more and more relevant in an increasingly complex and connected world where most organisations could be suspended or left behind within a brief period.

The results and advantages of open innovation research on large companies are only partially transferable to small and medium-sized businesses (SMEs) or cooperatives. In large companies, open innovation is more of a complement and does not change the entire strategic orientation of the company. Its financial strength and market position give it a different status in the open innovation ecosystem than an SME or other types of organisations. A large company can buy a start-up that simply fits their strategy and activities.

SMEs and cooperatives who want to remain successful in the market in the long run, think differently. Their specific knowledge and developments are important

factors of competitiveness, which can make open innovation seem like a threat to them. With a changing role of intellectual property rights in innovation processes, established protection mechanisms, such as patents, partly compete with the new methods of innovation management, such as open innovation, which can also bear economic risks.[28] However, with the potential knowledge and technology gaps which let organisations fall behind easily nowadays, all organisations are becoming aware that it is no longer possible to develop everything on their own, within their own company. Today, fast and successful product developments and keeping the pole position in your market require the right mindset of an organisation and the right positioning within your open innovation ecosystem.

The European Commission seeks to capitalise on their Open Innovation 2.0 (OI2) paradigm which is "based on a Quadruple Helix Model where government, industry, academia and civil participants work together to co-create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone".[29]

For a first idea of what it means to practice open innovation, an organisation can ask and answer the following questions:

- How is your company positioned in terms of innovation culture and processes?
- What are your assets to protect?
- Where are own assets and innovation processes insufficient to meet the new increasing demands of the market?
- Which new technological possibilities can enhance the value of your own processes, especially in the area of digitisation?

This first assessment aims at identifying those areas of the organisation that can become more sustainable by opening up to external knowledge. Then, the organisation will be able to formulate a strategically motivated orientation for a targeted open innovation process, which must be part of the overall innovation strategy of the organisation. To make open innovation work in the long run, it must be linked with the DNA of the organisation.

28 Künzel, M., Meier zu Köcker, G., Köhler, T. 2016. Clusters and Innovations: Cluster Initiatives as Drivers of Innovations, p. 17. Cluster-Agentur Baden-Württemberg.

29 The Open Innovation Strategy and Policy Group of the European Commission, DG CONNECT. 2019. Open Innovation 2.0. https://ec.europa.eu/digital-single-market/en/open-innovation-20

How and why clusters and cluster organisations can profit from open innovation, e.g. when developing smart value chains, will be discussed in chapter 3.3.2.

Social Innovations Addressing Societal Challenges

Organisations that want to innovate need to understand the relevance and potential impacts of social innovation because "innovation in technology and economy entails social transformation: a dramatic process that forces profound changes in the lives of people, their ideas, values, habits, norms, and institutions. It transforms the world in which we live and who we are." [30] Social innovations have emerged in communities across the world, but often depend on individuals who are implementing their ideas and improving the situation for a rather small group of people around them, responding to locally perceived problems or social needs. A replication of these solutions and social innovations is possible mostly in particular cases, but the broader impact is oftentimes missing. This broader impact challenging the status quo and current institutions is needed, as much as a "new vision that matches the challenges of the 21st century and meets the aspirations of Europeans".[31]

The European Commission defines social innovation as "developing new ideas, services and models to better address social issues [and inviting] input from public and private actors, including civil society, to improve social services".[32]

The scientific discourse on the concept of social innovation is manifold, reflecting various perspectives and approaches to the topic. To summarize the essence of various approaches, social innovations should 1) be driven by the need to address neglected societal needs, 2) focus primarily on developing concrete solutions to problems, often including an idea of social change, 3) aim first and foremost at the well-being of their target group, but also of all other stakeholders, especially by creating new relationships. Social innovations support the development and deployment of effective solutions to systemic problems and challenges often but not exclusively related to social or environmental challenges.

30 Addarii F., Fiorenza, L. 2017. Vision and Trends of Social Innovation for Europe, p. 5. European Commission, DG RTD, Brussels.

31 Ibid, p. 5.

32 European Commission. Definition of Social Innovation. European Commission, DG Employment, Social Affairs & Inclusion, Brussels. https://ec.europa.eu/social/main.jsp?catId=1022&langId=en.

A broader definition by *The Young Foundation* (2012) promotes social innovations as "new solutions (products, services, models, markets, processes, etc.) that simultaneously meet a social need (more effectively than existing solutions) and lead to new or improved capabilities and relationships and better use of assets and resources. In other words, social innovations are both good for society and enhance society's capacity to act".[33] Social innovation is indispensable in order not to not let the social progress fall behind the economic and technological progress and to promote equality and wealth across all regions of the world. However, this first part of the definition seems to also consider social innovation within an organisation, where improved capabilities and relationships, and the better use of assets and resources can enhance the organisation's outputs and improve its position in the market.

With respect to current global developments affecting social, economic and political systems, another definition by *Westley and Antadze* (2010) is of interest, which puts an emphasis on the systemic change resulting from social innovation:

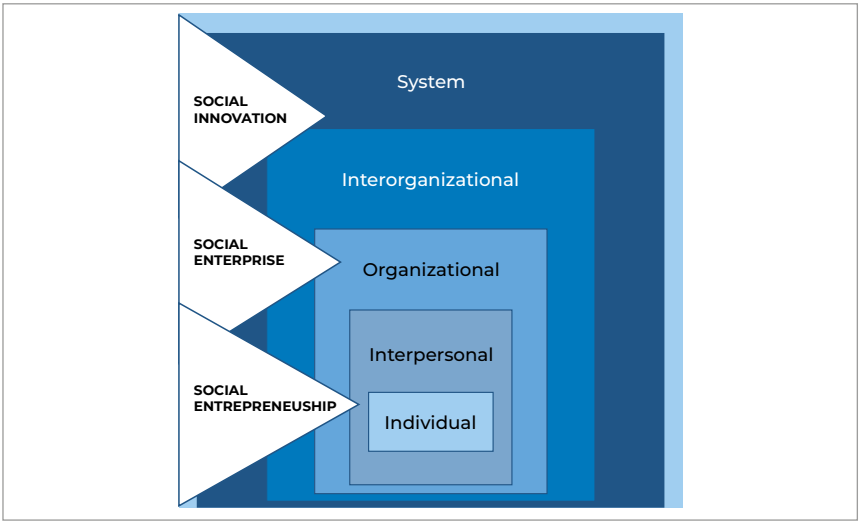

Figure 4: Systemic View (Source: Steinbeis 2i GmbH based on Westley and Antadze, 2010)

33 The Young Foundation. 2012. Defining Social Innovation. Overview of Social Innovation – A deliverable of the project: "The theoretical, empirical and policy foundations for building social innovation in Europe" (TEPSIE), European Commission, Brussels.

"Social innovation is a complex process of introducing new products, processes or programs that profoundly change the basic routines, resource and authority flows, or beliefs of the social system in which the innovation occurs. Such successful social innovations have durability and broad impact."[34]

This definition is based on **systems thinking**, addressing the culture, political and economic structure and social interactions of the respective social systems. It is relevant because the organisations within a cluster can also be seen as actors in a system setting, which exceed the simple bilateral or multilateral settings of inter-organisational cooperation. This means that cluster organisations can benefit from social innovations that address unmet needs and improve conditions within their organisations, and they can achieve significant improvements as a cluster at system level, e.g. by adopting organic production and fair trade practices along their value chains or connecting consumers to farmers and creating value-oriented agro-food communities.

3 The Innovation Management Dimensions

To provide a structured approach for innovation and innovation performance measurement, this guide will follow the five innovation management dimensions by Kearney (see Figure 5 below) also used in the Innovation Audits on Agro-Food Clusters performed as part of the Danube S3 Cluster[35] project in 2019.

34 Westley, F., Antadze, N. 2010. Making a Difference: Strategies for Scaling Social Innovation for Greater Impact, p. 2. In: The Innovation Journal: The Public Sector Innovation Journal, 15 (2).

35 Danube S3 Cluster project. 2020. Transnational Cluster Cooperation active on Agro – food, based on Smart Specialization Approach in Danube region. http://www.interreg-danube.eu/approved-projects/danube-s3-cluster.

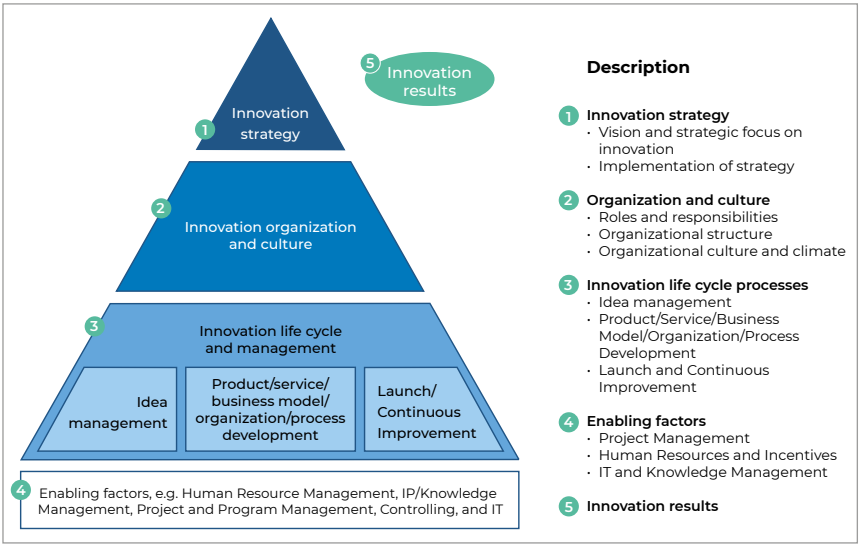

Figure 5: Innovation Management Dimensions based on the "House of Innovation" (Source: Steinbeis 2i GmbH adapted form A.T. Kearney, 2006)

A.T. Kearney's House of Innovation is focused on value creation and performance measurement and includes the following dimensions of innovation management and connected factors supporting innovation management development in the organisation:[36]

1. **Innovation strategy:** checking whether an organisation has or not an innovation strategy, i.e. a clear vision and strategic focus, which is communicated to and understood by employees and other stakeholders, including also the definition of outcomes and goals to be achieved as first step towards implementation.
2. **Innovation organisation and culture:** examining soft factors, which significantly contribute to innovation performance, e.g. openness, communication, information sharing and elimination of barriers.
3. **Innovation life cycle management:** ensuring knowledge and control over the entire innovation life cycle, including:

36 Diedrichs, E., Engel, K., Wagner, K. 2006. European Innovation Management Landscape: Assessment of current practices in Innovation Management Consulting Approaches and Self-Assessment Tools in Europe to define the requirements for future "best practices", p. 47. Europe INNOVA paper No. 2, Augsburg.

a. Idea management suggesting the systematic collection of new ideas and incentives (internally and through partners), their classification, evaluation and selection for implementation.

b. Product and process development describing the phase in which new ideas are translated into R&D projects supported by enabling factors over a time period.

c. Launch and continuous improvement of achieved invention outcomes and processes, including time-to-market (product is available in the market), break-even point (commercialisation absorbs R&D costs) and time-to-profit (time horizon within which innovation produces a profit).

4. **Enabling factors:** establishing or adapting the innovation support mechanisms and driving forces i.e. human resource management, knowledge management, information sharing, controlling and financial resources, project and process management, information technologies (IT) and management, etc.
5. **Innovation outcomes:** verifying visible and measurable outcomes of innovation management and performance turned into value, e.g. quality, quantity and timeliness of innovation.

Selected aspects of dimensions 1 to 5 are presented and discussed in the subsections of this chapter: chapter 3.1 revolves around the innovation strategy, i.e. the importance of a vision, strategic focus and planning instruments of an organisation. Chapter 3.2 looks at innovation from an organisation and culture perspective, describing roles and responsibilities, as well as organisational structure and culture within an innovation environment. Chapter 3.3 examines the innovation of processes, including product, process and business model development, and describes open innovation processes and idea management. Chapter 3.4 roughly outlines workforce skills and human resource management and knowledge and intellectual property management as enabling factors of innovation and chapter 3.5 deals with innovation results, covering the measuring of outcomes of innovation and the development of innovation capabilities.

3.1 The Innovation Strategy

Overall, the innovation strategy of an organisation defines the **systemic planning, implementation, management and controlling of innovation processes and activities**. To ensure relevant impact and best results of the innovation processes and activities, an innovation strategy must be part of and fit in with a company's or organisation's overall strategy. The strategy of involved divisions within the organisation needs to be aligned with the overall and innovation strategies as well.

"Generally, the innovation strategy is consistent with the overall strategy and strategic direction of the organization, can be aligned with the innovation vision and innovation policy and provides a framework for the setting of innovation objectives. [It] defines the rationale for engaging in innovation activities [...] and how those activities are expected to realize value for the organization and relevant interested parties."[37]

Concretely, the innovation strategy usually makes clear where the strategic focus of the organisation lies – in this case, for example, what types of innovations to focus on and which processes and activities will be needed for implementation. This includes the definition of interested parties and potential partners to be included, the required resources, structures and processes. The innovation strategy will provide information on who will be responsible, when activities will be completed, and how results will be monitored, measured, evaluated, protected, communicated, etc.

The innovation strategy of an organisation **defines the systemic planning, implementation, management and controlling of innovation processes and activities**.

A powerful innovation strategy will also clearly outline what the outside or inside need is which will have to be addressed (e.g. customer need vs. more efficient processes within the company) and what the organisation's competitive advantage is or will be, and how all activities relate to each other.

The following chapters 3.1.1 and 3.1.2 will give an overview of how to set an innovation vision and a strategic focus for an organisation and why these are important steps in the innovation process.

37 International Organization for Standardization (ISO). 2020. ISO 56000:2020: Innovation management – Fundamentals and vocabulary, 3.3.4.1. https://www.iso.org/obp/ui#iso:std:iso:56000:ed-1:v1:en:term:3.3.4.1.

3.1.1 Vision and Strategic Focus

"A vision without a strategy remains an illusion."
Lee Bolman

A **vision**, in general, is an aspiration of **what an organisation would like to become or achieve**. It is usually expressed by its leadership or management and circulated among all members of the organisation. In alignment with the innovation strategy, the innovation vision should be consistent with the overall vision of the organisation and present "a framework for the setting of an innovation strategy, innovation policy and innovation objectives".[38] An organisation should formulate a vision statement, which is to be seen as a living document meant to lead the organisation to its next innovation. This vision statement should be concise, clear, challenging, inspiring and future oriented. The following concrete steps can support the organisation in the formulation of a vision statement:[39]

- **Format:**
  - Keep it short, at a maximum of 2 sentences
  - Use present tense
- **Time horizon:**
  - Project 5 to 10 years in the future
  - Be ambitious enough for it to be exciting but not too ambitious that it seems unachievable
- **Language:**
  - Use clear, concise language, specific to your organisation, no jargon, metaphors, buzz-words
  - Keep it simple enough for people both inside and outside organization to understand
  - Do not use words that are open to interpretation (e.g. 'maximize shareholder return')
- **Content:**
  - Dream big and focus on success
  - Determine your purpose and position as an organization: objective, advantage, scope

38 International Organization for Standardization (ISO). 2020. ISO 56000:2020: Innovation management – Fundamentals and vocabulary, 3.3.1.1. https://www.iso.org/obp/ui#iso:std:iso:56000:ed-1:v1:en:term:3.3.1.1.

39 For the process of writing a good vision statement, also see: https://www.executestrategy.net/blog/write-good-vision-statement.

  - Describe a unique outcome that only you can provide, no generic vision statement
  - Align it with your business values (those people should integrate into the ways they work)
  - Revisit your vision and create a new one, once you have achieved your vision
- **Communication:**
  - Communicate your vision clearly and openly to your employees
  - Ask for and receive feedback on it to help the buy-in and alignment process
- **Commitment:**
  - Infuse it with passion and make it inspiring
  - Be prepared to commit time and resources to the vision you establish
  - Be prepared to track progress and achievements

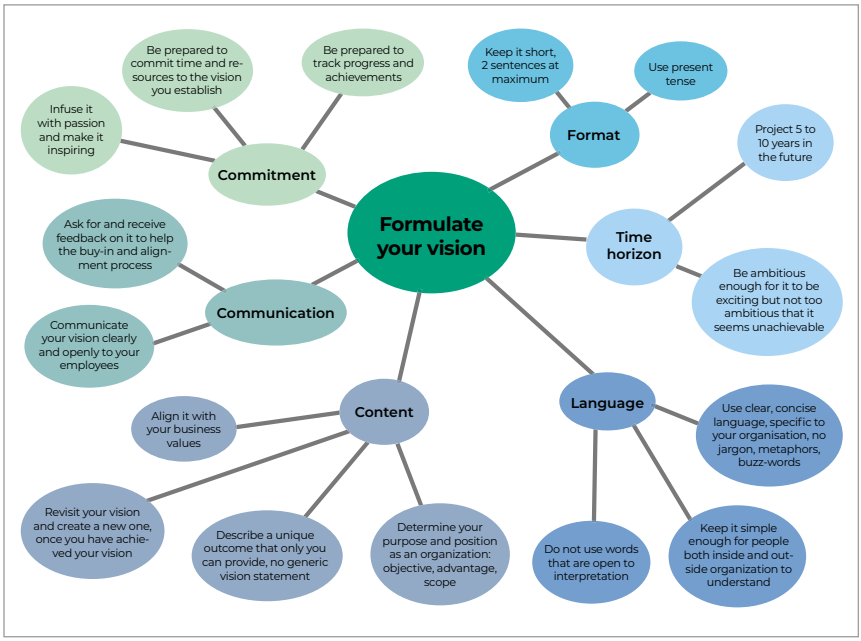

Figure 6: Clues for a Good Vision Statement (Source: Steinbeis 2i GmbH adapted from Cascade Strategy: How to Write a Good Vision Statement)

In the following, the organisation needs to implement a strategic framework to measure and help track progress in achieving the key aspects of its vision. Further information on strategic implementation and processes can be found in chapter 3.1.2 and in chapter 3.3.4.

Setting a **strategic focus** serves as enabler for innovation results. Innovation without a strategic focus, i.e. without limitations, would be ineffective because it lacks the purpose, objectives and guidance to achieve and sustain a competitive advantage. The strategic focus is the intersection of the organisation's purpose, i.e. its values, vision and goals which inspire and motivate the members of the organisation, its value proposition and its core and distinctive competencies. With a strategic focus, the organisation can now **define goals as long term outcomes and specific objectives to measure the progress of the innovation strategy** needed to achieve these goals.

Together, the innovation vision and the setting of a strategic focus are the first steps toward a clear definition of where and what you want to innovate and toward effective planning and implementation processes.

Vision and Strategic Focus for Agro-food Clusters

Agro-food clusters face multiple challenges at once. They need to achieve economies of scale in the supply chain while shifting toward circular economy business models, or they need to improve food sustainability and at the same time introduce new market-driven products. With those various challenges come a great number of opportunities to innovate. No organisation has the capacities nor resources to innovate in all these areas at the same time. Therefore, it is crucial to prioritise the potential areas for innovations and set a strategic focus within the scope of the innovation vision.

The Bioeconomy Cluster in Slovakia[40] (BEC) for example, defined as long-term vision to **build a common platform for the bioeconomy ecosystem in Slovakia** by raising awareness on bioeconomy, efficient economic and environmental use and protection of natural resources, and by promoting innovation and cooperation between various stakeholders in the bioeconomy sector. One of the cluster's main strategic objectives is to **create an innovation ecosystem for knowledge and technology transfer** between research and the agri-food industry through mutual cooperation.

40 Interview with Katarina Blicklingova from Bioeconomy Cluster Slovakia: http://bioeconomy.sk/en/ (12.05.2020).

3.1.2 Strategic Planning and Implementation: Innovation Roadmap

To create a successful and efficient innovation strategy, an organisation needs to develop and map strategic goals. It can then define the specific objectives to measure the progress in reaching these goals. An innovation roadmap is needed to stay on track with planned activities and results and serves as a kind of timetable for the innovation success.

A roadmap, in general, is a detailed plan to guide the progress towards a goal. *Product roadmaps* and *technology roadmaps* have been used in the technology and software industry ever since, to schedule when the products have to be ready for market launch or as an outline of required and anticipated changes in technologies, with expected dates, which will enable achievement or transformation of a product or product family.[41]

An innovation roadmap is a participatory planning instrument by which the various actors coordinate the measures of realising the commonly defined objectives. It serves as a **tool to set goals and derive an action plan**, i.e. a structured process including all the activities the organisation will undertake in line with these goals. The innovation roadmap is a control instrument. It supports the reduction of investment risks and the avoidance of duplicate investments by providing a clear and strategic **course of action with specific activities** and it allows for **constant progress monitoring**.

On a more strategic level, the process of innovation roadmapping usually includes the following overarching steps:

a) **Challenge the status quo:** One option to start would be to **review the previous year** (and beyond) and to examine which changes the organisation has embraced and which barriers it has encountered. The new and coming years will most likely not be the same as the last ones. What can or should be done differently, also with respect to current challenges and trends? However, a look back can reveal important **lessons learned**.

41 International Organization for Standardization (ISO). 2019. ISO/IEC 26560:2019: Software and systems engineering – Tools and methods for product line product management, 3.6. https://www.iso.org/obp/ui#iso:std:iso-iec:26560:ed-1:v1:en:term:3.6.

b) **Formulation of target goals:** It will be necessary to find out where it is important for the organisation to introduce significant, positive change in the coming year(s). This encompasses the **short, medium and long-term goals** with respect to quick-wins and incremental change improving the current offering, and also emerging trends and more transformative changes that will affect the company.
c) **Derivation of an action plan:** A great number of processes and methodologies[42] exist to **generate new ideas and putting them into action**, i.e. deliver on them. The company must choose the process that fit with the innovation strategy and work well with its activities and organisational culture.

Depending on the purpose and application, a roadmap may be created for products, technologies, trends, markets, projects or other measures an organisation wants to implement. Within these activities, regularly scanning the environment and external innovation pressures (see tools in 3.3.4) is one of the most important tasks for management, and all people in the organisation who potentially contribute to innovation, to stay informed and keep the organisation and its activities up to date. The future brings new challenges and opportunities fast. Agro-food is directly influenced by food trends like green or organic food, active or intelligent packaging, smart labelling, nanofood, food logistics, sustainable sourcing and food waste, and it is indirectly affected by megatrends and other developments like digitalisation and big data, smart and green business models, or drones, IoT, and automation.

The Basics of an Innovation Roadmap

For a first simple version of an innovation roadmap, the organisation needs to answer the following questions in relation to its innovation goals, objectives and activities along a timeline (also depicted in Figure 7 below):

- **Objective:** Why do we want to innovate?
  - Which are the pressures or incentives coming from external trends or markets driving us to innovate? What drives the change from within our organisation? Why does our organisation want to change something in general or in a specific area?

42 See for example: https://www.sessionlab.com/library/idea_generation or https://ideadrop.co/top-five-favourite-idea-generation-techniques/, https://www.viima.com/blog/idea-generation.

- **Content:** What do we want to innovate?
  - Which are the potential areas to improve? Which are the new technologies we want to implement? What new products or services should be developed or adopted? Which processes, structures or business models must be adapted?
- **Means:** How do we want to innovate?
  - By which means will we reach your goals and objectives, i.e. which projects will we implement? Which competencies and resources are needed? What is the scope for our innovation activities? This includes setting specific (e.g. SMART)[43] targets and indicators to check whether goals have been achieved in due time.

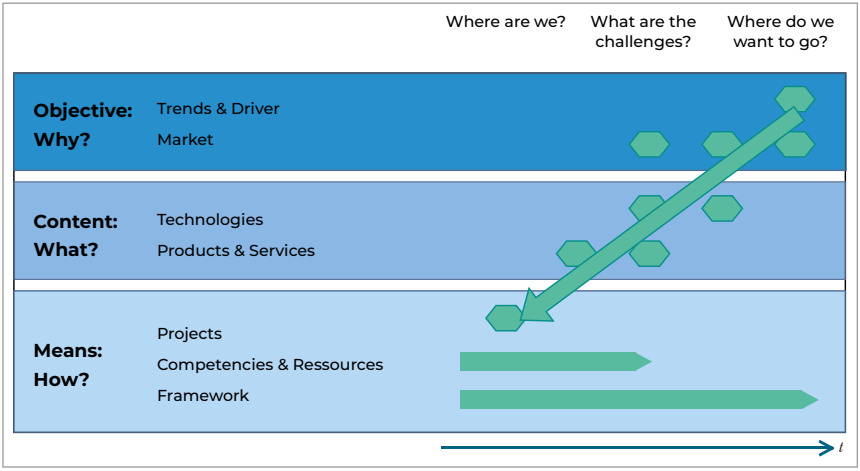

Figure 7: Simple Version of an Innovation Roadmap (Source: Steinbeis 2i GmbH)

The innovation roadmap is part of strategic innovation management and aims at aligning the organisation's divisions on strategic initiatives and maximising the use of the available resources. The planning period (until an objective is realised) can reach from one to ten years, depending on the industry and specifics of the organisation, but usually a minimum of three years is recommended to reflect the strategic focus of the organisation. A pharmaceutical organisation will plan for a longer period than an electronics organisation in a fast-moving environment with con-

43 See for example: https://www.mindtools.com/pages/article/smart-goals.htm.

siderably shorter product life cycles. For agro-food organisations, any time frame from three to ten years seems adequate.

This tool replaces a rigid project plan with fixed tasks and responsibilities with **clearly defined milestones and an adaptable "road" to achieve these milestones**. The long process from first idea to successful implementation is broken down into smaller steps that can be better managed and controlled. This approach is comparable to agile project management, where goals are defined and the responsibility for how these goals are achieved lies with the teams. If certain activities or measures on the way to the next milestone do not work or cannot be implemented as planned, innovation teams can change the course of action at any time and address new findings and challenges through teamwork and collaboration. With innovation roadmaps, organisations can be more agile in the implementation phase and increase the quality of their innovations due to constant adaptations and improvements on the way to achieving a goal.

The Detailed Innovation Roadmap

A more detailed innovation roadmap can be created by following a few more steps. Following the basic framework in Figure 7, the following activities should be conducted to reach a more sophisticated version of your roadmap:[44]

1. **Orientation Phase:**
    a. Know yourself and your innovation strategy as guiding parameters to analyse and define innovation areas or types (e.g. products or services, processes, business model, etc.).

    b. Define what the roadmap is intended to achieve, i.e. which topics are already relevant to the search. This will determine what the roadmap looks like in the end: What areas would you want to cover (e.g., marketing, technology, etc.), what would you like to represent and control (e.g., trends), how long is the planning period, etc.

2. **Analysis Phase:**
    a. Engage in intensive research and analysis to identify opportunities, risks, trends, etc. Possible sources and tools are:

44 Adapted based on https://www.lead-innovation.com/english-blog/creating-an-innovation-roadmap.

i. Trends and market analysis and studies including technology and innovation radars
ii. Assets and positioning including value chain analysis, competency matrix and technology portfolio assessment, analysis of product or service life cycles
iii. External competition and environment analysis
iv. Creativity tools for generation of inside and outside knowledge including design thinking tools, customer and lead user workshops, staff workshops, expert interviews

3. Prioritisation of Innovation Areas:

a. Summarize the findings and outcomes of the performed analyses e.g. in a SWOT analysis (chapter 3.3.4) through which specific innovation areas or topics can be defined as contexts for innovation.

b. Prioritise these innovation areas or topics, change or adapt if needed. They are the heart of the innovation roadmap. Possible criteria for the prioritisation are:

v. Strategic fit
vi. Market attractiveness
vii. Resources and development needed
viii. Transferability to own organisation and activities
ix. Level of risk

4. Roadmap Creation:

a. Select the innovation areas or topics and cluster them

b. Plot the innovation areas or topics on the time axis based on your prioritisation, setting specific objectives and key performance indicators (KPIs).

c. Ensure high quality of the roadmap, i.e. that all essential information is presented in a clear and useful manner and choose an appropriate graphic presentation for distribution and communication.

Now the innovation journey can begin with the roadmap as basis for all operational activities under the organisation's innovation management. All innovation

activities (at organisation or cluster level) must be monitored and reflected against the innovation roadmap. This means that the innovation roadmap sets the boundaries for the search and development of ideas, which again, are evaluated based on the roadmap and their strategic contribution to it. Idea development and management will be further discussed in chapter 3.3.3. The innovation project portfolio of a single organisation or among the cluster members is evaluated against the innovation roadmap as well.

Cluster members can perform the above-mentioned activities for their **individual organisation** or as a collective with the **cluster manager as leadership**, to define a vision, strategic focus and innovation roadmap for the entire cluster.

Further Use of the Innovation Roadmap

- The innovation roadmap has to be integrated into the operational innovation management and activities and processes have to be adapted to be in line with it. This also includes the assigning of budgets which should be clearly communicated and elaborated with the division heads or responsible persons.
- During the implementation of the innovation project, the innovation roadmap is used to monitor the achievement of the set targets.
- During the project the innovation roadmap should be reviewed and adjusted. Upon the completion of the project, it can be used for final evaluation of the innovation project and implementation of its activities.

3.2 Organisation and Culture

Defining an innovation strategy and innovation activities and integrating them into the overall business strategy often requires changes in people, structures and processes. Innovation is not only an economic or a technical process. It is a social phenomenon, in which the motivation and participation of employees are determinants of success in the process.[45] These employees and their roles in implementing innovation activities are at the heart of the organisation.

45 Szczepańska-Woszczyna, K. 2014. Innovation processes in the social space of the organization, p. 220. Regional Formation and Development Studies, 3, 220–229.

Innovation is a **social phenomenon** in which the motivation and participation of employees are determinants of success in the process.

They need to assimilate the change, take on new tasks and develop them. The employees are acting within the frame of the structure and culture of the organisation. The organisational structure and culture, therefore, play important roles for the implementation of an innovation strategy and related activities, and are crucial in **determining the success of any innovation project**.

The organisation of innovation activities within the organisation can entail the modification or reorganisation of structures and processes, roles and responsibilities to encourage innovation throughout the organisation, e.g. through the creation of an R&D or experimental lab or changed human resource practices. With all this potential change, it becomes even more clear that innovation management requires clear assignment of responsibility for innovation within the organisation.

Chapter 3.2 explores the characteristics of organisational structures and cultures, and the roles and responsibilities within these, that support the implementation of an innovation strategy and the related activities. The specific context of clusters, e.g. relating to the role of a cluster manager as driver of innovation, will be discussed in Chapter 3.4.1.

3.2.1 Roles and Responsibilities

Innovation management requires assigning roles and responsibilities for innovation objectives and specific activities within the organisation. These roles and responsibilities can be integrated with general management or assigned to divisions or teams, or to specific individuals or functions (e.g. innovation managers).[46] The role of the innovators is crucial since they will determine the capacity of an organisation to stay competitive.

The Oslo Manual indicates that innovation management includes all activities "to initiate, develop, and achieve results from innovation" [47] and list the following capabilities that are closely linked to general organisational and managerial capabilities:

46 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 111. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

47 Ibid, p. 110.

- Identifying, generating, assessing and pursuing ideas for innovation
- Organising innovation activities within the organisation (i.e. aligning different innovation activities)
- Allocating resources to innovation activities
- Managing innovation activities conducted in collaboration with external partners
- Integrating external knowledge and other external inputs into innovation activities
- Monitoring the results of innovation activities and learning from experience
- Exploiting and managing innovations and other knowledge that has been generated as part of an organisation's innovation activities, including protecting knowledge and innovation assets.

Types of Promoters of Innovation Processes

Innovations and innovation activities can encounter resistance, opposition and barriers to implementation. These challenges are normal, since innovations often cause changes and disruptions in routines and familiar processes, as well as in responsibilities and power relations. Resistance can emerge internally from employees or superiors, between organisations (partners, suppliers, customers) or from authorities and audit institutions. It will most likely prevent, delay or change the innovation activities. For these reasons, innovation management, which manages the implementation of the innovation activities, needs to consider who will drive or advance the innovation activities within the organisation.

One approach would be to ensure that *innovation drivers* or *promoters,* who are committed to the innovation product, service or process, actively support the innovation process, bring the necessary enthusiasm and overcome barriers and resistance, hold key functions within the organisation. The "Troika"-model of innovation promotors revisited by Hauschildt and Kirchmann[48], defines three types of "promotors" for more complex innovations: the "technology promotor", the process promotor" and the "power promotor" as shown in Figure 8 below.

48 Hauschildt, J. and Kirchmann, E. Teamwork for innovation – the 'troika' of promotors. R&D Management, 31, 1. Blackwell Publishers Ltd, 2001.

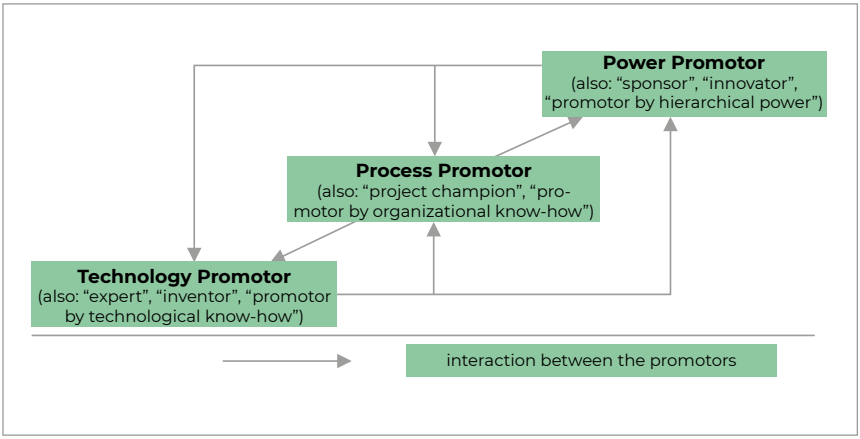

Figure 8: "Troika" Model of Innovation Promotors (Source: Steinbeis 2i GmbH based on Eberhard Witte 1973, revisited by Hauschildt and Kirchmann, 2001)

There is a division of labour between the different promotors, which makes it easier to overcome different types of resistance, for which specific types of energy, conflict management and power are required.

The **power promotor** is expected to overcome the psychological barrier of *unwillingness* by using hierarchical power to protect the innovation from opposition and secure its establishment even in the face of resistance, especially by securing resources and capacities for the innovation activities. The **technology promotor** or *promotor by know-how* must overcome the barrier of *ignorance* by contributing specific technical knowledge to the innovation process. He or she is acting as "educator" or "technologist" to win over reluctant colleagues or customers. The **process promotor** has the task of overcoming further barriers of *non-responsibility* and *indifference* caused by *organisational* and *administrative* resistance to the innovation. His or her influence is based on organisational know-how and he or she is able to translate the language of innovative technology into the traditional language spoken in the organisation. He or she has diplomatic skills and knows how to approach and win over different types of people on a one-to-one basis. Different studies[49] have shown that the application of the "Troika"-model leads to a higher

49 See for example Hauschildt, J. and Kirchmann, E. Teamwork for innovation – the 'troika' of promotors. R&D Management 31, 1. Blackwell Publishers Ltd, 2001.

degree of innovation and thus, prove it to be a useful approach for defining roles and responsibilities related to innovation activities within organisations.

The different roles of promoters in general, requiring different energies, will most probably be occupied by different persons. These persons should be selected carefully according to their knowledge and skills and to best fit the role and related tasks and responsibilities. The innovation process will be most successful when the different types of promoters cooperate closely, develop a common language and provide enthusiastic support for the innovation. This is valid for any organisation dealing with innovation.

Innovative Leaders and Managers for Initiation

Often, the most innovative organisations are led by **innovative personalities** and **innovative teams**.[50] Leaders of an organisation or a network have a significant influence on strategic, staff and process decisions within the organisation, including most projects and activities. They also have the means to encourage the staff creativity as an initial step in innovation and create the appropriate conditions for it.[51] They can secure the resources and capacities necessary to implement the innovation activities. If these individuals have previous experience in creating new products or developing discovery skills, they can even act as innovator role models.

Variations in organisational climate can occur and the levels of innovativeness of different teams or divisions, which is why the leader or manager of a team or division needs to create the right climate to encourage innovation, e.g. by:[52]

- Articulating a vision for the future
- Providing an appropriate role model
- Fostering the acceptance of goals
- Setting high performance expectations
- Providing individual support
- Providing intellectual stimulation

50 Christensen, C., Dyer, J., Gregersen, H. 2013. Le gène de l'innovateur: Cinq compétences qui font la difference, p. XVIII. Pearson, France.

51 Amabile, T., Conti, R., Coon, H. et al. 1996. Assessing the work environment for creativity, p. 1180. In: Academy of Management Journal, 39(5), pp. 1154–1184.

52 Podsakoff, P. M, MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. 2003. Common method biases in behavioural research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88, 879-903.

Additionally, cluster managers can play a key role as *network managers*[53] to foster collective innovation, advancing for example sustainability topics and projects in agriculture by:

- **Connecting:** initiating and facilitating the interaction processes between actors,
- **Framing:** guiding their interactions through process agreement,
- **Knowledge brokering:** facilitating knowledge transfer and capitalisation among the actors, and
- **Exploring:** searching for goal congruency by creating new content.

Innovative Teams for Implementation

An inspiring and powerful leader can initiate the innovation project, provide the necessary resources and framework for it, but most of the innovation work will be done in the teams working on the respective project. People are the most important resource in innovation activities – they can make the project fail or succeed as their performance fundamentally influences the implementation and the outcomes of the innovation project.

Innovation teams need to bring together **complementary discovery skills, such as questioning, observing, networking and experimenting**, and they need to be given the time, the room and the tools to engage in creative processes.

Most innovation projects are highly interdisciplinary, involving many divisions and people within an organisation. The selected teams leading or working on the innovation project need to know which parties or stakeholders they must involve, and which customer or market needs they are creating a solution for. They need to be well-structured and bring together complementary discovery skills, such as questioning, observing, networking, experimenting.[54] These teams also need to be given the time, the room and the tools to engage in creative processes, i.e. generate and develop ideas.

53 Berthet, E. T., Hickey, G. M. 2018. Organizing collective innovation in support of sustainable agro-ecosystems: The role of network management. Agricultural Systems, 165, pp. 44–54. Éditions Quæ, France.

54 Christensen, C. and Dyer, J., Gregersen, H. 2013. Le gène de l'innovateur: Cinq compétences qui font la difference, p. XVIII. Pearson, 2013.

The **team leadership** is also critical in shaping the team members' perceptions towards the organisation, their behaviour with respect to the organisational change that may come with the innovation project and their motivation to achieve target objectives. The performance in generating and promoting ideas within a team is found to correlate with its motivational orientation.[55] Motivation is key for the functioning of the team because it is "the process by which an individual or a group makes its actions consistent with its objectives, values and norms"[56].

Any team working on innovation projects or specific innovation activities is made of **individual employees**. In general, these individuals should have different skills, good communication, and be open to new ideas. They should also be able to challenge, trust and collaborate with each other to reach the highest possible performance within the team. These innovative individuals should have very good discovery skills and contribute their creativity, i.e. the production of new and useful ideas. If they cannot initiate the innovation process themselves, they also need to have relationships to other individuals who can bring an idea forward within the organisation.[57]

Beyond discovery skills and creativity, the commitment of an individual is relevant to the success of the innovation project and activities. Committed individuals usually can identify with the company vision and will bring passion to their work. These individuals stimulate innovation and drive the innovation process as opposed to non-committed individuals who do their jobs as required without any particular passion.

3.2.2 Organisational Structure

The organisational structure describes the way responsibilities, authority, lines of communication and processes are arranged in an organisation. It specifies how to achieve the target objectives, i.e. who does what and how it will be accomplished.

55 Rietzschel, E. F. 2011. Collective regulatory focus predicts specific aspects of team innovation, p. 344. In: Group Processes & Intergroup Relations, 14(3), 337–345.

56 Buisine, S., Davies, M. 2018. Innovation Culture in Organizations, p.104. In: Science, Technology and Innovation Culture, 3, 101–115.

57 Amabile, T. M. et al. 1996. Assessing the work environment for creativity, p.1180. Academy of Management Journal, 39(5), pp. 1154–1184.

It is often represented by an organisational chart. In general, there are four primary elements that determine the design of an organisational structure[58]:

1. **Job specifications:** defining what each division/office/unit is responsible for
2. **Departmentalization:** grouping of jobs and responsibilities in common sectors with the objective of achieving coordination
3. **Span of control:** defining how many job roles should be in each unit and which roles require coordination by a unit manager
4. **Delegation of authority:** assigning the right to make decisions without having to obtain approval from a supervisor

The organisational structure can be designed in various ways depending on the size of the organisation, its innovation policy, the innovation strategy and objectives, its focus, e.g. research-driven or user-driven.

For an organisational structure to support innovation, the leadership of the organisation must choose an appropriate organisational structure that allows for an effective implementation and monitoring of the innovation activities. As mentioned in the previous chapter, most innovation projects are highly interdisciplinary, involving many divisions and people within an organisation. Setting or adapting organisational structures so that they encourage collaboration and exchange across teams, divisions, functions, etc. will support the innovation project and its implementation.

Within these structures, the aspects of time, structures, chain of command, degree of centralisation, and role specification are of particular relevance when it comes to organising activities as part of the management of any organisation. Two of these aspects are of particular relevance: the **degree of centralisation** and the **chain of command** with respect to the distribution of responsibility and authority within organisations. Their relation to innovation management within clusters will be depicted in the following sections.

58 Swanson, B. E., Bentz, R. P., Sofranko, A. J. 1997. Improving agricultural extension: A reference manual, p. 167. Food and Agriculture Organization of the United Nations Rome (FAO), Rome.

Decentralised Structure and Handing over Responsibility

When authority is delegated within an organisation, there is a chain of command, which is "the formal channel which specifies the authority, responsibility and communication relationships from top to bottom in an organization".[59] In many organisations, complex links exist between various power levels, various platforms for communication and exchange of information, and procedures for maintaining the chain of command.

In many rather traditional organisations, the authority often flows top down from the president or the chief executive officer to division managers or directors, to managers, to team leaders, etc. These are *centralised organisations* with the key authority and decision-making roles focused on one or very few individuals. If the authority is distributed among many managers and other leaders, the organisation has a **decentralised structure**. Often, as an organisation diversifies in terms of projects, products and services, or geographical locations, a decentralisation in the organisational structure is taking place with authority being delegated to those who are closest to the action.[60]

Some of the benefits resulting from a decentralised organisational structure are the **increased autonomy** for divisions or teams or individuals within the organisation, their **specialisation** and potentially **higher efficiency** in implementation. Divisions and teams can be more responsive to changes, e.g. in local markets because staff on site have a greater local knowledge. Individuals will be more motivated, given a greater responsibility and opportunity to make decisions and to be creative. This is an advantage for any innovative organisation.

Organisations with **well-developed knowledge and communication flows** are better prepared for collaborating within a network or a cluster and, in turn, benefit more from these communication and knowledge flows.

At the same time, decentralised structures need excellent **knowledge and communication flows** to enhance collaboration across teams and divisions despite greater distance and specialisations. Organisations with these well-developed knowledge

59 Ivanevich, J. M., Donnelly, J. H., Jr., Gibson, J. L. 1980. Managing for performance. Irwin Dorsey, Georgetown, Ontario.

60 Swanson, B. E., Bentz, R. P., Sofranko, A. J. 1997. Improving agricultural extension: A reference manual, p. 167. Food and Agriculture Organization of the United Nations Rome (FAO), Rome.

and communication flows are better prepared for collaborating within a network or a cluster and, in turn, benefit from the communication and knowledge flows within the network or cluster. They will be more apt to work productively, while strengthening their cooperation and effectiveness, and they will be better than other organisations at applying open innovation processes.

3.2.3 Organisational Culture

Within the context of innovation management, the concept of organisational culture as "values, ways of thinking, managerial styles, paradigms, approaches to problem solving"[61] and organisational climate as "the shared meaning organizational members attach to the events, policies, practices, and procedures they experience and the behaviours they see being rewarded, supported, and expected"[62] have a key role in the planning and implementation of innovation activities. This guide will not examine the organisational climate (as the way members of an organisation experience the culture of the organisation), but rather focus on the creation of an innovative organisation culture which should be harmonised with the organisation's strategic goals.

Innovation Culture and Practices

Every organisation has a unique culture and climate, which provides guidelines and boundaries for the behaviour of its the members. To foster organisation-wide commitment to innovation, the leadership of the organisation has to encourage innovation management practices that contribute to the establishment and maintenance of an innovation culture. This **innovation culture** includes the *behaviours, values and beliefs with regard to innovation* shared by the organisation's members. "The characteristics of a supportive innovation culture can include open-mindedness, willingness to change, diversity, collaboration, and learning from failure."[63] To

61 Cameron, K. S., Quinn, R. E. 2011. Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework, p. 11. 3rd Edition. John Wiley & Sons, San Francisco.

62 Ehrhart, M. G., Schneider, B., Macey, W. H. 2014. Organizational Climate and Culture: An Introduction to Theory, Research, and Practice, p. 2. Routledge, New York.

63 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 112. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

build and measure a supportive culture, the Oslo Manual suggests developing and collect data on the following practices[64]:

- Communicating the importance of innovation, including the innovation vision and strategy
- Allowing time and resources for innovation activities and providing supporting tools and methods
- Recognising innovators and innovation results
- Training employees on how to engage in innovation
- Assessing innovation performance using dedicated innovation indicators

The innovation culture of an organisation can constitute a competitive advantage if it is different from other cultures, and its elements or practices are difficult to imitate and leveraged as an asset. These elements or practices, in turn, are based on the processes embedded with the resulting climate they create, aiming at the desired behaviours driving the innovation success. This means that innovation culture and climate are necessarily linked and should be unique in their focus on important internal organisational processes (e.g., fairness, ethics, inclusion) and strategic outcomes (e.g., service, safety, innovation). They are also linked to the organisation's mission statement and strategic focus and all processes and activities necessary to implement them. Innovation activities should be encouraged at all levels of the organisation to create a unique innovative and collaborative culture across the organisation, which can bring a competitive advantage to an organisation.

The innovation culture of an organisation can constitute a **competitive advantage**. Innovation activities should be encouraged at all levels of the organisation to create a **unique innovative and collaborative culture** across the organisation.

64 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 112. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

Creating an Innovation Culture

"When we give ourselves permission to fail,
we, at the same time, give ourselves permission to excel."
Eloise Ristad

Judge[65] discusses the innovative culture as one of the dimensions of organisational capacity for change, which should be promoted top-down by the management and implemented bottom-up across the organisation. An innovative organisational culture evolves around the following six main characteristics:

- **Creativity** as an essential characteristic of an innovative organisational culture. Based on the assumption that the "creative process is social, not just individual, and thus forms of organization are necessary [but these] elements of organization can and frequently do stifle creativity and innovation"[66], Judge argues that a creative and innovative organisational culture encourages employees to use their imagination to **combine ideas in new ways and play with them** to see how the new combination works in reality. Most organisations, following traditional cultural norms and values, command efficient and timely accomplishment of work tasks and duties, within budgetary constraints, which often prevents motivated individuals from deploying their full potential and frustrates them.

- The cultivation of **diversity of thought**[67] also facilitates the context of organisational culture and is fundamental to creativity. The focus is on the diversity in **ways of thinking** based on diverse background and expertise, not just the cultural or demographic diversity. Different perspectives and a great number of ideas to a problem and to its solution are necessary and must be exchanged to harvest innovation and new successful projects.

65 Judge, W. Q. 2012. Focusing on Organizational Change, v. 1.0, pp. 85–86. Flat World Knowledge, Boston, United States.

66 Florida, R. 2002. The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community, and Everyday Life, p. 22. Perseus Books, New York.

67 For more information, see: Basset-Jones, N. 2005. The paradox of diversity management, creativity and innovation. Creativity and Innovation Management, 14(2), 169–175.

- The relevance of **weak ties**[68] is often underestimated. Weak ties encourage *flexible working conditions* and *external networking*, i.e. spontaneity and serendipity, and could increase the level diffusion of a difficult innovation.

- The organisation-wide **ability to look long term** allowing for the continuation of the organisation's main profitable activities and at the same time freeing the time and resources to explore and exploit new markets.[69]

- An organisation also needs to examine its **tolerance of ambiguity and failure**.[70] Given a creative environment, a great number of ideas may be produced, of which a large number cannot and should not be implemented – not only because of limited resources, but especially because not all ideas can lead to successful projects. However, ideas that lead to failures are inevitable in the process of innovation. If an idea has been carefully selected and still fails, the *originator of the idea cannot be blamed or penalised*. Failure needs to be accepted and the relevance of learnings emerging from this failure should be perceived as valuable knowledge for future projects. Negative attitudes and an organisational culture reluctant to taking risks and accepting uncertainty will most probably suppress all ("good and bad") ideas and resulting innovation projects. Such an organisation is clearly underestimating the potential gains for the economic and cultural growth and development of the organisation.

- Most innovations come from **collaboration within and across teams**, not from the genius or perseverance of a single individual. The most innovative teams operate more like **target-oriented communities**, not competing and self-centred individuals unable to cooperate.[71]

68 Granovetter, M. S. 1973. The Strength of Weak Ties, pp. 1367–1368. American Journal of Sociology, 78(6), 1360–1380.

69 For more information between innovative organisational culture and the ability of organisations to look long term see: Judge, W., Blocker, C. 2008. Organizational capacity for change and strategic ambidexterity: Flying the plane while rewiring it. European Journal of Marketing, 42(9/10), 915–926.

70 Judge, W. Q. 2012. Focusing on Organizational Change, v. 1.0, p. 86. Flat World Knowledge, Boston, United States.

71 For more information, see: Judge, W., Fryxell, G., Dooley, R. 1997. The New Task of R&D Management: Creating Goal-Directed Communities for Innovation. California Management Review, 39(3), 72–85.

The Right Communication and Change Processes

The drive for a new strategic focus or an innovation strategy usually starts with the leadership of the organisation, but often the entire or parts of the organisation have to undergo change processes. This is also true for clusters, where all or some members of the cluster will most probably undergo change processes. The way for these change processes to be successful must be paved carefully. For this reason, once the innovation roadmap has been visualised, the organisation needs to communicate it to all people and divisions inside the organisation concerned by the innovation project to set a common ground for collaboration with respect to all the activities and potential changes ahead. This will also ensure the acceptance of change throughout the organisation. The same is valid at cluster level, where a new strategic focus or innovation strategy need to be communicated clearly and openly to all cluster members and within their organisations before engaging in any new activities.

Once on the way, organisations encounter barriers to change, such as the lack of new ideas, a lack of resources for implementation, etc. By setting this common ground and getting all parties involved to "buy in" early, as well as incorporating feedback from cluster members or the organisation's divisions, major implementation problems can be prevented.

Communication and Knowledge Sharing

"If communication isn't working, nothing else will."
Kenneth S. Taylor

Among the most important requirements for any innovative culture and team involved in creative tasks and problem solving, are the **willingness to share the own knowledge and experiences** with others and the **openness to collaborate based on the shared knowledge and experiences**. This will increase effectiveness and efficiency of implementation of activities within and across teams. An open culture, which promotes the participation of all team members in the creative process, is necessary to yield the highest potential for innovative ideas and activity from the employees. This open culture should be dominated by "dynamism, flexibility, fast adaptation to changing conditions, and non-stereotypical solutions"

and encourage employees to seek and discover unconventional, non-standard ways of achieving objectives and performing tasks.[72] Communication is key to drive change and promote innovation across the organisation. It must be implemented with care and strategically, i.e. contain clear messages about innovations and organisational change, be frequent and directed to the appropriate contact persons in the organisation.[73]

The willingness to share the own knowledge and experiences with others and the openness to collaborate based on the shared knowledge and experiences will **increase effectiveness and efficiency of implementation of activities within and across teams**.

The employees will have greater responsibility and motivation (chapter 3.2.1). Decentralisation and handing over responsibility (chapter 3.2.2) also support these processes and change of culture. But at the same time, innovation is a risky activity and questions of security, risk and uncertainty may keep individuals from fully immersing into the innovative organisational culture. The organisation should be prepared for such cases by providing transparent planning and monitoring, delegation of roles, responsibilities and tasks, e.g. like in a roadmap, and assurance with respect to the acceptance of risks and potential mistakes that may be associated with it. Honouring teams or team members for their active participation in the innovation process (e.g. through incentives or rewards) can be useful as well.

The Cluster as Innovative Milieu

An interesting concept promoting *innovative milieus*[74] emerged in the 1990s to support the relevance of social capital in advancing innovation. This concept points out the importance of social interactions and networks between individuals within organisations and between individuals in different organisations, which are based on previous collaboration and co-operation experiences and create trust bonds within the network. It promotes the idea that **the economic success of individual regions progresses on the basis of these social interactions, synergy**

72 Szczepańska-Woszczyna, K. 2014. Innovation processes in the social space of the organization, p. 223. Regional Formation and Development Studies, 3, 220–229.

73 For more information on how to shape communication to support and drive change in an organisation, see: Taylor, K. 1998. Corporate change: If communication isn't working, nothing else will. Employment Relations Today, 25(1), 69–76.

74 For a full discussion of the term, see: Aydalot, P. 1986. Milieux innovateurs en Europe. Groupe de recherche européen sur les milieux innovateurs (GREMI), Paris.

effects and collective learning processes which characterise a *milieu*. An innovative milieu can be defined as a "grouping of economic, social, political, and cultural elements" or as a "group of relationships having particular characteristics and occurring within a specific geographic continuum"[75].

"Creativity and continuous innovation are seen as the result of a collective learning process, fed by such social phenomena as inter-regional transfer of know-how, imitation of successful practices and technological innovations, interpersonal face-to-face contacts, formal or informal co-operation between firms, tacit circulation of commercial, financial or technological information".[76]

A cluster could be seen as an *innovative milieu*, in that both are not merely a general framework or geographical condition, but a significant factor, or even a key enabler, in the development of innovation. In fact, both provide a specific and important regional and social context for innovation activities of clusters and cluster members.

Cluster organisations can **use enhanced communication flows and knowledge sharing to increase their own competitiveness and that of clusters and regions.**

Within these specific regional and social contexts, cluster organisations can use enhanced communication flows and knowledge sharing to increase their own competitiveness and that of clusters and regions.

3.3 Innovation Processes

The innovation process begins with the decision to introduce a specific innovation or change in the organisation. It is a **systematic approach** for generating, prioritizing, evaluating and validating new knowledge and ideas, and putting them into practice, i.e. into marketable solutions. A systemic and structured approach to innovation and innovation processes is important to guarantee not only a successful development of ideas and innovation projects, but also their successful implementation.

Most innovation processes can be divided into very basic phases of discovery, development, and commercialisation. However, the characteristics and framework

75 Maillat, D. 1992. La relation des entreprises innovatrices avec leur milieu. In: Maillat, D. and Perrin, J.-C. Entreprises innovatrices et development territorial. Groupe de recherche européen sur les milieux innovateurs (GREMI), Neuchâtel: GREMA/EDES, pp. 3–22.

76 Camagni, R. 1991. Innovation Networks: Spatial Perspectives, p. 1. Belhaven Press, London/New York.

conditions of each model vary widely must be clear in order to define or shape the innovation activities of an organisation. Chapter 3.3.1 will give an overview of selected relevant innovation process models.

3.3.1 Innovation Process Models and Concepts

Within increasingly complex and changing environments, organisations need be able to implement innovation in a targeted and sustainable manner. Organisations must proactively define and build consistent and functional innovation processes.

A diversity of process models exists and there is no "best" model to shape an innovation process. Different models will have different foci and address different objectives and challenges. To provide some form of classification, this chapter will present generations of innovation process models and further discuss innovation processes in agro-food clusters will also be included.

Generations of Innovation Process Models

Preez et al. propose seven generations of innovation process models since the 1930s as defined in Figure 9 below.[77]

77 du Preez, N. D., Louw, L., Essmann, H. 2006. An Innovation Process Model for Improving Innovation Capability, p. 3. Journal of High Technology Management Research, 17, 1–24.

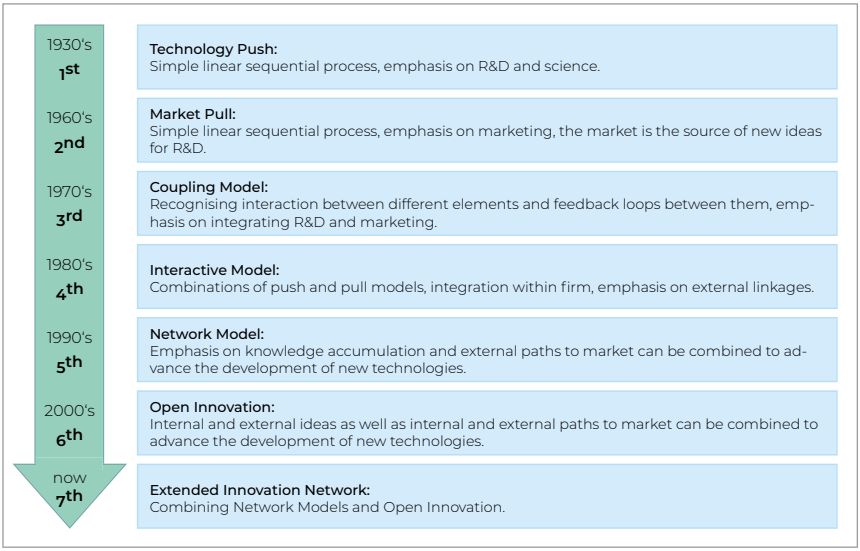

Figure 9: Different Generations of Innovation Process Models (Source: Steinbeis 2i GmbH based on Preez, Louw and Essmann, 2006)

These innovation process models have evolved from simple linear (or sequential) models (e.g. technology push and market pull) to increasingly complex interactive models (e.g. interactive and network models). The earlier models are still used mainly in R&D and technology-specific environments, but with the pressure of globalisation and increasing collaboration, the new models can better map the complex conditions and relationships within the innovation environment.

As introduction and to better understand the development of innovation process models, the following paragraphs provide a brief overview starting with the 3rd generation of innovation processes. The first two linear models seem too outdated and are disregarded.

The 6th and 7th generations of innovation processes are the most relevant for cluster organisation because they capitalise on open networks, exchange of ideas and joint technological development, i.e. activities which are usually supported by clusters and provide advantages over other players in the market. Open innovation processes are further described in chapter 3.3.2. The 7th generation of extended innovation networks is new and complex and is only briefly described in this guide.

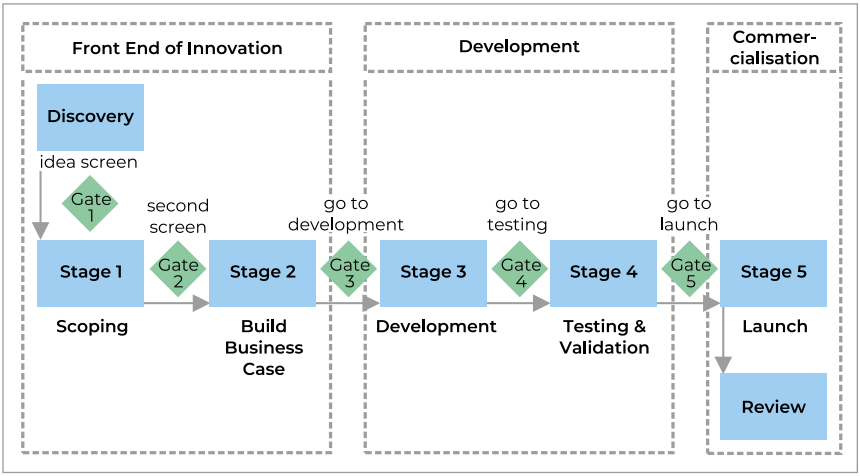

Figure 10: Third Generation Coupling Model of Innovation (Scource: Steinbeis 2i GmbH based on Preez, Louw and Essmann, 2006)

Out of the 3rd generation, two models are very common and will therefore be described briefly: The coupling model in Figure 10 below shows a common depiction of innovation processes that recognise the influence of technological capabilities and market needs within the framework of the innovating organisation.[78]

This coupling model includes feedback loops, but it is a sequential model with limited functional integration. Another widely known model which divides the product innovation process into stages with defined gates (acting as decision points between the stages) is the Stage-Gate model by Cooper.[79] This model is also linear and reflects the basic phases of discovery, development, and commercialisation as shown in Figure 11 below.

78 du Preez, N. D., Louw, L., Essmann, H. 2006. An Innovation Process Model for Improving Innovation Capability, p. 4. Journal of High Technology Management Research, 17, 1–24.

79 Cooper, R. G. 1990. Stage-Gate Systems: A New Tool for Managing New Products, p. 46. Business Horizons, 33(3), 44–53.

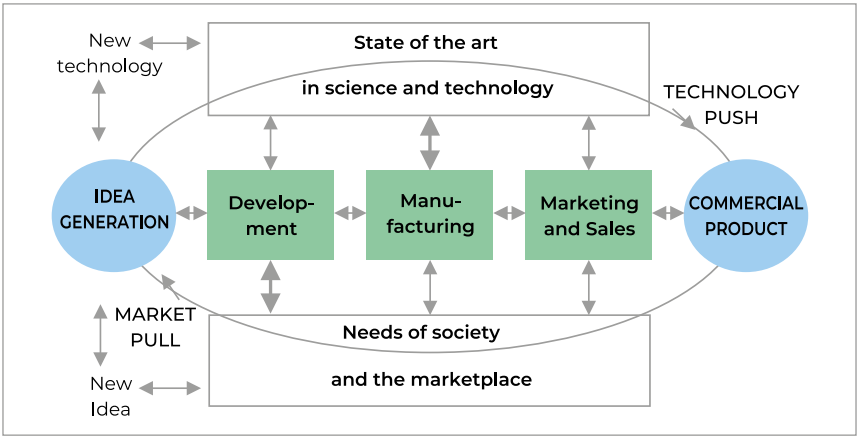

Figure 11: Stage Gate Process (Source: Steinbeis 2i GmbH based on Cooper, 1990)

Interactive models of the 4th generation were developed to tackle the lack of functional integration (i.e. R&D, product development, marketing, etc.) of the linear models through an interactive approach, which describes the innovation process as parallel activities across organisational functions. These models do not explain the entire innovation process, but they directed the focus toward a) horizontal strategic alliances and collaborative R&D consortia; b) strategic vertical relationships, especially with suppliers; c) innovative SMEs or organisations forging external relationships with other large and small organisations; and d) the development of cross-functional and parallel integration within organisations to gain greater potential from higher real-time information processing.[80]

The **5th generation innovation process or network models** attempt to illustrate a **more complex innovation process** taking place within a network of internal and external stakeholders, where the influence of and the effective communication with external environments is key. One example for such as model was published by Trott[81] in 2008:

80 du Preez, N. D., Louw, L., Essmann, H. 2006. An Innovation Process Model for Improving Innovation Capability, p. 5. Journal of High Technology Management Research, 17, 1–24.

81 Trott, P. 2005. Innovation Management and New Product Development, p. 26. 3rd Edition. Pearson Education Limited, Harlow, England.

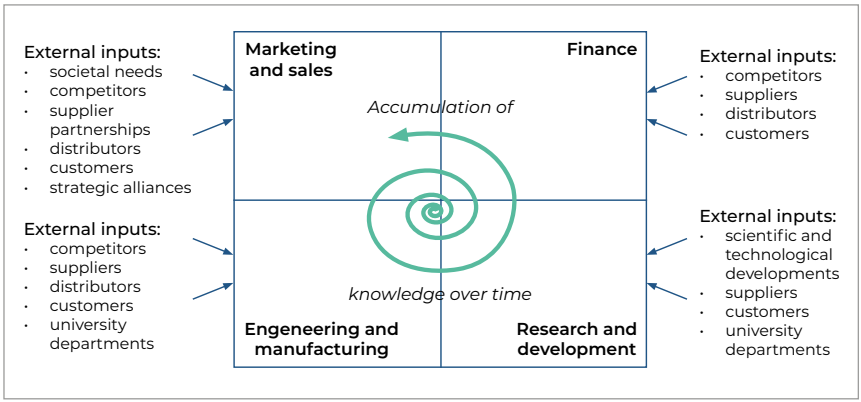

Figure 12: Network Model of Innovation (Source: Steinbeis 2i GmbH based on Trott, 2005)

The creative factory model shown in Figure 13 below depicts an even higher complexity of the innovation process. It is more comprehensive and is using a systems thinking approach. The organisation is generating and promoting innovations in the market, the industrial sector and the nation. The core innovation process is made of: 1) the knowledge creation process from public or industrial research; 2) the new product development process, which transforms knowledge into a new product, and 3) the product success in the market, which depends on the product's functional competencies and the organisational competencies to produce it at a reasonable price and quality and place it adequately in the market.[82] These core innovation processes are affected by internal factors of the firm (e.g. corporate strategy, organisational structure, etc.) and external factors in the national innovation environment (e.g. regulations, national infrastructure, etc.).

82 Based on the creative factory model cited in du Preez, N. D., Louw, L., Essmann, H. 2006. An Innovation Process Model for Improving Innovation Capability, p.8. Journal of High Technology Management Research, 17, 1–24. Or see: Galanakis, K. 2006. Innovation process: Make sense using systems thinking. In: Technovation, 26 (11), pp. 1222–1232.

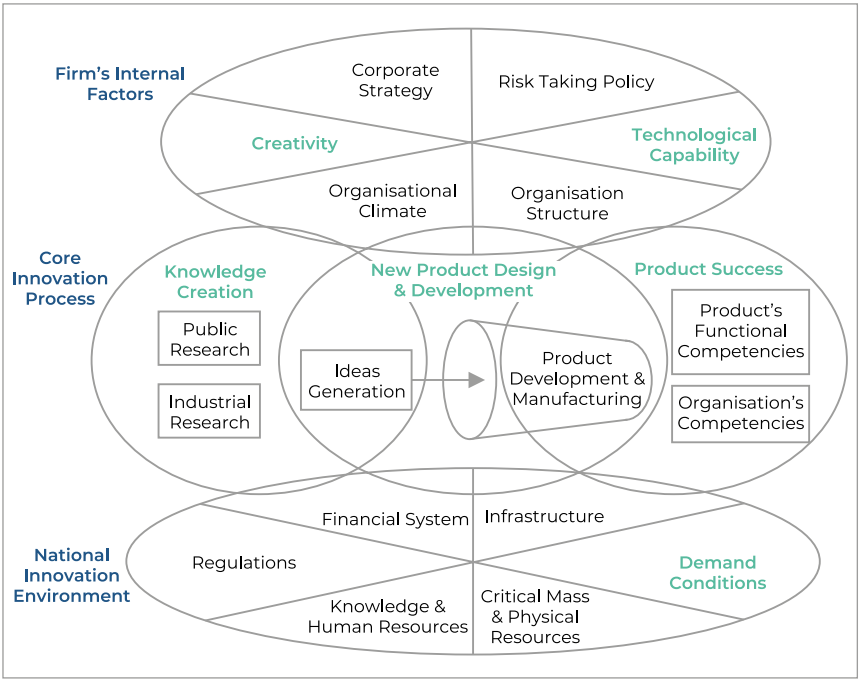

Figure 13: The Creative Factory Systems Innovation Model (Source: Steinbeis 2i GmbH based on Galanakis, 2006)

The 5th generation models are mainly **closed networks of innovation** where all processes focus on internal idea generation and development, and secrecy, i.e. all innovation, development and other processes take place within the organisation's boundaries as shown in Figure 14 below.

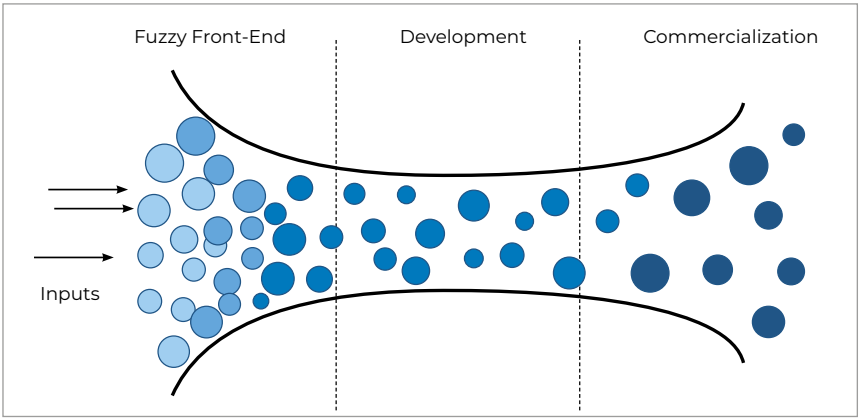

Figure 14: Closed Innovation Model (Source: Steinbeis 2i GmbH adapted from Chesbrough, 2003)

Taking a step further, the **6th generation** of innovation models **focus on open innovation**. They are also network models, but allow for *internal and external* ideas and development, as well as *internal and external* paths to market which can be combined to advance the development of new technologies as shown in Figure 15 below.

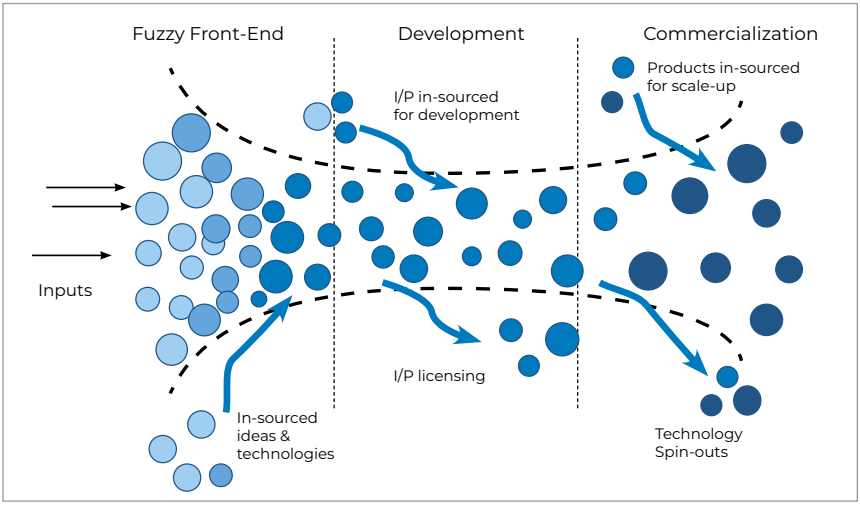

Figure 15: Open Innovation Model (Source: Steinbeis 2i GmbH adapted from Chesbrough, 2003)

These open innovation models (based on the concepts of closed and open innovation of Chesbrough[83]) promote openness and collaboration within networked or webbed communities with open and agile processes and activities. They combine the linear and coupling processes and require new ways of collaboration between organisations while these are still competing. Within an open innovation network or ecosystem, an organisation has access to a much larger base of ideas and technologies to be exploited. Further, open innovation should be a strategic tool to explore new growth opportunities at a lower risk. The innovation environment has changed through networking and collaboration. Open innovations call for a new logic, which put openness and collaboration at its centre. Networked or web communities are the open and agile tools to put into practice the open innovation concept.

Although the sixth generation of open innovation models is still relatively new, a **7th generation of extended innovation network models** emerges, that combine the open and networked innovation models to form an integrated innovation network. Here, organisations should develop *Integrated Knowledge Networks* to support the Innovation Knowledge Supply Chain as shown in Figure 16.[84]

83 Chesbrough, H. W. 2003. Open Innovation: The new imperative for creating and profiting from technology, p. 31 and p. 183. Harvard Business School Press, Boston.

84 Based on the Innovation landscape with integrated knowledge network components described by Clark cited in du Preez, N. D., Louw, L., Essmann, H. 2006. An Innovation Process Model for Improving Innovation Capability, p.8. Journal of High Technology Management Research, 17, 1–24. Also see: Clark, H. C. 1998. Formal Knowledge Networks. International Institute for Sustainable Development, Manitoba, Canada. https://www.iisd.org/sites/default/files/publications/fkn.pdf

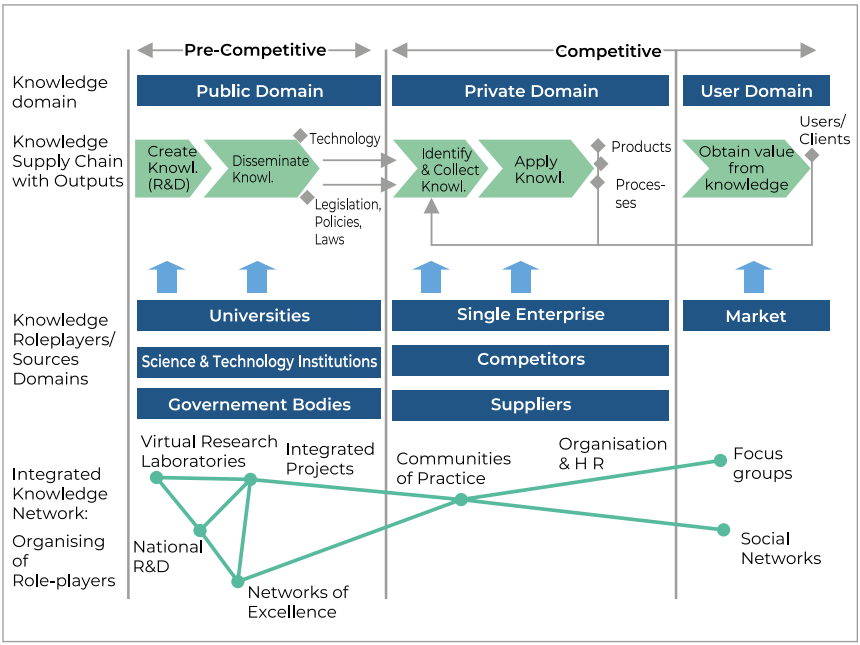

Figure 16: Innovation Landscape with Integrated Knowledge Network Components (Source: Steinbeis 2i GmbH based on Clark, 1998)

Through creating the integrated knowledge networks, the organisation leads and ensures the constant open exchange with the knowledge actors (e.g. universities, sciences and technology institutions and government bodies in the public domain; enterprises, competitors and supplier in the private domain; and the market in the user domain). This grants them incredibly valuable access to knowledge from which value can be created (jointly). The integrated knowledge networks can have varying forms and characteristics, e.g. be settled and legally approved collaboration centres like R&D institutions or laboratories or they can have loose or temporary structures like social networks or focus groups.

Within the context of clusters, the 6th generation of open innovation models is highly relevant and will thus, be further investigated in chapter 3.3.2.

Open Innovation and Design Processes in Agro-Food Organisations

Due to the potential complexity of innovation, it can be difficult to define appropriate innovation and design processes. Yet, these processes are crucial for a successful implementation and need to be adapted to their respective environment. The success of innovative action is dependent on the learning and transformative abilities of the organisation, which needs to function and constantly adapt work routines and processes. Learning is required by each individual and the entire organisation to set the space for collective innovation in the agricultural and agro-food sector. A variety of mechanisms is needed to create enabling conditions for innovation and to provide a step-by-step support to innovation communities, according to their capacities and learning needs. They can then generate new knowledge about innovation mechanisms themselves, helping to design and organise the support for collective innovation in a variety of situations.[85]

With respect to innovation processes in agricultural systems, Berthet et al. [86] present insights on co-design and co-innovation in agriculture, based on which they propose the following directions for future research and practice in agricultural design and innovation:

- Further **opening of design and innovation techniques and tools** to better account for visual, auditory, tactile and olfactory expressions in evolving designs and what they afford users, e.g. using diverse co-design and co-innovation methods paired with creativity techniques from design thinking and other idea generation and implementation methods.[87]

  The relationships between scientists, especially agronomists, farmers and other system actors can impact the performance and outcomes of joint efforts. These actors may have different perspectives, rationalities and affordances (i.e. what the environment offers the individual), which should be reflected continuously

85 Faure, G. et al. 2018. Innovation and development in agricultural and food systems, p. 112. Éditions Quæ, France. https://agritrop.cirad.fr/589862/1/ID589862.pdf.

86 Berthet, E.T., Hickey, G.M., Klerkx, L. 2018. Opening design and innovation processes in agriculture: Insights from design and management sciences and future directions, p. 113. Agricultural Systems. 165, pp. 111–115. Éditions Quæ, France.

87 See various creativity techniques and further information at: https://www.sessionlab.com/solutions/innovation/. To ensure these competencies are secured within the organisation, a selection of the staff should receive design thinking and innovation management trainings. Some aspects are further described in the following chapters.

during these processes. Improved open design and innovation techniques and tools are needed to allow for better reflection on the material elements generated in the process and to advance designs they offer to users.

- Further **opening of innovation networks** to create and stimulate integrative niches that can foster sustainability transitions.
  The transition toward sustainable agricultural practices and processes not only includes technological changes, but a much wider range of changes and alternative approaches to agriculture, such as agro-ecology, urban farming, care farming, bioeconomy and circular economy, smart or digital agriculture. These, in turn, rely on cross-paradigm, cross-scale, cross-sector integrations.

- Further **opening the range of innovation actors** to include material and ecological actants in agricultural design and innovation, i.e. biological and ecological processes embedded in natural artefacts.
  These non-human actants can help disclose how innovations (technologies, artefacts) interact with users during their actual performance in practice and how certain agricultural designs then exert power over users by governing their behaviour. The "actant" is a person, creature, or object playing any of a set of active roles in a narrative, e.g. a cow that produces X litres of milk per year, but can get health problems or for another reason not fulfill the expectations. In this context, the concept of actants could raise the potential agency of the non-human in agricultural design and innovation, e.g. non-human actants can have roles in i) conditioning the possibility of humans; ii) mediating; iii) as members of moral and political associations; and iv) gatherings of actors of different temporal and spatial orders.

These recommendations for research and practice in agricultural design and innovation converge at the point of co-design and co-innovation, which have similarities with the features of open innovation, and how they are used in agriculture. This suggests that the open innovation process models are key to shaping future agricultural innovation processes.

3.3.2 Open Innovation Processes

As open innovation and design processes have been defined as central to the innovation in the agro-food sector, this chapter will explore different aspects of open innovation that are relevant to organisations in this area.

Terms of Open Innovation

To avoid confusion or misconceptions, the following terms often used in relation to open innovation will be defined in Table 1 below:[88]

Co-development	Working with outside partners in the development of new products and/or services. Can be a subset of joint venturing or open innovation initiative. May include peer-to-peer or supplier/customer co-development.
Collaborative innovation	Similar to concepts contained in definitions of open innovation and co-development, but can also include formal networks or consortia that come together in an alliance to study common issues and/or develop new products/services.
Joint venture	Usually a formal legal arrangement between partners in a joint development and/or business initiative. Risks and rewards are negotiated and shared formally.
Open innovation	Popularized by Chesbrough's book "Open Innovation," this term refers to the broad concepts of leveraging external sources of technology and innovation to drive internal growth. Also entails the spin-off and outsourcing of unused intellectual property.
Open-source models	Derived from the term used in the software development industry, where informally structured collaborations take place (usually without ownership or remuneration) to create a shared outcome from which all can benefit.

Table 1: A Terminology Primer of "Open Innovation" Terms (Source: Steinbeis 2i GmbH based on Docherty 2006)

Open innovation is a broad concept and most probably influences all parts of an organisation. A few more aspects of this concept will be discussed below before examining how it can benefit clusters and cluster organisations in agro-food.

88 Docherty, M. 2006. Primer on "open innovation": Principles and practice, p. 13. PDMA Visions, 30(2), 13–17.

A more recent definition describes open innovation as "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries [...] in line with the organization's business model".[89] This definition leaves room for any type of cooperation, to include creative consumers or communities of user innovators, for example.

The Open Innovation 2.0 (OI2) paradigm of the European Commission is based on principles of integrated collaboration, co-created shared value, cultivated innovation ecosystems, unleashed technologies, and rapid adoption. It promotes user-oriented innovation models and cross-fertilisation of ideas, experimentation and prototyping in real world environments. According to the European Commission, open innovation processes comprise five key elements[90]:

- **Networking**
- **Collaboration**: involving partners, competitors, universities, and users
- **Corporate entrepreneurship**: enhancing corporate venturing, start-ups and spin-offs
- **Proactive intellectual property management**: creating new markets for technology
- **Research and development**: achieving competitive advantages in the market

These key elements should be integrated into an organisation's innovation processes as basic conditions. It is important to understand that, within our increasingly complex world where technological requirements and solutions evolve by the second, an organisation needs to leverage all resources available. Most organisations will not possess all the necessary capabilities and property rights to develop an innovation. Therefore, they will not develop all concepts, prototypes or designs that underpin their innovations. From an economic perspective it would be inefficient if all organisations were to start their own innovation from scratch and use too many financial and other resources to come to a solution that another organ-

It would be **inefficient if all organisations were to start their own innovation** from scratch and use too many financial and other resources to come to a solution.

89 Chesbrough, H., Bogers, M. 2014. Explicating open innovation: Clarifying an emerging paradigm for understanding innovation, p. 15.

90 The Open Innovation Strategy and Policy Group of the European Commission. 2019. Open Innovation 2.0. https://ec.europa.eu/digital-single-market/en/open-innovation-20. European Commission, DG CONNECT, Brussels.

Multiple organisations can **derive innovations from a single concept or technology**.

isation will develop simultaneously or has already been developed. At the same time, one single organisation cannot necessarily implement all concepts, processes or prototypes it may develop. Multiple organisations can derive similar innovations from a single concept or technology and many innovations come from "purchasing, imitating or modifying products, business process equipment, or business methods that are already in use by other firms or organisations".[91]

Open innovation promotes collaboration and should be an integral part of the design of organisational and development processes, innovation strategies and the necessary innovation capabilities. From an open innovation perspective, inbound and outbound knowledge are most relevant for innovation management activities:[92]

- **Inbound (or inward) knowledge flows** occur when an organisation acquires and absorbs externally sourced knowledge in its innovation activities. This encompasses knowledge acquisition and sourcing activities.
- **Outbound (or outward) knowledge exchanges** occur when an organisation intentionally enables other firms or organisations to use, combine, or further develop its knowledge or ideas for their own innovation activities. An example is when an organisation licenses its technology, patents or prototypes to another organisation

Organisations should use inbound and outbound knowledge flows and engage in coupled or joint innovation processes (e.g. the search for new sources of knowledge and the recombination of knowledge from inside and outside the organisation) to promote innovation and creativity within their organisation, but also within their entire ecosystem. Cluster organisations can be part of different ecosystems, but a cluster can have a greater positive impact on open innovation processes among cluster organisation by providing an even safer space for collaboration as the following sections show.

Cluster organisation can provide a **safe space for collaboration** and open innovation actitivies.

91 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 70. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

92 Ibid, p. 132.

Common Open Innovation Activities in Clusters

An investigation of the Portuguese cluster landscape with 902 cluster organisations showed that certain open innovation activities are already widely used within and outside clusters and their organisations. **Informal and formal collaborations**[93] with external parties (inbound or outbound) are a common practice among cluster members and developed by 80 % of cluster organisations. **Idea development** activities are often realised with external organisations as well. Other activities, such as IP management, innovation management and the creation of start-ups or spin-offs, tend to be carried out in closed innovation environments. R&D management and the use of public funding are activities mostly performed in a state of transition from a closed to the open innovation model.[94] The cluster members also use open innovation activities for the identification, selection and analysis of "external" technologies and knowledge, and in their integration into the production process (inbound). Less often, they transfer internally developed knowledge or technology to other organisations (outbound) via licensing agreements or joint ventures.[95]

In the same study, based on the perceptions of cluster members, the influence of the cluster was the highest in those areas where open innovation predominated (i.e. informal networks and formal collaborations, etc.) and low in the areas where open innovation is being implemented less. [96]

With barriers to the adoption of open innovation mostly referring to existing deficits at the level of the cluster organisations themselves, the case of clusters in Portugal suggests that, overall, the membership in a cluster supports the adoption of open innovation in the organisation.

93 Informal collaboration: e.g. maintenance of relationships or informal information exchange vs. formal collaboration: e.g. joint R&D projects

94 Santos, A. B. 2015. Open Innovation in clusters: The Portuguese case, p.24. MPRA Paper No. 70032. University Institute of Lisbon. https://mpra.ub.uni-muenchen.de/70032/1/MPRA_paper_70032.pdf.

95 Ibid, p. 25.

96 Ibid, p. 26. With one exception in the development of ideas, where most organisations (78 %) were very active, but said the cluster had little influence on the development of initiatives in this direction.

Open Innovation and Collaboration in Agro-food

A great example for how open innovation and collaboration is made possible is the Digital Innovation Hub **DIH AGRIFOOD**[97] founded by the Slovenian Innovation Technology Cluster (ITC) as an informal network to support organisations in coping with future agro-food challenges. DIH AGRIFOOD works with farmers, farmer cooperatives, food producers, solution providers, and other stakeholders in the agro-food area to support development, technology transfer and implementation of innovative smart farming applications, and other services to help build the future Slovenian and European agro-food systems. In this example, research teams and SMEs can jointly develop novel solutions around e.g. drones, blockchain, robots, IoT sensors, while ITC Slovenia and DIH AGRIFOOD provide the infrastructure and ecosystem to support market entry and scaling for these solutions.

DIH AGRIFOOD mainly supports organisations by connecting supply and demand, involving them in different projects, initiatives and international networks, supporting them in testing, verification and piloting and finally helping them to scale-up and grow their market. The DIH works based on a multi-actor approach and is free and always open for new members. It was established as "coral reef" model elaborated at the EIP-AGRI Seminar Digital Innovation Hubs for Agriculture in Kilkenny back in 2017, by Grigoris Chatzikostas (Biosense Institute): "The DIH ecosystem can be seen as a coral reef where there are big and small fish, hunters and prey, but overall, everyone performs better compared to isolation". Every stakeholder involved in agro-food is welcome to join and contribute to the "common asset", while being able to use it in their own daily business. This approach and the clear benefit for its members help promote the growth of the DIH AGRIFOOD and its network.

Agro-food organisations contact the DIH mainly because they have a lack in knowledge, skills and financing needed within the context of digital transformation. The DIH provides support in choosing and implementing the most relevant and beneficial technological solutions within a specific context. This support is provided by (part and full-time) experts coming from different member organisations (e.g. research organisations, SMEs, business support organisations, agricultural advisors).

In one of the DIH's projects called CYSLOP (use case of the H2020 project "Internet of Food and Farm"), a Greek partner is providing an Internet of Things (IoT) technology which is being implemented at 12 vegetable farms in Slovenia. Through this technology transfer, the Slovenian farmers access technology, that was not available to them and greatly supports the digitisation of their farms and further digitalisation efforts. In another project called DEMETER, the DIH is equipping vineyards, apple orchards and chicken farms with IoT equipment.

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97 Find more information on the DIH AGRIFOOD in chapter 4.

Learning activities: Other projects of the DIH, involve for example the organisation of workshops and conferences within the AGRA fair in Slovenia (one of the largest Agricultural fairs in South-Eastern Europe) to foster and enhance knowledge of and trust in digitalisation. For knowledge exchange and learning, the DIH organises a yearly gathering for its members, who come together to learn about new technologies and share their experiences and perspectives. Within the Erasmus+ project Smart Farming Innovation Brokers, ITC Slovenia and DIH AGRIFOOD are developing a training programme to give facilitators the tools to support end-users in digitisation and digitalisation processes. One of these training programmes will also be targeted directly at end-users.

Open Innovation for Smart and Sustainable Value Chains

Today, the digitisation and digitalisation[98] of agro-food processes within organisations are main conditions for success. The **integration of information and communications technology (ICT) and Internet of Things (IoT) solutions** is necessary across the ecosystem for all stakeholders, processes, and practices. Many solutions exist and cloud computing allows for new services and applications (e.g. interactive and real-time applications that are location-, context-, and environment-aware) which affect the organisations, the broader ecosystem and the value chain in agro-food. Within the realm of new technologies and disruptive innovations, cloud computing for example will change the roles of the traditional stakeholders in the agro-food sector and add new ones.

Figure 17 below by Allen & Wolfert[99] shows that the stakeholders will not only be the providers of the products and services, but also the recipients, meaning that agro-food businesses lead the changes and development and directly benefit from the results that are being established. These organisations will need to prove their openness and adaptability to new conditions and ways of working.

98 Digitisation refers to the conversion of non-digital, analogue material to a digital format. Digitalisation means the transitioning to digital business models, e.g. the use of digital technologies to change a business model and provide new revenue opportunities.

99 Allen, J. and Wolfert, J. 2011. Farming for the future: Towards better information-based decision-making and communication, p. 7. Palmerston North, New Zealand: AgFirst Consultancy and Netherlands: Wageningen University and Research Centre.

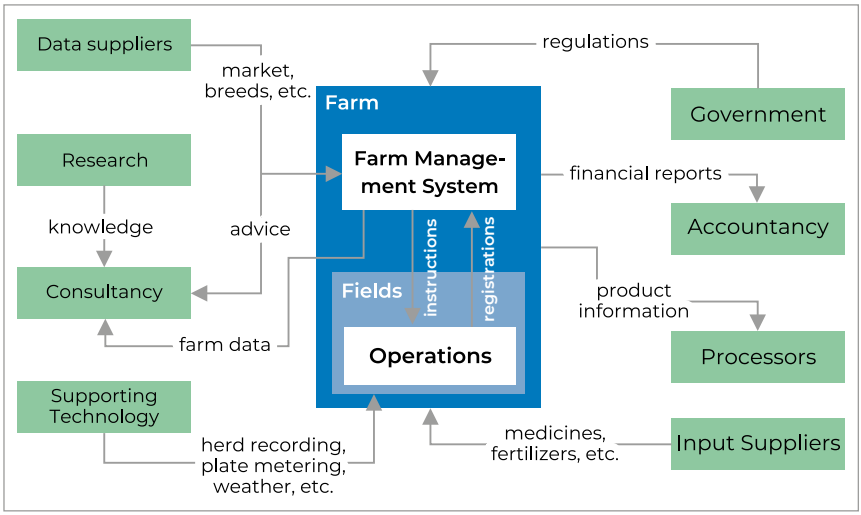


Figure 17: Simplified Representation of Information Flows within and around the Farm (Source: Steinbeis 2i GmbH based on Allen and Wolfert, 2011)

The challenges related to the adoption and integration of ICT and IoT solutions are manifold, ranging from a timely and flexible availability of product and quality information across complex and variable networks, to the need for seamless interoperability of organisation and supply chain systems, allowing for hybrid cloud and decentralised approaches. To successfully overcome these challenges, agro-food organisations need to establish a collaborative environment (including platforms for industry data collection and processing to which all actors have access) and implement major improvements in coordination and communication activities along the value chain. Within today's highly networked, regional and international ecosystems, organisations must be able to easily connect and share information for good decision making in a secure and trusted way.

Precision agriculture technology for example, facilitates data collection and provision along the entire food chain. "It avoids manual data collection and allows farms to keep track on its processes in digital format. This in turn could improve the capability of farms to more easily comply with information requirements of its customers and the chain."[100] The rather traditional agro-food organisations, may

100 Lehmann, R. J., Reiche, R., and Schiefer, G. 2012. Future internet and the agri-food sector: State-of-the-art in literature and research, p. 170. Computers and Electronics in Agriculture, 89, 158–174. https://doi.org/10.1016/j.compag.2012.09.005.

Precision agriculture technology facilitates data collection and provision along the entire food chain.

be held back from implementing important technological changes because they are unfamiliar with the new technologies, perceive an disadvantageous cost-benefit ratio or simply cannot navigate through the endless waves of information in today's technology world. Therefore, support mechanisms and organisations like the DIH AGRIFOOD[101] are needed to support these organisations along the value chain.

ICT and Optimised Agro-food Interventions

As the environmental and socio-economic conditions in all parts of the world develop and grow more interdependent, they increase the complexity of requirements for food safety and sustainability. **Agro-food organisations need new business models providing them with better information about customer needs, better coordination of product flow, and more of the available margin.** They must revise their motivation, ways of working and their processes along the value chain. Figure 18 below shows a process model that can support the transformation of agro-food systems towards a more transparent and sustainable value chain. This transformation needs to include the improvement of the communication and coordination within agro-food systems and the development of appropriate communication schemes, models and tools for complex data collection and knowledge management for information on food safety, quality, and integrity for all actors, including consumers.

For all these elements, ICT plays an important role as an enabler of business process innovation and must properly interact with other management and operational capabilities within an organisation. Agro-food organisations will have to adopt or create new business processes to continue to create value and adapt to the environment.[102]

101 See p. 48. For more information on DIH AGRIFOOD see: https://itc-cluster.com/dih-agrifood/.

102 For more information on research showing that organisations with superior ICT capability are more effective in their collection, analysis, and dissemination of information to relevant stakeholders, see: Chen, Y., Wang, Y., Nevo, S., Jin, J., Wang, L., Chow, W. 2014. IT capability and organizational performance: the roles of business process agility and environmental factors. European Journal of Information Systems, 23, 326–342.

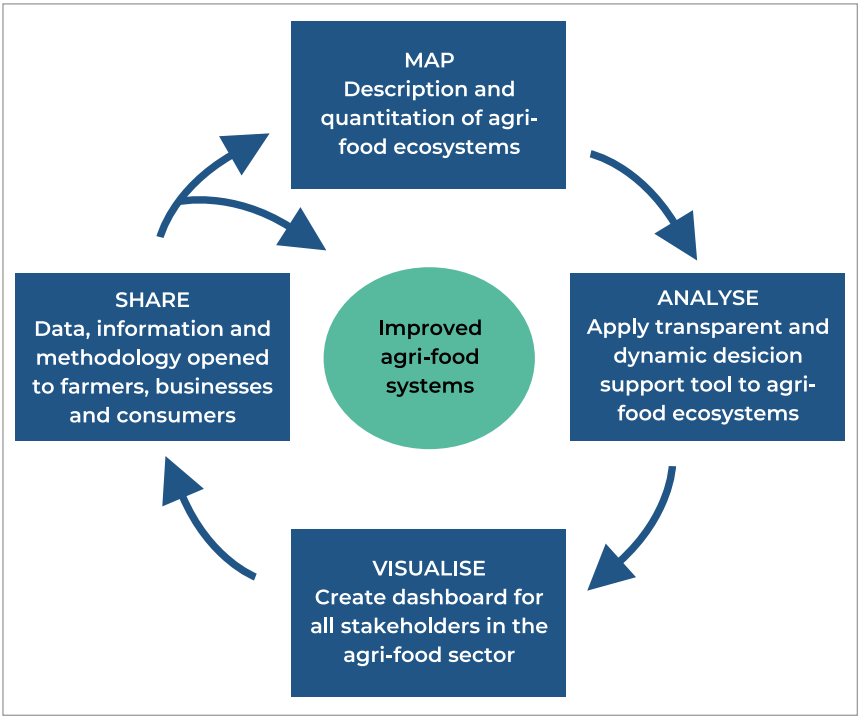


Figure 18: MAVS Cycle for Optimised Agro-food Interventions (Source: Steinbeis 2i GmbH based on Horton et al., 2015)

Transitions towards sustainable agricultural futures will require systemic approaches to design, where local solutions are also capable of contributing to larger-scale solutions – requiring both an intimate knowledge of the local context, needs and culture while also involving a range of actors and local user communities.[103]

Making agro-food value chains smarter and more sustainable will engender a transformation of the ecosystems around it. The ecosystem around agro-food reaches beyond agriculture and the food retail industry. It encompasses agricultural production and harvesting, whole foods, food ingredients and beverages, packaging, logistics and marketing. The sector involves private businesses, government entities, education providers, research organisations, trade unions, industry

103 Turner, J.A., Klerkx, L., White, T., Nelson, T., et al. 2017. Unpacking systemic innovation capacity as strategic ambidexterity: How projects dynamically configure capabilities for agricultural innovation. Land Use Policy, 68, 503–523.

associations, sustainable environment advocates, local communities and consumers. Figure 19 illustrates the various disciplines involved in agro-food.[104]

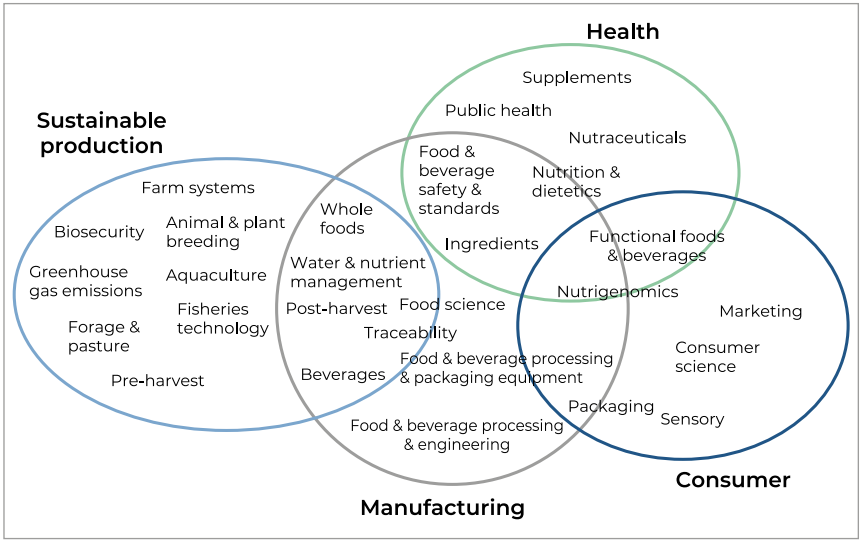


Figure 19: Scope of Disciplines Involved in Agro-food (Source: Steinbeis 2i GmbH based on Marshal et al., 2012)

3.3.3 Idea Management in the Innovation Process

"A really good idea is illustrated by the fact that its realisation seemed impossible from the outset."
Albert Einstein

Idea generation is a main part of the innovation process. According to the Oslo Manual, a major innovation management capability is to **stimulate, collect and evaluate novel ideas produced within the organisation**. Data collection can identify the use or importance of the following methods[105]:

104 Marshal, K., Avery, G., Ballard, R., and Johns, D. 2012. A Call to Arms: A Contribution to a New Zealand Agrifood Strategy, p. 9. Riddet Institute, Palmerston North, New Zealand.

105 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 111. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

- Knowledge management systems
- Idea management platforms
- Employee suggestion schemes
- Financial and non-financial incentives (awards, promotion) for employees to propose innovative ideas
- Delegating decision-making to innovation project managers and innovation staff
- Involving employee representatives in innovation decisions
- Actions to identify, promote and motivate key individuals and groups to drive innovation

To develop and sustain this innovation management capability and become good at idea generation, an organisation should install structured processes and reach standardisation of idea generation and processing to make sure ideas are further developed and implemented and do not get lost. This chapter will present different processes, methodologies and tools for generating, selecting and testing ideas in the innovation process.

Design Thinking as Systematic Process for Idea Generation

Design thinking is a systematic methodology for the design process that uses design methods to identify needs, define problems, generate ideas, develop prototypes and test solutions. It is meant to harness creativity to solve complex problems for innovations in private and public sector organisations. It can be used for the design of systems, products and services. The use of design thinking often does not meet the novelty and uncertainty requirements of R&D. However, the methodology can support the innovation activities of all types of organisations, ultimately resulting in improvements in competitiveness and economic outcomes. But more than other methodologies designed for the different types of innovation processes, it can support buy-in of all actors involved, i.e. management, employees, users, etc.[106] This is crucial for the implementation of innovation.

106 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, pp. 120–121. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

Among the commonly used methods in design thinking are activities such as:

- Divergent idea generation or brainstorming
- Techniques to develop an understanding of the customer experience, particularly ethnographic field research methods (e.g. observing how people use a product in real-world environments, developing an empathetic understanding of what users want in a product)
- Co-design or co-creation (involvement of potential users in generating design concepts)
- Prototyping and testing

Other activities an organisation can engage in to better understand user experiences include identifying opportunities and problems in relation to new or existing products or services. To this end, data can be collected on the following information from users:

- Feedback from sales or marketing personnel
- Evaluation of user-initiated reports of their experiences with a product (e.g. social media, online reviews and comments)
- Structured data collection (feedback forms, dedicated user surveys, focus groups)

Different Roles in Idea Generation

To ensure a good performance of innovation teams, i.e. abundance of ideas, their further development and follow-up, there should be different creativity types and roles for the team members. In design thinking, the role differentiation usually encompasses an ideator who initiates and generates many ideas, a modulator who brings structure to the process and further develops ideas rather than generating them, and an animator who mediates and arbitrates between individuals in the team and drives the process as a positive force. These three creativity types are essential to ensure the success of the team in generating and new pursuing ideas as shown in Figure 20 below:[107]

107 Zysno, V. P., Bosse, A. 2009. Was macht Gruppen kreativ? p. 131. In: E. H. Witte & C. H. Kahl. Sozialpsychologie der Kreativität und Innovation [Social Psychology of Creativity and Innovation], pp. 120–150. Pabst Science Publishers, Lengerich.

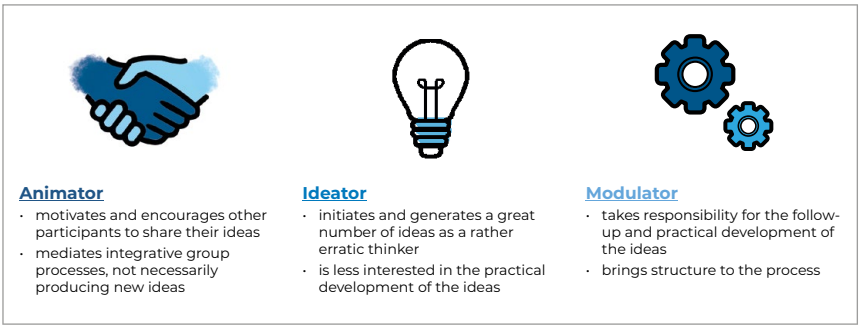


Figure 20: 3 Types of Creativity in Design Thinking (Source: Steinbeis 2i GmbH)

The **animator** mediates the integrative group processes, removes inhibitions and ensures that the other players express any ideas they have, even the "craziest" ones. He or she enjoys the brainstorming process, even though he or she is not necessarily a passionate idea generator. The animator motivates and encourages others by acknowledging their contributions.

The **ideator** generates plenty of new ideas or 'in principle' solutions in a rather erratic manner, e.g. jumping from one idea to the next. He or she finds enjoys abstract problems but is not interested in practically developing ideas further.

The **modulator** is good at absorbing and elaborating on ideas, not necessarily producing them. He or she will be thinking through ideas that have already been generated and thus contributes to the practical development of these ideas.

Innovation Ideas from Research: Agro-food Examples

Innovation processes can make use of new insights from research or from other industries. The Wageningen University & Research (WUR) and the Institut National de la Recherche Agronomique (INRA) have defined innovation areas based on major global challenges faced by the EU in the agro-food sector and in rural areas:[108]

108 Détang-Dessendre, C., Geerling-Eiff F., Guyomard H., Poppe K. 2018. EU Agriculture and innovation: What role for the CAP?, pp. 8–9. Institut national de la recherche agronomique (INRA) and Wageningen University & Research (WUR). https://edepot.wur.nl/447423.

- **Genetics:** New plant and animal breeding techniques are available bridging traditional breeding with genetic modification. Advances in gene editing and modification can remove unwanted genes leading to susceptibility to diseases or allergies, or help developing a tolerance to abiotic factors (e.g. drought). Precision breeding for precision foods and the enhancement of nutritional quality are gaining ground.

- **Digitisation and big data:** ICT enables new systems for farming, using sensors, satellites, robots and all types of machinery, and increasing productivity and outpurs, making farming more climate-smart and helping to solve environmental issues. These new systems also allow for food traceability (e.g. through blockchain technology) or improved control of animal welfare. ICT enables new systems for farming, using sensors, satellites, robots and all types of machinery, and increasing productivity and outpurs, making farming more climate-smart and helping to solve environmental issues. These new systems also allow for food traceability (e.g. through blockchain technology) or improved control of animal welfare.

- **Energy and bio-based transitions gaining ground:** The trend towards low-carbon industrial processes will demand for increased non-fossil biological materials which can only be produced via agriculture, forestry, marine activities and recycling, whereby resource efficiency plays an important role in all agriculture-related activities. There is a trend towards low-carbon industrial processes replacing petro-chemicals and fossil fuels. The demand for non-fossil biological materials will increase and these can only be produced via agriculture, forestry, marine activities and recycling.

- **Eco-system services:** Agriculture plays a vital part in the overall eco-system of many regions, preventing erosion and wildfires, maintaining the landscape and biodiversity or water management. This contribution can entice a re-evaluation against investments from public and private funds, potentially leading to new organisation and collaboration among farmers with new business models, new labels or sustainability schemes.

- **Redesign of food systems on circular principles:** With todays circularity efforts and improvements in biomaterial manufacturing processes, agriculture must be linked to bio-economy chains, to supply them through smartly designed systems with minimum losses of produced biomass. This includes the problem of food waste, where in the EU-28, around 20 % of produced food does not arrive on a plate for human consumption due to losses and waste.

Ideas are needed to initiate innovation processes. To understand how an entire innovation process functions, the next sections focus specifically on product, process and business model development.

3.3.4 Product, Process and Business Model Development

As there are various ways for how an organisation can innovate, it should narrow its focus on a specific type or category of innovation for an innovation project or set of innovation activities to ensure high effectiveness in implementation. The three main categories of product, process, and business model innovation will be discussed in this section.

Product or Service Innovation

The first thing that comes to mind when thinking of innovation is generally product innovation or innovation of a service, which aims at differentiation of an organisation's products and services against those of competitors and can come in different forms:

- The **development of a new product or service**, e.g. new drought-tolerant maize, biofortified beans or waste collection and reuse
- An **improvement of the performance or quality of the existing product or service**, e.g. complementary sensors and IoT software added to harvesting equipment
- A **new feature to an existing product or service**, e.g. low-cost wooden greenhouses for high quality vegetable production with netting as walls to create a physical barrier to prevent virus-transmitting insects and a roof made of plastic to prevent high humidity and keep out bacteria and fungi

Potential drivers of product innovation are technological advancements, regulatory changes, changes in customer requirements, or outdated product design. Product innovation is generally visible to the customer and user and should aim at an increased demand for this product.

(Source: © Innovation Technology Cluster Slovenia, 2020)

These are examples of on-field installations of sensors for control of microclimate and environmental parameters to maintain the ideal conditions for plant growth in a greenhouse tomato production in the Primorska region and in the vineyards of the Pomurje region, implemented by organisations in collaboration with the ITC Cluster in Slovenia.

Process Innovation

Process innovation deals with the combination of facilities, skills and technologies used to produce, deliver, and support a product or provide a service. This can relate to any processes across an organisation's value or supply chain (see Figure 21). Processes can improve in many ways:

- Changes in **equipment and technology used in manufacturing and processing**, including software used in product design and development (e.g. autonomous tractors, sensors or drones for monitoring of crop, irrigation or soil assessment, nutritional technologies for livestock farming)
- Improvement in **tools, techniques, and software solutions** used to help in **supply chain and delivery system** (e.g. farming software to share data between farms and wholesalers or distributor, blockchain solutions for transparency of the supply chain, robotic harvesters)
- Changes in **tools used to sell and maintain products or services** (e.g. digital seed business, biodegradable or multi-use types of packaging against post-harvest loss)

A change in process often has lower risk than product innovation, is mainly valued internally, and will often reduce costs of production or processing rather than driving an increase in revenue. Process innovations can be manifold and should be exploited where possible.

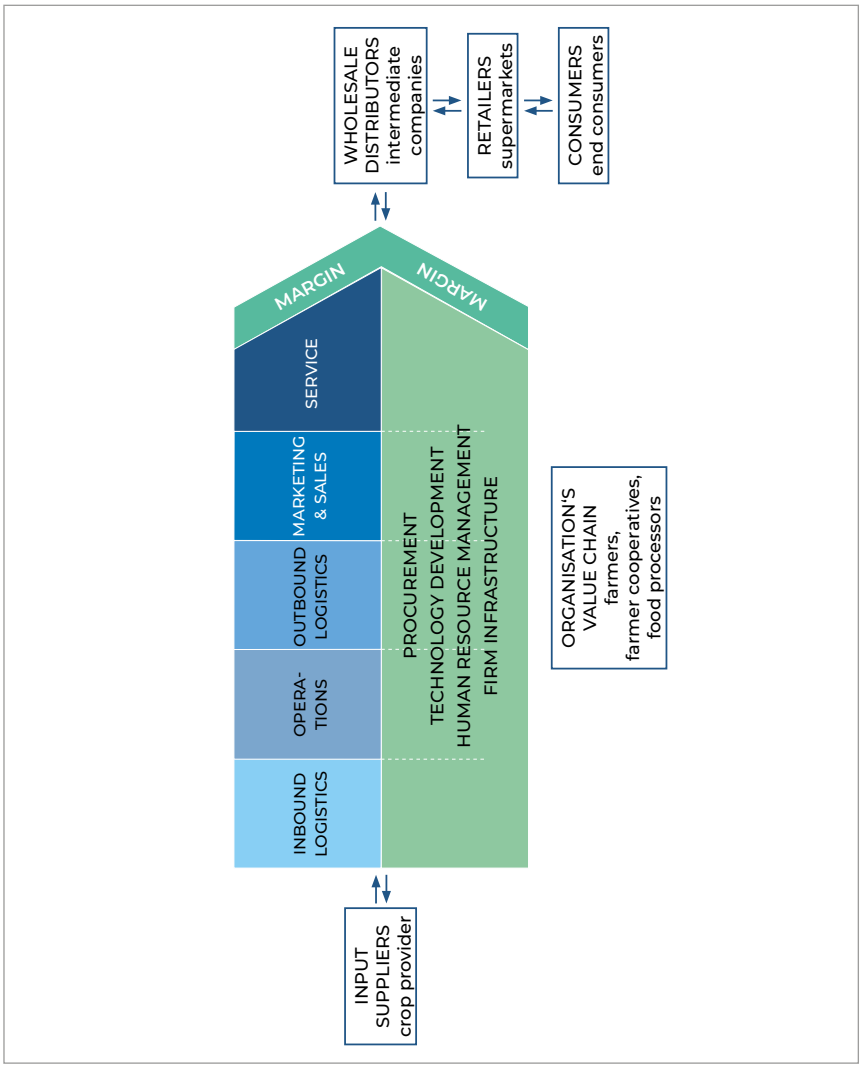


Figure 21: Integrated Presentation of an Organisation's Value Chain
(Source: Steinbeis 2i GmbH adapted from Porter, 1985)

(Source: TERMODRON d.o.o.)

A start-up company from the DIH AGRIFOOD is working with the ITC Cluster in Slovenia on improving a solution based on drone technology. The ITC Cluster is connecting the organisation with different research organisations and end-users with which they can test the solution. By using drone scanning of the fields, the farmer can dose the optimal consumption of fertilisers in plant protection bodies. This can save 20 % of fertiliser, which is potentially detrimental to the environment and expensive.

One of the main challenges within the project is related to data management: the data from the drone has to be processed and translated into data the precision farming equipment in the tractor can process. The solution is already being sold, but the organisation and its partners are working on its improvement to provide a system optimised for all types of precision farming equipment. This is an example for continuous improvement (see chapter 3.3.5).

Business Model Innovation

Business model innovation relates to the way products and services are brought to the market and often requires major changes. Product and process innovation can be incremental, but business model innovation is almost always radical (or disruptive) and has great transformative potential for a sector or industry (e.g. AirBnB, Uber, etc.). Business model innovation can affect:

Business model innovation relates to the way products and services are brought to the market.

- **Capabilities** that made the organisation successful at some point in time
- **Processes** which made the organisation profitable

These changes can threaten elements of the organisation identity and conflict with brand expectations or promises.

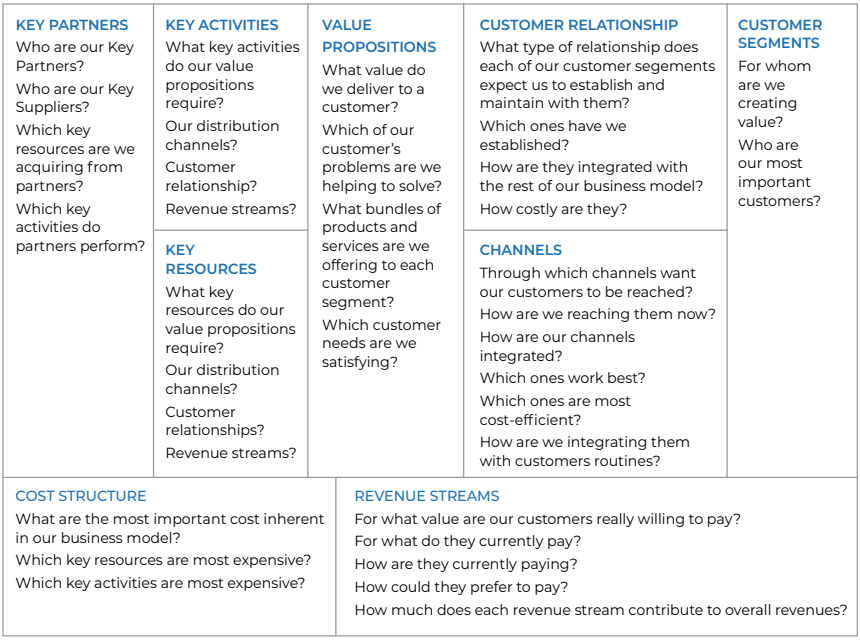


Figure 22: Example of Business Model Canvas (Source: Steinbeis 2i GmbH based on Alexander Osterwalder, 2005)

The business model canvas[109] (BMC) is a basic management tool to describe the rationale of how an organisation creates, delivers, and captures value, in economic, social, cultural or other contexts. It helps the organisation to define and prioritise their value proposition, customer segments, relationships with those customers and channels to reach them. In order to understand how the value propositions are delivered to the customers, the organisation must define key activities to be performed and key resources needed in order to do so. Based on the latter, the organi-

109 For basic definitions and methodologies around the business model canvas, see: Osterwalder, A., Pigneur, Y., Clark, Tim. 2010. Business Model Generation: A Handbook For Visionaries, Game Changers, and Challengers. Strategyzer series. John Wiley & Sons, Hoboken, New Jersey.

sation defines the most important partners for implementing key activities, as well as the cost structure and potential revenue streams of the business model.

Revising the BMC can help an organisation identify elements of its business model that could be outdated or have the potential to be further developed, e.g. discover new markets and business fields or improve on internal processes within the cost structure.

There are plenty of examples for business model innovation in agriculture. Some of the most impactful in today's economies will include the data-driven farming and digital solutions, and they will also require the collaboration of many actors within the agro-food ecosystem. The following cases are transferrable to different applications and contexts:

- Using blockchain technology does not only make the supply chain more transparent, it also makes it possible to create inclusive business models where value is shared fairly among the stakeholders within a specific value chain (e.g. coffee or fruit) without raising prices.[110]

- An app-based e-commerce platform where farmers' surplus and buyers' demand for crops are advertised and traded, specifically to connect smallholder farmers to markets.[111]

- An agricultural training centre can boost a territory while keeping the youth in rural areas, with the municipality granting one hectare of land to each young farmer trained to support them in the development of productive farms.[112]

Prototyping Business Models

After ideas for business models have been generated and selected, they can be translated into business model prototypes, e.g. into a sufficiently precise and complete description of the new business model which allows the decision-maker to make a final decision on whether it should be implemented or not. Such as prototype can reveal the robustness or quality of the business model when checked

110 See: https://fairchain.org/our-story/
111 See: https://innovation.wfp.org/project/virtual-farmers-marke
112 See: http://www.fao.org/family-farming/detail/en/c/418372/

against the competition, or checked for consistency of the business model in itself and between all its elements.

For an organisation to better target where it should innovate, it needs a better understanding of the contexts and driving forces within its industry. An organisation needs to know itself and also its environment. The following paragraphs will provide a more detailed view of the agro-food ecosystem and supply chains and how to analyse the inner workings and outer environment of an organisation.

Considering the Context: Ecosystems and Supply Chains in Agro-food

As became clear in the previous chapters, the agro-food sector affects and is affected by many other industries and disciplines. Therefore, agro-food ecosystems and supply chains become more and more complex. Figure 23 below provides a simplified, but clear representation of a complex agro-food ecosystem, including value chain, external factors and inputs, environmental penalties, and ecosystem functions, indicating influences on the wider network, and the impacts the value chain has on the environment and consumer health. To understand the complexities of the agro-food ecosystem and find potential areas for innovation, an organisation should look at "the various functions, factors, inputs, key actors, losses and wastes, and the environmental and health penalties involved in the sector".[113]

113 Kelly, S. et al. 2017. Disruptive technology in the agri-food sector: An examination of current and future influence on sustainability, bio-security and business effectiveness, p. 9. Based on Horton, P., Koh, L. and Guang, V. S. 2016. An integrated theoretical framework to enhance resource efficiency, sustainability and human health in agri-food systems, p. 166. Journal of Cleaner Production, 120, 164–169. The figure was adapted from the New Zealand Ministry of Research, Science and Technology (MoRST) Food Research Roadmap.

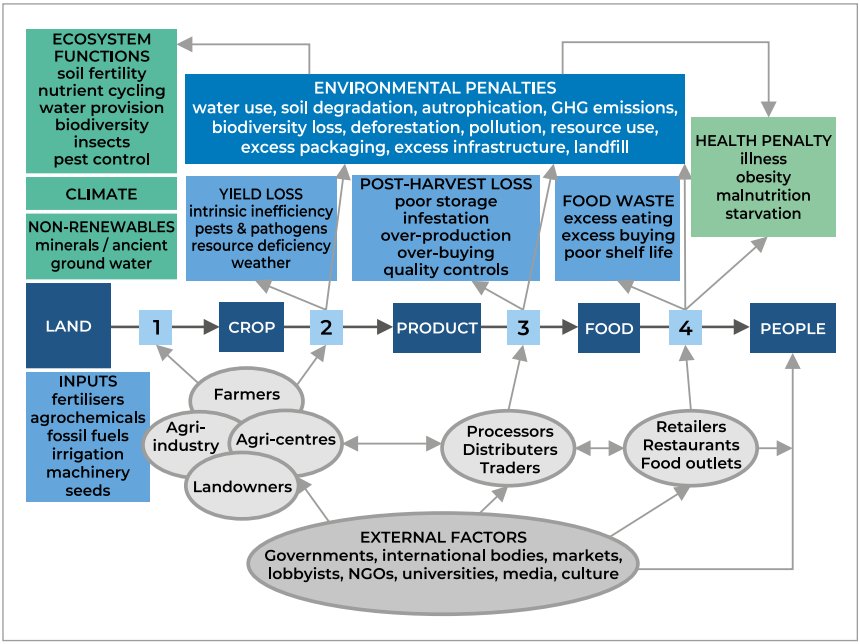


Figure 23: Generic Agro-food Ecosystem Template (Source: Steinbeis 2i GmbH based on Horton et al., 2016)

Various factors, actors and activities are interconnected within this complex agro-food ecosystem and affect the agro-food value chain. When planning and implementing innovation activities, the organisation must consider the effects on and interdependencies between these factors and actors. From an open innovation perspective, such **a broad ecosystem offers great opportunities for collaboration on product, process and business model development**.

SWOT Analysis for Innovations in the Value and Supply Chains

The SWOT analysis is a strategic method of analysis used to evaluate the *Strengths* and *Weaknesses* of and the *Opportunities* and *Threats* for an organisation, or a specific project or product. It will help an organisation to define a direction and strategic objectives for business or innovation activities. The organisation should make use of its strengths and take advantage of current and future markets, technological and financial opportunities that will help to achieve its goals.

At the same time, it must be aware of its own weaknesses to be able to improve on them, and detect potential threats coming from its environment to better overcome obstacles on the way to success. The organisation's innovation strategy and activities need to continuously be adapted on the basis of this knowledge and regularly reviewed based on updated SWOT analyses.

Figure 24 shows a set of potential questions organisations in agro-food could use when performing a SWOT analysis.

Strength	Weakness
• What is your organisation doing well? What do other organisations see as your strengths? • What are the major sources of your organisation's revenue and profits? • Why do your customers buy from your organisation (e.g. consistent quality, advertising)? • What differentiates your operations from other in the market? • What relevant resources does the organisation have (e.g. forages, cereals, water resources, buildings)? • What is the organisation's greatest asset?	• What does your organisation or operation not do well? • What do other organisations see as your weaknesses? • What are the organisation's least profitable divisions or activities? • Is your operation "wandering" (e.g. no direct focus or objective)? • Is your organisation's marketing, advertising effective (e.g. buyers from only one point of sale)? • What is the biggest expense of your operation which could potentially by reduced? • What relevant resources does your organisation need and is it dependent on others (e.g. water supply, rural water line)?
Opportunity	**Threat**
• What market trends are you observing (e.g. price/sales related to different seasons or holidays)? • Can the quality of products or operations be improved without incurring serious costs or can a competitive edge be created e.g. through addition of value-added product, new technologies, etc.? • Is there an opportunity to demand better prices from suppliers (e.g. allow supplier to use your name in their advertising, etc.)? • What new government policies and programs are available for financing (e.g. cost-share for watering systems, or fencing)? • What interesting local events might benefit the operation (e.g. county fairs, farm field days)?	• What obstacles does your organisation's operation face (e.g. lack of rural water system, drought, rural roads and bridges)? • Are there any existing or future potential competitors in your organisation's market? • Are there any (new) regulations in the industry that make it difficult to be profitable (e.g. state approval for processing, collection, and sale of certain products)? • Are international or distant competitors taking over market share? • Is changing technology threatening your organisation's profitability (e.g. buyers now purchase frozen products over the Internet)?

Figure 24: SWOT Analysis with Sample Questions for Agro-food Organisations (Source: Steinbeis 2i GmbH)

All these questions can be asked with respect to activities at the cluster or supply chain levels. Some questions can be used to identify both strengths and weaknesses depending on the answer, e.g. "Is the organisation's marketing, advertising effective (e.g. buyers from only one point of sale)?"

SWOT Analysis and Supply Chains in Agro-food

One of the key objectives for agricultural and food-related organisations is to assure food quality throughout the supply and value chains, and all food functionalities for the consumers. Figure 25 shows a conceptual agro-food supply chain optimisation model which aims at explaining supply chain optimisation considering specific coordination mechanisms (contracts, information sharing, joint decision-making, collective learning) and applying a six-step process including: [114]

1. The selection of efficient key performance indicators (KPIs)
2. The measurement of efficient key performance indicators (KPIs)
3. Benchmarking
4. The definition of improvement actions and opportunities
5. The calculation of the impact of the improvement actions
6. The implementation of improvement strategies

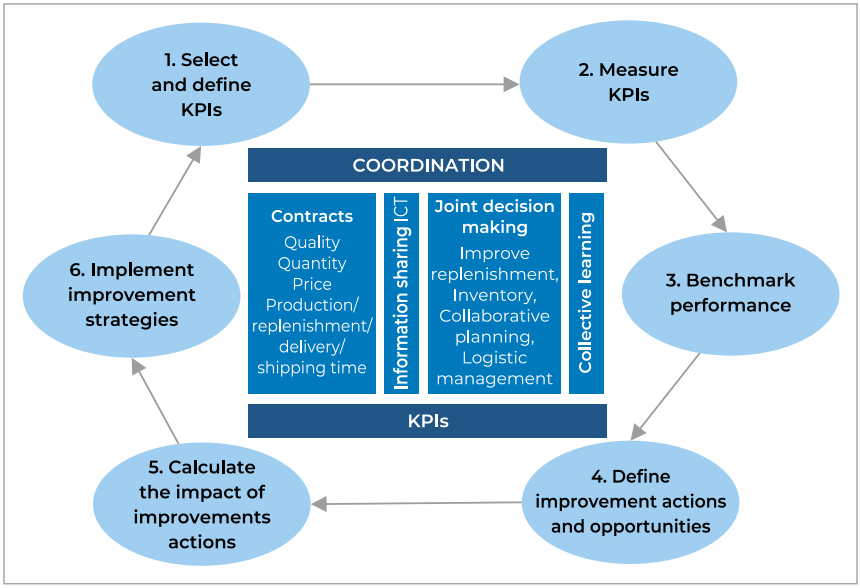


Figure 25: Agri-food Supply Chain Optimization Conceptual Model (Source: Steinbeis 2i GmbH based on Fiore et al., 2018)

114 Fiore, M., Stašys, R., Pellegrini, G. 2018. Agri-food supply chain optimization through the SWOT analysis, p. 30. Management Theory and Studies for Rural Business and Infrastructure Development, 40 (1), pp. 28–36.

Fiore et al. performed SWOT analyses with agro-food organisations which had implemented the six-step process along their supply chain to identify internal and external factors as strengths and weaknesses, and opportunities and threats they faced. The outcomes of the analyses provided insights on how the organisations' operations could be improved with respect to the economic and social contexts in which they operated.

The SWOT analysis can also be used to optimise entire agro-food value chains. According to a recent study, the strengths of the fruit and vegetables supply chains in Italy, for example, are: [115]

- High production volume
- High product assortment
- Presence of agro-food districts and high level of supply chain organisation in certain areas
- Export to international markets
- Local traditional-certified food products
- Several companies considering food
- Health organic products
- Good entrepreneurial skills (e.g. business model)
- Wellness culture

The weaknesses of the fruit and vegetables supply chains of Italian enterprises are: [116]

- High pro-duction costs with high production standards
- Fragmented SMEs
- Insufficient organisation of the production control systems
- Insufficient logistics and distribution networks (low internationalisation)
- Limited presence of distribution centres
- Fragmented distribution (retail)
- Inadequate national and international market networks
- Lack of port facilities
- Lack of national branding

115 Fiore, M., Stašys, R., Pellegrini, G. 2018. Agri-food supply chain optimization through the SWOT analysis, p. 32. Management Theory and Studies for Rural Business and Infrastructure Development, 40 (1), pp. 28–36.
116 Ibid, p. 33.

The study also suggests that economic crisis and stagnation can affect trends in consumption, reducing the profit of organisations that face difficulties in seizing new markets. This could indicate that innovation efforts should be dedicated to other areas, such as **improving business processes** to reduce costs and increase margins. A different perspective would put **stronger cooperation with partners in new markets** as priority (instead of engaging in solo efforts for market entry). The same study also highlights resistance to innovation by agro-food Italian businesses in relation with their size. As opposed to resisting innovations, an organisation that is willing to invest, e.g. in ICT technologies, can benefit from the opportunity to **improve its productivity and competitiveness**.[117]

Competence Matrix

The **Competence Matrix** is a tool that captures not only the core business of an organisation (including its internal value chain), but also its assets and the technology fields and markets that are relevant to its operations, and potential user markets. The following Figure 26 provides an example for the competence matrix for a fictive agro-food organisation which produces cereal.

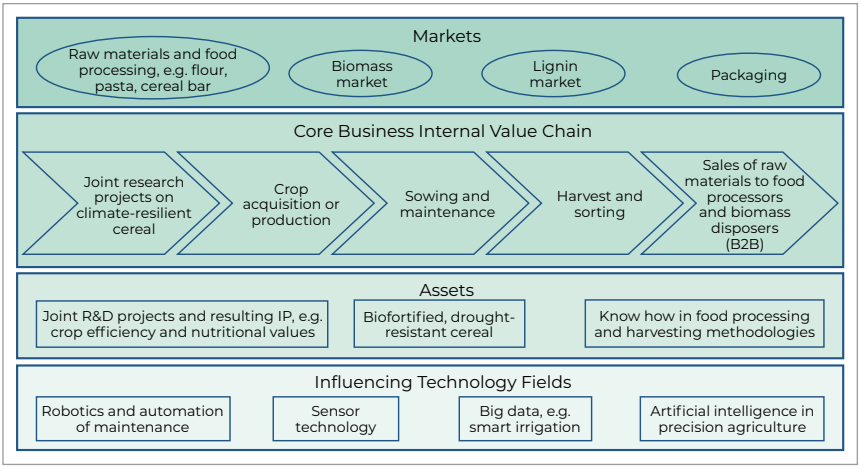


Figure 26: Example of Competence Matrix for Agro-food Organisation (Source: Steinbeis 2i GmbH)

117 Fiore, M., Stašys, R., Pellegrini, G. 2018. Agri-food supply chain optimization through the SWOT analysis, p. 34. Management Theory and Studies for Rural Business and Infrastructure Development, 40 (1), pp. 28–36.

The organisation proceeds as follows:

1. Defining the **components of its value chain**, which is divided into the upstream value-added components, main value-added components and downstream value-added components.
2. Defining its **assets** including important knowledge components which have been created within the organisation, e.g. through R&D activities, or are simply available inside the organisation as expertise. They also include intellectual property rights and secrets (e.g. patents or recipes).
3. Defining the **fields of technology** referring to superordinate technologies that affect one or more components of the organisation's the value chain.

Once all components, assets and technologies have been listed, the organisation needs to prioritise each element contained in the competence matrix. The evaluation should be based on **resource strength** (e.g. financial in terms of budget size or related to the know-how available in the organisation) and **strategic relevance** according to the organisation's own vision.

After the organisation has compiled and evaluated all elements, it needs to prioritise the different technologies and relating markets to derive strategic insights guiding future activities. This is further developed based on Pfeiffer´s technology portfolio analysis described in the following paragraphs.

Technology Portfolio Analysis

The Technology Portfolio Analysis (TPF analysis) depicted in Figure 27 below is an instrument of strategic technology management initially developed by Pfeiffer[118]. It is used for the systematic evaluation of (new) technologies and provides the basis for strategic investment decisions in favour of economically promising (new) technologies.

118 Pfeiffer, W., Dögl. R. 1986. Das Technologie-Portfolio-Konzept zur Beherrschung der Schnittstelle Technik und Unternehmensstrategie, p. 154. D. Hahn, D., Taylor, B. 1986. Strategische Unternehmungsplanung – Strategische Unternehmungsführung. Stand und Entwicklungstendenzen. 4th Edition. Heidelberg/Wien, S. 149–177.

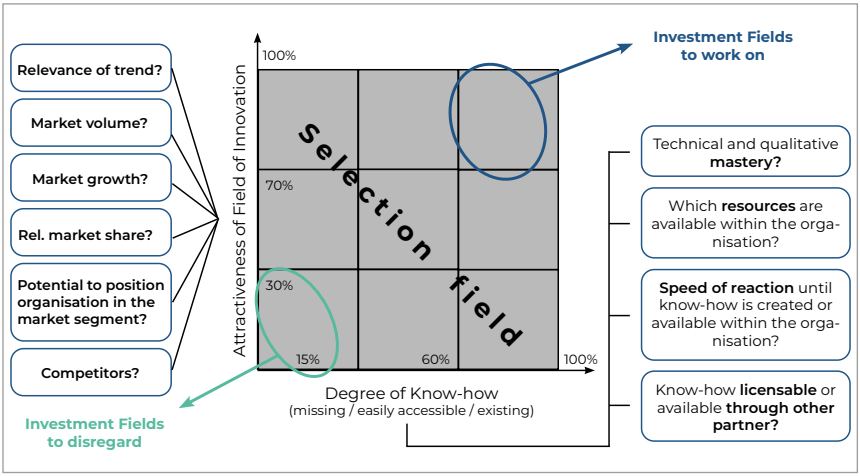


Figure 27: Technology Portfolio Analysis (Source: Steinbeis 2i GmbH adapted from Pfeiffer, 1986)

In the TPF analysis, the organisation first **evaluates the attractivity of the technology** based on market trends and its own strategy (vertical axis). In a second step, the organisation **evaluates its strengths** – technical as well as financial – in **terms of resources**, and in comparison to its competitors (horizontal axis). In a third step, the organisation **analyses the findings and evaluates them against the insights of the competence matrix**. This approach leads to a strategic understanding of the recommended courses on how to go about the technologies, products and/or business fields taken under consideration.

The competence matrix and the technology portfolio analysis allow the organisation to **assess its technological competencies and overall strengths against the trends and the perception of the market in a dynamic process**. They provide a structured overview of the relevance of examined technologies, based on which the organisation can review its strategic objectives with respect to technologies, products or markets and adapt its course of action.

The Organisational Environment: Stakeholder and Environment Analysis

An environmental analysis is a strategic tool to also identify the external and internal elements, which can affect the performance of an organisation. It also entails assessing the level of threat or opportunity the different factors might present. The previously mentioned SWOT analysis and the subsequently described PESTEL analysis are linked, but have different areas of focus. The PESTEL analysis looks at the "big picture" that influences a decision, a market, or a potential new business area, whereas the SWOT analysis investigates these factors at a business or product level.

The PESTEL analysis is applied as a framework and a methodology to analyse macro- environmental factors that can have an impact on an organisation's performance based on its capacity to respond or react to them. It allows the organisation to better understand its market and environment, and the way these can affect or benefit its strategic choices. PESTEL stands for Political, Economic, Social, Technological, Environmental and Legal factors:

- **Political:** This factor represents the way the government influences the economy and businesses. This could be at the federal, state or local level. Considerations include factors, such as a potential change of government, unstable government due to the balance of power, tax law, changing policies, labour laws, and trade restrictions.

- **Economic:** Factors that may influence your business plan include inflation rates, interest rates, economic growth, exchange rates, and property prices. Economic factors differ for each region, city or county and must be analysed for their impact on your business.

- **Social:** This factor refers to demographic factors, including population growth rates, cultural aspects, age distribution of population, and changing social behaviours; e.g. people using social media applications to discuss products and services. Many of these factors may impact the way you do business with your clients and the methods of interaction you may have.

- **Technological:** This refers to the rate of technological changes and Research and Development (R&D) activities, automation, and incentives. These factors influence outsourcing decisions, quality, and efficiency considerations. Some examples include mobile internet, tracing technology and smart sensor systems, emergence of artificial intelligence, etc.

- **Environmental:** This refers to all the factors directly related to, influenced, or determined by the surrounding environment. This could include weather and natural disasters, geographical position, climate changes, and sustainability. Think about the apparent increased frequency of natural disasters (floods, drought, etc.) and their impact on the business and future planning of many affected organisations.

- **Legal:** This factor refers to all the laws directly connected to an organisation and its area of activity.

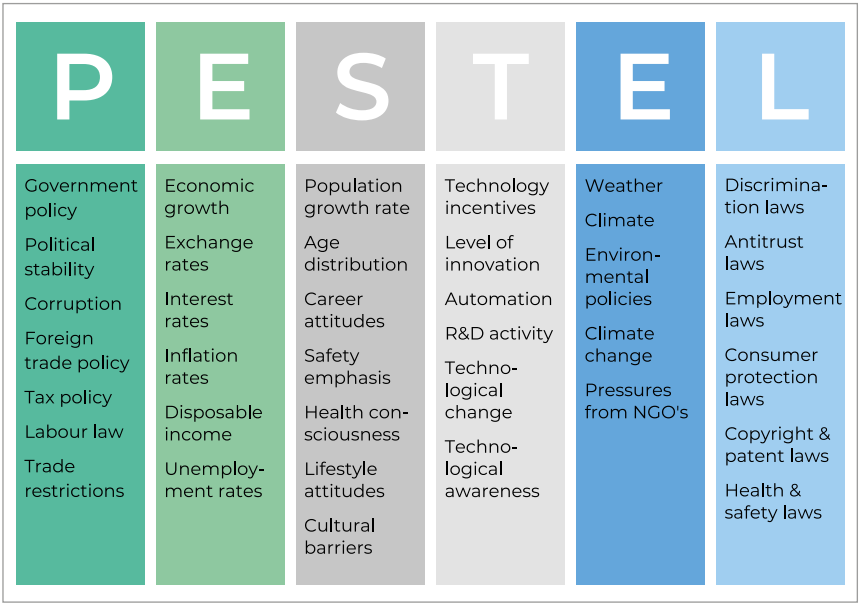


Figure 28: Example of PESTEL Analysis for Agro-food Organisation (Source: Steinbeis 2i GmbH adapted from Aguilar, 1967)

Analysing Innovation Pressure: The Innovation Radar

Another tool that can be used to identify potential innovation areas of an organisation is the **Innovation Radar**. This tool can help an organisation to **identify innovation pressures** that can have an influence on the organisation's success. Figure 29 provides a generic example of an Innovation Radar for an organisation in the fruit & vegetable processing industry. The tool comprises four quadrants depicting pressures coming from **customers and users, competitors, regulations and other markets and disruptive technologies**. The innovation pressure increases toward the centre of the circle. Based on the innovation radar, the organisation can detect a specific innovation need, i.e. *where* to innovate with respect to products and services, internal processes or the business model, and can derive insights for further trends and developments of innovation activities.

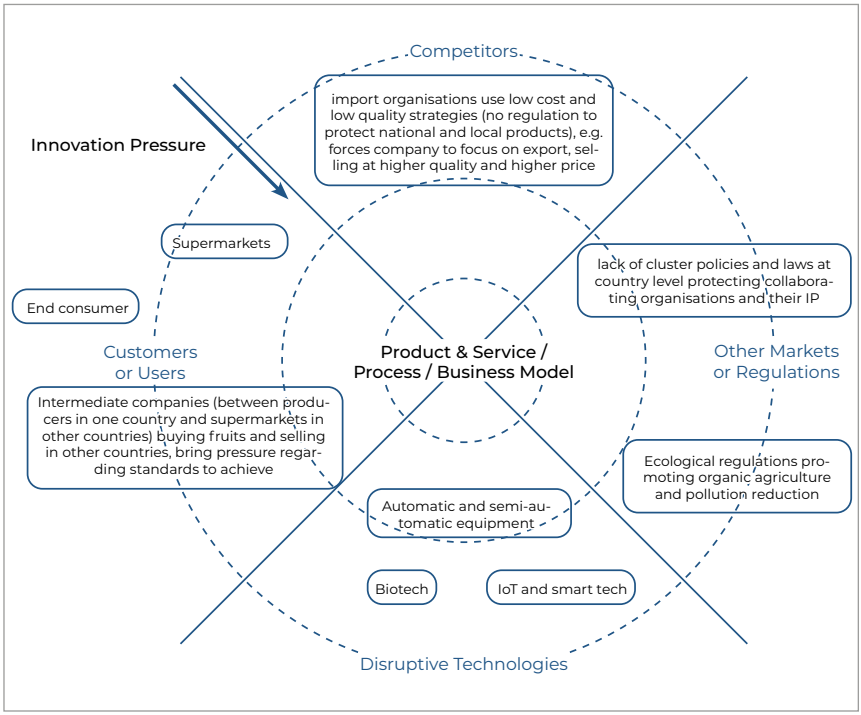


Figure 29: Innovation Radar for a Fruit and Vegetable Processing Organisation in Slovenia (Source: Steinbeis 2i GmbH)

The following are sample question to find out about the different pressures affecting the organisation.

Questions regarding **customers and users:**

- Are customers satisfied with our services, the channels and communication we provide them with?
- Are they willing to pay? Why?
- Can they switch to other products and services easily? What are the main mechanisms of switching?
- Do we have to change our pricing model with respect to the need of our customers?

Questions regarding **competitors:**

- Are there competing products or services on the market that are superior to ours? In what way?
- Which competitors are offering more than we do?
- Do we have to find a way to sell our product or provide our service cheaper?

Questions regarding **other markets:**

- Are other markets (related or not) threatening to seize customer share from us?
- Are other markets (related or not) threatening to make our offerings?

Questions regarding **disruptive technologies:**

- Which disruptive technologies reach our market?
- How will they change the relations between the customers and our offerings?
- How will they influence our own business processes or business model?

The organisation may also ask some of the following questions:

- How can we increase revenue from each customer?
- How can we improve on customer loyalty or retention?
- How can we improve on our communication channels or provide better services?
- Which types of new or improved products can we offer to increase revenues?
- How can we reduce costs in production or other processes to sell products cheaper?

- In what ways can we improve our products or services?
- How can we reduce costs in production or other processes to increase revenues?
- How can we access and use these disruptive technologies for all the above?

All these questions can trigger different types of innovations in different parts and at different levels of the organisation. The innovation radar helps to identify where the potential for innovation lies with respect to products and services, internal processes or business model of the organisation.

External Factors as Drivers and Obstacles to Innovation

Every organisation operates within a specific context. This context is characterised by certain factors and conditions which can act as drivers of innovation or barriers to innovation, e.g. product quality regulations which can create barriers to new entrants while motivating specific types of innovation activities for organisations active in the market. External factors can also provide opportunities and incentives to develop a competitive advantage and thereby create new value for the firm.

Potential external factors that can drive innovation are presented in Table 2 below and be grouped into the following three main categories: [119]

- The organisation's market environment
- Public policies including regulations
- The social environment

119 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, p. 160. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

General area	Specific area	Importance as a driver of innovation
Markets	▪ Domestic customers ▪ Access to international markets ▪ Suppliers and value chains ▪ Availability/cost of skills ▪ Availability/cost of finance ▪ Competitors ▪ Standards ▪ Markets of knowledge ▪ Digital platforms	Low, medium, high
Public policy	▪ Regulations ▪ Functioning of courts and rules enforcement ▪ Taxation ▪ Public spending (level and priorities) ▪ Government support for innovation ▪ Government demand for innovations ▪ Public infrastructure ▪ General policy stability	Low, medium, high
Society	▪ Consumer responsiveness to innovation ▪ Favourable public opinion towards innovation ▪ Level of trust among economic actors	Low, medium, high

Table 2: Collection of Data on External Drivers of Innovation (Source: Steinbeis 2i GmbH adapted from Oslo Manual, 2018)

Collecting data in these specific areas and on their respective importance as drivers of innovation provides the organisation or cluster with information on which trends, technologies, regulations or other market, policy or societal factors to consider when innovating its products, processes or business model.

Prototyping, Launch and Continuous Improvement

For an invention, a new idea, model, method or prototype to become an innovation, it needs to be implemented. "Implementation requires organisations to make systematic efforts to ensure that the innovation is accessible to potential users, either for the organisation's own processes and procedures, or to external

The implementation of innovations requires **systematic efforts comprising the development, testing and validation of the innovation**.

users for its products." [120] These systematic efforts comprise different activities like the development, testing and validation of the innovation the organisation decided to pursue, but also the launch and the continuous improvement of achieved innovations, to ultimately build continuous improvement processes.

Prototyping and Experimentation

Prototyping is an essential part of innovation and development activities in organisations and fundamental to the design of products, services, processes or business models. A Prototype can be "any representation of a design idea, regardless of medium"[121] or, slightly more specific: a representation of all or part of a product or system that, although limited in some way, can be **used for testing and evaluation**. By testing and evaluating a prototype, the organisation can **obtain early feedback on the requirements or features of the innovation** without the risk of committing large investments into manufacture or process improvements. The following sections will provide examples of different kinds of prototyping activities. Not only products and services but also social processes can be prototyped to give valuable insights on social innovation processes for example.

Robotics Innovation Experiments in Agro-food

An interesting example involving innovation experiments is the "agROBOfood" project[122], a EU funded project which aims at building a European ecosystem for the **effective adoption of robotic technologies in the agro-food sector**, involving Innovation Experiments, organised and monitored by 49 Digital Innovation

120 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, p. 47. 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

121 Houde, S., Hill, C. 1997. What do prototypes prototype?, p. 3. Handbook of Human – Computer Interaction, 2nd Edition, 367–381. Elsevier Science B. V., Amsterdam. http://blogs.ischool.berkeley.edu/ict4sc/files/2010/09/Prototypes_prototype.pdf.

122 The agROBOfood project is a European Innovation Action and is coordinated by Wageningen University & Research (a collaboration between Wageningen University and the Wageningen Research foundation). For more information see: https://agrobofood.eu/project/.

Hubs and 12 Competence Centres. Initial Innovation Experiments demonstrate robotics innovations in agro-food in seven regional clusters to promote the replication and wide adoption across Europe. The Digital Innovation Hubs support companies in their digitisation and digitalisation efforts by connecting various stakeholders in robotics and agriculture, R&D and business. Open Calls will attract additional Innovation Experiments and Industrial Challenges. There are €8 million available to the benefit of SMEs. An Industrial Advisory Board will provide strategic guidance and also define priorities for the selection of solutions to be funded.

Within the project, a **demonstrator robot** (mixed palletiser) able to work in a freezer room is being built to protect people from working in sub-zero temperatures. Another demonstrator is being built to judge the maturity of fruits and vegetables (e.g. cucumbers) and pick and handle them automatically in a greenhouse. Other projects involve the development of drones to monitor vineyards or the robots that harvest fruit automatically, on time and with less manpower, which could result in reduced production and resource costs, while countering labour shortage.

Rice Fields as Prototypes of Social Innovation Processes

Prototyping and experimentation in agricultural practices can have various forms and settings. A practice-based design research project conducted in China offers interesting insights on the meaning of the involvement and support of the community in innovative agro-food practices.[123] In a field research in Chongming Island, a rice field was used both as a **prototype of a social innovation process** through the involvement of local community and as a **communication and experimentation tool** among designers, farmers and city networks to develop organic agricultural practices.

The research team designed communication, services and experiences in a way to help increase the farmers' awareness on daily practices of agriculture and reconstruct their knowledge identity. The field was managed in a continuous process of **knowledge sharing** among designers (suggesting and implementing creative solu-

123 Valsecchi, F., Pollastri, S., Lou, Y. 2012. Agriculture prototypes: A design experiment of sustainable open fields in China, p. 5.

tions) and farmers (contributing with experience and technique), building trust between the different actors. Even though it was not possible to fully apply practices of organic agriculture, all practices were kept as natural as possible. This showed that the examined processes not only pertained to a certain way of food production but was linked to the **social and economic development of the community**. The involvement and support of the community in innovative agro-food practices also constituted the envisioning and development of the local and food networks, as well as a new common perception of public space, where connections and trust among different stakeholders were facilitated.

Sustainability and Food Quality through Cooperation

A second part of the same project involved the urban segment and the project communication and distribution in nearby cities.[124] The direct communication with committed customers, involving storytelling on the experience and the role of farmers (through branding and visual tools like pictures, printed material and a book), created a sense of connection between the consumer and the place of origin of the rice. The knowledge and practices implemented in the fields were translated into knowledge value for the final customers. The rice was distributed to farmers markets around the city, at public events and in restaurants supporting local production and sustainable approaches to urban development. Other local associations and commercial initiatives started showing interest in sustaining and redistributing the immaterial value, i.e. the knowledge produced within the experiment.

The knowledge and practices implemented in the fields were **translated into knowledge value for the final customers**.

The local administration started to be more concerned with food safety and quality and launched new services such as an automatic machine at a market allowing customers to scan the receipt of their bought vegetables to receive precise information on their place of origin. Other efforts involved technology-based farming solutions, urban farming networks, cooperation between universities and local farms, and a local chapter that was launched to "cultivate and promote a robust eco-system for the production, supply and consumption of Good, Clean, Fair

124 Valsecchi, F., Pollastri, S., Lou, Y. 2012. Agriculture prototypes: A design experiment of sustainable open fields in China, p. 6.

Food".[125] The researchers continued to focus on the implementation of networking strategies, aiming at the implementation and improvement of the urban gardens network by facilitating the process of knowledge sharing among different actors in the sustainable food system and generating more awareness among the local urban community. Together with GoodToChina, they designed an interactive "Explore Urban Farming" exhibition as part of the Shanghai Eco Design Fair, the biggest event on sustainability in the city. Another initiative was launched with the Nokia Research Center on the design of a product service system solution to connect rural and urban areas in a digital marketplace for the exchange of local produce and knowledge (using mobile devices).

The experiments implemented in this project show that community building and sustainable food practices can help promote each other by bringing together actors from different parts of the value chain and other stakeholders from the agro-food ecosystem as shown in Figure 23. They demonstrate strategies that clusters and their members can transmit to their field of application and implement within the Danube region.

Prototyping Integrated and Ecological Arable Farming Systems

A prototype can also be a **pilot that can be replicated** and thus, benefit from a bottom-up dissemination of the innovation. In a project on prototyping integrated and ecological arable farming systems in interaction with pilot farms in Europe[126], a five-step approach is presented to design, test, improve and disseminate prototypes of integrated and ecological farming systems. The first step establishes a hierarchy of objectives considering the shortcomings of current farming systems in the region. The second step translates the objectives into a set of multi-objective parameters to quantify them and establish a set of multi-objective farming methods to achieve them. In **step 3** a theoretical prototype is designed by linking parameters to farming methods and designing the methods in the specific context

125 Ibid, p. 7.

126 The Concerted Action (AIR 3 – CT920755) of 25 research teams from 15 European countries was sponsored by the Commission of the European Communities, in the specific RTD programme for Agriculture and Fisheries and coordinated by Vereijken (Research Institute for Agrobiology and Soil Fertility) who produced a manual on the topic as major deliverable of the project. The Manual does not necessarily reflect the views and future policy of the sponsor or author. See: Vereijken, P. 1999. Manual for prototyping integrated and ecological arable farming systems (I/EAFS). Wageningen, The Netherlands.

of the farm to prepare for initial testing. **Step 4** lays out the prototype on at least 10 pilot farms in appropriate variants and testing and improving the prototype (variants) until the objectives, as quantified in the set of parameters, have been achieved (after repeated layout). In **step 5** the prototype (variants) is disseminated to other farms with gradual shift in supervision from researchers to consultants. These steps are also expressed in an identity card of the prototype consisting of six parts as described below:[127]

1. **Hierarchy of objectives:** drawing up a hierarchy in 6 general objectives (e.g. abiotic environment, food supply, basic income or profit, health and well-being, employment), subdivided into 20 specific objectives (for food supply, e.g. quality, sustainability, quantity, stability, accessibility) as a base for a prototype in which the strategic shortcomings of current farming systems are replenished (Part 1 of the identity card of a prototype).
2. **Parameters and methods:** transforming the 10 major specific objectives into multi-objective parameters to quantify them, establishing the multi-objective farming methods needed to achieve the quantified objectives (Part 2 of the identity card).
3. **Design of theoretical prototype and methods:** designing a theoretical prototype by linking parameters to farming methods (Part 3 of the identity card), designing methods in this context until they are ready for initial testing (Multifunctional Crop Rotation as major method and Part 4 of the identity card).
4. **Layout of prototype to test and improve:** laying the prototype out on an experimental farm or on pilot farms in an agro-ecologically appropriate way (Part 5 of the identity card), testing and improving the prototype in general and the method in particular until (after repeated laying out) the objectives, as quantified in the set of parameters, have been achieved. (Part 6 of the identity card).
5. **Dissemination:** disseminating the prototype by pilot groups (<15 farmers), regional networks (15–50 farmers) and eventually by national networks (regional networks interlinked) with gradual shift in supervision from researchers to extensionists.

127 Vereijken, P. 1999. Manual for prototyping integrated and ecological arable farming systems (I/EAFS), p. 2. Wageningen, The Netherlands.

Vereijken argues that "interactive prototyping can create a group of capable and motivated pilot farmers, which is an indispensable technological and social base for dissemination throughout a region"[128] because **they offer demonstration farms and can provide training and guidance for other farmers who want to change their systems**. These replication efforts can be extended to other regions and countries if necessary, using the networks of organisations, clusters, and other actors described in chapter 4. The project was implemented as a collaboration between pilot farms and the research team as shown in Figure 30 below.

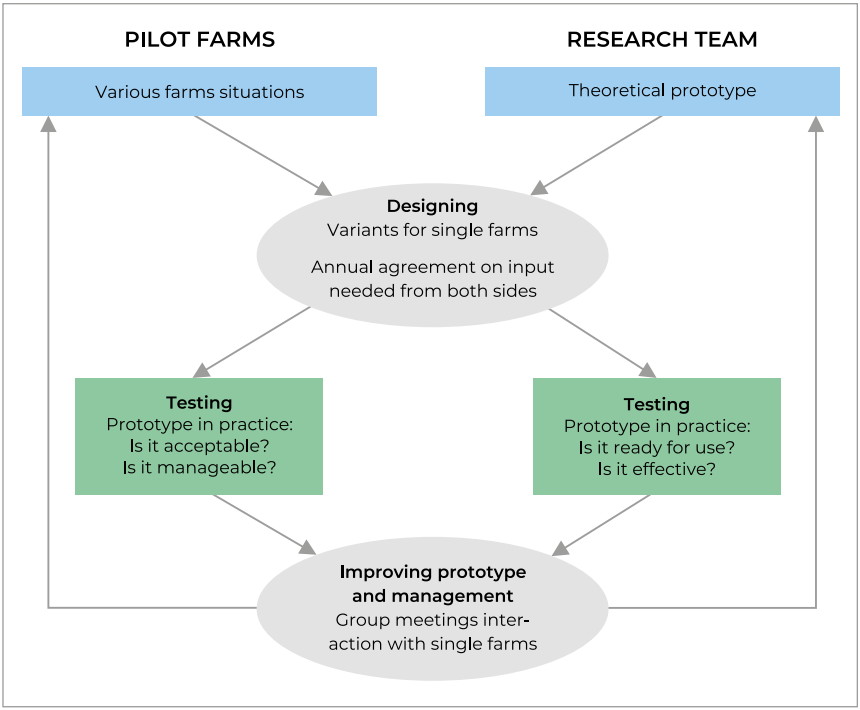


Figure 30: Interactive Prototyping: Designing, Testing and Improving a Prototype through Interaction of Pilot Farms and the Research Team (Source: Steinbeis 2i GmbH adapted by Vereijken, 1999)

128 Ibid, p. 50.

Launch and Continuous Improvement

Once an innovation has been validated, is needs to be brought to the market, i.e. into actual use. The time to market is the length of time it takes from a product being conceived until its being available for sale. It is important in industries where products are outmoded quickly and seems to matter most for first-of-a-kind products. In agro-food, this is a factor. An organisation's time to market goals should be aligned with its business strategy and the innovation strategy related to the respective products, process or business model. Potential time to market types include the following:

- **Flexibility to catch the market window** as the optimal time to launch a product and maximise the profits (before this point, a product will never reach the full targeted audience and after this point, the sales will never reach the optimal peak).
- **Speed**, i.e. bringing the product to market as quickly as possible, is valuable in fast-moving industries, but it is not always the best objective.
- **Predictable schedules** for delivering on a new product on schedule, e.g. for a trade show.
- **Minimizing resources**, especially labour, e.g. many managers figure that the shorter the project the less it will cost, so they attempt to cut expenses, but to reduce time to market a project needs to be staffed more heavily, so that a faster project may actually be more expensive.
- **Flexibility to make changes** since product innovation is tied to change, and often the need for change appears along the progressing project.

Further, follow-on activities to review innovations after their implementation can result in minor improvements or radically new innovations, e.g. through a fundamental redesign or major improvements. Some of these follow-on efforts could potentially result in (other) innovations. Post-implementation reviews can also lead to the abandonment of innovations. [129]

129 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 47.

Continuous Improvement and Innovation in Beef Profit Partnerships

A case study on the South African Beef Profit Partnerships project[130] examined how a specific continuous improvement process could support the maximisation of the impact of agricultural R&D. The relevant part of the project relates to "developing profitable beef business systems for previously disadvantaged farmers in South Africa", aiming at empowering small-scale and emerging farmers to be self-sustaining by opening new markets for their beef and beef products. The Continuous Improvement and Innovation (CI&I) methodology should provide insights on whether the evaluation approach to sustainable socio-economic development used in the project was effective.[131]

The specific target outcome of the project was "to achieve sustained improvement in profit per beef enterprise, per year, in a growing number of enterprises, communities and regions, in two South African provinces (Limpopo and North West)". The application of the outcome-focused, whole-system Continuous Improvement and Innovation process (CI&I) model[132] helped the participating organisations to overcome obstacles they had experienced in previous agricultural R&D projects, i.e. managing to produce outputs but failing to achieve these outcomes within the planned timeframes. The CI&I methodology increased the relevance, effectiveness, efficiency and sustainability with which target outcomes were achieved, incorporating the concepts of capacity building, economic growth and distribution, participation, empowerment, institutional coordination, culture and self-reliance.[133]

130 This project is large bilateral project between the governments of Australia and South Africa, funded by the Australian Centre for International Agricultural Research (ACIAR) over the period 2001/02 to 2006/07 to the amount of $1.3 million. ACIAR. 1999. Phase 3 Project Proposal. "Developing profitable beef business systems for previously disadvantaged farmers in South Africa". Canberra, Australia.

131 Madzivhandila, P., Groenewald, I., Griffith, G., Fleming, E. 2008. Continuous Improvement and Innovation as an Approach to Effective Research and Development: A 'Trident' Evaluation of the Beef Profit Partnerships Project.

132 Clark, R., Bacusmo, J., Bond, H., Gabunade, F., Matjuda, L.E., Motiang, D.M., Madzivhandila, T.P., Nengovhela, N.B., Trevos, A.A., Timms, J. and Toribio. J. 2005. A Model for Achieving Sustainable Improvement and Innovation in Regions, p. 5.

133 Madzivhandila, P., Groenewald, I., Griffith, G., Fleming, E. 2008. Continuous Improvement and Innovation as an Approach to Effective Research and Development: A 'Trident' Evaluation of the Beef Profit Partnerships Project, p. 13.

The CI&I used in the project is depicted in Figure 31. The concept records the support and supervision offered to farmers to undertake activities in their beef enterprises on issues relating to improving profitability.

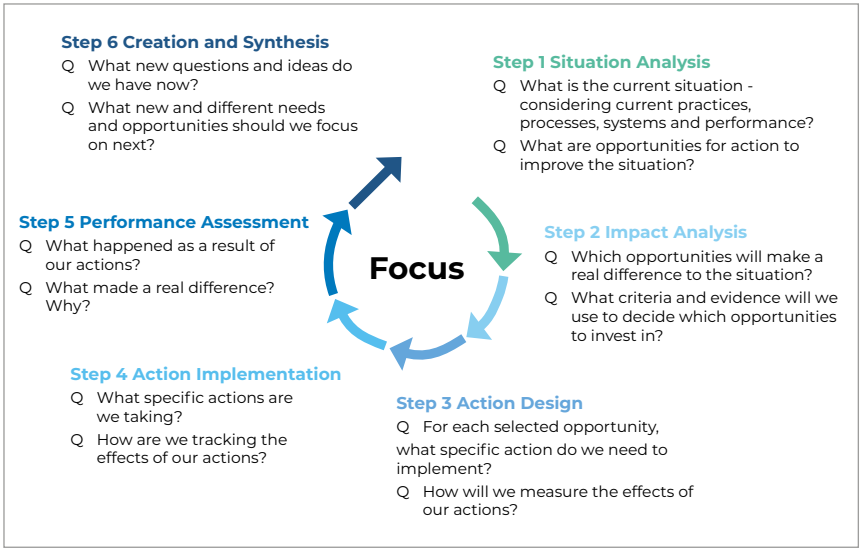


Figure 31: The Six Steps of the Better Practices Process (Source: Steinbeis 2i GmbH based on Clark et al., 2005)

This model can help agro-food organisations to set up a continuous improvement process of their activities within a specific project. It is designed to enable individuals to continually improve thinking, decisions, and performance. It provides questions used to focus thinking, action and creativity for continuous improvement and innovation. Part of any continuous and sustainable innovation process is also the constant integration of customer and user information and feedback.[134]

Setting up a **continuous improvement process** is key to enable individuals to continually improve thinking, decisions and performance.

134 For inspiration see: https://www.hubspot.com/customer-feedback, https://www.strategyzer.com/blog/posts/2015/11/26/a-quick-guide-for-asking-good-customer-questions or https://www.strategyzer.com/blog/starting-with-the-customer.

3.4 Enabling Factors of Innovation

Beyond innovation and design processes, the implementation of innovation activities needs other enabling factors such as financial and human resources or knowledge assets and management capabilities, without which the economic and social impacts of inventions and ideas could not be deployed. Good innovation management must allocate scarce resources as effectively and efficiently as possible. Management methods to meet this objective include:

- Organisation of innovation activities into dedicated projects with defined objectives, a budget, time schedule, and manager
- Systematic evaluation and prioritisation of innovation ideas
- Use of quantitative methods to assess likely returns from innovation ideas
- Choice of methods to allocate resources to innovation activities, e.g. stepwise depending on progress made or all-at-once
- Offering incentives for stopping or revising unsuccessful innovation activities
- Stopping innovation activities before completion if they do not meet certain objectives

Within the scope of this guide, the human resources and the knowledge assets will be examined in more detail.

3.4.1 Workforce Skills and Human Resource Management

People are the most important resource for innovation as they are the source of creativity and new ideas. The design, development and implementation of innovations require a variety of skills and the co-operation of different individuals. To understand innovation activities and innovation outcomes, the organisation must also gather and evaluate data on the skills represented among an organisation's workforce and on how these skills are organised through human resource management, e.g. including how it attracts and retains talent.

The design, development and implementation of innovations require a **variety of skills** and the **co-operation between different individuals**.

Workforce Qualifications and Competences

The diversity of an organisation's workforce can influence innovation performance. As innovation activities usually involve communication and interaction among employees, **diversity can either stimulate or hamper the exchange of knowledge**. To investigate the effects of diversity on innovation, an organisation can collect information on personnel along relevant dimensions of employee diversity including age, gender, nationality, and sociocultural background. It can pove useful to link (at least limited) employer-employee surveys or organisation-level with employee-level data to gain some insights on the effects of diversity on the innovation capacity of the organisation.[135]

An organisation that wants to develop its innovation capacity needs to know and develop the skills of its workforce. Not only formal qualifications, but a much wider range of skills and competences are important for an organisation that wants to drive innovation. Among different models for capturing various facets of skills, the O*NET occupational content model[136] incorporates tasks, skills, knowledge requirements and values to identify the following workforce characteristics with potential relevance for innovation:

- **Enduring attributes of workforce members that influence performance**, such as:
  - Cognitive abilities, in particular idea generation and reasoning abilities of the workforce
  - Adaptability and flexibility towards change

- **Workforce capacities that facilitate performance of activities occurring across different jobs**, e.g.:
  - Social skills, to work with people to achieve goals
  - Complex problem-solving skills, to solve novel, ill-defined problems in complex, real-world settings
  - Technical skills, to design, set up, operate, and correct malfunctions involving machines or technological systems
  - Systems skills, to understand, monitor, and improve sociotechnical systems

135 Organisation for European Co-operation and Development, European Union. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, p. 116.

136 O*NET. 2018. The O*NET* Content Model. https://www.onetcenter.org/content.html. The O*NET provide a large pool of data on skills assessment and development among proficiencies in various sectors.

- **Work values and styles**, important to an organisation's business strategy, e.g.:
  - values and styles related to entrepreneurialism, teamwork and creativity in a workforce

Human Resource Management

Human resource management practices can influence the ability of an organisation to profit from the creative potential and skills of its workforce. Many of these practices can benefit innovation, but also other goals. Human resource management practices that support innovation activities within the organisation include:[137]

- Employee recruitment policies that seek creative skills
- Training and skills development
- Appraisals and incentives for employee performance in suggesting ideas for innovation or in developing innovations
- Promotion and career development opportunities.

Other human resource management policies can indirectly improve innovation outcomes by increasing employee satisfaction and loyalty, such as flexibility in working hours and places (flexible work time, home office, sabbatical) and social initiatives (family-friendly policies). Organisations can collect data on the number of existing initiatives, including policies and the share of employees that benefit from these schemes.

The Cluster Manager as Driver of Innovation

Cluster and network management have new tasks and responsibilities in today's cross-stakeholder cluster environments, where one of their roles is to contribute to a strengthening of the cluster members' innovation capabilities. Organisations which cannot afford their own explicit innovation management, can benefit from these efforts if the cluster or network management takes on a role that incorporates at least some tasks of an innovation manager of the network.

Cluster and network managers can **contribute to the strengthening of the cluster members' innovation capabilities**.

137 Organisation for European Co-operation and Development, European Union. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 117.

The cluster or network manager can use and transmit tools and methods that can be applied at cluster or network level or organisation level. Some common innovation methods like roadmapping (see section 3.1.2), the SWOT analysis or the innovation radar (see section 3.3.4) can easily be adapted for use at cluster level. The benefits of and for innovation management in a cluster environment include the analysis of the value chains and the outreach to the critical mass or market share through the number of cluster members. Within a network or cluster, basic external conditions can be transformed into advantages like economies of scale (e.g. through purchasing associations) or the utilisation of political stakeholders. Further, through joint actions, cluster members can also implement group innovation labs or open innovation arenas.[138]

With respect to open design and innovation concepts, cluster managers – just like network managers – need to be able to **stimulate and maintain openness** in the visions for networks, seeking balance between stability and openness. They also need a broader awareness of organisational structures and culture, as well as related power structures resulting from these, to help a transformation away from silo mentalities in agricultural organisations and systems towards building networks for co-design and co-innovation in agriculture.[139]

3.4.2 Knowledge and Intellectual Property Management

According to the Oslo Manual, "innovations derive from knowledge-based activities that involve the practical application of existing or newly developed information and knowledge", which can both be sourced or created within or outside the organisation.[140] In this case, *information* consists of **organised data** and can be *reproduced* and *transferred* across organisations at low cost and innovation-relevant information can generally be gathered without a specific application in mind, for instance to help develop and evaluate options for

Information consists of organised data and can be reproduced and transferred across organisations at low cost.

138 Künzel, M., Meier zu Köcker, G., Köhler, T. 2016. Clusters and Innovations: Cluster Initiatives as Drivers of Innovations, p. 19. ClusterAgentur Baden-Württemberg.

139 Berthet, E. T., Hickey, G. M. 2018. Organizing collective innovation in support of sustainable agro-ecosystems: The role of network management, p. 53. Agricultural Systems, 165, pp. 44–54.

140 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, p. 46.

future actions. *Knowledge* refers to an **understanding of information** and the **ability to use information** for different purposes. It can be obtained through cognitive effort and consequently, *new knowledge requires learning* on the part of the recipient which makes it difficult to transfer.

Knowledge management is a major innovation management capability and supports internal and external knowledge sources and flows (see chapter 3.3.2). Knowledge management practices and mechanisms should support the following three key knowledge activities within an organisation:[141]

- Knowledge capture
- Codification of knowledge (to assist internal knowledge flows)
- Activities to promote knowledge sharing within the organisation

Knowledge refers to an understanding of information and the ability to use information for different purposes.

Acquiring Knowledge

Examples for activities that can generate innovations or help acquire useful knowledge for innovation are the following:[142]

- Research and experimental development (R&D)
- Market research
- Engineering activities to assess the efficiency of processes
- Analysing data from the users of digital goods or services

Considering that innovation activities typically involve different functional areas within the organisation or across different organisations and require communication between different people, groups and departments, knowledge management must also support co-operation and mutual learning within the organisation. The following methods can support the internal exchange of innovation-related knowledge and experience within or across organisations:[143]

141 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, p. 111.
142 Ibid, p. 46.
143 Ibid, pp. 111–112.

- Innovation circles[144] and teamwork in innovation projects
- Stimulating informal contacts between employees
- Joint development of innovation strategies across functional areas exchanging innovation ideas openly across the firm
- Mutual support across functional areas to address problems in innovation projects
- Regular meetings of heads of functional areas to discuss innovation issues
- Mechanisms for iterative and interactive project development and delivery
- Temporary involvement in innovation projects of personnel from different functional areas

External Knowledge

Within the context of open innovation activities, it is also key to develop an absorptive capacity through which the organisation can benefit from external knowledge and information, i.e. to identify and evaluate external knowledge. The sourcing of external knowledge can be supported through:

- Regular, systematic communication with customers, suppliers and other organisations along an organisation's value chain to identify opportunities and needs for innovation
- Regular, systematic screening of the organisation's knowledge environment (e.g. through patent searches, attending trade fairs, reading trade or scientific journals, web searches)
- Entering into alliances, joint ventures or strategic co-operation with other organisations in order to access external knowledge
- Support for innovation contests or crowdsourcing to provide ideas for solving innovation problems

Knowledge flows with external sources can require **supporting systems, institutions and procedures to enable social relationships and networks** for identifying and collecting knowledge from external sources. Among other things, organisations need to search and evaluate potential knowledge partners, sources and

144 Based on the concept of Japanese Quality Circles, an innovation circle is the formation of a group of workers who sit together to investigate, analyse, and find innovative ways of solving problems in an organisation using several problem-solving tools and processes.

their offerings, agree on the terms of knowledge purchases where necessary, and resolve potential disputes.[145]

Knowledge Assets and Management

Knowledge management is an important process that organisations need to develop in order to gain sustainable competitive advantages. It can be described as the systematic "process of gathering, managing and sharing of employees' knowledge capital throughout the organisation" and it can enhance existing organisational business processes, introduce more efficient and effective business processes and remove redundant ones.[146]

Knowledge management requires collaborative and integrated approaches to the creation, capture, organisation, access and use of knowledge assets in an organisation. Bhojaraju defines six knowledge assets in an organisation:[147]

1. **Stakeholder relationships:** includes licensing agreements; partnering agreements, contracts and distribution agreements.
2. **Human resources:** skills, competence, commitment, motivation and loyalty of employees.
3. **Physical infrastructure:** office layout and information and communication technology such as databases, e-mail and intranets.
4. **Culture:** organisational values, employee networking and management philosophy.
5. **Practices and routines:** formal or informal process manuals with rules and procedures and tacit rules, often refers to "the way things are done around here".
6. **Intellectual Property:** patents, copyrights, trademarks, brands, registered design and trade secrets.

145 For more information see Chapter 6 of Organisation for European Co-operation and Development, European Union: Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. Organisation for Economic Co-operation and Development Publishing, Paris/Eurostat, Luxembourg.

146 Bhojaraju, G. 2005. Knowledge management: Why do we need it for corporates, p. 37. Malaysian Journal of Library & Information Science, 10(2), 37–50.

147 Ibid, p. 41.

He further argues that knowledge management processes have the potential to maximise the value of knowledge assets through collaboration, discussions, and knowledge sharing, and that an organisation can manage and grow its intellectual capital by implementing processes such as the generation, codification (making tacit knowledge explicit in the form of databases, rules and procedures), application, storing, mapping, sharing and transfer of knowledge.

Knowledge Protection

Over the past decades, economic and social developments have initiated a trend toward economic and legal practices that make knowledge an "excludable good", i.e. the use of secrecy or other intellectual property (IP) protection methods. These practices affect the incentives and ability to source and transform new knowledge into innovations, as much as technological, market and regulatory changes. A contemporary example is the growing ability to digitise, organise and access information at zero or marginal costs, which has increased the stock of knowledge that can be made available, and created advantages from being able to exclude other users.[148]

Organisations can benefit from the results of their innovation activities through different methods of exploiting their knowledge, e.g. the products or new business models as outcomes of innovation activities. Other methods include: [149]

Organisations can assess innovation results and learn from past innovation by developing and using **indicators to monitor and evaluate innovation inputs, outputs and performance**.

- Protecting intellectual assets generated by innovation activities through formal and informal mechanisms
- Licensing-out knowledge to external organisations
- Transferring knowledge to external partners
- Exploring alternative applications for their knowledge

To maximise the returns from innovation activities, organisations can **assess innovation results and learn from past innovation**. They can support these processes by developing and using indicators to monitor and evaluate innovation inputs, outputs and performance.

148 Organisation for European Co-operation and Development, European Union: Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 46.
149 Ibid, p. 113.

Documenting innovation activities or projects, e.g. in databases, allows the members of an organisation to learn from experience, which should lead to improved implementation and performance in future innovation activities or projects.

Intellectual Property Rights and Types of Protection

The World Intellectual Property Organization[150] defines IP as "creations of the mind, including inventions, literary and artistic works, symbols, names and images used in commerce" and divides it into two categories: 1) *industrial property* including patents for inventions, trademarks, industrial designs and geographical indications, and 2) *copyright*[151] covering literary works (e.g. novels, poems and plays), films, music, artistic works (e.g., drawings, paintings, photographs and sculptures) and architectural design.

The management of IP and associated IP rights includes strategic decisions for the application and registration processes as well as the types of IP rights use. IP rights aim capturing economic value from innovations, i.e. securing a return on the financial and timely investment for innovation activities.

"The economic rationale for IP rights is that it is in everyone's long-term interest for people and businesses that create knowledge to have well-defined, enforceable rights to exclude third parties from appropriating their ideas, or the expression their ideas, without permission."[152]

The Oslo Manual provides the following table[153] that gives an overview of different IP rights, what they protect, application requirements, and the relevant jurisdiction for obtaining a right.

150 World Intellectual Property Organization (WIPO). 2004. What is intellectual property?, p. 3 WIPO Publications, No. 450(E), Geneva. www.wipo.int/edocs/pubdocs/en/intproperty/450/wipo_pub_450.pdf.

151 Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings, and broadcasters in their radio and television programs. See ibid, p. 2.

152 Organisation for European Co-operation and Development (OECD): Enquiries into Intellectual Property's Economic Impact, p. 8. http://www.oecd.org/sti/ieconomy/KBC2-IP.Final.pdf.

153 Organisation for European Co-operation and Development, European Union: Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 114.

Type of IP right	Protection	Application requirements	Jurisdictions
Patents (utility)	Exclusive rights for patentable inventions A utility model is a subclass with lower requirements	Application filing, granting by authority (post examination), possible invalidation	National; the Patent Cooperation Treaty (PCT) permits a single international patent application
Trademarks	Exclusive rights to a sign that identifies the commercial source of a product	Application, examination and registration	National; international for countries party to the Madrid Agreement
Industrial design rights	Exclusive right for the aesthetic elements of an object	Application, examination and registration (national variations)	National; international for countries party to the Hague Agreement
Copyright and related rights	Copyright grants authors, artists and other creators protection for literary and artistic works, including literary works, computer programs, databases, films, music, choreography, visual arts, architecture, maps and technical drawings	Copyright obtained automatically, but some countries offer optional registration that facilitates dispute settlements	National; international countries party to the Berne Convention
Plant breeder's rights	Exclusive rights to new plant varieties	Application, examination and registration	National; international for countries party to the International Union for the Protection of New Varieties of Plants (UPOV) convention
Geographical indications	Right to use a sign on goods indicating geographical origin and qualities or reputation due to the place of origin	Accreditation for use of existing indications National and regional procedures for new ones	National and international rights vary by country or region
Trade secrecy	Unauthorised use of manufacturing, industrial or commercial secrets by persons other than the holder is regarded as an unfair business practice	No registration, but the firm must undertake reasonable steps to protect secrets	National in accordance with articles 35–38 of the World Trade Organization (WTO) Trade-related Aspects of Intellectual Property Rights (TRIPS) agreement
Layouts of integrated circuits	Exclusive rights to the layout of semiconductor products	Application and registration required in some countries	National in accordance with article 39 of the WTO TRIPS agreement

Table 3: Types of IP Rights Adapted from the Oslo Manual 2018 (Source: Steinbeis 2i GmbH based on OECD, 2018)

The act of application or registration represents disclosure, initially to the managing authority and subsequently to the public. As a result, and in relation to open innovation principles discussed in previous chapters, IP registration is an indicator of outbound knowledge flows and supports knowledge diffusion.

Knowledge Management in Clusters

Knowledge development in a cluster can be described as a **dynamic phenomenon, resulting from interactions between people and organisations**, which can take various dimensions (e.g. practical, theoretical, explicit, tacit, cognitive, automatic, expertise, individual, collective, hypothetic, and interdisciplinary knowledge).[154] The knowledge of a cluster can be based on acquired information, experience, intuition, consciousness and understanding. It can be understood as "all the knowledge and skills used by the decision-makers, including cluster members to solve problems", at the cluster level, the cluster member level, or at project team level.[155] Within an organisation or a cluster, knowledge should be seen as a strategic resource.

The **knowledge of a cluster** can be based on acquired information, experience, intuition, consciousness and understanding and should be seen as a strategic resource.

Through open innovation processes, clusters have an enormous potential to build knowledge bases (with knowledge from inside and outside the cluster) which all cluster members can benefit from for their innovation and development processes.

The knowledge in a cluster can be acquired through the mobilisation of tacit knowledge, collaborative formal and informal research and development work, reverse engineering, competitive intelligence, contracting research and development work outside the cluster, strategic research and development partnership (consortia and joint-venture), patents and licenses purchasing, e-learning, coaching, mentoring, building project teams, and brainstorming. "Innovation is about knowledge – creating new possibilities through combining different knowledge sets."[156]

154 Bembenek, B., Piecuch, T. 2014. Knowledge Management In Industry Clusters As An Indication Of Entrepreneurship, p. 8. CBU International Conference Proceedings, 2(0), 5–14. ISE Research Institute.
155 Ibid, p. 9.
156 Tidd, J. and Pavitt, K. 2011. Managing Innovation: Integrating Technological, Market And Organizational Change, p. 39.

Knowledge management in cluster development aims at increasing the capability of the cluster members to learn and gain knowledge through cooperation and helping to spread knowledge of individuals or groups across organisations to enhance performance.[157] It should support the manager in making decisions by analysing already existing and acquiring and analysing new knowledge. The cluster manager should identify possible barriers for knowledge development and put efforts into removing them. He can use knowledge management to design and implement changes, in order to ensure the functionality and development of the cluster. Processes for knowledge management are based on the following processes:[158]

- **Organisational learning**, in which a cluster attains and develops its knowledge
- **Knowledge production**, which is linked to an active transfer of data and information into knowledge, making it useful in solving the emerging problems
- **Knowledge distribution**, where a cluster provides the access to common knowledge to its members and other key stakeholders, and enables them to take advantage of it
- **Knowledge protection**, aiming at protecting knowledge from its loss, unauthorised use, among others, through improper selection, preservation, and updating

Research on Polish clusters[159] indicated that cluster members exchanged commercial and technological data, information about contractors or clients, and supported each other with the acquisition and transfer of information concerning legal changes and possibilities of cooperation, e.g. draft and the fulfilment of common projects. These practices were more common in clusters with members truly oriented toward cooperation, instead of personal benefits, and especially clusters which had built a high level of trust among members.

157 Sureephong, P., Chakpitak, N., Ouzrout, Y., Neubert, G., and Bouras, A. 2007. Knowledge Management System Architecture for the Industry Cluster, p. 1971.

158 Bembenek, B., Piecuch, T. 2014. Knowledge Management In Industry Clusters As An Indication Of Entrepreneurship, p. 9. CBU International Conference Proceedings, 2(0), 5–14. ISE Research Institute.

159 "Cluster benchmarking in Poland": Comparative analysis of 47 operating clusters. Performed within the framework of the initiative launched by the Polish Agency for Enterprise Development titled: "Development of Human Resources Through the Promotion of Knowledge, Transfer and Dissemination of Innovation". Nowakowska, A., Przygodzki, Z., Sokołowicz, M., Matusiak, K., Bąkowski, A. 2010. Cluster Benchmarking in Poland – 2010. Survey Report. 2010. Warszawa: PARP.

Later research[160] on Polish clusters confirmed that the presence of active scientific institutions and R&D institutions in a cluster strengthened the knowledge transfer. Clusters creating knowledge and innovation based on a model for active participation of the science sector in cluster work were 26 % more successful than other clusters. Informal exchange of information also played a key role, providing opportunities for knowledge transfer among cluster members in the forms of regular meetings, get-togethers, joint formulation and implementation of project concepts, joint scientific reports and analyses, and publications.

Knowledge Management Processes

Igbinovia and Ikenwe[161] define the following knowledge management processes:

- **Knowledge Acquisition and Generation:**
  - Acquisition of explicit and tacit knowledge (which needs to be transferred to explicit knowledge through externalisation, i.e. tacit knowledge is converted to recorded form, in documents or databases for reference by others)
  - Knowledge generation focusing on knowledge creation for exploration and knowledge exploitation, through a) writing both formal and informal, b) research as systematic investigation to generate knowledge, c) shared problem solving or brainstorming, i.e. knowledgeable persons in a particulars area coming together to share their view about a problem in order to proffer solutions, e.g. seminars, conferences, workshop, etc.

- **Knowledge Capture:**
  - (Information) technologies for facilitating the creation and sharing of knowledge

160 "Cluster Benchmarking in Poland – 2012": Positioning of 35 particular clusters on the basis of the entire population and identification of their position in relation to the benchmark. Analysing their strengths, it has been noticed that on the map of clusters in Poland, there are more and more, whose share of investments on R&D in expenditures on innovative activity in the core of the cluster within the last two years, has exceeded 25 %. Within the last two years, more than five research projects have been implemented; the members of the cluster and products of the cluster were at least on 10 foreign markets. In: Hołub-Iwan, J. 2012. Cluster Benchmarking in Poland – 2012. General Report. Warszawa: PARP.

161 Igbinovia, M. and Ikenwe, I. 2018. Knowledge management: processes and systems, pp. 30–32. Information Impact: Journal of Information and Knowledge Management, 8 (3), pp. 26–38.

  - Knowledge Mapping as method to identify where knowledge resides within the organisation, i.e. persons with special knowledge or expertise, using techniques of questionnaires, interviews and observations

- **Knowledge Organisation:**
  - Acquired or generated knowledge needs to be properly organised for easy access and retrieval, e.g. through cataloguing, indexing and abstracting for classification of messages, texts, and other content

- **Knowledge Storage:**
  - Acquired or generated knowledge needs to be properly stored and preserved for subsequent access and use, and for the sake of posterity, e.g. through capturing, transcribing, and coding

- **Knowledge Sharing:**
  - Leveraging the knowledge gained by ensuring that acquired information, knowledge, ideas, skills, and experiences can be exchanged and shared among people, organisations and institutions

- **Knowledge Application:**
  - Shared knowledge should be applied to solve a problem, i.e. put to affective and efficient utilisation to fill a gap or need, and for proper knowledge application, knowledge management process should be communicated to users

Tools or technologies that support knowledge management processes are: Knowledge Portals, Database Management System (DBMS), E-Mail, Group Wares, Data Warehouse, Content Management Systems (CMS).[162]

The practice of knowledge management has three components: processes, people and systems. With regards to processes and supporting systems or technologies, which are necessary to successfully manage knowledge, organisations should:[163]

162 Igbinovia, M. and Ikenwe, I. 2018. Knowledge management: processes and systems, pp. 32–33. Information Impact: Journal of Information and Knowledge Management, 8 (3), pp. 26–38.
163 Ibid, p. 35.

- Encourage the **creation of knowledge** by supporting research activities, encouraging collaborations and teamwork
- Set up **reward systems** through which members will be motivated to acquire as well as share knowledge for common good
- Carry out **knowledge mapping** to identify best practices related to their areas of operations and inculcate such practice into their organisational activities
- Create k**nowledge repositories** that are accessible with user friendly interface
- Ensure that **generated knowledge is applied** in solving real-time problems
- Endeavour to **acquire tools and technologies** necessary to support people and processes involved in knowledge management

Knowledge as Intellectual Capital of a Cluster

Within the trends around the knowledge economy and information society, knowledge currently represents one of the main sources of growth and competitive advantage of an organisation, even though it is an intangible resource and strongly related to the human factor. The dimensions of (explicit and tacit) knowledge in a cluster can be derived from: 1) **individual knowledge** of particular members of a cluster, so-called "knowledge workers," in its respective organisations, 2) **knowledge recorded** in documents, databases, and procedures, and 3) **knowledge legally protected** by patents, licences, trademarks, copyrights, formulas, and trade secrets.[164]

The **ability of a cluster to generate new, common knowledge** indirectly **influences its development**.

The ability of a cluster to generate new, common knowledge indirectly influences its development and the process of knowledge management is strongly influenced by the individual and collective intelligence of a cluster and the complex network of cooperation within a cluster. Intellectual capital can be defined as **collective knowledge embedded in the personnel, organisational routines and network relationships of an organisation**. It is vital to determine a cluster's

164 Bembenek, B., Piecuch, T. 2014. Knowledge Management In Industry Clusters As An Indication Of Entrepreneurship, p. 8. CBU International Conference Proceedings, 2(0), 5–14. ISE Research Institute. Bembenek, B., Piecuch explain: "Explicit knowledge and tacit knowledge, occurring in a cluster, constitute the core component of intellectual capital of the cluster. Explicit knowledge, as formal, externalized, and systematized knowledge, is easy to transfer by means of wildly available, common forms of transmission. Whereas, tacit knowledge, as silent knowledge, is transferred mainly verbally in face-to-face contact; and it is gathered as the experience, competencies, and intuition increases."

operational and strategic efficiency in acting and functioning on the market. Value is created through:[165]

- **Human capital:** experience, expertise, skill and creativity of employees, which can be further encouraged by investing more in their training programs;
- **Structural capital:** all systems, procedures, databases, copy rights, structural procedures, rules and policies, which are important for decision-making; and
- **Relational capital:** all the relationships of the organisation with different stakeholders, cumulative trust, experience and knowledge on building relationship, or partnership.

Knowledge-based clusters benefit from **simplified information flow** and **developed processes of learning**, also enhancing innovation processes. Cluster managers, leaders and members have a higher consciousness of the importance and the role of knowledge in building a strategic and competitive advantage. Established intra- and inter-organisational relations enable more effective identification of partners for the future projects, a shortened learning cycle, and a permanent improvement of knowledge structures.[166]

3.5 Innovation Results

The incentive for an organisation to engage in innovation activities, is the prospect of outcomes such as an increase in market share, sales, or profits, or any other economic and social benefits. At the societal level, the impacts of innovation are usually the satisfaction of current or future human needs at either the individual or collective level. In order to assess whether innovation activities have led to the expected outcomes, it is important to measure these outcomes, which can have various facets, from productivity, profits and jobs to social and environmental impacts. This can be in the interest of the organisation performing innovation activities, or in the interest of the user of the innovation or even society in general.[167]

165 Rehman, W., Rehman, C. A., Rehman, H., and Zahid, A. 2011. Intellectual Capital Performance and Its Impact on Corporate Performance: An Empirical Evidence from Modaraba Sector of Pakistan, p. 9.

166 Bembenek, B., Piecuch, T. 2014. Knowledge Management In Industry Clusters As An Indication Of Entrepreneurship, p. 11. CBU International Conference Proceedings, 2(0), 5-14. ISE Research Institute.

167 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 56.

An organisation that is systematically assessing its innovation results and learning from past innovation will be able to maximise its returns from innovation activities over time. For this, an organisation needs to **develop and use indicators to monitor and evaluate innovation inputs, outputs and performance**. It is crucial to document innovation activities in projects, for example in databases, to enable learning from experience, support and improve future innovation activities.[168]

3.5.1 Measuring Outcomes of Innovation

Innovation outcomes can be widely distributed over time, organisations and individuals. It is important to measure innovation impacts directly (e.g. through self-reported impacts), or indirectly through the analysis of data on innovation activities, data on outputs (e.g. different types of innovations) and data on internal or external outcomes (e.g. profits).[169] Data about innovation provides an empirically grounded understanding of how innovation works in organisations or economic and social environments and is therefore important for managers and stakeholders of any organisation or institution to assess innovation impacts, e.g. on business models, strategic focus, technological impacts, benchmarking, funding.[170]

Data about innovation provides an empirically grounded understanding of how innovation works in organisations or economic and social environments.

During the planning and development stage of innovation activities, the organisation needs to set objectives that the innovation is expected to achieve (see chapters 3.1.1 and 3.1.2). These objectives can refer to characteristics of the innovation itself (e.g. its specifications) or market and economic objectives. In this same way, the outcomes of an innovation need to be measured. **Innovation outcomes include the extent to which the organisation's objectives are met and the broader expected and unexpected effects of innovation on other organisations, the economy, society, and the environment.** Economic objectives of innovation include the generation of profits, an increase in sales or brand awareness from product innovation, and cost savings or productivity improvements from business process innovations. Other objectives include the improvement of the organisa-

168 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 113.
169 Ibid, p. 56.
170 Ibid, p. 44.

tion's capabilities, expansion into new markets, or the acquisition of new types of customers. The broader effects can include different types of spill overs and externalities that can change the structure of competition in markets and stimulate or hamper the innovation activities of other organisations. They can also contribute to or hinder societal goals such as improvements to employment, health and environmental conditions, or help solve or influence other societal challenges.[171]

The following sections will present different approaches to measuring innovation objectives and outcomes, i.e. qualitative measures of the variety of innovation objectives and outcomes, evaluation of quantitative measures of innovation outcomes for product and business process innovations.

The **innovation objectives of an organisation are the identifiable goals that reflect its motives and underlying strategies with respect to its innovation efforts** (see chapters 3.1.1 and 3.1.2). Collecting data on innovation objectives is useful for research on the factors that drive an organisation's decision to engage in innovation activities, such as the intensity of competition or the opportunities for entering new markets, and how the organisation responds to these drivers or pressures, such as improvements to the efficiency of the organisation's operations or enhancements to its innovation capabilities.

Qualitative Measures of Innovation

At a minimum, the Oslo Manual suggests collecting data on either the objectives or the outcomes of innovations because *objectives can become outcomes*. Data on outcomes can only be collected for innovations that have been implemented, while data on objectives, should encompass all completed, ongoing, postponed or abandoned innovation activities. If data are collected for both innovation objectives and innovation outcomes, both sets of questions should be limited to *innovations* (as outcomes, see section 2.1) to ensure comparability between objectives and outcomes, and exclude those innovation activities that are ongoing, postponed or ceased.

171 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 164.

Outcome data are often collected through survey, based on the perceptions of respondents in innovative organisations. In this case, a single question can be used to collect data on both objectives and outcomes. It is then recommended to use an importance scale for the objectives. The response options for the outcomes should include the following aspects:

- Whether the objective was achieved or not
- If the outcome occurred without a corresponding objective (i.e. it was unintended)
- If it is "too early to tell"

Outcomes can only be observed if they occur within the observation period for data collection, effects that occur after this period are not "observable" and cannot be part of the data collection. The Oslo Manual recommends that the length of the observation period should not exceed three years and not to collect outcome data for innovations that occur outside (before or after) the observation period. This would decrease data reliability due to a decline in the accuracy of the respondents' ability to recall past objectives. It can damage the logic of data collection and negatively influence responses of the respondent to other questions.

Table 4 lists common objectives that can become outcomes if realised, grouped by areas of influence (i.e. markets, production and delivery, business organisation, and economy, environment and society):[172]

- Objectives and outcomes that influence **markets** mainly concern product innovations, although some business process innovations can also play an indirect role, e.g. in improving the quality or marketing of services enhancing the visibility or reputation of these services. The objectives listed under "markets for the firm's products" capture whether or not the organisation planned to change its product portfolio (increase range of goods or services), enter new markets, target existing markets (increase or maintain market share), or change customer perceptions of the organisation's products (increase its reputation or visibility). Organisations also need to comply with market regulations, e.g. by meeting product emissions or recycling standards.

172 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 165.

- Objectives and outcomes for **production and delivery** concern the cost and quality of an organisation's operations. They are mainly related to business process innovation, although some product innovations can contribute. An example is a change in the materials used for a product that reduces the material costs per unit of output.

- Objectives and outcomes that influence the **business organisation** capture the effects of business process innovations on an organisation's capabilities. Some of these effects can improve the organisation's capabilities for absorbing, processing and analysing knowledge. Others influence the ability of the organisation to adapt to changes or improve working conditions as well as ensuring the continued existence of the organisation itself.

- Outcomes that affect an **economy, society or the environment** are influenced by innovation objectives that target externalities, such as reducing environmental impacts or improving health and safety. Innovation outcomes can also contribute to wider societal goals, e.g. social inclusion, public security or gender equality. Both product and business process innovations undertaken to comply with standards or regulations can contribute to environmental and societal goals.

Markets for the organisation‘s products
▪ Upgrade goods or services ▪ Expand the range of goods or services ▪ Create new markets ▪ Enter new markets or adapt existing products to new markets ▪ Increase or maintain market share ▪ Increase the reputation, brand awareness, or visibility of goods or services ▪ Comply with market regulations ▪ Adopt standards and accreditation
Production and delivery
▪ Upgrade outdated process technology or methods ▪ Improve quality of goods or services ▪ Improve flexibility for producing goods or services ▪ Increase speed of producing goods or delivering services ▪ Reduce labour costs per unit of output ▪ Reduce material, energy costs or operating costs per unit of output ▪ Reduce time to market
Business organisation
▪ Improve capabilities for absorbing, processing and analysing knowledge ▪ Improve sharing or transfer of knowledge with other organisations ▪ Improve the efficiency or function of the firm‘s value chain ▪ Improve communication within the firm ▪ Improve or develop new relationships with external entities (other firms, universities, etc.) ▪ Increase business resilience and adaptability to change ▪ Improve working conditions, health or safety of the firm‘s personnel ▪ Implement a new business model ▪ Contribute to the development of standards
Economy, society or environment
▪ Reduce negative environmental impacts/deliver environmental benefits ▪ Improve public health, safety or security ▪ Improve social inclusion ▪ Improve gender equality ▪ Improve quality of life or well-being ▪ Comply with mandatory regulations ▪ Comply with voluntary standards

Table 4: Innovation Objectives and Outcomes for Measurement, by Area of Influence (Source: Steinbeis 2i GmbH adapted from Oslo Manual, 2018)

Based on a selection of these objectives, the organisation can draw a matrix or table with questions for the objectives (e.g. „The priority for this objective was to create a new market X."). The answers can be scaled from "fully achieved" to "not at all achieved". Further, a category for "unintended outcomes" can be added and an alternative answer defining if it is "too early to tell".

Relationship between Innovation and Business Strategies

In addition to the basic objectives and outcomes, the Oslo Manual suggests the collection of data on the *relationship between innovation and business strategies*, including the contribution of innovation to the organisation's business strategy, the extent to which innovations require substantial internal changes in the organisation, and the effects of innovation on the market in which an organisation operates. This data can be collected for objectives only, or for both objectives and outcomes. [173]

A first set of innovation objectives and outcomes measures how organisations *position their product innovations in their market*. Potential strategies include:

- A focus on distinct market segments: **specialisation**
- The diversification or extension of existing offerings: **diversification**
- Solutions for specific customers: **customisation**

Objectives and outcomes for *internal capabilities* can cover:

- **Improvements in the skill levels of employees**, for instance to enhance absorptive capacity
- More efficient or effective **methods for organising innovation activities**
- **Methods to manage risk**

Innovation objectives concerning an organisation's strategy with respect to its competitors comprise:

- **Imitation or adoption of innovations from competitors**: "follower" strategy where the organisation's innovations lag behind those of its competitors

173 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 167.

- **First-to-market strategies for goods and service innovations or business process innovations** in terms of quality or cost advantages
- **Technology leadership:** strategy seeks to remain ahead of its competitors
- **Design or cost leadership**: leadership based on the design characteristics or technical functions of product innovations, or on

A first-to-market strategy (including also technology, design and cost leadership) can be based on imitating goods or business processes in other markets, or on technology, design or cost leadership.

Quantitative Measures of Innovation for Product Innovation

Quantitative outcome measures for both product and business process innovations are of interest because of three main reasons.

- The data are required for research on the economic significance of innovations for the innovative organisation and for the markets where the innovations are sold.
- The data can be used to analyse the effectiveness and efficiency of innovation expenditures and the effects on innovation outcomes, of how organisations or clusters organise their innovation activities (for example their use of collaboration, information sources, methods to protect their intellectual property and receipt of public funding support).
- The data are relevant for research on the impacts of innovation on other organisations, the economy, society and the environment.

The potentially most important quantitative measure of product innovation outcomes is the share of sales accounted for by product innovations. The indicator of **innovation sales share** reflects the share of an organisation's total sales in the reference year that is due to product innovations (by book numbers or estimation of respondents). It is an indicator of the economic significance of product innovations at the level of the innovative organisation and can be aggregated to measure the share of sales from product innovations in the total sales of a specific industry or market. Sales share data can also be used to estimate the share of total demand in

an industry that is met by domestic product innovations, if data on total sales from imports and domestic production are also available. [174]

The Oslo Manual recommends collecting data on the innovation sales share as an output measure of product innovations (both new and improved products) for the following three types of markets (for which the responses should add up to 100 %) and a given observation period:[175]

- Product innovations introduced that were **new to the organisation's market**
- Product innovations introduced that were **only new to the organisation**
- Products that were **unchanged or only marginally modified** during the observation period.

The innovation sales share could also be disaggregated by the **type of product innovation** (goods or services), or by the **location of sales** (domestic or foreign markets). Another disaggregation useful for research and policy is by the **level of novelty** with the following methods:[176]

- Sales from new products or improved products
- Sales from world-first, market-first, or only first to the organisation innovations
- Sales from innovations that are not available from any of the organisation's competitors, or from innovations that are identical or very similar to products already offered by competitors

An alternative to providing an exact figure for the innovation sales share (if this is not possible) is to provide categories: such as "0 %," "more than 0 % to less than 5 %", "5 % to less than 10 %", etc. These categories need to be narrowly defined to provide useful data. This also applies to the following measuring methods.

Disaggregation by type of innovation is difficult if organisations combine goods and services or multiple innovations into a single product or if this product contains several sub-systems, but it can provide better accuracy. Data collection for innovation counts should use predefined categories (e.g. 0, 1, 2, 3–5, 6–10, 11–20, more than 20) and instruct respondents not to consider minor variations of the same product as different product innovations. Information on the innovation

174 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 168.
175 Ibid, pp. 168–169.
176 Ibid, p. 169.

sales share by type of market is useful for differentiating between the diffusion of product innovations that were previously available in the organisation's markets and product innovations that are market novelties.

For this type of outcome measurement, it is important to notice that several factors can influence the time gap between product innovation and sales, including when the innovation occurred during the observation period and the time required to market and sell the innovation. If the time between the innovation and the measurement of its sales is too short, there may be few or no sales. Certain products such as customised and expensive machinery are likely to be pre-sold, but often consumer products experience a slow, gradual uptake in sales. In this case for example, a three-year observation period makes more sense than a one-year period.[177]

Collecting data on the number of product innovations is also useful for interpreting data on the objectives and outcomes of innovation. Indicators on the **share of innovation projects completed** during the observation period can also be calculated from count data for the number of innovation projects. In this case, the variety of innovation objectives is likely to be positively correlated with the number and diversity of product innovations.[178]

Other quantitative outcome indicators for product innovation include the **profit margin of product innovations** and the **market share of the organisation's product innovations** out of all sales in the market for similar products (including the sales of products sold by competitors) providing a better measure of the economic and market success of product innovations than the innovation sales share.179 The profit margin is a measure of economic success that is positively correlated with the competitive advantage of the organisation's product innovations over other products offered in this same market. A high market share can indicate that a product innovation has outcompeted offerings from competitors. However, a high innovation sales share for product innovations can still result in lower economic advantages, e.g. when the organisation ceases to sell older products due to another innovation or if it sells high volumes of a product innovation at low profit margins.[180]

177 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 168.

178 Ibid, p. 170.

179 Data can be collected for relative measures, i.e. the difference between the average profit margin for product innovations and the average profit margin for other products.

180 Ibid, p. 170.

Quantitative Measures of Innovation for Business Process Innovations

Data on the savings from business process innovations can be very difficult to collect for organisations, as they can relate to very different areas of operations, requiring different indicators for each type of business process. The following indicators are more suitable for small and medium-sized organisations, or for questions that focus on business process innovations that are directly linked to products, e.g. the share of sales affected by business process innovations in production, delivery and logistics:

- The percentage of an organisation's **personnel who were directly affected** by the innovations during the observation period. Respective data helps to measure the influence of business process innovations across an organisation, but it does not provide information on whether business process innovations were successful or if they had any positive or negative effects on operations.

- The **change in sales that can be attributed** to business process innovation. This indicator is similar to the innovation sales share indicator for product innovations and can be driven by efficiency-enhancing business process innovations that reduce costs or that enhance product quality.

Efficiency-enhancing innovations should, directly or indirectly, result in lower costs.

Many business process innovations aim to improve the efficiency of an organisation's operations. Efficiency-enhancing innovations should, directly or indirectly, result in lower costs (e.g. operating costs) compared to the situation before they were implemented or compared to business process innovations that did not improve efficiency. Cost reduction can refer to costs per unit of output or per operation but exclude scale-related cost changes from an increase or decrease in production or operations.

Other business process innovations aim to **improve the quality characteristics of processes**, such as flexibility, adaptability, speed, precision, accuracy or customer-friendliness. In some cases, quality-enhancing business process innovations can increase unit costs, but these additional costs can be matched or exceeded by an increase in the value of the resulting output. Quantitative indicators on quality-

enhancing business process innovations are developed as part of quality management and cover for example:[181]

- Improvements in the **timeliness of business processes** (lead time, processing time, on-time delivery)
- Improvements in the **quality of outputs from business process innovations** (customer satisfaction rate, defect rate, accuracy rate, reworking rate, scrap rate)
- Improvements in **process complexity** (the number of steps) and **employee satisfaction**

3.5.2 Developing Innovation Capabilities

Innovation capabilities of an organisation can be described as the ability to **understand and respond to changing conditions of its context, to pursue new opportunities, and to leverage the knowledge and creativity of people within the organisation, and in collaboration with external interested parties.**

ISO defines innovation capabilities as the "ability to perform innovation activities and innovation initiatives to achieve innovation. [...] Innovation capabilities can include proficiency in technologies, strategic intelligence, access to funds, operational functions and processes contributing to innovation performance, competent and experienced people contributing to innovation objectives".[182]

The innovation management capabilities as defined by the Oslo Manual are listed in chapter 3.2.1 and cover all activities to initiate, develop, and achieve results from innovation and are closely linked to general organisational and managerial capabilities.

Lawson and Samson[183] present two models that depict well how the innovation capability of an organisation needs to be integrated with its "mainstream activities" and "newstream innovation". "Mainstream operational activities" are those which convert raw materials into products that are delivered to customers and yield today's profit in the form of sale of established products and services. These

181 Organisation for European Co-operation and Development. 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting and Using Data on Innovation, p. 171.

182 International Organization for Standardization (ISO). 2020. ISO 56000: 2020. Innovation management – Fundamentals and vocabulary, 3.7.5. https://www.iso.org/obp/ui#iso:std:iso:56000:ed-1:v1:en:term:3.7.5.

183 Lawson, B. and Samson, D. 2001. Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach. International Journal of Innovation Management, 5(3), 377–400.

profits can be distributed or reinvested in other parts of the organisation, e.g. innovation projects. With times passing, the ability of the mainstream to fulfil customer demands will decline as competition intensifies and the product line ages. Even if the organisation is continually improving processes and decreasing cost, its market shares can be lost within a short time frame. Investments in innovation projects or activities, i.e. the innovation newstream, is key to create new products, markets, technologies and business models of the future.

What the authors call the "newstream" describes all the resources the organisation can and will devote to identifying and creating new business streams and value for itself and its clients or customers. It is powered by the innovation capability of the organisation, which brings together the efficiency of the mainstream with the creativity of the newstream by enabling the newstream to "act like a funnel seeking, locating and developing potential innovations that can be transferred into the mainstream" – a key mechanism for self-renewal within the organisation and with regard to its products.[184] The innovation capability is understood as the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the organisation and its stakeholders, as shown in the first model in Figure 32 below.[185]

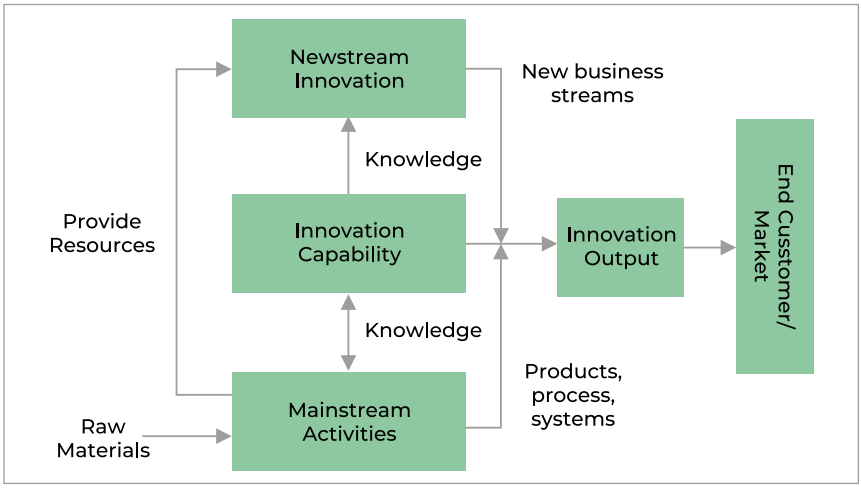


Figure 32: An Integrated Model of Innovation (Source: Steinbeis 2i GmbH based on Lawson and Samson, 2001)

184 Lawson, B. and Samson, D. 2001. Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach, p. 384. International Journal of Innovation Management, 5(3), 377–400.

185 Ibid, p. 383.

The second model shown in Figure 33 aims at building a theoretical framework highlighting the innovation management dimensions and approaches which most affect innovation success and should therefore be developed to support innovation activities. It assumes that the organisation is focused on innovation and innovation outcomes as their primary competitive strategy, and it can be seen as a predecessor to the innovation management dimensions described at the beginning of chapter 3. Innovation capability is not a detached concept, but rather is composed of reinforcing practices and processes within the organisation which stimulate, measure and reinforce innovation. In Figure 33, the elements have been grouped into seven major elements.[186] These have further been integrated into Kearney's House of Innovation (see chapter 3).

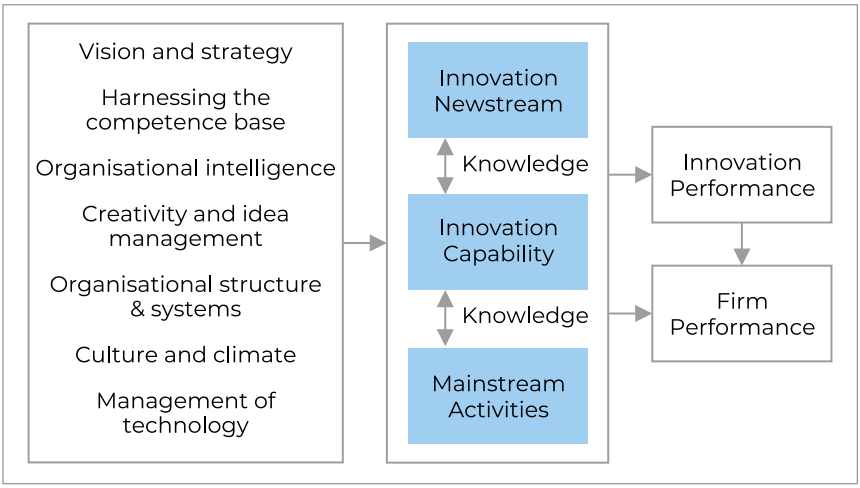


Figure 33: A Model of Innovation Capability (Source: Steinbeis 2i GmbH based on Lawson and Samson, 2001)

To summarise, A.T. Kearney's critical success factors for each innovation management dimension are:[187]

186 Lawson, B. and Samson, D. 2001. Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach, p. 388. International Journal of Innovation Management, 5(3), 377–400.

187 Diedrichs, E., Engel, K., Wagner, K. 2006. European Innovation Management Landscape: Assessment of current practices in Innovation Management Consulting Approaches and Self-Assessment Tools in Europe to define the requirements for future "best practices", p. 47. Europe INNOVA paper No. 2, Augsburg.

1. **Innovation strategy:**
    a. Create a clear vision for innovation aligned with business strategy
    b. Spread and communicate it to all hierarchies
    c. Analyse all environmental trends (e.g. customers, competitors, technologies)
    d. Measure achievements against strategic objectives

2. **Innovation organization and culture:**
    a. Provide time, space and money to exploit new ideas
    b. Support and active involvement from top management
    c. Built excitement about innovation
    d. Accept failures and mistakes
    e. Involve internal and external resources

3. **Innovation life-cycle management:**
    a. Create systematic idea generation and innovation processes
    b. Turn lots of new ideas into innovation projects
    c. Built continuous improvement processes
    d. Accelerate time-to-market and time-to-profit

4. **Innovation enablers:**
    a. Establish incentive systems to support innovation management activities
    b. Ensure sound project management and control of resources
    c. Ensure systematic management of intellectual property resources
    d. Apply appropriate IT tools for innovation management tasks
    e. Integrate lessons learned and knowledge sharing

Selected aspects of these capabilities have been discussed in chapters 3.1 to 3.4, e.g. the development or modification of an innovation strategy; the characteristics of an innovative organisation structure and culture or the roles and responsibilities within an organisation or a cluster; the stimulation, collection and evaluation of novel ideas; human resource practices to encourage innovation throughout the organisation.

ISO[188] suggests that an organisation can innovate more effectively and efficiently if all necessary activities and other interrelated or interacting elements are managed as a system. An innovation management system can guide the organisation to determine its innovation vision, strategy, objectives, etc. and to establish the support and processes needed to achieve the intended outcomes.

The potential benefits of implementing innovation management systems in can be:

- Realization of value
- Future-focused leaders
- Strategic direction
- Culture
- Exploiting insights
- Managing uncertainty
- Adaptability
- Systems approach

To improve their innovation performance, an organisation should develop its innovation management capacities. Each innovation capacity is a key asset, but the organisation may need a **systemic approach to better utilise these assets** for its innovation activities and outcomes. Particular capabilities and capacity will need to be deployed dynamically at strategic points in the non-linear innovation process. Understanding the interrelations of the capabilities and resulting capacities within the innovation system is crucial to the application of these assets within the organisation's unique context. The next section will present a systemic approach to innovation capacity. [189] present an analytical framework for systemic innovation capacity in the agricultural innovation system (AIS), presented in the next paragraphs.

188 International Organization for Standardization (ISO). 2019. ISO 56002:2019: Innovation management – Innovation management system – Guidance. 2019. https://www.iso.org/obp/ui#iso:std:iso:56002:ed-1:v1:en

189 Turner, J. A., Klerkx, L., White, T., Nelson, T., Everett-Hincks, J., Mackay, A. and Botha, N. 2017. Unpacking systemic innovation capacity as strategic ambidexterity: How projects dynamically configure capabilities for agricultural innovation. Land Use Policy, 68, 503–523.

Systemic Innovation Capacity of an Organisation

Systemic innovation capacity is having the right configuration of capabilities in enough amounts to be able to successfully implement innovation activities and outcomes.

Capabilities constitute capacity in the sense that capacity is having the right configuration of capabilities in enough amounts to be able to successfully implement innovation activities and outcomes. "Innovation capacity is built through the practices, routines or processes used to mobilise, create and reconfigure arrangements of resources and capabilities."[190] In this context, resources as tangible financial and physical artefacts, or institutions (e.g. incentives for innovation such as intellectual property rights and subsidies) used in the innovation process and innovation capabilities (i.e. processes for exploring and exploiting opportunities to innovate), adaptive capabilities (i.e. development and adaptation of individual resources and capabilities, and arrangements of these, in view of a changing external environment) and absorptive capabilities (i.e. processes for acquiring, assimilating and transforming external knowledge and resources.

Table 5 by Turner et al.[191] below depicts different forms of innovation capacity observed at different levels of the innovation system. The authors reason that innovation capacity at one level has been observed as capabilities constituting innovation capacity at higher levels of the innovation system, e.g. innovation capacity of individuals within organisations build capabilities at organisational level, which can combine with other individual capacity to build project- and network-level capabilities. The other way around, capabilities at one level can feedback to contribute to innovation capacity at lower levels, e.g. formation of a network of actors supports project-level capacity to share risk.

190 Turner, J. A., Klerkx, L., White, T., Nelson, T., Everett-Hincks, J., Mackay, A. and Botha, N. 2017. Unpacking systemic innovation capacity as strategic ambidexterity: How projects dynamically configure capabilities for agricultural innovation, p. 505. Land Use Policy, 68, 503–523.

191 Ibid, p. 505.

	Capabilities			Innovation Capacities
Levels	**Innovation capabilities**	**Adaptive capabilities**	**Absorptive capabilities**	
Individual	Leadership to develop, maintain & use actor linkages to meet individual & collective interests Entrepreneurial attitude to generate new ideas for action	Leadership for supporting change Individual reflexivity	Leadership to foster culture of openness to learning Link with others to access, share and process external knowledge	Capacity of individuals to recognise & realise possibilites in emerging problems & opportunities Changes in individual knowledge, understanding, discourse, vision and attitudes
Organisation	Culture of embracing change & risk-taking	Organisational reflexivity, learning & adaptive management (i.e., a flexible management strategy in view of emerging needs and circumstances as opposed to rigid planning) Challenging organisational goals and current practices	Supports collaborators agendas & shares knowledge, capabilities and resources	Openness of organisation to new ideas & actions
Project	Presence of actors with broad range of skills & experience facilitated to acquire knowledge through interaction, learning, research, experimentations & experience	Project reflexivity Maintain flexibility in solutions to allow adaptation	Pool resources to build external networks to access, share and process external knowledge, capabilities & resources	Capacity to share risk from social, economic, institutional and technological uncertainties Capacity to experiment with social, institutional & technical options in response to prioritised problems & opportunities
Network	Formation of network of actors to shape technical, social & institutional changes to address prioritised problems & opportunities Balancing of individual and collective interests	Reconfiguring of network actors & interactions to adapt to changing internal and external environment	Network interactions to co-develop knowledge & share capabilities & resources	Capacity to share risk from social, economic, institutional and technological uncertainities Capacity to exeriment with social, institutional & technical options in response to prioritised problems & opportunities
Innovation environment	Institutions to support technical, social & institutional experimentation by network of actors Institutions for sharing risks & benefits from innovation	Institutions that allow dynamic & rapid adaption to changing circumstances	Institutions to stimulate interactive learning & sharing of knowledge, capabilities & resources	Building & spread of actor, organisational and network innovation capacity

Table 5: Capabilities and Innovation Capacities at Different Levels within the Agricultural Innovation Systems (AIS) (Source: Steinbeis 2i GmbH adapted from Turner et al., 2017)

To succeed in a complex AIS and tackle complex issues (e.g. unsustainable land management), project actors must successfully configure the capabilities of multiple actors at different levels of the AIS. Turner et al. present two case studies[192] of agricultural innovation projects that successfully tackled agricultural problems of differing scale and complexity to present how project actors have configured capabilities at different levels in the AIS to build systemic capacity.

Both cases demonstrate "that systemic innovation capacity is formed by project actors configuring and reconfiguring capabilities at individual, organisational and network levels, and dynamically deploying these at strategic points to progress the innovation process".[193] Figure 34 shows the capabilities and innovation capacity at different levels of actor aggregation within the AIS (individual, organisation, project, network, innovation environment) which were used to understand how actors in the respective projects built innovation capacity by linking with other actors to configure capabilities across multiple levels of the AIS and at different phases in the innovation process.

192 Turner et al. studied two cases: 1. a farmlevel improvement in lamb survival through genetic selection and farm management (see: Everett-Hincks, J.M., Dodds, K.G. 2008. Management of maternal-offspring behavior to improve lamb survival in easy care sheep systems. J. Anim. Sci. 86, E259–270.) and 2. A more complex and larger catchment-scale land management to reduce erosion of hill and steep land through farm management, policy and new organisational capabilities (see: Manderson, A., Mackay, A., Lambie, J., Roygard, J., 2012. Sustainable land use initiative by Horizons. N. Z. J. For. 57, 4–8.). The catchment-scale land management case involved configuring capabilities from a larger network of actors, spanning organisational boundaries to connect to capabilities across levels. The lamb survival case progressed predominantly through the boundary spanning activities of the project leader, who was able to connect to other actors to fill missing project capabilities. Important to achieving this were project actors using individual, organisational and project adaptive capabilities for exploring and creating new capability configurations to respond to emerging circumstances. More details can be found in the case study which is openly accessible: https://www.sciencedirect.com/science/article/pii/S0264837717300698.

193 Turner, J. A., Klerkx, L., White, T., Nelson, T., Everett-Hincks, J., Mackay, A. and Botha, N. 2017. Unpacking systemic innovation capacity as strategic ambidexterity: How projects dynamically configure capabilities for agricultural innovation, p. 507. Land Use Policy, 68, 503–523.

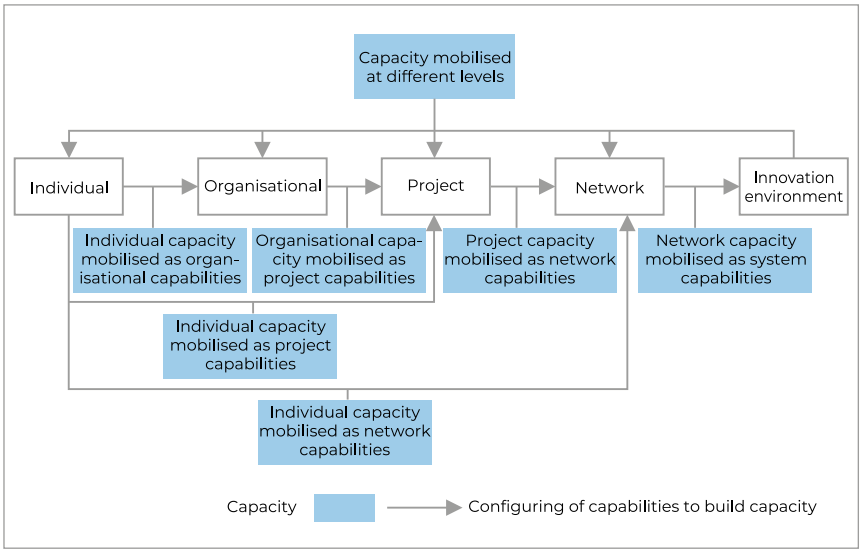


Figure 34: Analytical Framework for Systemic Innovation Capacity (Source: Steinbeis 2i GmbH adapted from Turner et al., 2017)

Problem-oriented phases

- **Agenda setting**, when the initial scope of the problem and stakeholders are defined
- **Describing problems**, when the spatial and temporal aspects of the social, economic, institutional and biophysical systems relevant to the initial problem scope are described, including various drivers in these systems
- **Explaining problems**, when processes and interactions in the systems are elucidated through experimentation, modelling and stakeholder dialogue

The studies investigate events around a Sustainable Land Use Initiative which was initiated as response to widespread devastation from a storm. The initiative obtained a mandate from all communities to affect changes in land management to reduce the risk from future events. The Chair of one organisation calling the community meeting was a key individual who was able to bring together diverse actors around a common agenda. An outcome from the meeting was the formation of the Sustainable Land Use Group (SLUG), representing stakeholders, key influencers, and other actors like a financial contributor at a later point.

This represents the starting point of a series of activities which illustrate organisation the interrelation and interaction of the organisations' capabilities and systemic innovation capacity within the innovation process. Figure 35[194] pictures an innovation project pathway including the configuration and reconfiguration of capabilities and resources within the phases of the innovation process explained below:

Solution-oriented phases

- **Exploring solutions**, when potential innovation pathways to address the problem are developed and the consequences and trade-offs of these are explored;
- **Designing solutions**, when a preferred solution pathway is identified and resources and processes for its implementation are determined
- **Implementation and monitoring**, when the solution pathway is implemented, along with monitoring activities for evaluating progress toward the desired change

The authors conclude that project actors need to be aware of:[195]

- Capabilities present and needed at different levels of actor aggregation;
- How they strategically or serendipitously (by adapting to circumstances and using windows of opportunity) engage capabilities at different levels;
- Whether capacities are readily available or need to be configured from the right mix of innovation, adaptive and absorptive capabilities available elsewhere in the AIS.

194 Turner, J. A., Klerkx, L., White, T., Nelson, T., Everett-Hincks, J., Mackay, A. and Botha, N. 2017. Unpacking systemic innovation capacity as strategic ambidexterity: How projects dynamically configure capabilities for agricultural innovation, p. 519. Land Use Policy, 68, 503–523.

195 Ibid, p. 519.

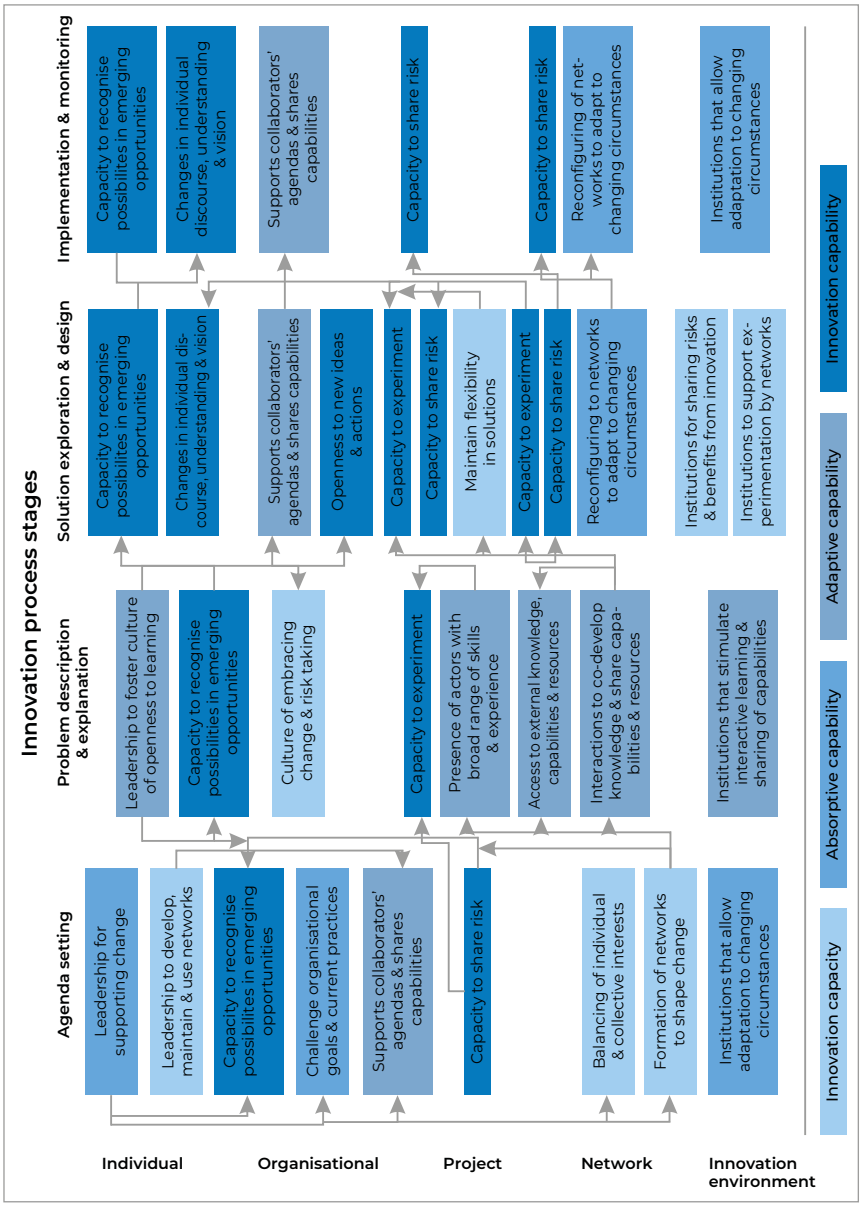


Figure 35: Innovation Project Pathway Formed by Configuring and Reconfiguring Capabilities and Resources across AIS-Levels (Source: Steinbeis 2i GmbH based on Turner et al., 2017)

The studies reveal that project actors should aim at exploring and creating new combinations of capabilities and resources in view of needs and emerging circumstances (e.g. forming core teams, drawing on new relationships, actors from 'flexible partner pools', or from 'sleeping relationships'. They should simultaneously explore existing and new networks to access, combine, create, or even disconnect capabilities within or across organisations. This includes constantly scrutinising whether the AIS provides the right mix of capabilities or should undergo changes in combinations of capabilities at the individual, organisational, project, network and enabling environment levels in the AIS.

The cluster context can be used as an intensified and highly interconnected network to support its member organisations to develop innovation capabilities and systemic innovation capacity at the various levels of actor aggregation. The cluster manager and the cluster members can collaborate to build capabilities at organisational level to also build project- and network-level capabilities. Especially at project and network level, the cluster can facilitate relationships within the ecosystem and with external actors. Seen as a network or facilitator of joint projects, it can positively influence the right configuration of capabilities for successful implementation of innovation projects and activities.

4 Innovation Support for Agro-food Organisations

"An important source of inspiration for innovation processes are agricultural practices themselves. In the past, many innovations in agriculture originated from innovative farmers."[196] The various technologies that exist and better education among the farmers and other actors offer great innovation potential and capacity on the side of the actors themselves. Keeping an open (innovation) mindset and designing processes that support knowledge exchange, will allow those actors along the agro-food value and supply chains to increase their competitive advantage, e.g. through collaboration in ventures, linking producers, processors, marketers, food

196 Détang-Dessendre, C., Geerling-Eiff F., Guyomard H., Poppe K. 2018. EU Agriculture and innovation: What role for the CAP?, p. 9. Institut national de la recherche agronomique (INRA) and Wageningen University & Research (WUR). https://edepot.wur.nl/447423.

service organisations, retailers and others. However, engaging in these innovation and transformation processes is challenging for the agro-food organisations. The following chapter will present support organisations with relevant expertise which can help build a strong and innovative agro-food ecosystem.

4.1 Digital Innovation Hubs for Agriculture

The environmental, social and demographic challenges ahead have a strong impact on the agro-food sector and the circumstances for farmers and all other organisations. Cultivation, production and processing is changing rapidly, and farmers and food producers need to adapt to the new environment quickly – they need to innovate just like any other sector. Many innovations and changes require technological solutions including internet of things (IoT), blockchain, robotics, etc.

But digitisation makes slow progress in the very traditional agricultural sector. This is where Digital Innovation Hubs (DIH) step in to support organisations in planning and implementing their innovations. A few examples of support organisations and activities are given below.

A digital innovation hub (DIH) supports organisations in **planning and implementing their innovations**.

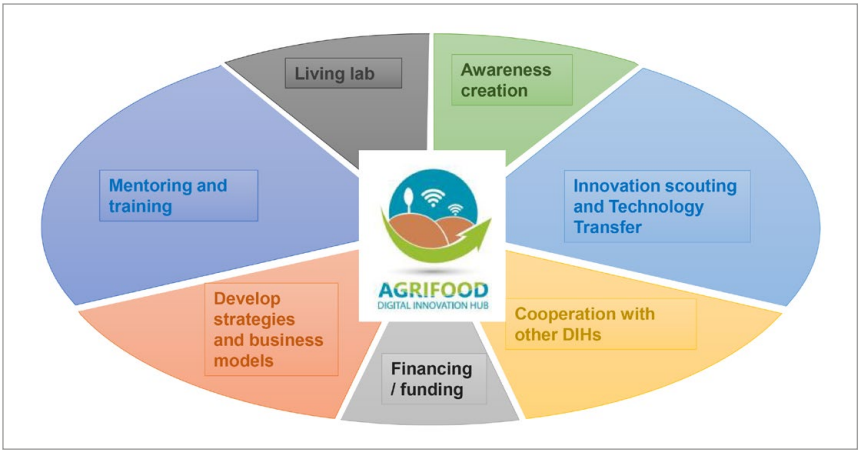
Innovation Technology Cluster Slovenia and Digital Innovation Hubs for Agriculture

The Slovenian Innovation Technology Cluster (ITC) is a private, non-profit, business support organisation, with the goal to foster cross-sectoral innovation, based upon novel technologies and ICT. Together with other stakeholders from the Slovenian agro-food sector, it founded the Digital Innovation Hub **DIH AGRIFOOD** as an informal network to support organisations in coping with future agro-food challenges.

DIH AGRIFOOD works with farmers, farmer cooperatives, food producers and solution providers, but also with other stakeholders, e.g. research organisations, public authorities, business support organisations, in the agro-food area. Research

teams and SMEs are developing novel solutions around e.g. drones, blockchain, robots, IoT sensors, while ITC Slovenia and DIH AGRIFOOD provide the infrastructure and ecosystem to support market entry and scaling for these solutions.

The vision of the hub is to become Slovenian and regional leader in development, technology transfer and implementation of innovative smart farming applications, and other services creating maximum value for Slovenian and European agro-food systems. It is an informal network, with the following defined set of services:



Source: DIH AGRIFOOD Services and Support Activities, provided by Slovenian Innovation Technology Cluster (ICT), 2020

1. **Awareness creation:** *Awareness creation* around digital technologies is crucial for farmers to understand why and how new technologies should be implemented. Knowing and evaluating the *challenges and benefits of digital transformation* is an important step towards acceptance and activation by farmers.

2. **Innovation scouting and Technology Transfer:** *Identification of needs* of farmers and food producers, and *mapping of solution providers*, and identification are important services. There are all sorts of technologies already available for implementation. The main challenge is how to use and implement them effectively.

3. **Cooperation with other DIHs:** Collaboration with other DIHs is a key for more efficient technology transfer. It is important to have an international overview when considering bringing technologies into Slovenian agriculture or promoting Slovenian solution providers at the European level.

4. **Financing and funding:** Farmers, food producers and solution providers (predominantly Start-ups and SMEs) need financial support for digital transformation and developing innovative digital products and services. The key question is how to motivate farmers to adopt new technologies at a faster pace to not fall behind and lose against the competition. Access to funding through European projects, cascade funding opportunities and other sources is an important part of the hub's service portfolio.

5. **Developing strategies and business models:** The DIH caters to the farmers who *need to understand which technology to adopt and why* (e.g. economic benefits for the farmer) and to the *solutions providers* (Start-ups and SMEs) who come with a need for business model and development support when placing their new product on the market.

6. **Mentoring and training:** Famers need mentoring and training on how technologies will affect their work and life. The DIH helps farmers and food producers to understand complex technologies and their benefits, seeking to develop new ways of mentoring and training focused on experience and experimentation.

7. **Living lab:** Experience and experimentation will help the often sceptical farmers to better understand and learn about new opportunities evolving around technology. The living lab infrastructure brings together use cases from Slovenia and Europe to showcase existing technologies implemented in real-world environments and provide first-hand experience and information on new technologies. Every stakeholder dealing with agro-food is welcome to come on board and contribute to the "common asset", while being able to use it in their own daily business. This will make sure that the DIH AGRIFOOD is growing its network, for the benefit of its target groups.

In order to be able to implement and develop services, DIH AGRIFOOD is relying on some of the following tools:

- **Farm management tool** for business case modelling, which will become the central database for real-time data processing (monitoring, data capturing, big data manipulation) and Predictive analytics tool that can serve farmers in predicting various environmental impacts;
- **AGRIFOOD Cooperation Platform**, which is the fundamental platform for the ASSET CREATION and COLLABORATION among target groups since it identifies and maps: organisations (SMEs and Startups, farmers, stakeholders.), projects, products and services, living lab use cases, DIHs and facilitators;
- **E-learning platform** that helps users to learn about digital transformation in the agro-food sector.

Clients of DIH AGRIFOOD benefit from free technology, knowledge and skills transfer services that are financed through projects of the members. Other paid services, e.g. public advisory services, are also provided by DIH AGRIFOOD members.

IND-AGRO-POL Pole of Competitiveness Romania and Digital Innovation Smart eHub

The IND-AGRO-POL pole of competitiveness[197] is an innovation cluster linking the main actors in the agro-food industry and related sectors. The cluster has 128 members (including SME, large enterprises, professional associations, research and development institutes, universities, regional authorities) from all Romanian regions and is now working with the DIH named Digital Innovation Smart eHub.

The Digital Innovation Smart eHub[198] provides an ecosystem to support the digital transformation journey of regional business and public administration bodies, working to increase the competitiveness of SMEs through cross-sectoral cooperation and co-creation. The hub identifies opportunities for collaborative projects in digital innovation and brings together the relevant stakeholders to implement

197 IND-AGRO-POL sees itself as a national network with international vocation. https://www.inma.ro/indagropol/.
198 See main page of Digital Innovation Smart eHub website: https://smartehub.eu/.

them. The parties involved want to stimulate technological and innovation capabilities of organisations in the region to deliver services for the European Digital Single Market.

A digital innovation hub can provide an **ecosystem to support the digital transformation** journey of regional business and public administration bodies, working to increase the competitiveness of SMEs through **cross-sectoral cooperation and co-creation.**

The actors contributing to the development of the Smart eHub provide different types of support:

- Chambers of commerce and professional and non-professional associations: lectures, conferences, general trainings, knowledge and information on digital transformation, e.g. in the form of articles
- Centres of competency and technology transfer: exchange of knowledge and experience through matchmaking, articles, and other informative initiatives
- Universities: curricula for students adapted to digital transformation, scientific trainings and site visits
- Consultants: customised and adaptable concepts and solutions elaborated with the respective organisation, support applications for national and EU funding programs

A Network of Digital Innovation Hubs

Another agro-food innovation support pioneer in Europe is the H2020 **SmartAgriHub**[199] project which aims to accelerate the digital transformation of the European agri-food sector by building a network of Digital Innovation Hubs (DIHs) that will boost the uptake of digital solutions by the farming sector. Within the project, nine regional clusters from seven regions[200] each represent a group of agricultural DIHs, Competence Centres and Innovation Experiments. 140 Digital Innovation Hubs across the different regions maintain working relationships with different actors to provide agro-food organisations with access to technology-testing, financing advice, market intelligence and networking opportunities. One or more Competence Centres inside or outside the region provide

199 See main page of SmartAgriHubs website: https://www.smartagrihubs.eu/, or page "About": https://smartagrihubs.eu/about.

200 Find contact information on the regional clusters here: https://www.smartagrihubs.eu/flagship-innovation-experiments.

the knowledge, technology, infrastructure and facilities that support the technological transformation.

The network has developed *Flagship Innovation Experiments*[201] in which technology solutions are put into practice and which serve as benchmarks for other innovation experiments to strive towards. These experiments involve businesses that want to test and experiment with digital innovations and advanced technologies relevant to their products, processes or business models. They are conducted with the help of Digital Innovation Hubs which facilitate access to the latest knowledge and expertise, and technology support provided by Competence Centres. Out of the European pool of Innovation Experiments, 28 have been highlighted as Flagship Innovation Experiments based on the following criteria:

- The innovativeness of the experiment
- The endorsement by existing Digital Innovation Hubs
- The degree to which it unites end-users and technology providers, by solving various agricultural challenges

The Flagship Innovation Experiments represent a variety of different solutions and applications around digitising farm machinery or supply chains, data-driven precision farming, tracking animal health, autonomous greenhouses and many more.

4.2 Danube Transfer Centres as Gate Centres

The *Danube Transfer Center Network*[202] is a transnational structure in the Danube Region which fosters innovation and knowledge transfer between academia and the economic environment in 10 countries. It provides assistance and support to organisations seeking to improve their competitiveness and internationalise. In each country, one or two gate centers[203] are established, which create their own local network of offices, in order to be as close as possible to the intended benefi-

201 See page "Flagship Innovation Experiments" on the website of SmartAgriHubs: https://www.smartagrihubs.eu/flagship-innovation-experiments

202 See main page of Danube Transfer Center Network: http://www.dtcnetwork.eu/.

203 From 2012 to 2019, the network has established partnerships with partners from Cluj-Napoca, Bucharest, IASI and Craiova (Romania), Nitra (Slovakia), Novi Sad (Serbia), Maribor (Slovenia), Györ (Hungary), Ruse and Sofia (Bulgaria), Vukovar and Zagreb (Croatia), Odessa (Ukraine) and Villach (Austria). The network now counts a total of 14 members.

ciaries. The members of the network provide services in technology transfer, intellectual property management and innovation management.

4.3 Enterprise Europe Network

The *Enterprise Europe Network* (EEN)[204] describes itself as the world's largest support network for small and medium-sized enterprises (SMEs) with international ambitions as it helps businesses to innovate and grow on an international scale. The network promotes technology transfer in and among over 60 countries, and brings together the knowledge of over 600 business support member organisations, including for example:

- Technology poles
- Innovation support organisations
- Universities and research institutes
- Regional development organisations
- Chambers of commerce and industry

Each member organisation knows the local business environment and has contacts for business opportunities worldwide. It offers personalised services to organisations in different sectors such as:

- **Market access** for SMEs: services relevant to understanding and navigating the Single Market including access to finance, EU laws and regulation (current and future), practical support in accessing new markets and searching for European partners.
- **Innovation services** for SMEs: information on relevant European innovation programmes and regulations, training courses on (open) innovation topics including IPR, financing innovation, etc., search for international cooperation, technology and know-how transfer helping clients to increase competitiveness, e.g. by purchasing technological solutions.
- **Cooperative research** in Horizon 2020: support in identifying relevant EU research programmes, building project partnerships, applying for and implementing cooperative research projects.

204 For more information on the Enterprise Europe Network see: https://een.ec.europa.eu/.

Overall, the collaboration and knowledge exchange taking place between clusters and their members, DIHs, networks of DIHs and other actors, such as the Danube Transfer Centers and the partners of the Enterprise Europe Network is beneficial to the regional development and innovation potential of all organisations participating.

5 Conclusions: Effective Innovation Management for Agro-food Clusters

Through regional agglomeration or concentrated centres of activities, clusters can achieve higher efficiency advantages, flexibility advantages and innovation advantages. This means that clusters can support the economic performance of organisations and their regions to increase economic prosperity. The Danube region has formal and informal cluster structures and mostly smaller-scale organisations active in the agro-food sector. The competences of these organisations differ widely and leave much potential for the enhancement of different innovation capabilities. Innovation is an active commitment to invest in new products, services, processes or business models and to shape future trends in the sector.

This commitment needs to be enforced by the leadership of an organisation in the form of an innovation strategy comprising a vision and a strategic focus for the innovation activities the organisation wants to pursue. An innovation roadmap can serve as a tool to bring the organisation's strategy to life, defining objectives and specific activities, projects and milestones that pave the way to achieve the intended outcome. With respect to implementation, innovation depends on people, on their ability to generate knowledge and ideas and to apply these to their workplace and society. The development of an innovation culture that supports these people in driving innovation is not an easy process, but necessary to ensure a successful implementation of open-minded structures, processes and behaviours within an organisation generating excellence in innovation.

Innovation can affect products, services, processes or the business model of an organisation. Once a focus has been set, ideas must be generated and evaluated to select or prioritise those that should be implemented. Systematic processes for idea

generation, evaluation and selection are crucial to the innovation process. Once chosen, the idea must be further developed. Depending on the area of innovation, different tools can be applied for product, process or business model development. From there, a prototype should be built, or an experiment conducted to validate the innovation before it can be launched or replicated. After the innovation was launched or implemented, the organisation should engage in a continuous evaluation and improvement process to ensure quality, efficiency and general success with respect to future innovations. To allow the evaluation and the continuous improvement of innovation in an organisation, its innovation activities should be measured, and efforts made to develop its innovation capabilities.

Various innovation process models provide guidance through the innovation development and implementation processes, generally involving idea and knowledge management, development and testing activities, as well as launch and improvement processes. In today's highly interconnected world, a special attention should be given to open innovation processes that can boost collaboration efforts and knowledge exchange within and among clusters. An even bigger impact can be achieved if the entire agro-food ecosystem, including DIHs, networks of DIHs and other actors and networks like technology transfer centres and EENs engage in joint innovation activities, also with related fields like health and consumer industries.

Acknowledgements

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As important economic driver for many European regions, the agro-food sector (including agriculture, food processing and disciplines beyond that) is at a turning point - now accelerating innovation activities to drive the transformation towards more efficient and sustainable practices. This transformation is synonymous with great challenges for the producing and processing businesses in the sector. With the increasing pressures of global markets and prices, but also higher standards for production and processing, diverse organisations along the agro-food value chain need to join forces to keep pace with the current and future technological, economic and social developments.

Innovation and economic growth are often spurred by geographically concentrated economic activity. This suggests that organisations can benefit from the membership and active engagement in clusters, tapping into their infrastructure and networks, and participating in the targeted activities they offer.

Based on the need for improved innovation management knowledge and capabilities among agro-food organisations in the Danube Region, this guide aggregates knowledge and tools to support the innovation management in agro-food organisation and the clusters they are a part of. This shall support the efforts being made within the Smart Specialization Strategies of the Danube region, implementing agro-food related priorities relating to health, environment, bioeconomy, and sustainability.

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