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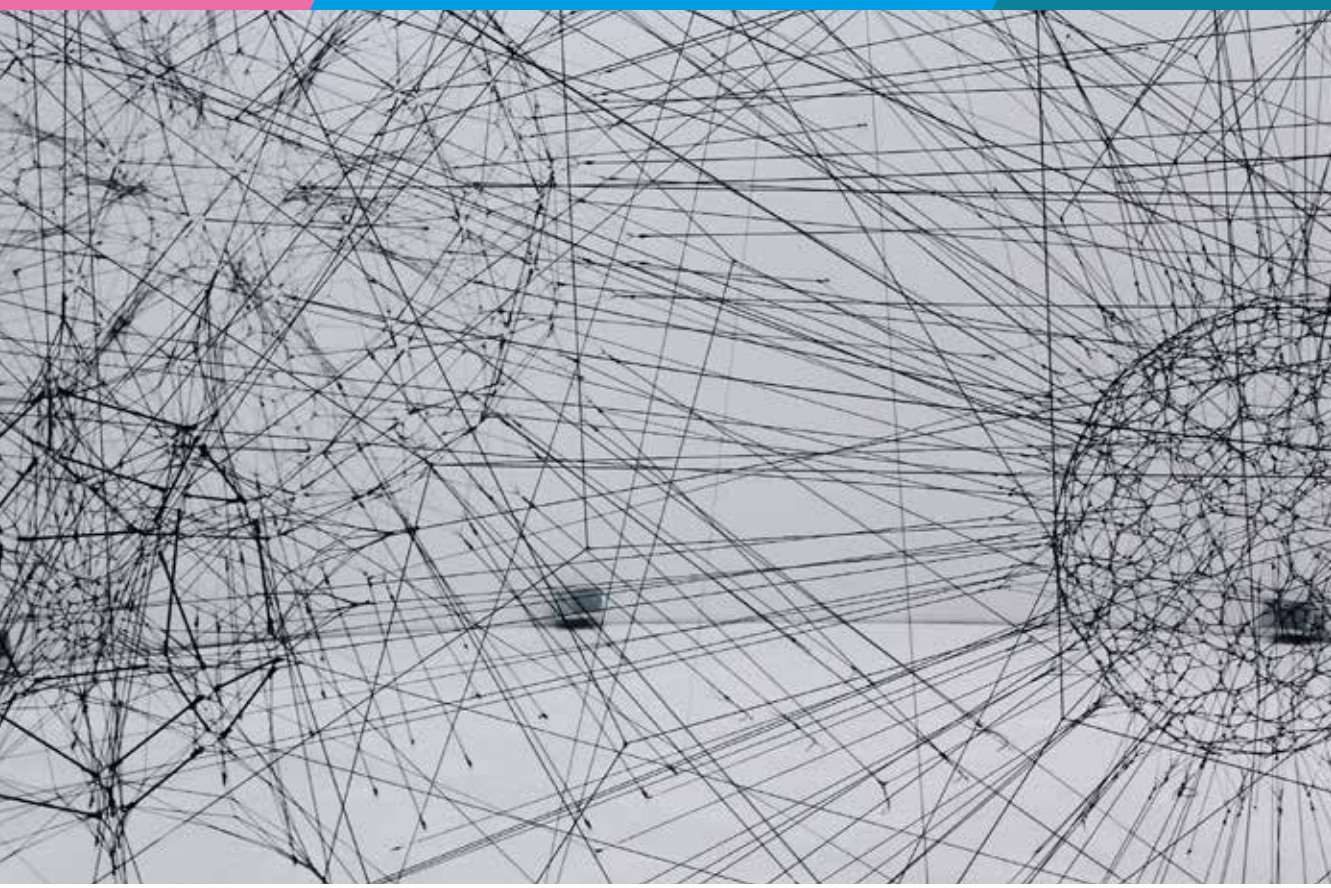

Tuija Hirvikoski, Anne Äyväri, Maija Merimaa, Hanna Lahtinen &
Kaisla Saastamoinen (eds.)

European university as an enabler-orchestrator of participatory research, development and innovation. Innovation ecosystem perspective on multistakeholder co-creation

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Innovation ecosystem perspective on multistakeholder co-creation

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Preface

Tuija Hirvikoski

THIS PUBLICATION DISCUSSES the role of universities at the crossroads of European research, innovation and higher education policies when the aim is to tackle large societal problems in collaboration with multiple innovation ecosystem actors. It introduces the idea of higher education institutions as an 'enabler orchestrator' supporting the effective and impactful implementation of these policies. Metaphorically, the enabler orchestrator is perceived as a 'roundabout' allowing the intersecting 'traffic' of knowledge, solutions, and value-added from different innovation, science and education actors to proceed smoothly. The underlying idea of this publication is that the newly created European University alliances operate as Pan-European meta-networks liaising and orchestrating value co-creation with and across regional and thematic innovation ecosystems.

Today's urgent wicked problems are inherently complex and systemic and will not be solved by individual disciplines, organisations, or countries operating in isolation. To tackle wicked problems and foster enabling innovation requires a systemic approach of value co-creation and collective learning. That approach is inclusive and collaborative, it involves diverse disciplines, actors, institutions and territories, it shares risks and maximizes the value of innovation to all, moreover, it ensures equitable diffusion of its benefits. In complex and systemic innovation ecosystems, continuous mediation, facilitation, and support are the prerequisites for scientific excellence as well as innovation efficiency and capacity. We call this support orchestration. Apart from supporting the collaboration or balancing the actors' conflicting goals, orchestration is also needed to enlarge the participation of more diverse innovation actors, reduce the innovation divide in Europe, or reinforce the innovation aspect of the European Research Area.

Apart from the traditional innovation actors such as universities, research institutions and companies, the ecosystems would benefit from many more stakeholders. The EU sees that such innovation actors as social innovators, civil society organisations, non-governmental organisations, citizens or residents, investors, and foundations as well as the public and private buyers still miss from many innovation ecosystems.

When addressing large societal problems such as global warming or the Covid19 pandemic, individual and isolated innovation ecosystems are however powerless. Therefore, by interconnecting the European innovation ecosystems, the EU aims to promote the Pan-European Internal Knowledge Market as well as the deployment and scale-up of innovative solutions.

Value-added, innovation, scientific knowledge, and learning are the intertwined core elements of the ambitious vision of an innovative, globally competitive and attractive European Education Area (EEA) by 2025, in full synergy with the European Research Area (ERA) and the European Higher Education Area (EHEA).

The interconnected European universities innovate, educate, conduct research and serve society in diverse economic, political, cultural, and geographical contexts and situations. Hence, this publication sees the European University alliances as potentially strong Pan-European innovation orchestrators. As orchestrators, they would enable local innovation actors and researchers to liaise with other regions in the most effective way, and facilitate joint learning and value-added in accelerated input-output relationships. By implementing and achieving systemic, structural and sustainable cooperation, the university alliances would have an ideal position to balance the societal needs related to innovation with academic freedom and independent self-correcting science.

This publication is based on scientific literature, policy documents, and technical reports. It aims to shed light on the idea of universities as enabler orchestrators. The first article discusses the long-term European policy evolution and related challenges and opportunities from the viewpoint of higher education institutions and science. The second article introduces the concepts related to innovation orchestration. Whereas the last article discusses the benefits and hurdles of connecting the challenge-driven iterative approach of innovation co-creation with the independent self-correcting science. The article introduces various approaches and services the academic enabler orchestrator could implement when the aim is to avoid jeopardizing scientific excellence or innovation efficiency and capacity.

This publication is an outcome of the multistakeholder co-creation orchestration (CCO) profile project of Laurea University of Applied Sciences. The work was supported by the Finnish Ministry of Education and Culture.

1 Interaction between higher education institutions and society in Europe, development from the 1960s to 2022

The impact on the emergency of multi-stakeholder co-creation orchestration

Tuija Hirvikoski

> ***The test of a first-rate intelligence is the ability to hold two opposed ideas in the mind at the same time, and still retain the ability to function.***
>
> ***F. Scott Fitzgerald, 1936, 'The Crack Up'***

ABSTRACT

This article discusses the development of concepts that have contributed to the inception of multi-stakeholder co-creation from the 1960s to this day and how the development has been reflected in the interaction between the European higher education institution and society and its change.

We discuss the change first from the perspective of an economy-driven and innovation-oriented higher education institution and then from the perspective of independent science and higher education institutions (HEI). We also consider the tensions, paradoxes, and differences in values and operating methods that affect the co-creation orchestration in everyday life.

Based on the literature review observations the following arguments were built:

1. *The economy-driven and innovation-oriented development that started in the 1960s has changed the legitimacy of science and higher education institutions. It has also made science and higher education institutions assistants to the innovation ecosystem. At the same time, the development has enabled multi-stakeholder co-creation to spread to all levels of innovation ecosystems from micro-level to macro-level.*
2. *The mission- and challenge-oriented RDI funding and activities that have become more common in the 2020s emphasise inclusive co-creation involving all levels, activities and actors of the innovation ecosystem. Today, innovation-oriented RDI activities emphasise the role of citizens as a subject of action, not as an object of an innovator or as a mere scientific factor.*
3. *As participation and the instrumental benefits of the higher education institution have been emphasised, it seems to have been forgotten that independent science and the autonomous universities have, by their mere existence, probably brought about a similar change in society that the economically driven innovation system has been aiming for over recent decades. It should therefore be remembered that autonomous science produces independent and reliable knowledge for co-creation only if it ensures the quality of the research itself; the combination of independence, responsibility and criticality is the most important precondition for the societal impact of science.*
4. *Despite paradoxes and contradictions, we recommend that policymakers and follow-up studies on orchestration should also look into the worlds of independent science and autonomous universities to find positive cooperation that benefits all parties involved in co-creation activities. As a tool for this, we propose JV Snellman's university concept, in which education and academic freedom are linked to the important challenges and problems of the world and society. We also recommend the multistakeholder co-creation orchestrator role for the universities as only they have the built-in capacity to simultaneously produce knowledge and innovation as well as pursue truth and participate in solving problems.*

Keywords: multi-stakeholder co-creation, innovation ecosystem, science, higher education institution/university, societal interaction, open innovation 2.0 (OI2), quadruple helix, enabler-orchestrator

1.1. INTRODUCTION

IN AN ECONOMY based on global knowledge, *research knowledge and innovations have become key sources of economic growth and competitiveness*. For example, the Finnish State established The Finnish Research Impact Foundation with the aim of "strengthening public-private partnerships and enhancing the interaction between industrial and academic stakeholders" (The Finnish Research Impact Foundation).

At the same time, many *wicked problems*, such as the pandemic, climate crisis, species loss and population ageing, affect societies, organisations and people. Three characteristics that require cross-sectoral cooperation are associated with wicked problems: they change over time, their causes and impacts are scientifically uncertain, and they involve value conflicts between different stakeholders in society. Collective activities and co-creation[1] between the different sectors of society, i.e. private, public, academia and civic society, are needed to face wicked problems. This is the only way that it is possible to achieve effective and transformative development in organisations and systems that are based on a fundamental change in the knowledge, attitudes and competencies of individuals. The need to respond quickly to many wicked problems has increased the number of *multi-stakeholder initiatives (MSIs)*. MSI refers to voluntary and self-directed arrangements between different stakeholders (Dentoni & Bitzer, 2015).

Instead of bilateral cooperation projects between individual companies and higher education institutions, efforts are currently being made to implement research, development and innovation cooperation (RDI) through structures and innovation ecosystems that are suitable for long-term multilateral cooperation. In these, co-creation refers to value co-creation or the creation of innovations and markets and the introduction of solutions through cooperation between actors and by involving individuals[2].

Multi-stakeholder co-creation refers to innovation in open innovation ecosystems, the aim of which is to generate a large number of solutions that create value for ecosystem actors and promote ecosystem well-being (Reypens, Lievens, Blazevic, 2016).

Orchestration

In this article, we call the management and coordination of multi-stakeholder co-creation in innovation ecosystems "orchestration". We focus in particular on *the role of the higher education institution as an enabler-orchestrator* that does not operate in a competitive market and thus does not pose a threat to the business activities of network members (see Äyväri 2022). The goal of the enabler-orchestrator is the well-being of the innovation network and smooth cooperation (Pikkarainen, Ervasti, Hurmelinna-Laukkanen & Nätti 2017, ibid.). The main processes of orchestration are managing knowledge mobility, ensuring a fair distribution of revenues from innovation and ensuring the stability of the network (Dnanaraj & Parkhe 2006, Ibid). The network partners rely on the activities of the non-player orchestrator which ensure that everyone can utilise the value creation potential of innovation (Leten et al. 2013, ibid.).

Paradoxically, as the need for quick solutions in society has increased, it is no longer trusted that the existence of higher education institutions and their independent research would sooner or later lead to a change in the world. In fact, the state of free thinking and research in the world has narrowed, even though it is known that self-correcting science is an important force for human development (Väliverronen & Ekholm 2020; Saarikivi & Saarikivi 2021).

1 In the Finnish language, the word "co-creation" ("yhteiskehittäminen") can be understood in different ways. In service design, it is seen as a method, way of working, or an approach to customer-oriented business. However, in this article, co-creation is seen more extensively as value co-creation or the co-creation of innovations and their markets, especially when science and innovation are used to find solutions to the global wicked problems and education is intended to promote a sustainable future. The aim is that the solutions meet the needs of users and increase public trust in science and change people's behaviour.

2 Depending on the field and the purpose of the activities, inclusion applies to citizens, people, consumers, customers or experts.

As the global innovation-driven economy, wicked problems and *New Public Management (NPM)* have become more common, higher education institutions have been expected to continue to provide an increased flow of innovation and expertise to enable individuals, companies, regions and nations to operate in a rapidly changing operating environment and compete in an increasingly competitive global market. While the value of research as a socio-economic instrument has increased, the instrumental value of education has also been emphasised. Higher education is expected to improve the ability of society, companies and individuals to utilise new knowledge and innovations in daily decision-making and activities. However, the role of independent research and autonomous higher education institutions in the current RDI funding and policy programmes for co-creation and innovation ecosystems is difficult to identify. Provided we continue to trust independent science, we want to create the conditions for its independent development also in the future.

Structure and approach of the article

In the 2020s, education and RDI activities are seen globally as part of innovation policy and different levels of innovation systems and ecosystems. As a result of the long-ongoing change, the activities of HEIs are subject to different cross-sectoral pressures, not only from the outside but also from science and from within the higher education institutions.

This article describes the change and current state of societal interaction between the science institution and the higher education institution. We describe how development has taken us towards multi-stakeholder co-creation and increased the need to orchestrate it. Orchestration refers to all measures on different levels of society that support positive interaction between different parties, activities and levels of the innovation ecosystem. In this article, we limit our review to the concept of enabler-orchestration (see Äyväri 2021).

First, we describe the instrumental role of the science institution and the higher education institution in innovation ecosystems; then we focus on their independent role. The article first focuses on describing the decades of development and the flow of new concepts that have preceded the popularisation of multi-stakeholder co-creation. In the second chapter of the article, we discuss concepts that have influenced higher education institutions and the latest European and Finnish funding and policy programmes[3] in the 2020s. These concepts describe the emergence of an economically driven and innovation-oriented scientific institution and a higher education institution. In Chapter 3, we describe the fundamental values that affect independent and self-corrective science, autonomous higher education institutions, critical thinking and education, and their relationship with the instrumentalisation of higher education institutions.

We examine development both from the perspective of phenomena and the real world. In the review, we mainly use concepts from innovation and education research as well as funding and policy programmes (i.e the phenomena). Through them and our observations, we describe how European policy and funding programmes have developed and how they have been implemented in the everyday life of higher education institutions (i.e. the real world).

We describe the stages and tensions of social interaction using literature, funding and policy programmes and our practical observations on such co-creation and open innovation initiatives and development stages in which we have been involved ourselves[4].

3 These include the European Commission's Horizon Europe funding programme, European Research Area (ERA), European Education Area (EEA), European University Initiative (EUI), or the Finnish Government's innovation and experimentation policy.

4 Experiential knowledge consists from the following: The pilot evaluation of the Finnish higher education institution; legislative work related to the institution of the Finnish university of applied sciences; the establishment and management of the European Network of Living Labs; work on RDI projects on practical innovation ecosystems and evaluation of funding applications; the interim evaluation of the impact of the H2020 programme; membership of the Open Science and Policy Platform (OSPP); cooperation with Open Innovation Policy and Strategy Group (OISPG) and the European Committee of the Regions (CoR); the preparation work of the new ERA; and participation in the statutory decision-making of the regional cooperation group (MYR).

We examine the described phenomena as a problem related to identity and change. In the world of ideas and metaphysics, the question would be: to what extent or how does the identity of an object or other entity remain as it changes? In the real world, we ask how the change in the interaction between the higher education institution and society has affected the identity of the higher education institution and science, and how their change has affected the nature of innovation, the inception of co-creation or how we perceive the world.

We approach the problem of identity through the definitions of change and transformation in modern science. Regardless of the field, one factor that the definitions have in common is that "transformation manifests itself as a change in the fundamental attributes of the system" (Brown et al. 2013, 100-101). This is what Brown et al. (ibid.) mean exactly with that phrase: The change is visible in individuals, society, institutions, technology, economy and ecology. It can be seen in e.g. power dynamics, norms and values, or as a lifestyle and a way of operating. The change requires the ability to imagine alternative and potential futures, which is why it emphasises learning and commitment to innovation, new things and diversity. Change requires constant critical questioning. As there are contradictions and conflicts associated with change, it is also important to consider the subject and main driver of the change. Is the change planned or voluntary? How does it change our way of looking at the world?

Catalysts of change work in many spatial or temporal scales. They can be gradual or fast, consisting of surprises or periodic events. Interaction between fast and slow drivers of change takes place at global, national, and local levels. Interaction between drivers of change often leads to unpredictable and confusing transformation processes which are rarely elegant full turns from one state to another. In most cases, many elements of the pre-change stage remain in the new system or in the collective memory of humanity and are therefore ready to arise and influence the new system as soon as the event chains and conditions become favourable to them.

Innovation ecosystems as an environment for the orchestration of multi-stakeholder co-creation

In this sub-chapter, we describe different innovation systems and ecosystems as an environment for multi-stakeholder co-creation.

The societal impact of innovations responding to complex societal problems (Rittel & Webber, 1973) requires systemic and sustainable innovations (Hämäläinen & Oksanen, 2015) and combinations of commercial and social innovations (Russo & Hughes, 2000). They are sought through cooperation between the public and third sector that cross the boundaries of disciplines, organisations and countries (Mazzucato 2018a; Pera, Occhiocupo, & Clarke, 2016) as well as through cooperation between higher education institutions, research institutes and companies (Hämäläinen & Oksanen, 2015; Luoma-Aho & Vos, 2010; Kaihovaara, Härmälä & Salminen, 2016).

The orchestrator of multidimensional and multilateral cooperation must therefore understand complex and systemic problems and have the ability to bring together a sufficiently complex set of actors that are committed to a shared goal and who are capable of systemic innovation (Kaihovaara, Härmälä & Salminen 2016; Zivkovic, 2018). The concepts of *innovation systems and ecosystems* describe close interaction between companies, research institutes, the public and third sector, consumers and other actors aiming to achieve a common goal.[5]

5 The phenomenon is described through various concepts, such as: the innovation network, the innovation system, the innovation ecosystem (Fasnacht 2018; European Commission, Directorate-General for Research and Innovation 2016), the regional innovation system or ecosystem (Lappalainen, Markkula & Kune 2015) and Living Labs (Aversano 2016).

As far as we are aware, Finland is the first country in the world to introduce the concept "innovation system"[6]. It refers to the different actors involved in producing, sharing and utilising economically useful knowledge and the interactive relationships between them (Sotarauta & Mustikkamäki 2008, 18).

According to Edquist (2005), *innovation systems* consist of all the actors of economy, politics, society, institutions and organisations that have an impact on the development, diffusion (i.e. sharing) and use of innovations. According to studies on innovation systems, innovation increases in time with diversity and interaction. The interaction between higher education institutions and profit-making organisations promotes the creation of innovations and has been identified as the most important individual dimension of innovation systems. (Mercan & Göktaş 2011; Florida 2002; Hautamäki 2015.)

The concept of an ecosystem is a metaphor taken from nature. It refers to a situation in which all elements of the system are in dynamic interdependence with each other. According to Granstrand & Holgersson (2020), the innovation ecosystem is a set of actors, activities, artefacts, institutions and relationships (including complementary and substitute relationships) that improve the innovative performance of an individual operator or group of operators.

The innovation ecosystem developed from the national and regional innovation systems described by the OECD. Systems, unlike ecosystems, are managed by the governments and policies of each country. Higher education institutions and science are also part of official innovation systems. However, as a word, "ecosystem" better describes the informal, dynamic and self-guiding nature of interaction related to innovation activities and the fact that the public sector, companies, higher education institutions and organisations, as well as their staff and members, can operate in a wide variety of ecosystems as they choose. Roles, division of labour, value creation and their introduction vary in each case and situation according to the current shared vision.

Innovation ecosystems may be closed or open. In this article, we focus on open co-creation structures. In them, the gatekeeper organisation alone does not decide which party can participate in co-creation. Instead, their diversity and complex and cross-sectoral interconnections are open to new actors as diversity is believed to increase innovation potential and improve the noise resistance of the ecosystem in the discontinuities of society and the economy.

Open ecosystems are multidisciplinary, dynamic and interdependent networks of close interaction between science, research institutes, companies, the public sector, citizens, other actors and artefacts. The higher education institution can act as one member in different ecosystems or take greater responsibility for the orchestration of an ecosystem. (Reypens, Lievens, Blazevic 2016; Curley and Salmelin 2018, Hoffecker, 2019; Curley & Salmelin 2013; The European Commission, Directorate-General for Research and Innovation 2016.)

According to the Finnish Ministry of Economic Affairs and Employment (TEM 2021), ecosystems are networks of interdependence between companies, entrepreneurs, research, public administration and third sector actors. Kaihovaara, Härmälä & Salminen (2016) and Zivkovic (2018) emphasise that innovation ecosystems are close-knit, dynamic and self-directed networks in which openness, interaction and interdependence are stronger than in conventional networks and clusters.

According to Curley & Salmelin (2013), an open multi-stakeholder ecosystem that crosses organisational boundaries and is based on trust and shared resources, vision and values, is most effective when clearly orchestrated.

6 "At the end of the 1980s, the idea of a national innovation system was adopted in Finland as a superpolicy guiding education, research and business life" (Tuunainen, Miettinen and Esko 2020, 114).

Polyphonic and dynamic ecosystems operate in a societal environment with complex phenomena and wicked problems. As no actor alone can understand all dimensions of complex phenomena nor develop such solutions whose negative externalities could also be controlled by society, multi-stakeholder co-creation is necessary. Ecosystems are also needed to share solutions and knowledge and to create markets.

However, diverse ecosystems are not fully self-guided. They must be orchestrated which means that their cooperation is guided and supported. Regional developers use orchestration to refer to research, society and their interaction. As a result of research and practical action, as well as the dialogue between science and society, researchers and the rest of society create a shared understanding of the challenges and the possibilities of research to generate solutions. Based on a shared understanding, research is carried out, access to research results is safeguarded, the consequences of them are understood, and the research results are put into practice. (Äyväri 2021; Äyväri, Hirvikoski and Jyrämä 2018; Lappalainen 2015; Curely & Salmelin 2018.)

As mentioned earlier, in this article, we focus on the role of higher education institutions as enabler-orchestrator that does not operate in a competitive market and thus does not pose a threat to the business activities of network members (see Äyväri 2021).

1.2. ECONOMY-DRIVEN AND INNOVATION-ORIENTED DEVELOPMENT OF HIGHER EDUCATION INSTITUTIONS

Economic and innovation-driven development targeting higher education institutions and science has been both researched and politically managed through different concepts and reference frameworks. In this sub-chapter, we will examine the accelerated change in the generation of knowledge, innovations and competence since the 1970s and the concepts describing them as well as how multi-stakeholder co-creation has become more common alongside the change. Through a few observations, we demonstrate how the change has manifested itself in the interaction between higher education institutions and society as well as in the funding and policy programmes concerning RDI activities and higher education.

1.2.1. Early development stages of multi-stakeholder knowledge production and innovation

Cooperation and innovation between higher education institutions and stakeholders have changed dramatically in the decades following the Second World War. In general, it is thought that the commercialisation of knowledge and the development and research of multi-stakeholder innovation started when the Organisation for Economic Co-operation and Development (OECD) was established in the 1960s. The OECD report (1971) *Science, Growth and Society* was the waymarker that guided attention to the role of science in society and the desire of society to guide science.

In the research and development of science and higher education institutions, the focus has changed over the past decades. Innovation activities between many actors have first been referred to indirectly and lately directly with several different concepts emphasising the nature or approach of the activities at hand. The concepts have been used not only to understand the change in higher education institutions and their relationship with innovations but also to resolutely manage the change as a society. The concepts are mainly and intentionally wide-ranging or descriptive, thus leaving room for a discourse between science and policy programmes (see Miettinen 1994). Thus, concepts have created preconditions for a stronger trend in the 2020s to

increase interaction across scientific boundaries and sectoral boundaries and to open up science, innovation and learning. From the perspective of higher education institutions and stakeholders, the opening of activities has been one step towards multi-stakeholder co-creation.

Science Technology and Innovation (STI) continuum and the DUI innovation model based on experiential knowledge

The societal interaction of science and innovations has been perceived both as a linear continuum between science, technology and innovation and later as a multidisciplinary and cross-sectoral open innovation. In the past, innovations were thought to be based primarily on codified scientific or technological knowledge. The starting point was that innovation is created when scientific knowledge is transferred to the use of companies and other beneficiaries in a linear knowledge transfer process. This linear innovation model is referred to as STI. The abbreviation stands for Science, Technology and Innovation (Jensen et al. 2007).

It seems likely that innovations have always arisen also outside of science and technology but it was not until the 1980s that research introduced other innovation models alongside the STI model. When studying national and regional innovation systems, Bengt-Åke Lundvall (1985) from the University of Aalborg identified and named *the DUI innovation model*. In it, knowledge and innovations did not progress linearly but cyclically with numerous repetitions and two-way feedback. According to the DUI model, actors in an ecosystem - including citizens or consumers and organisational staff - exchange experiential and tacit knowledge in an informal interactive relationship. Interaction promotes innovation capacity and learning which are some of the most important prerequisites for creating innovations. DUI stands for Doing, Using and Interacting, which refer to the core message of the model, i.e. learning in many different ways: *Learning-by-Doing, learning-by-Using, and learning-by-Interacting* (Jensen et al 2007).

According to Mario Davide Parrill and Henar Alcalde Heras (2016), the STI model affects technological innovations in particular, while the DUI model has a greater impact on the development of commercial, organisational and other non-technological or social innovations. The STI model has made it possible for science institutions to focus on basic research and enable students in doctoral programmes to also participate in STI activities. Alongside basic research and doctoral programmes and as support to the STI model, universities have also created knowledge and technology transfer units, or science parks have been established in their vicinity to promote business cooperation and commercialisation of research results. The STI model and the related knowledge transfer mechanisms have created science-based growth companies and economic growth as well as increased the attractiveness of many regions. Known examples include Silicon Valley in the USA, Cambridge in the UK, Sophia Antipolis in France and Leuven in Belgium. In Finland, we can bring up Oulu Innovation Alliance as an example of a coalition in which scientific knowledge, societal challenges and the interests of companies are interlinked (Äyväri & Hirvikoski 2021). It could therefore be seen that the benefits of the STI and DUI models are combined in the Oulu region.

Multi-stakeholder co-creation utilises both STI and DUI models

Multi-stakeholder co-creation and experimentation are related to both STI and DUI models. The DUI model is closest to the idea of co-creation in needs-oriented innovation. In Finland, many regional and practical RDI projects of universities of applied sciences in particular are based on the DUI model. The STI model, on the other hand, produces unique scientific knowledge for the innovation process which is hoped to also help generate radical or breakthrough innovations. The Covid-19 vaccine is an example of science-based innovation. The vaccine came about so quickly only because its developers had broad scientific understanding and

in-depth virological knowledge that had accumulated over decades. The actual development of the vaccine then took place in a multi-stakeholder manner through public and private funding. (State-of-play on the PACT for research and innovation 2021.)

1.2.2. Stages emphasising the societal interaction and entrepreneurial activities of higher education institutions

During the 1980s and 1990s, the interaction between higher education institutions and society was managed and studied from the perspective of producing and commercialising knowledge, competence and innovation. Researchers described the change in higher education institutions with the concepts of Knowledge Creation Mode 1 and 2, the Triple and Quadruple Helix, and the Entrepreneurial University. At the same time, the idea of the third task of higher education institutions was launched. Later in Europe, researchers introduced the concepts Responsible Research and Innovation (RRI), Knowledge Triangle, and Knowledge Square - the concept used by the European University Initiative that states that higher education institutions have four missions[7]. The article discusses these concepts in more detail later. Together, these concepts and their funding have guided the current interaction between higher education institutions and society.

Knowledge Creation Mode 1 and 2

The economic development of higher education institutions was going through an important stage in the late 1980s and early 1990s. At that time, the desire to solve problems in the real world increased and cooperation between disciplines intensified. The concept of *Knowledge Creation Mode 2* was coined by Gibbons et al. (1994) to describe this change. Knowledge Creation Mode 2 emphasises applied research and describes how knowledge is typically produced for innovation activities in multidisciplinary and authentic environments. *Knowledge Creation Mode 1,* on the other hand, refers to the creation of knowledge that emphasises the autonomy of science, usually within one discipline and often hierarchically codified. (Etzkowitz & Leydesdorff 2000; Mustikkamäki & Sotarauta 2008.)

In the 1990s, Knowledge Creation Modes 1 and 2 were used eagerly in Finland as a dual model of higher education was being created in the country, and its development focused on differences in ethea of science universities and universities of applied sciences. At that time, Mode 2 provided the Finnish universities of applied sciences with a theoretical framework in which the principle of subsidiarity was applied[8] and their regional development task defined by legislation concerning Finnish universities of applied sciences was interpreted and developed.

At that time, Laurea operating in the Greater Helsinki region became Finland's most awarded university of applied sciences in national evaluations (Excellence in regional development and education). The success was thanks to Laurea's Learning by Developing (LbD) operating model implementing the Knowledge Creation Mode 2. In addition, LbD made use of the subsidiarity principle of the national legislation. Following the principle, decision-making power and responsibility for the results were brought as close to the teacher and

7 The aim of the European University Initiative is to develop versatile cooperation between different types of higher education institutions. The activities of the higher education alliances are based on close, systematic and sustainable cooperation, which at the same time strengthens the links between higher education and research and innovation activities as well as the societal impact and dialogue of higher education in regional ecosystems. Knowledge Square is the operating principle and funding criterion of European Universities. Communication from the European Commission (2020a) to the European Parliament defines it as follows: "A concept understood as the junction of four core domains: education, research, innovation, and service to society"

8 According to the principle of subsidiarity, decisions by public authorities should be taken as close to people as possible and handled at the lowest possible level in bureaucracy. Only decisions that cannot be made at lower levels should be taken to higher levels. Wikipedia *https://fi.wikipedia.org/wiki/L%C3%A4heisyysperiaate*

learner as possible also at Laurea. Thus, the creation of the LbD operating model also accelerated practical and user-oriented innovation activities in cooperation with partners.

The numerous trials and working life projects of the 1990s and 2000s later formed the basis for Laurea's externally funded and international RDI project portfolio, first with support from TEKES (national innovation funding agency) and the European Ambient Assisted Living programme, and later with EU framework programme funding. Consequently, Laurea's acquisition of funding from the framework programmes has been the best of the Finnish universities of applied sciences throughout the 2000s, and Laurea ranked 14th in the country's recovery statistics in 2021.

Triple and quadruple helix

In 1995, Henry Etzkowitz and Loet Leydesdorff presented research results showing that knowledge creation takes place in cooperation between the parties of a so-called Triple Helix, i.e. higher education institutes, industry and public administration. In a triple helix, the production of goods and services takes place in business life, whilst public administration secures a stable interaction and exchange environment, and universities produce the knowledge and technology needed by the knowledge society.

The triple helix is a figure of speech that depicts the double helix of the DNA molecule. The full name of the model is *Triple Helix University-Industry-Government Innovation.* In the 21st century, the concepts of triple, quadruple and quintuple helix became widespread and rooted in the daily parlance of innovation policy and innovation operators. In the Quadruple Helix, civic society, communities or citizens are taken as a starting point or alongside the cooperation between higher education institutions, public administration and business life. (Leydesdorff & Etzkowitz 1996; 1998; Etzkowitz & Leydesdorff 2000; Kostiainen 2008 in Mustikkamäki & Sotarauta 2008; Carayannis & Campbell 2009; Rönkä et al. 2007, 29; OKM 2015)

The change in rhetoric from triple to quadruple helix expanded and diverged the interaction between many higher education institutions that had previously been based on a dyad, i.e. bilateral interaction. At the same time, indirect innovation models based on needs, markets and practices became more common. They were developed and utilised in Finland, where the Helsinki Manifesto, which was created at the initiative of higher education institutions and Nokia, launched the activities of the global LivingLabs network through cooperation between the Finnish Government and the European Commission in 2006.

In the activities of the European Network of Living Labs, organisations, consumers or citizens participate in the co-creation, testing, piloting, demonstrations and validation of innovations. They are active actors alongside companies, researchers and public sector actors. LivingLabs emphasise the role of people as a subject of innovation activities and learning, not an object or a research factor.

As a result of international development activities, the 2000s brought about the concepts of inclusiveness, citizen engagement and citizen science that have now become commonly used in the rhetoric of ERA, European Universities and European RDI funding.

When awareness of research results on climate change spread from science and higher education institutions to other sectors of society and citizens, the concepts of Penta/Quintuple helix and multiple helices were also introduced. These concepts and related new methods of co-creation were intended to give a voice not only to future generations and citizens in a vulnerable position but also to nature.

The objectives of RDI funding for multi-stakeholder co-creation emphasised the need to involve not only organisations and people but also artefacts or new institutions, such as the media and culture. This was particularly the case in the context of the Commission's H2020 and Horizon Europe financial programme periods. The calls for proposals for work programmes (e.g. Science with and for Society and Green Deal, SwafS)

sought a balance between the triple helix actors and the new dimensions mentioned above. The EU Green Transformation related funding programmes also asked for ways to increase the number of people involved in co-creation through technological solutions in ways that would allow up to hundreds of thousands or millions of people in different countries to participate in large-scale pilots or demonstrations. (The European Commission 2020b, Carayannis Barth & Campbell 2012; Franc & Karadžija 2019; Peris-Ortiz, Ferreira, Farinha & Fernandes 2016)

Entrepreneurial University

The triple helix also involves the concept of an Entrepreneurial University. With this concept, Clark (1998, 2001) has described the transformation of higher education institutions into key components of innovation ecosystems. The concept emphasises the commercialisation of scientific solutions for the use of society and the fact that higher education institutions have primarily become actors that work for the benefit of society and meet future needs.

This trend is also highlighted in the 2020s in an initiative by the European Institute of Innovation and Technology (EIT) called the EIT HEI Initiative and in the HEInnovate self-assessment tool for higher education institutions launched by OECD and The Commission's Directorate General for Education and Culture (DG EAC).

Related to entrepreneurial activities, there were however also contradictory opinions, whereas innovation researchers such as Nelson and Miettinen already stated at the beginning of the millennium that "commercialisation of research results cannot become a significant source of income for universities." They also warned that "extending the ownership rights of knowledge produced by universities could limit the development of knowledge and cooperation between universities and industry" (Tuunainen, Miettinen & Esko 2020, 104).

The third and fourth tasks of higher education institutions: Responsible Research and Innovation (RRI) and Knowledge Triangle and Knowledge Square

Next, we discuss the latest, partly unestablished concepts that are used to emphasise the importance of the social role of higher education institutions. In the early 2000s, a third basic task was added to the Universities of Applied Sciences Act in many European countries. In addition to teaching and research, institutions were now tasked with social impact or regional development. Paradoxically, the third task does not refer to the international name of higher education institutions; "Universitas" translates to connections, unity or shared universe. Nor does it refer to the fact that science and higher education lead to the accumulation of knowledge in the world view of each new generation by their mere existence and thus inevitably rely on societal change and innovations (Saarikivi & Saarikivi 2021).

Instead, the third basic task refers to the instrument of interaction between higher education institutions and society as well as the expectations of companies or society about direct commissioned research and development project type results. Indeed, the expectations of European Universities even more directly refer to *the fourth mission*, that is, "the service of higher education institutions to society".

We suggest, that the following concepts can be connected to universities' third task or the fourth mission: Entrepreneurial University, a new form of knowledge production Mode 2, a Triple Helix and Responsible Research and Innovation (RRI).

In the framework programmes of the European Union, *Responsible Research and Innovation (RRI)* emphasises reciprocal cooperation between societal actors, innovators and researchers (von Schomberg 2012). In RRI, the research and innovation process promotes ethical acceptability, sustainability and societal desirabili-

ty as well as the utilisation of scientific and technological development in commercial products whose negative externalities to the environment and society have been eliminated (ibid.).

In emphasising the commercialisation and economic importance of research and innovation, the European Institute of Innovation and Technology (EIT) and the European Committee of the Regions (CoR) have also recommended the use of the term *Knowledge Triangle*. According to the Regulation (EC) No 294/2008 of the European Parliament and the Council (2008), Knowledge Triangle describes the "trinity of competence" formed by higher education, research and innovation. Later on, the European Commission's Communication (2020) uses the term Knowledge Square to describe the "competence square" or "meeting point" of knowledge formed by education, research, innovation and societal services.

The European Institute of Innovation and Technology (EIT) also uses the knowledge triangle to describe the partnership between higher education institutions, companies and research centres, which it also calls innovation communities (EIT 2012; EIT 2021a). The EIT communities have been financially supported by society and the Commission, so they are also open to new applications from higher education institutions. For higher education institutions interested in entrepreneurial activities, the Commission and the OECD have also jointly developed a self-assessment tool (HEInnovate). The tool covers all dimensions of the economy and innovation-driven universities of the 2020s, enabling the institution to find suitable benchmarks and use their best practices (EIT 2021b).

1.2.3. The Open Innovation 2.0 (OI2) paradigm challenges all innovation levels and actors

This subchapter introduces the Open Innovation 2.0 (OI2) paradigm to better understand the role of universities and science in innovation ecosystems and their emerging role as innovation enabler-orchestrators. We first discuss the definition and principles of OI2, and then we explore how the new paradigm could better illustrate the role of universities in society.

Open Innovation 2.0 (OI2) is a new paradigm created in the 2010s based on the following principles: "integrated collaboration, co-created shared value, cultivated innovation ecosystems, unleashed exponential technologies, and extraordinarily rapid adoption." In addition, the paradigm emphasises that it is not only for use between a few experts but is suitable for large groups of actors. The model stresses the importance of systematic orchestration. (Curley & Salmelin 2013.)

The OI2 paradigm was identified by analysing the functioning of the innovation ecosystems in the real world and applying the aforementioned principles to them. It was modelled in the late 2010s in the dialogue between the European Commission's Open Innovation Strategy and Policy Programme Group (OISPG), consisting of leading technology companies and researchers. The OI2 operating model was studied and applied in the interaction between ecosystem actors.

OI2 from the perspective of the multi-stakeholder co-creation orchestration

As we are not aware of any OI2 model studies on the role of higher education institutions as enabler-orchestrators, we will merely use our own experiences of practical orchestration and related expectations in this sub-chapter. The main sources of the description of OI2 activities are Curley & Salmelin (2013 and 2018), Open Innovation 2.0 Yearbook (2013-2018) and the European Commission Directorate-General for Research and Innovation (2016).

The OI2 model emphasises that in the ideal world, it would be used to turn the models of top-managed knowledge and innovation production upside down. Whereas the concept of open innovation (OI), launched by Chesbrough (2003), emphasised the cooperation between companies and users of their products, the OI2 was revolutionary. It was a breakthrough from the point of view of multi-stakeholder co-creation, as it turned the previous top-lead models upside down. Moreover, it was the first paradigm both contributing to and utilising all levels of ecosystems and the real world as a whole. In other words, it operated in the mash-up of the ecosystems of reality, which consist of many different social and political elements, technologies and the ecological environment.

In an authentic environment, the OI2 parties collect and combine both scientific and practical knowledge on phenomena, needs, experiences and markets. In the real world, they also carry out quick trials or pilots, validate and demonstrate solutions and create synergy between different innovations. Quick failures, fast learning, fast scaling, and serendipity are typical features of OI2 activities. (Curley & Salmelin 2018.)

OI2 considers both the supply and demand, in other words, it pays attention to the co-creation of innovations and their spread. Another important principle is the ability of regions and citizens to utilise knowledge and adopt innovations. The model emphasises the need for co-creation and challenges all ecosystem levels and actors to create innovations and markets. To be realised, this requires facilitating actions and orchestration at all levels of the innovation system and society. The main orchestrators at the system level are the European Union, the Member States and the financiers of RDI activities.

Public-private partnership (PPP) and the European Single Market are the main instruments for those co-creating markets. Higher education institutions, for their part, produce research-based initiatives for policy programmes, market mechanisms, regulation and funding programmes. The national government is usually responsible for ensuring that citizens' education and competencies enable them to utilise innovations and research-based knowledge. These activities could be called system-level orchestration (see European Commission Directorate-General for Research and Innovation 2018b ; Mazzucato 2018a, 2018b and 2019).

The co-creation of tangible innovations and solutions takes place in thematic and regional innovation ecosystems. In these projects, the hub firms or consultants usually orchestrate the development of commercial innovations (see Äyväri 2021, Zegel et al. 2021). Municipalities are the enabler-orchestrators for public innovations (see 6Aika), and higher education institutions are enabler-orchestrators that may aim at common benefits and the well-being of the ecosystem (Äyväri 2021). In the following sub-chapters, we focus on describing the features of the OI2 model that higher education institutions should take into account when they operate as enabler-orchestrator.

Contrary to the models presented earlier in which the user was usually considered as an object of innovation or a mere research factor, the OI2 emphasises human subjectivity, critical thinking and an active role in polyphonic innovation ecosystems.

In OI2, Open Innovation is no longer narrow bilateral cooperation between two organisations or a dyadic exchange. Nor is it innovation development in one organisation by involving only customers and users (OI). It is not a linear STI activity led either by the national government and companies or by science. Instead, OI2 progresses through cyclically repeated phases which means that the role of ecosystem functions and actors, including higher education institutions, varies continuously from cycle to cycle.

In OI2, unilateral scientific communications or technology transfer in higher education institutions are no longer sufficient. They alone do not adequately serve the achievement of the shared objectives of the ecosystem or the school's objectives. Instead, the cyclic nature requires that the enabler-orchestrator is agile and able to assess when the innovation can best benefit from multistakeholder cooperation, or which party

could help improve orchestration at a given time. As complexity increases, the enabler-orchestrator uses data repositories (e.g. EOSC), RDI portfolio management, and digital solutions to make its orchestration services more efficient for researchers and other innovators.

In the OI2 ecosystem, actors have a shared view of challenges and opportunities that guides the development of innovations. Science can be the starting point for innovations (STI model), but it can also play a different role in any stage of the cycle (DUI model). The orchestrator can identify scientific expertise and thesis authors with whom they can cooperate during the testing and validation phases of innovation. Utilising civic science, research data can be collected and analysed for scientific purposes.

Numerous quick and simultaneous OI2 trials start, end, and continuously feed knowledge, experiences and lessons from them to the development of other innovations and for the use of science, practical actors and decision-makers. Ensuring communication requires both orchestration and technological solutions. They can also be used to integrate the projects and learning assignments of higher education institutions into trials.

OI2 does not fight against the polyphony of the real world or the mash-up of actor-networks and artefacts; instead, it utilises diversity. The orchestrator must be neutral and trustworthy as its task is to ensure that the innovation ecosystem also benefits all actors that contribute to the creation of incremental and radical innovations and disruptions.

In OI2, scientific, market, experiential and professional knowledge complement each other. The enabler-orchestrator must constantly cross the boundaries of disciplines, sectors and organisations to share and utilise the knowledge and expertise needed to understand a phenomenon and overcome a challenge or produce shared value. The task can be facilitated by an orchestration team formed by experts from different sectors (see Äyväri 2021).

A joint orchestration team from the public, private and higher education sectors is also needed to follow the OI2 principles to utilise both basic scientific results and "collateral damage" (Enqvist 2020, 63) and serendipity to solve challenging problems. The orchestration team can also help to fairly share the risks and costs associated with OI2 activities, or the knowledge and other resources needed for them between different actors. A fair share makes it possible to create costly disruptions or overcome wicked problems and to share the created value and benefits between the actors.

OI2 and higher education institutions in literature

In innovation ecosystems based on the OI2 approach, higher education institutions are also considered to play an important role. Although the OI2 yearbooks (Open Innovation 2.0 Yearbook 2013, 2014, 2015, 2016, 2017-18) contain hundreds of references to search words "higher education", "university/universities" and "academia" that are related to higher education institutes as actors in a quadruple helix as well as the benefits of cooperation, open innovation and cooperation with universities, the analysis of the role of higher education institutions is surface-level. In addition, some articles mainly examine higher education institutions as a tool that influences whether the technology-socio-economic ecosystems produce meaningful results (Salmelin 2017).

Schofield (2015) emphasises the role of higher education institutions in creating, exchanging and transferring knowledge. Higher education institutions are considered to be "the glue" between ecosystem actors and degree programmes and they are hoped to develop curricula that facilitate innovations. The yearbooks also considered it important that higher education institutions offer their laboratories, Living Labs and other environments, functions and entrepreneurship training to other actors in the ecosystem.

When discussing the connection between the OI2 activities and the European Union's H2020 framework programme, Markkula and Kune (2013) stressed in their article the need to orchestrate knowledge, skills, competence and activities in order to create innovation expertise in complex projects. They emphasised the need for advanced leadership and management skills in the orchestration of multidisciplinary, cross-sectoral and cross-cultural communities. According to them, bottom-up activities and user orientation accelerate innovations and enable their introduction and spread. This kind of development presents a new and challenging role for universities: How to play a key role as an orchestrator in guiding these kinds of interactive processes and equally involve all actors in the triple helix? (Markkula & Kune, ibid.).

The role of the autonomous higher education institution is mentioned in an article by Schofield (2015) in which Schofield points out that it is also important for universities to find the right balance between independence and commercialisation of knowledge in order to carry out their tasks, increase sustainability and maintain their competitiveness. As the OI2 ecosystems and the quadruple helix operating models become more common, it is also important to carry out studies that can be used to assess both higher education institutions' investments in multi-stakeholder co-creation and the benefits of their main tasks, i.e. teaching and research.

1.2.4. Drivers for multi-stakeholder co-creation and the need for orchestration in the 2020s

A recent report by The Finnish Research Impact Foundation (Koski, Suominen & Hyytinen 2021) provides an up-to-date literature review of research and business cooperation aimed at societal impact. The results of the studies summarised in the review emphasise the importance of continuous, multi-directional and overlapping interaction between companies and researchers in terms of the effectiveness of cooperation. However, this report and the studies included in it also examine cooperation mainly only from the point of view of the instrumental benefits produced by higher education institutions, and not how the basic tasks of higher education institutions benefit from cooperation at all. Inspired by this observation in this sub-chapter, we will examine the latest European rhetoric and the funding and policy programmes on this phenomenon. We will look for signs that they consider all actors following the principle of inclusion; not as tools or objects of co-creation, but respecting the subjectivity, values and sovereignty of all actors.

Higher education institutions aiming at the well-being of the ecosystem and the OI2 paradigm

Following the discussion in subchapter 1.3., we suggest the usage of the open innovation 2.0 as a tool when examining wicked problems, multi-stakeholder co-creation and its orchestration from the perspective of non-profit universities. Just like independent science and autonomous higher education institutions as public institutions, OI2 also recognises and acknowledges the perspective of the society and ecosystem and sees the possibility of co-creating shared value (Porter & Kramer 2011).

If open innovation OI (Chesbrough 2003) is limited to enriching the innovation of one organisation through the views of customers and users, then OI2 and universities broaden the perspective to produce shared value and allow its takeover for all actors in the ecosystem. OI2 and universities are also considered producers of societal benefit (Calhoun 2009) from the perspective of sustainable wealth and the well-being of humanity.

The OI2 paradigm helps the ecosystem orchestrator to define multi-stakeholder co-creation both in the phenomenal world and in the real world, i.e. in the confusing innovation ecosystems. It does this by creating synergies between siloed public, academic and commercial innovations and replacing silos with a

Creative Commons license as well as by utilising the results of systematically generated solutions and trials. Using knowledge and communication technology, OI2 enables mass participation in the development of innovations and sharing them.

Both research and practical activities have shown that multi-stakeholder co-creation and OI2 require systematic orchestration on all levels of society. For the central government, this means measures and incentives facilitating society, such as funding, policy instruments, and repealing regulations that control or limit the operating environment and experimentation of innovations. It can also mean enabling access to instruments related to the demand, such as regulation or taxation that encourage public innovative procurement or the introduction of innovations. Higher education institutions or municipalities can play the role of an enabler-orchestrator in innovation ecosystems that are specialised in a location or a specific thematic challenge. The goal of an enabler-orchestrator is to realise the ecosystem's objectives and well-being. This can be achieved by supporting the internal functioning of the ecosystem and by conducting a proactive and facilitating dialogue also with the state administration and the European Commission.

In activities aiming at a common good and the well-being of ecosystems, the measures and balancing incentives that enable society are important. Without them, higher education institutions, organisations and the public sector will only appear as assistants and facilitators of commercial innovations orchestrated by hub firms. However, achieving the best possible societal result requires a deep understanding and continuous equal consideration of the purpose, values, objectives and needs of all parties, both from the state and the orchestrator of the ecosystem. This can only be achieved if they have the ability to continuously change perspectives between individual groups of actors and the shared well-being of the ecosystem.

Missions, challenges and openness as current drivers of the development in Europe

The concepts we summarised in the previous chapters describe how the management of science and higher education as societal institutions has changed over the decades towards an economically driven and innovation-oriented direction.

In this sub-chapter, we discuss the latest European policy programmes. We look at how higher education institutions' orchestrator role is becoming visible in multi-stakeholder co-creation.

In the 2020s, the mission-oriented approach of the EU's funding and policy programmes[9] has brought innovation activities towards multi-stakeholder co-creation that involves all groups of actors. By mission-oriented approach, the OECD refers to all technological, social and organisational solutions, products, services and processes that aim to help face major societal challenges (i.e. missions) and that produce societal value. Research, co-creation, testing, demonstration, implementation, as well as innovation and solution launching are supported by decisions across different policy programmes and by decrees, combining practices increasing both supply and demand (OECD 2021).

Missions are realistically achievable and measurable challenges (e.g. reducing litter in the ocean). In other words, a mission is a lower and more concrete level than global challenges that actors aim to achieve through a project portfolio. A distinction between mission-oriented innovation policy and traditional innovation policy

9 The current mission policy was preceded by the RISE (Research, Innovation and Science) report (European Commission, Directorate-General for Research and Innovation 2018b). The report discussed mission-oriented science and innovation policy, reminding that societies need mission-based policy that promotes technological diffusion and resolves major societal problems. The report states that the missions have a few things in common: challenge-orientation, creation of markets, and the integration of the supply and demand of policy programmes. The report describes the multi-dimensional and multi-level approach needed to face major, complex societal challenges, which does not only produce individual innovations or technologies, but at the same time results in change in both the operating environment and human behaviour. (See Graph 1 in the report, Multilevel Perspective to Socio-Technical Change Source: Geels and Schott.) The report (Ibid., p.11) states: "In short, a mission-oriented policy requires engagement of all levels of society. [..] Hence, when we mention the engagement of all levels of society, we do not mean the engagement of representative actors. A mission touches everyone, every person. Engagement therefore does not pass through "representation" but through direct engagement of "all" those concerned."

is that instead of developing and spreading individual innovations (linear STI and Knowledge Transfer), the focus is on missions and possible solutions to them in a multidisciplinary and multi-sectoral manner. Mission-oriented innovation policy also strongly includes the idea of the positive side-effect or the so-called collateral damage of basic science or knowledge spill overs, i.e. that innovation developed under one mission may only become radical later in another context. For example, many of the critical technologies of smartphones and the Internet have originally been developed for other purposes. (European Commission Directorate-General for Research and Innovation 2018b; Mazzucato 2018a & 2019; Enqvist 2020.)

The missions of the current framework programme of the European Union promote shared priorities, such as The European Green Deal, Europe fit for the Digital Age, Beating Cancer and the New European Bauhaus.

In Europe, the motivated participation of higher education institutions and their researchers in multi-stakeholder co-creation is also influenced by the joint European University Initiative and the new European Research Area (ERA) prepared by the Commission and the Member States. In them, higher education institutions are directed in a mission-oriented and challenge-based manner (see European Commission 2021b; European Commission 2020a; Council of the European Union 2021).

Other concepts of the new EU programme period that guide science and higher education institutions include for example Open Science, Citizen Science, Open Innovation, Open learning and learning material. In addition, the availability of scientific data will be promoted through the FAIR principles of the EU and OECD. The aim is that research materials are as open as possible and as closed as necessary. The objective is to make the data easily Findable, Accessible, Interoperable and Reusable. (OSPP-REC 2018.)

The principles of the current EU programme period encourage higher education institutions and also all stakeholders in the direction of co-creation and to solve complex and extensive societal challenges. (Mazzucato 2018a; European Commission 2021a; European Commission 2021b; Coordination of open science, Federation of Finnish Learned Societies 2020, Chesbrough 2003; Curley & Salmelin 2018; OSPP-REC 2018.)

The systemic change in higher education has been visible for a long time in the European Research Area. Since 2000, the ERA has made the European research and innovation system less fragmented and thus contributed to the European internal market development of shared knowledge and innovation between universities and stakeholders (ERA Communication 2020).

Nevertheless, based on several stakeholder consultations on the new ERA organised by the Commission in 2021, on our way towards the new ERA, there still might be potential challenges. During the stakeholder consultations, it was repeatedly reminded how some wordings, such as challenge-orientation, can steer the focus away from objectives promoting curiosity-driven research and self-corrective science towards narrowing, instrumental science and education that emphasise merely an immediate benefit. Thus, the dialogue has emphatically stated that science and the highest level of education have a basic intrinsic value that serves humanity. The future will show whether the message conveyed by stakeholders has also been heard.

Continuous and persistent dialogue pushing slow change

As the above discussed conceptual development shows, the change toward an economy-oriented and innovation-driven higher education institution has gradually taken place over the past decades. The transformation has been influenced by changes in the global operating environment, the dissatisfaction of taxpayers, but also by the prevailing economic theories (Mazzucato 2019).

Changes that have continued across programming periods of the European Union have been managed with determination. The planning, decision-making and implementation of the change have been based on a massive and tense dialogue between the Commission, the Member States, expert groups and various stakeholders. In the spirit of the main theme of the paper, the planning, decision-making, and implementation of programmes could even be called "the co-creation of policy programmes". It is important to remember that researchers and higher education institutions have also had the opportunity to influence the transformation either by participating in consultations, registering for expert positions or publishing policy briefs. A slow and continuous dialogue between experts and decision-makers can also impact decisions.

For example, the interim evaluation report on the H2020 funding worth EUR 80 billion that was prepared by experts in 2017 set the objective of increasing RDI funding and simultaneously improving the effectiveness of funding. As development methods, experts recommended mission- and challenge-oriented activities, open science, citizens' participation and striving for breakthrough innovations. The recommendations were adopted as the criteria guiding current funding and activities in Horizon Europe, the European University Initiative (EUI), the new ERA, the European Education Area (EER) and the European Skills Agenda. These new concepts and principles steer researchers and higher education institutions applying for funding and guide them to open up their activities and share research knowledge and data. The aim is to simultaneously improve the quality of science and innovation and to reduce the time it takes from the development of innovation to its introduction (The EU's Open Science Policy).

New public management and academic capitalism

In addition to external factors, higher education institutions face internal pressure to change. The idea of New public management applied by universities has directed them to develop new revenue models that are based on business cooperation with fast results and commissioned research, service sales or the financial benefits of patenting, licensing and protecting intellectual property rights. (Gumport 2019; Remenyi et al 2019; Vuolteenaho 2021.)

The concept of academic capitalism (Slaughter & Leslie 1997) describes how universities, higher education institutions and researchers operate in the market and compete for funding or profit through licences and patents. Different funding indicators, international ranking lists and publication indicators of higher education institutions also reflect academic capitalism. The reputation produced through them improves the position of higher education institutions in the funding competition and student recruitment, also increasing the attractiveness of the region in which the higher education institution is located among investors, skilled labour and companies.

The underlying idea of NPM and academic capitalism is that, in an ideal situation, a creative environment and a positive cycle are created between the stakeholders of the school and the region, in which technology, talent and tolerance attract experts, capital and companies in equal measure. Similarly, if the cycle is negative, the region and its business life face the threat of recession (see Florida 2002; Curley & Salmelin 2013).

Funding and policy programmes (European Commission 2018; European Commission, Directorate-General for Research and Innovation 2017) aim for such a positive cycle through increasing citizen engagement, breakthrough innovations and opening up science and innovation. Indirectly, it is believed that together these factors not only increase competitiveness but can also create common good (Calhoun 2009), such as tax revenue, sustainable development, meaningful new jobs and the ability to prevent, face or prepare for wicked problems. The actions also seek citizens' acceptance of public spending.

In the real world, however, the goals of the ideal or phenomenal world can cause tensions and problems, such as the self-censorship of researchers. These tensions are thoroughly discussed in the article collection edited by Professor Esa Väliverronen and Researcher Kai Ekholm. The collection "Tieteen vapaus & tutkijan sananvapaus" ("Freedom of Science and Researcher's Freedom of Speech") was awarded the Finnish Science Book of the Year in 2021. Väliverronen refers to international studies on the basis of which "it is known that the freedom of science and the freedom of expression of researchers can be indirectly restricted, for example, through complaints, refusal of funding, threatening to end an employment relationship or defamation. (..) The usual consequence is the self-censorship of researchers: They give up research intentions and publishing, or they stay silent in the public on topics whose publication may cause difficulties" (ibid., 32).

Previous development cumulates in the daily life of higher education institutions in the 21st century

In Finland, the previously discussed progress toward multi-stakeholder co-creation became a reality in the late 1990s' pilot legislation on universities of applied sciences and during the Centers of Excellence evaluations . As a result, cooperation between Finnish universities of applied sciences, companies and other employers became the starting point for all educational and RDI activities.

Nowadays, the criteria for basic funding for Finnish science universities and universities of applied sciences emphasise the performance-based nature of revenue formation and quantitative indicators, such as the number of degrees or the volume of funding for competitive research and development activities. Researchers (Tuunainen, Miettinen & Esko 2020) have also criticised the quantitative indicators of the societal impact of universities for failing to consider the multidimensional, indirect, long-term and unpredictable nature of the impact.

Success in European RDI funding competitions also requires the authors of funding applications to implement, among other things, the objectives of the policy programmes described above and the skills to utilise networks and innovation ecosystems operating in different European regions. This requirement might call for orchestration services.

In searching for international funding, researchers and higher education institutions are currently facing the concept of co-creation across Europe, i.e. multi-stakeholder co-creation. The Commission's web page alone has more than 19,000 matches for the search word "co-creation" which cover all policy areas. The CoVal project funded by the European Commission showed that co-creation has increased not only in companies but also in the public sector activities which is the other major partner of higher education institutions. According to the European survey carried out during the project (Arundel et al. 2020), 85% of top public administration representatives said that they used co-creation to innovate ways of providing public services.

In Finland, the co-creation of innovations and markets as well as quick trials became rapidly more common in 2014 when the *6Aika project* was launched between the six largest cities and they created a joint strategy. The implementation of the 6Aika strategy was supported with nearly EUR 80 million by the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Finnish Government, the six cities and project partners, such as higher education institutions (6Aika 2021). Pilots will continue to be a key funding target in 2021, for example, in the ERDF programme of the Regional Councils of Southern Finland. With the low-threshold funding, higher education institutions have been able to intensify cooperation with local stakeholders, participate in building collaborative platforms (see Äyväri & Hirvikoski 2021) or develop and share co-creation expertise.

The number of joint RDI projects has increased over the decades, first between higher education institutions and companies or the public sector, and later in cooperation between all stakeholders. According to a study conducted by VTT Technical Research Centre of Finland and the University of Tampere for The Finnish Research Impact Foundation (Koski, Suominen & Hyytinen 2021), the interaction between research and business life has been significant in Finland, even though the trend in the amount of cooperation has been decreasing[10].

It can therefore be said that multi-stakeholder co-creation of innovation is no longer just a theoretical concept used in the phenomenal world. Nor is it a tool for merely profit-making organisations, as in Europe it is often used and funded by non-profit organisations and citizens. In the future, with the popularisation of co-creation, also the demand for related education is expected to increase.

As the need for cooperation has increased, researchers have developed and utilised methods of co-creation and participatory research (Banks, S. et al. 2018). In addition, a large number of methods, guidebooks and manuals have been developed for the operative implementation of open innovation (OI2), co-creation, and experimentation (see e.g. Polaine, Løvlie & Reason 2013; Stickdorn, Hormess, Lawrence & Schneider 2018; Miettinen & Koivisto 2009; Ståhlbröst & Holst 2012; Mustonen, Spilling & Bergström 2017; Santonen et al. 2019; Hagman, Hirvikoski, Wollstén & Äyväri 2018). Based on our analysis, the guides have been targeted either jointly at all actors or e.g. for cities, but not particularly at higher education institutions. As the purpose of the guides is to provide instructions in a "cookbook" type manner, they do not address the strategic importance of higher education institutions or their long-term role in the development and competitiveness of ecosystems.

1.3. MULTI-STAKEHOLDER CO-CREATION FROM THE PERSPECTIVE OF INDEPENDENT SCIENCE AND AUTONOMY OF HIGHER EDUCATION

As described in the previous chapter, funding and policy programmes have provided tools for science and higher education institutions by guiding their development towards an economically driven and innovation-oriented direction. Even though the state of free thinking and research has narrowed at the same time (Väliverronen 2020; Saarikivi & Saarikivi 2021; Kivistö & Philström 2018), efforts have also been made to protect the autonomy of science at least on a rhetoric level during the preparation of policy programmes.[11] Although the principle of freedom of science has been recorded in the legislation in many countries[12], its implementation requires that higher education institutions continue to exert influence in the public sector and the preparation of policy programmes.

10 "Compared to other European countries, the interaction between research and business has been considerable in Finland, but the trend in cooperation has been decreasing. One example of this change is that in the last decade, the number and relative emphasis of business-funded research has declined considerably in the project portfolio of higher education institutions [..], currently, business life cooperates exceptionally much with research organisations also in scientific publishing in Finland."

11 This has been realised at least at the meetings of the Commission's Open Science and Research Policy Group (OSPP), European Research Area stakeholder consultations, and at the meetings of the independent H2020 Science with and for Society interim review group in which the author of this article has participated. In them, self-corrective science has been the starting point for both evaluation work and the development of activities. Independent basic research and autonomous higher education institutions have been considered necessary as this is the only way to safeguard not only the quality of science but also the quality of education and innovation activities and their impact on the development of humanity and the economy in the long term.

12 In Finland, the principle of freedom of science is recorded in the Constitution which states that "the freedom of science, the arts and higher education is guaranteed" (Finnish Constitution 11.6.1999/731, section 16).

Scarcity of basic funding and elimination of degree programmes undermine researchers and higher education institutions

However, rhetoric that values curiosity-driven science and education or the promised restoration of the glory of higher education by the Finnish Government is not yet reflected in the funding of higher education institutions and in guaranteeing their pluralistic worldview. Higher education researchers in different parts of the world have identified development that occurs in similar ways time and time again: Although civilisation and mental growth are emphasised in society, the use of performance-based indicators excludes knowledge and eliminates basic research and education that have no direct economic value. As the multidisciplinary perspective on the world's issues becomes narrower in this way, there is a risk that the negative externalities caused by short-sighted innovation activities will not be noticed and that the problems that are developing now will not be observed later. (Kivistö & Philström, 2018; Väliverronen 2020; Saarikivi & Saarikivi 2021; Gumport 2019; Stevens et al 2020.)

Paradoxically, the current language and vocabulary of administration also use research knowledge to attack science and education. Policy rhetorics want narrow research interests and science or expertise related to specific fields as they can be easily commercialised and strategically guided. Researchers worried about the future of humanity have however reminded us that universities are becoming working life production facilities or think tanks in which research knowledge and strong ideologies are combined in a new way that does not anymore safeguard the reliability of research. At the same time, they point out that self-corrective science is only reliable if it is independent of social values and is critical of social ethea. (Kivistö & Philström, 2018; Väliverronen 2020; Saarikivi & Saarikivi 2021; Gumport 2019.)

The opportunities of higher education institutions are manifold: not only to unilaterally benefit innovations but also to mutually enrich both independent science and education. To be able to identify the diverse opportunities offered by science or the universities as the orchestrators for multi-stakeholder innovation, we will now discuss researchers' views of self-correcting science and its societal role.

Science and higher education institutions change the world - and how we view it

While the economy has changed the current university, science and education have always changed the world: human development has stemmed from human curiosity, the desire to understand and learn.

"Science is the most influential force in the history of the world" and "the benefits of basic research are almost unmeasurable" (Enqvist 2020, 62). Many of the products and technologies we take for granted[13] are also based on science. Curiosity-driven science (blue sky science) is largely unplanned or unpredictable. It is also autonomous, self-directed and self-corrective. (Enqvist 2020, 59, 62.)

Väliverronen reminds us that as science changes the world and our worldview, "science institutions must ensure that cooperation strives towards openness and the common good from the perspective of science. Without this, science will not develop and self-correct, and everyone will not be able to benefit from scientific results "(Väliverronen 2020, 25 and 52). Quoting Jonathan R. Cole, Väliverronen (2021, 54) continues that 'the task of researchers is not only to share knowledge, but also to provoke, inspire ideas, and teach students to think'.

Kari Enqvist (2020, 66) writes that the most significant value of even basic science lies in its humanistic dimension and in the humanistic education process, not in the instrumental results of science or technological

13 Enqvist (2020, 62) refers to the indirect economic benefit of basic research and uses electricity as an example: "Even if it comes out of the wall now, it had to be invented and understood first." Enqvist (2020, 64) adds that "basic research can cause collateral damage which proves to be socially and economically significant"; the example presented are the solutions developed in CERN for the transfer of large particle physics research files, which resulted in the Internet browser.

spin-offs. He stresses that scientific findings are always related to humanity, as they define humans' perception of themselves and are therefore a measure of humanity. "It's a value that doesn't have a price." Finally, he states that "the habitat of natural sciences is restricted mainly by short-sighted administrative thinking, according to which the humanist civilisation process is a waste of resources."

Johan Vilhelm Snellman's university concept: a step towards multi-stakeholder co-creation orchestration

Based on the above views, we propose that the role of science and universities as enabler-orchestrators could be approached with the help of JV Snellman's[14] university concept. In it, "education and academic freedom are linked to the responsibility for the important challenges and problems of the world and society. This view can be justified by "the understanding of critical realism on the double determination of knowledge guiding scientific work". According to it, "the researcher is simultaneously motivated by the creation of knowledge, the pursuit of truth, and participation in solving societal problems." (Tuunainen, Miettinen & Esko, 2020, 105.)

When looking for the orchestrator role of higher education institutions, we recommend the following three views on independent and responsible science from Väliverronen (2020), Enqvist (2020) and Tuunainen, Miettinen and Esko (2020):

Firstly, because universities have accumulated different tasks over the years and different disciplines interact with society in different ways and through different mechanisms, *the idea of the unity of universities and disciplines should be abandoned in the university's enabler-orchestrator role. Instead, when looking for knowledge, expertise and partners, the orchestrator must be aware of and take into account the heterogeneity typical of science.* Moreover, it is important to know when the worldviews, methods and societal interactions of different disciplines, the public sector and commercial actors are similar and when their different approaches complement each other or how they can be used to create the creative tension needed in the innovation process.

Secondly, when science is integrated into co-creation, the starting point should be the epistemological impact of science (from the Greek phrase epistēmē logos). In other words, in addition to the instrumental value of scientific knowledge, *the understanding provided by science should also be utilised in co-creation.* I.e. the understanding gained in scientific research makes it possible to develop new ways of solving societal problems. In research, the so-called indirect strategy may serve the encounters of wicked problems better than direct solutions or optimisation. With indirect strategy, Raiski (Tuunainen, Miettinen and Esko (2020) refers to the fact that "understanding and generalising phenomena enables the application of results in several uses".

Thirdly, co-creators should recognise and acknowledge that researchers and autonomous higher education institutions bear *responsibility for the common good and well-being and respond to major problems of the era*, even if they do not always participate in cooperation or otherwise produce direct benefits. Autonomous science produces reliable knowledge for co-creation only if it ensures the quality of the research itself; "the combination of independence, responsibility, and criticality is the most important precondition for the societal impact of science" (Tuunainen, Miettinen and Esko (2020, 113)). In the spirit of the ethos of open innovation ecosystems, we must be aware that the combination of academic freedom and social responsibility highlighted by Snellman can create an atmosphere of trust which is the best way to promote effectiveness; not the short-sighted funding and control[15].

14 Johan Vilhelm Snellman (12.05.1806 – 04.07.1881) was an influential Fennoman philosopher and Finnish statesman

15 Tuunainen, Miettinen & Esko (2020, 127) first describe trust in comprehensive schools' teachers and then the resulting good international results. After that they ask: "Do university researchers not deserve the same level of trust; are they not able to assume the responsibility that comes with it in their own activities?"

Finally, as the importance of science in overcoming major societal challenges is undoubtedly unquestionable, it is worth asking whether *universities and higher education institutions should themselves provide their researchers and stakeholders with orchestration services that support cyclically progressing innovation processes and co-creation*. The heterogeneity of disciplines, the epistemological impact and the combination of freedom, responsibility and criticism require in-depth knowledge of academia's operating mechanisms as well as the ability to curate scientific results and interpret the understanding produced by science to the parties involved in co-creation. The co-creation orchestrator, whether it be a higher education institution or some other actor, must also strengthen the atmosphere of academic trust, while utilising its lessons in cooperation across sectoral boundaries.

1.4. SUMMARY AND DISCUSSION

In this literature review, we discussed the concepts that illustrate the interaction between universities and society and its impact on the development of multi-stakeholder innovation co-creation since the 1960s. As a basis for our reflection, we utilised the common features of the transformation definitions in different disciplines and the research questions about the nature of the change (Brown et al. 2013). In this way, we aimed to continuously change perspectives and examine the development of complex phenomena from different angles. We discussed the university-society interaction first from the viewpoint of innovation-driven science and then from the perspective of autonomous science and universities. We also considered the differences in their ethea, values and operating methods as well as the tensions and paradoxes arising from them and affecting the orchestration of co-creation in everyday life. We illustrated the concepts with our observations in the daily life of Finnish higher education and the dialogues of the expert groups in the European Commission. The literature review was utilized to build the following argumentation and recommendations:

General observations and arguments arising from the transformation of university-society interaction from the 1960s to 2022

The literature analysis suggests that *science and universities became mere assistants to innovation ecosystems.* This decade lasting step-by-step transformation has had revolutionary consequences. The instrumental higher education development, or industrial institutional logic, as the sociologist Gumport (2019) calls it, *has changed both the legitimacy of higher education institutions and the world around them.*

Today, we are however witnessing *simultaneous instrumentalisation and the pursuit of the "excellence" of science.* According to the latest European University Initiative, higher education institutions must, in addition to their main goals, "react to the digital and green transition and socio-economic challenges while at the same time commit themselves to top quality"[16]. We take this as a positive signal indicating a turning point towards balanced societal impact and independent, self-correcting science.

The review also demonstrates how the described transformation has enabled m*ulti-stakeholder co-creation to spread to all levels of innovation ecosystems* from the micro-level to the macro level. The rise of mission- and challenge-driven RDI in the 2020s emphasises *inclusive co-creation involving all levels, activities and*

16 Erasmus+ Programme (ERASMUS), Call for proposal, Partnership for Excellence – European Universities – ERASMUS-EDU-2022-EUR-UNIV, Version 1.1, 30 NOV 2021 document describes the objectives of European Universities in the following manner: "Develop and implement an integrated long-term joint strategy for education with, where possible, links to research and innovation and service to society, that is responsive to the digital and green transition and key socio-economic challenge, while remaining committed to excellence:.." (..) "Build European knowledge-creating teams ("challenge-based approach") of students and academics, possibly together with researchers, entrepreneurs, companies, local and regional actors, and civil society actors (..) working together to address societal and other challenges of their choice in an inter-disciplinary approach through:.."

actors of innovation ecosystems. The increase in multi-stakeholder co-creation is reflected in, for example, how cooperation creates value and markets for individual innovations or generates systemic innovation that enables society, organisations, and individuals to prepare for major societal challenges. Based on the EC funding criteria, it is evident that many complex societal challenges need to be addressed through multiple scientific disciplines. Technical solutions are often preconditions for new policy outcomes, but lasting societal impacts and the elimination of negative externalities call for insights from social sciences and the humanities. Moreover, recently several European projects created innovative mechanisms and new approaches to engage citizens and stakeholders in transformative processes in different thematic, cultural, social, political and environmental contexts. More importantly, the role of citizens has been emphasised as a subject of action, not as an object of an innovator or as a mere research factor.

Paradoxically, as a consequence of the participatory multistakeholder co-creation, there is a risk that *the role of science might become narrower*. This is a concern that deserves continuous follow-up by policymakers, researchers, and most importantly enabler-orchestrators.

Our conceptual analysis is also to be read in the context of an ongoing reflection *emphasising the independence of education*. This is in line with the societal need to enhance Citizen Science because independent education protects society against hybrid warfare waged with false knowledge. In addition to new knowledge, a university "teaches citizens to always look at life and the world with new eyes, new perspectives and critically" (Kivistö and Philström 2018). Curious, critically thinking citizens that are willing to change their opinion are the prerequisite for the development and use of innovations.

The new and ambitious European University Initiative indicates the deepening of cooperation that crosses disciplines, organisational, and sectoral boundaries as well as country borders. *Collaboration is both an objective and an instrument to achieve a fundamental institutional transformation of the European higher education system* whilst co-creating "social and technological innovation[17]".

The analysed conceptual development fits with the transformation theory of Brown et al (2013): The transformation progressed over a long period of time on many different fronts of society and mainly as a periodic change[18]. In line with Brown et al (2013), the concepts of each stage preceding the change in the interaction between universities and society have transferred over to the new stage and the collective memory of the actors. As a result, *the change has "glided" from one step to the next, and previous steps have affected the next step.*

For practical implementation of our findings, the Erasmus+ funding programme[19] has been our focus. The programme expects European University alliances to be able to develop cooperation and to use it to improve the HEIs' "excellence" as well as the societal impact of education, science, innovation and service to society. Consequently, grant writers and others aiming for the ERASMUS+ funding and those evaluating the project proposals might benefit from the previous description and argumentation related to the transformation of HEIs.

17 The Erasmus+ Programme (ERASMUS), Call for proposal document states: "(..) all learners, teachers, researchers and staff to cooperate and co-create knowledge within different European and global cultures, in different languages, across borders, sectors and academic disciplines." (…) "(..), thus fostering education, social and technological innovation to address societal challenges, and build a more sustainable future.

18 Key concepts and policy programmes (in brackets) were related to knowledge (Mode 1 and 2), science (STI, DUI, self-corrective independent science, ERA), innovations (user-orientation and openness, OI2) as well as the interaction between higher education institutions and their stakeholders (entrepreneurial higher education institution, quadruple helix, OI2, multi-stakeholder co-creation, mission-orientation, or the European University initiative and Finland's objective to be the most competent and attractive innovation and experimental environment in the world.)

19 Erasmus+ Programme (ERASMUS), Call for proposal document describes the objectives and funding criteria of European universities and their role in implementing the vision of the European Education Area 2025 and synergies with ERA and the European Higher Education Area.

In line with Brown et al (2013), it is good to keep in mind that continuous changes in concepts and understanding them require us to be able to imagine alternative and possible futures. Abstraction and imagination might also help us to *tolerate the uncertainty associated with the continuous change in the concepts used by policy programmes* and to see similarities in the continuous conceptual change in the old and new funding programmes.[20]

Observations and arguments related to the need for an enabler-orchestrator

It is also appropriate to provide that, we need to *tolerate tensions, conflicts and paradoxes* manifested in particular between independent science and economically driven innovation. Their role in the orchestration of multi-stakeholder co-creation should therefore be further studied.

In Chapter 3, we described the fundamental role of independent science and the autonomous university and their impact on the change in the world and how we perceive the world. We argue that as participation and the instrumental benefits of the higher education institution have been emphasised over the recent decades, it paradoxically seems to have been *forgotten how independent science and the autonomous university have, by their mere existence, probably brought about a similar change in society that the economically driven innovation system has been aiming for over decades*. However, the way in which change is created is quite different in both of them, so there are *unavoidable tensions and conflicts* between innovation-driven operating models and models that respect the independence of science. Encountering these tensions calls for orchestration services from within the universities.

There is a need for academic enabler-orchestrators as they know how autonomous science produces reliable results for innovation co-creation only if it ensures the quality of the research itself; the combination of independence, responsibility and criticality is the most important precondition for both the independence and societally impactful science. Similarly, teaching is not just about sharing professional knowledge, but about education that includes the requirement to see - or learn to see - life and the world with new eyes, new perspectives, critically, self-reflectively and self-critically (Kivistö & Philström, 2018). For this reason, the task of researchers is "also to provoke, inspire ideas, and teach students to think" (Väliverronen 2020, 54).

Instead of a juxtaposition, the co-creation orchestration should seek ways to *promote positive cooperation and coexistence that benefit all parties and activities*, despite paradoxes and conflicts. We recommend that in further orchestration studies and policy programmes, positive cooperation be sought also from independent science and autonomous university.

We propose JV Snellman's university concept as a tool for the reconciliation of the above-mentrioned contradictions and tensions. The concept presents that "education and academic freedom are linked to the responsibility for the important challenges and problems of the world and society" and that "they are realised in different interactions between researchers and societal actors" (Tuunainen, Miettinen & Esko, 2020, 105, 124). Snellman's university concept states that the so-called "understanding of critical realism about the double determination of knowledge guides scientific work", and therefore researchers are initially "simultaneously motivated by the production of knowledge, the pursuit of truth and participation in solving societal problems" (ibid., 105).

As early as 1840, Johan Vilhelm Snellman wrote about academic studying and required students to provide "knowledge that would enable them to solve an important social issue that is based on a field of science

20 For example, the concept of Knowledge Square is used in the 2021 description of European Universities, as it refers to the four missions of higher education institutions: science, education, innovation and service to society. Some time ago, the concept of Knowledge Triangle was still being used; it included research, teaching and innovation but not service to society. In Finland, the legislation on higher education institutions is based on the idea that on top of teaching and science, higher education institutions also have a third task, which refers to the societal or regional impact of higher education institutions.

that the student has studied on the basis of their profession" (ibid., 111). Higher education is therefore based on an in-depth understanding of both the dynamics of teaching, learning, and education and their societal significance. Thus, we would like to emphasise that this understanding and competence should also be used to promote learning in innovation ecosystems and to produce, utilise and critically assess innovations that are important to society and their potential negative externalities. As the lasting societal impacts of multistakeholder co-creation call for an enabler-orchestrator, we would recommend this role for the universities as only they have the built-in capacity to simultaneously produce knowledge and innovation as well as pursue truth and participate in solving problems.

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2. Innovation ecosystem orchestration

Anne Äyväri

2.1 INTRODUCTION

INNOVATION ECOSYSTEMS OR networks have been discussed in both works intended for professionals and scientific publications for at least twenty years. Actors in an innovation ecosystem or network put their trust in an open innovation paradigm which assumes that companies should also make use of external ideas to develop their products, services and technologies (Chesbrough 2003).

Today, the basic premise of discussions on innovation ecosystems mostly is the view that the complexity of problems makes multi-actor co-creation essential, as no individual actor can arrive at an in-depth understanding of the problem or find solutions alone. The term orchestration has been coined for managing multi-actor co-creation.

The objective of this article is to describe frameworks of orchestrating innovation ecosystems or networks, orchestrator types, and orchestration modes at a generic level. The article can be characterised as a conceptual analysis of innovation ecosystem orchestration. The concepts 'innovation ecosystem' and 'innovation network' are both used in this article.

The article begins with describing the orchestration of hub firm centric innovation networks, as the theme has first been studied in the specific context of companies. Innovation ecosystems or networks today mostly include actors of very different types: private, public and third sector organisations in different fields, research, development and education organisations and citizens. Perceptions of the types of actors that can operate as orchestrators have also become wider.

As part of this development, orchestrators primarily interested in promoting the wellbeing of the entire ecosystem or network have also been identified. Research in orchestration modes has similarly highlighted new practices and hybrid models for managing innovation ecosystems and networks.

The final section of the article sums up changes in orchestration frameworks. As one of its conclusions, it proposes widening the scope of the key processes of orchestration. The final section also draws attention to needs for further research.

2.2. VARIED FRAMEWORKS OF INNOVATION ECOSYSTEM ORCHESTRATION

2.2.1. Hub firm centric view of orchestration

The approaches to conceptualising orchestration have diversified in recent years. However, Dhanaraj and Parkhe's views of innovation network orchestration published in 2006 are still frequently cited. They argue that orchestrating an innovation network is the responsibility of a hub firm which has a central role and a prominent position in the network and which has the authority – without a hierarchical position – to coordinate, direct and lead other companies in the network. Through its well-judged and determined orchestration, the hub firm strives to pull together the dispersed resources and capabilities of other actors, enabling the open innovations launched by companies in the network to both encourage market growth and increase the network actors' market share and profitability. (Dhanaraj & Parkhe 2006.)

Nambisani and Sawhney (2011) also argue that the hub firm is solely responsible for orchestrating network-centric innovation. It should be noted that earlier studies on the orchestrator's role and tasks focus on networks which only have companies as their members. We can consequently say that, in a nutshell, orchestration refers to the hub firm's actions aiming to develop, manage and coordinate an innovation network formed by companies (Ritala, Armila & Blomqvist 2009).

As the orchestrator, the hub firm may assume the role of an architect, deciding who will be invited to participate in the innovation network, or which companies will no longer be part of the cooperation. In this role, the hub firm also determines what the network in question is studying and developing. (Pikkarainen, Ervasti, Hurmelinna-Laukkanen et al. 2017; Hurmelinna-Laukkanen & Nätti 2018.)

The key orchestration processes of the hub firm are relevant to knowledge mobility, innovation appropriability, and network stability (see Figure 1, Dhanaraj & Parkhe 2006). Managing knowledge mobility refers to sharing, acquiring and using knowledge. The hub firm is expected to facilitate common meeting places for the network companies where they can share both explicit and tacit information with each other and learn together (Gausdal & Nilsen 2011). Another purpose of these meetings is to strengthen the identity of the network and socialisation between actors. Informal ties build up social capital while creating preconditions for lucky coincidences that promote innovation. By supporting the network actors' ability to adopt and use the knowledge they receive from each other, the hub firm improves the chances of success of the multi-actor innovation process and innovation. (Dhanaraj & Parkhe 2006.)

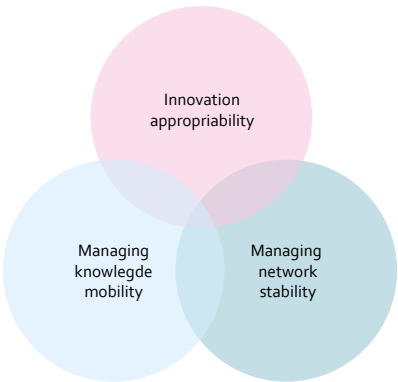

Figure 1. Key processes of orchestration in a hub firm centric innovation network (based on Dhanaraj & Parkhe 2006).

Smooth mobility of knowledge within the network promotes value creation. It is up to the hub firm to ensure that value is distributed equitably within the network and that its members experience the distribution as fair. Distributing the costs and benefits of cooperation in a way that is experienced as just is essential for the stability of the network. (Dhanaraj & Parkhe 2006.) Distribution of intangible rights created during the innovation project that is just and experienced as fair has also been included in this key process (Nambisan & Sawhney 2011). To illustrate their synergies, Figure 1 shows the key processes of orchestration as partly overlapping.

If cliques emerge within the innovation network or certain organisations withdraw from the cooperation, either fully or partly, the network will lose some of its capacity to create value. This is why one of the objectives of the hub firm's orchestration is to increase dynamic stability. Dynamism and agility are also typical of networks: the group of actors inevitably varies over time, and the strength of the relationships between the actors may change. On the one hand, dynamism is needed to ensure that the network can keep growing. On the other, stability is necessary to maintain the network's capability for value creation and innovation. (Dhanaraj & Parkhe 2006.)

As we noted above, the orchestrator coordinates interaction and cooperation between the actors in the innovation network or ecosystem (Davidson, Harmer & Marshall 2015; Leten, Vanhaverbeke, Roijakkers, Clerix & van Helleputte 2013; Nambisan & Sawhney 2011). This coordination may be partly formal, or based on contracts and regulations, and partly informal, or based on values, norms and unspoken rules (Davidson, Harmer & Marshall 2015; Dessaigne & Pardo 2020).

As open innovation is about companies also drawing on the other actors' resources in the innovation process, Nambisa and Sawhney (2011) propose as one of the orchestrator's tasks ensuring that network partners are able to use both the hub firm's and each other's technologies, tools and other resources to speed up product development and maintain a consistent quality. The hub firm must also ensure the coherence and consistency of the network's development efforts (internal coherence of the multi-actor innovation process) on the one hand and, on the other, make sure that all network partners' development work meets the changing requirements of the market (external coherence of the innovation process) (Nambisan & Sawhney 2011).

The hub firm centric views of innovation network orchestration described above still provide a foundation on which more recent ways of conceptualising orchestration rely. However, these views have been criticised for assuming that the orchestrator is always a large company (e.g. Verhoeven & Maritz 2012). The critics have consequently replaced the 'hub firm' concept with the more generic term of 'focal organisation'. This concept can refer to companies, public sector organisations or other non-profit organisations. (Verhoeven & Maritz 2012, Hurmerinta-Laukkanen & Nätti 2018.)

Despite the criticism, the definition of innovation network orchestration modified by Verhoeven and Maritz is very close to the analysis proposed by Dhanaraj and Parkhe (2006): "Orchestration refers to the set of deliberate, purposeful actions undertaken by a focal organisation for initiating and managing innovation processes in order to exploit marketplace opportunities, enabling the focal organisation and network members to create value (expand the pie) and/or extract value (gain a larger slice of the pie) from the network." (Verhoeven & Maritz 2012, 5).

2.2.2. Expanding array of concepts

We talk about innovation ecosystems and networks in many contexts today. While an exact typology of innovation ecosystems has not yet been produced, at least the following can be identified in the literature:

open innovation business ecosystems, regional and national innovation ecosystems, digital innovation ecosystems, innovation ecosystems of cities or innovation areas, SME-based high technology ecosystems, the highly localised innovation ecosystems of business incubators and accelerators, and university based ecosystems (Oh, Phillips, Park & Lee 2016).

For their part, innovation ecosystems are linked to knowledge ecosystems aiming to produce new knowledge or technology. Knowledge ecosystems focus on networked research often carried out in form of a project, the results of which are used by innovation ecosystems. (Valkokari, Hyytinen, Kutinlahti & Hjelt 2020.)

The understanding of the type of actors that can operate as orchestrators has also expanded. Actors in orchestrated ecosystems can include global platform companies (Amazon, Google, Microsoft), large global companies, large public and private sector organisations operating at the national level (postal services, ports, water and electricity sector operators), small and medium-sized enterprises, start-ups, research organisations and higher education institutions as well as public sector organisations (cities, central government organisations) - and the orchestrator can be any one of these actors (Kola, Koivukoski, Koponen & Heino 2020). Complex innovation networks or ecosystems may have several orchestrators with different roles (Pikkarainen et al. 2017).

In addition, different concepts are used to refer to orchestrators, including innovation brokers or intermediary organisations, whose task is to support other organisations' shared innovation efforts. Consequently, the innovation intermediary does not itself participate in actual product development or the manufacturing of a new product. (Batterink, Wubben, Klerks & Omta 2010.) In English research literature, the range of concepts is even wider: 'innovation broker' (Batterink et al. 2010), 'intermediary' (Howells 2006), 'innovation intermediary' (de Silva, Howells & Meyer 2018) and 'innovation champions' (Klerkx & Aarts 2013). In addition, analyses of network management are very close to the concept of orchestration (see e.g. Aarikka-Stenroos & Ritala 2017, Ritter, Wilkinson & Johnston 2004).

2.2.3. Orchestrator types

A hub firm orchestrator described above has been referred to as a 'player-orchestrator'. The player-orchestrator of an innovation network strives to achieve its own business goals and to improve its competitiveness. (Leten et al. 2013.) A player-orchestrator manages a relatively closed system or network, as it strives to select the network members judiciously based on how well the resources and capabilities of other actors meet the needs of the innovation network. In other words, this evaluation focuses on the potential benefits each actor can generate for the network. The orchestrator strives to tap the resources of others by coordinating the innovation activities of all members. (Guidici, Reinmoeller & Ravasi 2018.)

However, the innovation network can also be orchestrated by a 'non-player orchestrator', which does not operate in a competitive market and consequently does not pose a threat to the network members' business. For example, a research institute focused on technology development can be a non-player orchestrator, in which case it ensures the equitable distribution of intellectual property rights, among other things. In an innovation network led by a non-player orchestrator, discussions between the actors may be more open than in a player-orchestrator's network, as the former is not driven by a profit interest. Network partners trust a non-player orchestrator to ensure that everyone can take advantage of the value creation potential of innovation. (Leten et al. 2013.)

A non-player orchestrator may be a sponsor orchestrator, which may have its own financial objectives but which does not directly compete with the business members of the innovation network in the market. (See

Table 1.) A sponsor orchestrator may charge membership fees or commission when working for the benefit of the network members. This type of orchestrator may also claim shareholdings in the companies developing innovations, in which case it expects to gain long-term business benefits. Its own success is consequently based on the success of the other innovation network members.

A sponsor orchestrator must have a prominent position in the network, as it has the vital role of an intermediary between the network members as well as other actors and innovation networks. It also needs to have financial or technological resources (for example, a capital investor or a technology development organisation with extensive intellectual property rights). (Hurmelinna-Laukkanen & Nätti 2018.)

Table 1. *Orchestrator types*

	KEY FEATURES	TYPICAL ORGANISATION
Player orchestrator	Strives to achieve its own business goals and to improve its competitiveness.	Large enterprise
Non-player orchestrator: sponsor-orchestrator	Strives to achieve its business goals over the long term; does not compete with the network's business members in the same market.	Capital investor, business accelerator, technology development centre
Non-player orchestrator: enabler-orchestrator	Aims for promoting the wellbeing of the innovation ecosystem and smooth cooperation between actors; encourages interaction, knowledge sharing and multi-actor co-creation.	City, higher education institution, third-sector organisation

Another non-player orchestrator type is the enabler-orchestrator1, which differs from both orchestrator types discussed above in that, rather than having its own business interests (Hurmelinna-Laukkanen & Nätti 2018), it works to promote the wellbeing and smooth cooperation of the innovation network (Pikkarainen, Ervasti, Hurmelinna-Laukkanen & Nätti 2017). Consequently, a city, higher education institution or third sector organisation operates in the specific role of an enabler-orchestrator when it leads a multi-actor co-creation ecosystem or network.

In other words, its aim is to support the innovation processes of other actors by bringing the actors together and removing obstacles to cooperation. Orchestration encourages interaction and knowledge sharing between the actors as well as facilitates and supports multi-actor co-creation.

The enabler-orchestrator must also have a prominent position in the network based on impartiality and integrity that is recognised by the other actors (Hurmelinna-Laukkanen & Nätti 2018). An orchestrator of this type is expected to have an in-depth understanding of the problem area. The enabler-orchestrator is passionate about tackling the problem and seeking solutions (Pikkarainen et al. 2017, see also Gausdal & Nilsen 2011). As it aims for the wellbeing of the entire innovation network, it works to help the other actors identify new business opportunities and social innovation needs. Additionally, it promotes the development of the actors' capabilities and knowledge by supporting experiential learning in multi-actor innovation processes.

2.3. ORCHESTRATION MODES

We have described how player-orchestrators' goals differ from those of non-player orchestrators. A player-orchestrator aims for gaining competitive advantage and improving its profitability through the innovation network. Its orchestration orientation can be described as orchestrator-centric and directive (Guidici et al. 2018). As we noted above, a player-orchestrator is often a large company that leads a relatively closed innovation network. Consortia formed for large RDI projects and cross-sectoral development programmes supported by a public funding provider often are networks of this type (see Guidici et al. 2018).

The two extremes of orchestration modes are the dominating and consensus-based model (Reypens, Lievens & Blazevic 2020). The dominating mode resembles hub firm centric orchestration, in other words the orchestration of a closed system or network (see Guidici et al. 2018 for more information on closed system orchestration). The description of the consensus-based mode, on the other hand, would appear to be consistent with the operating method of an enabler-orchestrator. This mode can also be called open system orchestration (see Guidici et al. 2018 for further information). In Table 2, we use a different term for the consensus-based orchestration mode: it is called a mode that supports interaction and actors' self-directiveness, as the word consensus may create associations of avoiding conflicts and mandatory reconciliation of different perspectives and objectives.

Table 2. *Main features of the dominating orchestration mode and the mode that supports interaction and actors' self-directiveness (modified and supplemented from Reypens et al. 2020, 64 and Guidici et al. 2018, 1371)*

ORCHESTRATION TASK	DOMINATING MODE (CLOSED SYSTEM)	MODE THAT SUPPORTS INTERACTION AND ACTORS' SELF-DIRECTIVENESS (OPEN SYSTEM)
Formulation of vision	The orchestrator defines the vision of the ecosystem.	The vision is created by negotiating.
Diversity management	The orchestrator selects mutually complementary actors whose goals are as consistent as possible with the ecosystem's objective.	The orchestrator creates a platform for cooperation. The orchestrator strives to promote awareness and consensus regarding different objectives among the actors.
Creation of ties between actors	Arranged marriages and blind dates.	The orchestrator supports the building of teams around sub-problems and key actors.
Coordination	Top-down division of labour and assignment of innovation tasks centrally by the orchestrator.	Bottom-up, voluntary, each actor selects their task in the innovation process.
Managing knowledge mobility	The orchestrator strives to acquire knowledge from other actors and learn from their experiences	The orchestrator supports all actors' peer learning and the creation and sharing of new knowledge in the co-creation of an innovation.
Monitoring of results and impacts; innovation appropriability	The orchestrator monitors the achievement of results and communicates about them.	The orchestrator communicates actively and continuously about both the outputs of the ecosystem and individual actors' results as well as the benefits of co-creation experienced by the actors. The rules of co-creation have been agreed.
Commitment of the members; network stability management	Confirmed by contracts.	Based on relationships between actors; the parties know and trust each other. Actors participate in joint actions on a voluntary basis.

A dominating orchestrator (one operating in a dominating mode) mainly determines the vision of the innovation ecosystem itself and merely informs the other actors of it, while an orchestrator operating in the opposite mode facilitates discussions resulting in a shared vision among the group of actors. In this case, an initial vision may serve as an open invitation to get a larger set of actors together. Consequently, an orchestrator operating in the mode that supports interaction and the actors' self-directiveness does not determine the actors to whom an invitation to ecosystem cooperation is sent; both the challenge to be solved and the impact-centric vision of the platform attract those actors who are interested in developing new solutions in multi-actor cooperation or who feel that the challenge and its possible solutions are relevant to their operations.

A dominating orchestrator, on the other hand, invites at its discretion actors who complement the resources and capabilities of both the orchestrator and others to join in. A precondition for this is that the orchestrator maps the competences of potential partners before the cooperation is initiated (Kazadi, Lievens & Mahr

2016). In addition, a dominating orchestrator pays attention to the other actors' goals being as consistent as possible with those of the innovation ecosystem (Reypens et al. 2020). As the orchestrator is aware of the other actors' competences, it brings suitable actors together, in other words organises 'arranged marriages and blind dates'.

The enabler-orchestrator of an open system, on the other hand, has a different way of managing the diversity of actors. It creates a platform for interaction and cooperation. There is a great need for interaction, as the actors drawn by the challenge and vision do not necessarily know each other. The orchestrator strives to make the actors aware of each other's resources, skills and objectives. Meetings that facilitate interaction play an important role in enabling the actors to perceive and understand each other's different perspectives and objectives (Reypens et al. 2020). A shared understanding of the challenge and an impact-oriented vision unite the diverse actors. Once the actors have got to know each other, they are able to direct themselves in building teams around key actors and sub-problems.

A dominating orchestrator takes care of the division of labour between the actors in a closed system. It decides which tasks each actor should assume in the innovation process, whereas an orchestrator that supports the actors' self-directiveness allows each actor to choose their own tasks.

Managing knowledge mobility is one of the most important tasks of the orchestrator (Dhanaraj & Parkhe 2006). A dominating orchestrator strives to acquire as much information and knowledge as possible from the other actors and to use the new knowledge both in its own business and in the management of the closed innovation ecosystem.

Through its support measures, the orchestrator of an open innovation system invests in strengthening the entire network's ability to adopt and use new knowledge (see Nätti, Hurmelinna-Laukkanen & Johston 2014). In other words, the orchestrator supports peer learning among all actors, a precondition for which is open reflection on other actors' knowledge and experience at meetings organised and facilitated by the orchestrator. The orchestrator strives to maximise everyone's experiential learning, the generation of new shared knowledge, and the use of the knowledge in the co-creation of innovation.

A dominating orchestrator monitors the achievement of goals set at the innovation ecosystem level and communicates about it. If a specific actor does not achieve its targets, the orchestrator may terminate the cooperation agreement (Aarikka-Stenroos, Jaakkola, Harrison, et al. 2017). An orchestrator representing the other extreme also communicates actively about the outputs of the entire ecosystem. In addition, a positive atmosphere is created by communicating about each actor's contributions and the results and impacts obtained through them, as well as the benefits of co-creation experienced by the actors. Jointly agreed co-creation rules support the equitable distribution of innovation value.

In a closed network led by a dominating orchestrator, the members' commitment is confirmed by contracts. An orchestrator that supports the actors' self-directiveness promotes the stability of the network by helping the actors to also know each other on a personal level, which is a prerequisite for building trust between people. Relationships based on trust create stability. Stability is also reinforced by commonly adopted norms, the codes of conduct of multi-actor co-creation.

The orchestrator supports the building of trust

Multi-actor co-creation is needed when the problem or need to be solved is so multidimensional that no actor can develop a solution alone. Consequently, the actors in the innovation ecosystem depend on each other. A need for trust ensues from this co-dependence. While a dominating orchestrator strives to ensure that the responsibilities for co-creation, authorities and rights to the outputs are defined in written contracts,

co-creation consists of goal-oriented work between people in an open dialogue whose success depends on trust between the participants.

Japanese researcher Mari Sako (1992, 37-48, 122) has identified three types of trust: contractual trust, competence trust and goodwill trust (Figure 2). Contractual trust refers to the general ethical principle of keeping promises. The more co-creation between the innovation ecosystem actors relies on verbal agreements rather than written contracts, the more contractual trust the parties have in each other. This type of trust is reinforced by classical moral virtues: keeping your promises and speaking the truth (Ilmonen 2000). The orchestrator can promote the creation of this type of trust, at least between the orchestrator and the innovation ecosystem actors, through their communication and actions: only giving promises that they can keep and also communicating about problems and limitations where necessary.

Competence trust is created between the actors when both parties believe that the other is able to manage the agreed tasks. This type of trust is naturally built while working together and as a result of experiential learning. However, the orchestrator can promote the creation of competence trust between actors by organising opportunities for the actors to showcase their competence and solutions based on it. Case descriptions of completed multi-actor co-creation processes communicate about the competences of both the orchestrator and the participants.

An example of the third type of trust, or goodwill trust (Sako 1992, 38-39, 44) is the ecosystem actors believing that the benefits of innovation cooperation will balance out over time, even if a particular actor would benefit more at times. When the orchestrator succeeds in ensuring that the distribution of the value created by innovation is considered fair, this type of trust is strengthened. In this case, the actors also commit to seizing opportunities that are expected to improve the profits of others. When the innovation ecosystem actors trust the goodwill of the orchestrator, they agree to the orchestrator's requests without preliminary conditions or limitations.

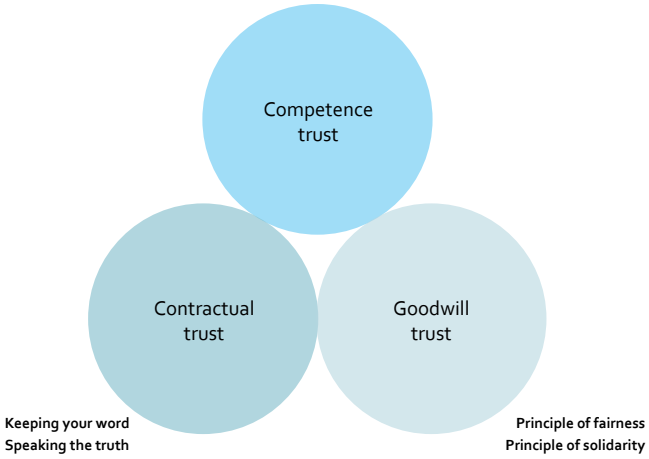

Figure 2. *Types of trust and classical moral virtues*

The third type of trust, or goodwill trust, is associated with two moral virtues: the principle of fairness and the principle of solidarity (Ilmonen 2000), which should guide multi-actor co-creation and the distribution of the resulting value. The principle of fairness means that people feel they are being treated fairly. The principle of solidarity, on the other hand, includes the idea that the criteria for distributing the output do not unduly favour one party at the expense of others.

As the preconditions for this type of trust have, among other things, been identified the actor's moral responsibility, interest in and caring for others, understanding and respecting others, and good intentions (Blomqvist 2002, 177). Consequently, an innovation ecosystem orchestrator needs not only a prominent position in the network and resources but also a partnership-centric, rather than orchestrator-centric, mentality and behaviour.

Hybrid orchestration

In practice, the orchestrators of innovation ecosystems vary in their orchestration styles as required by the situation (for more information about hybrid orchestration, see Reypens et al. 2020). For example when the innovation network is very large, it may be difficult for the network actors to self-directedly identify the resources and competences of others, in which case the orchestrator must actively bring certain actors together even if they did not otherwise operate in the dominating mode.

In keeping with funding providers' requirements, large international RDI projects often involve a wide variety of actors selected by the orchestrator because they complement each other's resources and perspectives. While the orchestrator may formulate a preliminary vision to manage a high level of diversity, the interaction and self-directiveness of actors is usually stressed in the orchestration of the actual multi-actor co-creation.

There may also be several orchestrators, in which case the orchestration modes may vary depending on the orchestrator. The enabler-orchestrator – for example a higher education institution – could be responsible for practices related to managing knowledge mobility that support peer learning among all ecosystem actors and the generation of new knowledge. In the meantime, assigning innovation tasks managed from top down could be the responsibility of another orchestrator operating in the dominating mode.

Polyphonic orchestrator of innovation processes

An orchestrator who has adopted the hybrid mode leads the innovation ecosystem flexibly and as required in each situation. An orchestrator that facilitates multi-actor work in practice is similarly polyphonic, which means that they switch between the roles of a leader or a participant in co-creation meetings. Consequently, a polyphonic orchestrator operates differently from a service designer guiding the group process who constantly stays in the same role of guiding and supporting the group's work, a role which does not include taking a stand on the group members' views or outputs. If necessary, the orchestrator may invite a professional facilitator of the group process from outside the ecosystem to lead co-creation workshops, enabling the orchestrator to focus on coming up with ideas and co-creating solutions.

A polyphonic orchestrator who supports the creative group process switches roles between a challenger and a driver, or from a control oriented to radical oriented role (Ness 2017, Figure 3).

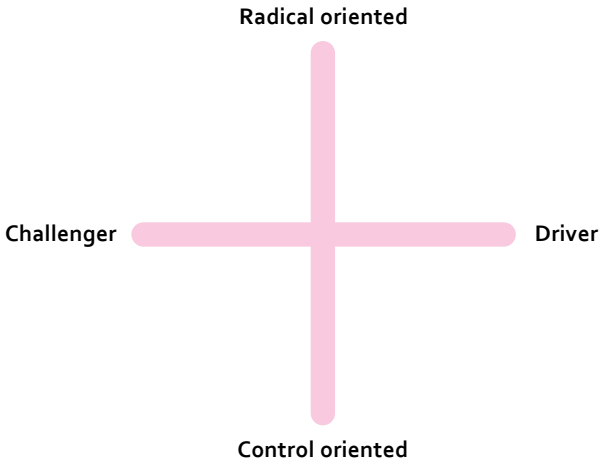

Figure 3. *The four roles of a polyphonic orchestrator (Ness 2017)*

To launch the process of co-creation, the orchestrator uses the voice of a driver. To promote the participants' creativity and the abundance of ideas and views, the orchestrator may switch between a challenger's and a radical oriented role, whereas a control oriented role is needed especially when putting the finishing touches on the solution to ensure that it meets the requirements of various laws and regulations, for example. The driver ensures that the creative process is brought to a completion and that the necessary decisions on further actions are made. (Ness 2017.)

Through their flexible and variable practices and modes of speaking, the polyphonic orchestrator or team of orchestrators strives to promote dialogue and the creation of a shared understanding between the actors. The benefits of multi-actor co-creation are only realised when the views and ideas of all actors are heard in the joint discussion.

2.4. SUMMARY AND CONCLUSIONS

Both researchers and practical professionals today agree that the innovation ecosystem consists of actors of very different types, as a wide range of capabilities and viewpoints is needed to understand and solve complex problems. In addition to large companies, innovation networks may be orchestrated by so-called non-player orchestrators, including research institutes, higher education institutions, cities or business accelerators. The earliest conceptualisations of innovation ecosystem orchestration are hub firm centric, whereas the latest view is that the orchestrator stresses the wellbeing of the entire ecosystem.

The following were identified as the key processes of orchestration already in the early 2000s: managing knowledge mobility, managing innovation appropriability, and managing network stability (Dnanaraj & Parkhe 2006). The importance of these processes remains indisputable. It should be noted, however, that co-creation in an innovation ecosystem is increasingly being led and coordinated by an enabler-orchestrator who strives for both solutions leading to the desired impacts and the wellbeing of the ecosystem as a whole. Multi-actor co-creation is additionally used to solve large-scale societal problems, rather than only striving for

new commercial products and services. For these reasons, it is necessary to expand the content of the above key orchestration processes.

To the first key process, orchestrator-centric management of knowledge mobility, is added the goal of maximising the learning of all actors involved in the co-creation. The orchestrator works to support the building of new shared knowledge and the creation of shared meanings. Given the increasing complexity of the problems to be solved, the innovation ecosystem needs a great deal of new knowledge and shared understanding of the problem area or the theme of the challenge, before solutions are developed together. The orchestrator also supports peer learning between the ecosystem actors by enabling them to share expertise and experiences. The orchestrator can build digital platforms or learning environments to support experiential learning.

Managing innovation appropriability, or in other words, ensuring the equitable distribution of value from innovation was cited above as the second key process. When the innovation network consists mainly of business operators, the value refers to business value. When we also take into account other types of actors, the complexity of problems and the multidimensional nature of developing solutions to them, the meaning of this key process expands. The orchestrator makes sure that everyone participating in multi-actor co-creation feels that the benefits they gain from the cooperation process and its results are equitable in relation to the resources they use and the risks they take, and also fair in relation to the benefits experienced by other actors. For example, experienced benefit may refer to improved competence, contacts, a strong sense of meaning or the positive impacts of the solution.

When we take each actor's experienced benefits from the innovation as the starting point for assessing fairness, rather than the measurable value of the innovation, and the perspective of benefit is extended to the co-creation process and the impacts of the solution, written contracts are little use for an orchestrator who wishes to ensure a fair distribution of benefits. This is why the orchestrator strives to create a common set of rules with the actors. Compliance with these rules strengthens the norms of co-creation and trust in the goodwill of the others.

When the orchestrator leads an open innovation network, the core tasks of the third key process of orchestration – managing the dynamic stability of the network – are firstly, to manage diversity by building trust between actors and, secondly, to support the actors' self-directiveness. The orchestrator's open dialogue with both the ecosystem actors and those outside it strengthens dynamic stability.

A skilled orchestrator works flexibly and as required by the situation, adopting the hydrid mode. Multifaceted and polyphonic orchestration of an innovation ecosystem can be ensured by sharing the responsibility for orchestration and its tasks with several actors. As one option, the so-called circle of mediators has been proposed (Hirvikoski, Lehto & Äyväri 2016, 7-9; Äyväri, Jyrämä & Hirvikoski 2018). The circle of mediators is a team of orchestrators in a given innovation ecosystem that together leads and coordinates co-creation in the ecosystem. More research in multi-actor orchestration is needed to understand its advantages and disadvantages.

Similarly, more research in the orchestration of multi-actor co-creation from the perspective of citizens is necessary. Users, customers, citizens – whichever word we prefer – are important agents in perceiving complex problems and developing solutions. Until now, however, the literature on innovation ecosystem orchestration has mainly focused on the perspective of organisations. When the objective of orchestration is the wellbeing of the entire innovation ecosystem, citizens' needs and experiences should not be overlooked.

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3. Orchestration of multi-stakeholder co-creation from the perspective of independent science and the autonomous university

Tuija Hirvikoski

> ***The task of researchers is not only to share information, but also to provoke, inspire ideas, and teach students to think.***
>
> ***Jonathan R. Cole (in Väliverronen 2020, 54)***

ABSTRACT

Due to globalisation, the complexity of societal challenges has increased. As a result, society is increasingly seeking solutions from innovation ecosystems and their multi-stakeholder co-creation involving universities and their research, development and innovation activities. Literature and practical experience indicate that to function, innovation ecosystems need systematic orchestration.

This paper is based on research literature, policy documents and experiential knowledge. In it, we examine the possibilities to orchestrate innovation ecosystems from the perspective of independent and responsible science and the autonomous higher education institution. By definition, the enabler-orchestrator of the innovation ecosystem considers all actors, functions and levels of the ecosystem equally as well as the differences in their operating logics and objectives. This is a precondition for achieving the ecosystem's shared objectives and generating a large number of solutions that create value for ecosystem actors and promote ecosystem well-being.

The previous paper's focus has been on the benefits of one type of organisation, either company, public sector organisation or academia. Whereas, in this paper, we reflect on the benefits of multi-stakeholder co-creation for all ecosystem stakeholders. We also argue that the multistakeholder co-creation orchestrator role is compatible with the universities as only they have the built-in capacity to simultaneously produce scientific knowledge and innovation as well as pursue truth and participate in solving problems. The paper discusses the enabler-orchestrator's opportunities to bring independent science into cooperation with an innovation ecosystem whose objective is to anticipate and solve extensive societal challenges whilst promoting ecosystem well-being. The main focus is on how independence and scientific excellence can be safeguarded and how also science and universities might benefit if they are orchestrated for multi-stakeholder co-creation

The discussion is built on three concepts: Johan Snellman's concept of open and responsible science and education, the concept of an enabler-orchestrator, and the metaphor of academic capitalism and research markets. Based on the conceptual analysis of these concepts, this paper argues that "the university as an enabler-orchestrator" is in line with the current European University Inviative as it promotes positive synergies and the reconciliation of logical conflicts between the fundamentals of commercially driven innovation and independent and responsible science.

Keywords: multi-stakeholder co-creation, open innovation ecosystem, independent and responsible science, open innovation, higher education, JV Snellman's university concept, research market metaphor, university, enabler-orchestrator, European University Initiative

3.1. INTRODUCTION

AS A RESULT of globalisation, societal challenges have become more complex. This is also visible in the policy and funding programmes concerning European universities and European Research Area (ERA), including various research, development and innovation activities (RDI). The programmes are increasingly emphasising the role of innovation ecosystems and multi-stakeholder co-creation. This is because extensive societal challenges or wicked problems cannot be tackled by an individual discipline or sector, let alone by a single organisation or RDI project. Based on Reypens, Lievens & Blazevic 2016, *multi-stakeholder co-creation* refers to activities and value co-creation when *the aim is to develop several solutions creating value for ecosystem stakeholders and promoting ecosystem well-being*.

Innovation ecosystems, multi-stakeholder co-creation and their orchestration are not yet established concepts, even though they are the product of decades of development (see Hirvikoski 2021, 2022). Co-creation in the interaction between the public, private and higher education sector and civic society requires systematic orchestration (Curley and Salmelin 2018; Lappalainen, Markkula & Kune 2015; Äyväri 2021). Also, recent technical reports have highlighted the need to coordinate and orchestrate cooperation between higher education institutions and business life as well as the activities of business-oriented innovation ecosystems (Koski, Suominen & Hyytinen 2021 and Zegel et al. 2021). So far, however, little research has been carried out on the orchestration of ecosystems from the perspective of independent science and autonomous universities.

In this article, orchestration refers to all supporting and auxiliary measures related to multistakeholder co-creation activities on different levels of society. Whereas the *enabler-orchestrator promotes the well-being and smooth cooperation of the innovation network.* Consequently, a city, higher education institution or third sector organisation operates in a specific enabler-orchestrator role enhancing a multi-actor co-creation ecosystem or network. (Äyväri 2021.)

Managing knowledge mobility is one of the most important tasks of the orchestrator (Dhanaraj & Parkhe 2006). It refers to sharing, acquiring and using knowledge. By supporting the network actors' ability to adapt and use the knowledge they receive from each other, the enabler-orchestrator improves the chances of success of the multi-actor innovation process and innovation.

Based on Äyväri 2021 and Curley and Salmelin 2018, this paper suggests that an enabler-orchestrator enhances smooth knowledge exchange within the network and promotes value co-creation. The orchestrator ensures that value is distributed equitably within the network and that its members experience the distribution as fair. This means sharing risks related to the development of innovation and distributing the costs and benefits of cooperation in a way that is experienced as essential for the stability of the innovation ecosystem.

A higher education institution may solely be a member of an innovation ecosystem, or it may also actively sell its service, or it can orchestrate the operation of the ecosystem either alone or together with other stakeholders, e.g. the cities. Hereafter, this paper examines universities' roles, tasks and services through the concept of enabler-orchestrator. It focuses on such ecosystems that can also benefit independent science and autonomous universities supporting the ecosystem's well-being merely through their existence.

By definition, the enabler-orchestrator operates either in cross-regional or city-based innovation ecosystems aiming to solve societal challenges promoting the well-being and smooth cooperation of the innovation network. In addition, this paper argues that the orchestration activity is needed in the latest European policy initiatives such as the European Research Area (ERA), European Higher Education Area (EHEA) and the

European University Initiative (Council of the European Union 2021; Erasmus+ 2021, European Commission 2021b)1.

The European Universities Initiative (EUI) covers all types of higher education institutions and levels of education. European University alliances must be an inspiration and role model for other higher education institutions. Universities under the initiative are expected to have deeper, more ambitious and more goal-oriented international cooperation at institutional levels. Cooperation between higher education alliances must be systemic, structural and sustainable. It must lead to significant progress in terms of their quality, achievements, attractiveness and international competitiveness, as well as enable the profound institutional transformation of higher education institutions. They are also expected to contribute to the digital and green transition and to benefit the European knowledge-based economy, employment, creativity, culture and well-being. We suggest that this ambitious aim will be reached by multistakeholder collaboration within and across the ecosystems in which the universities reside. As stated earlier, collaboration or innovation co-creation in ecosystems calls for systematic orchestration whereas the universities are their inborn enabler-orchestrators.

There are several objectives and activities related to the European University Initiative which would benefit from professional orchestration services. For example, according to the EUI, the education and training must provide students with the skills to collaborate and the competencies to work and co-create value across country borders, sectoral boundaries and disciplines. The European University alliances are expected to support local ecosystems and produce scalable social and technological innovations to address societal challenges and support the sustainable future of societies across Europe. All this must be done while *committing to "excellence" and "respecting academic freedom" and institutional autonomy*. The alliances are expected to achieve their goals through the relevant and efficient shared leadership and management structures they have[2] developed. (See Council of the European Union 2021; Erasmus+ 2021, European Commission 2021b. Info Box 1) *This paper considers that the enabler-orchestrator activity and service would be part of the governance structure of the EUI alliances.*

In Europe, *the mission-driven and challenge-oriented RDI funding and activities* that have become more common in the 2020s emphasise inclusive co-creation involving all levels, activities and actors of innovation ecosystems. In addition, the role of experiential knowledge and citizens is also emphasised in participatory RDI activities. Multiple EU projects have produced a large number of *practical guidebooks and recommendations* that can be found using such search words as "service design", "co-creation", "fast trials", "innovation ecosystem", "quadruple helix", "Living Labs" and "Test Beds" or see e.g. Polaine, Løvlie & Reason 2013; Stickdorn, Hormess, Lawrence & Schneider 2018; Miettinen & Koivisto 2009; Ståhlbröst & Holst 2012; Mustonen, Spilling & Bergström 2017; Santonen et al. 2019; Hagman, Hirvikoski, Wollstén & Äyväri 2018).

The guides and manuals provide practical advice on how to implement co-creation and experimentation approaches and methods between companies, the public sector, NGOs, citizens and higher education institutions in a manner that produces joint value. They describe in detail how scientific knowledge, market knowledge, and experiential knowledge can be used to serve the creation of better products and solutions. The manuals and their methods usually consider the needs of society and the parties that commercialise results, in addition, they give a voice to innovation users and such beneficiaries as future generations or the planet earth.

1 Erasmus+ Programme (ERASMUS), Call for proposal, Partnership for Excellence – European Universities – ERASMUS-EDU-2022-EUR-UNIV, Version 1.1, 30 NOV 2021 document describes the objectives of European Universities in the following manner:
"Develop and implement an integrated long-term joint strategy for education with, where possible, links to research and innovation and service to society, that is responsive to the digital and green transition and key socio-economic challenge, while remaining committed to excellence:.." (..) "Build European knowledge-creating teams ("challenge-based approach") of students and academics, possibly together with researchers, entrepreneurs, companies, local and regional actors, and civil society actors (..) working together to address societal and other challenges of their choice in an inter-disciplinary approach through:.."

2 Examples: setting up joint …. p. 6

However, mainstream research and practical manuals that follow the principles of economic-driven innovation development primarily see universities and science merely as a tool or assistants for innovation activities. They rarely focus on how independent and responsible science and education or an autonomous university, by their mere existence, bring about such a change in society and people's worldview which the economically driven innovation system and citizen science have been aiming for over recent decades. *Practical guides rarely cover how an innovation ecosystem orchestrator can safeguard the independence of science and education in practice, or how value co-creation helps researchers succeed in the academic world.* (Hirvikoski 2022)

Due to these above-mentioned factors, this paper identifies potential challenges and benefits of cooperation between challenge-driven innovation and curiosity-driven science. Moreover, *we aim to find different ways in which universities in their role as an enabler-orchestrator can reconcile the different operating logics of the benefit-driven innovation ecosystems and independent science and autonomous universities.* When successful, this contributes to the well-being and positive cooperation of the ecosystem.

3.2. TOWARDS AN ORCHESTRATION MODEL THAT DOES NOT JEOPARDISE INDEPENDENT SCIENCE

In the following sub-chapter, we present the commonly used approaches and basic principles that form the basis for our examination of the higher education institution as an enabler-orchestrator.

In the second sub-chapter based on Ylijoki (2020) we shed light on the different operating logics of science and research. We discuss the features of different research markets and we complement Ylijoki's description of funding bases with the latest funding programmes suitable for multi-stakeholder co-creation.

In the third sub-chapter, we address the challenges and potential benefits which, in an ideal case, may arise when an independent scientific institute and researchers operate in different research markets and cooperate with other innovation co-creators. Finally, we propose actions that empower the enabler-orchestrator to reconcile the different operating logics of the different research markets and innovation ecosystems.

3.2.1. Approaches and basic principles of the paper

In our search for possible ways and means of reconciling the different operating logics of independent science, autonomous universities, and innovation ecosystems, we aim for a situation in which the *direct and indirect societal benefits of higher education institutions can be achieved without putting the independence of science at risk.*

Our reflection relies on three conceptual papers in particular. The first is a description of the development stages of multi-stakeholder co-creation and the nature of independent science (Hirvikoski 2021, 2022). The second paper describes the different orchestrators and orchestration styles of innovation ecosystems (Äyväri 2021, 2022). Finally, Ylijoki's (2020, 137-147) paper on research markets ("Tiede markkinoilla") describes metaphorical markets- where science manifests itself in the form of a growing number of projects.

Enabler-orchestrator supporting multi-stakeholder co-creation

Regarding higher education institutions, we apply the enabler-orchestrator concept described by Äyväri (2021, 2022). An enabler-orchestrator does not have business interests and is primarily focused on the well-being of the entire ecosystem or network. An enabler-orchestrator applies new orchestration practices and

hybrid models flexibly, in context and appropriately. A city, higher education institution, or a third sector organisation may act as a multi-voiced enabler-orchestrator or orchestrator team supporting a multi-stakeholder co-creation. Without forgetting the many innovation specific tasks that are part of the role of an orchestrator, we focus particularly on Äyväri's (ibid.) proposal that a university orchestrator could be responsible for practices that ensure knowledge exchange and thus support peer learning between all actors and the co-creation of new knowledge (see Äyväri 2021).

An enabler-orchestrator must also consider all special characteristics and tensions between different research markets (Ylijoki 2021) as well as the economy-driven RDI activities and autonomous science (Hirvikoski et al 2021). We also emphasise that multi-stakeholder co-creation can only work if independent scientists and researchers, autonomous universities as well as companies and the public sector organisations specialise in their own tasks and cooperate to exploit the best possible knowledge and expertise in their field. This is the only way to provide benefit to the other parties involved in co-creation and to enhance the ecosystem's well-being, especially when the joint objective is to overcome extensive societal challenges or tackle wicked problems.

By applying the research market metaphor used by Ylijoki (2021), we consider that overcoming wicked problems through multi-stakeholder co-creation requires orchestration capacity and competence to find and curate the knowledge needed for co-creation from each different research market. Different types of enabling orchestration activities and services are needed at all stages of research, development, and innovation, from the building of the ecosystem to the launch of its final solution. An orchestration team is tasked with maintaining the dynamic stability of the ecosystem, promoting learning, and collectively creating knowledge and understanding of the challenges and opportunities of a constantly changing operating environment.

JV Snellman's university concept integrates independent science with societal relevance

While we reflect on the positions of independent science and autonomous higher education institution, we do not propose to return to the concepts of freedom and education as presented by Alexander von Humboldt. Instead, our starting point is a philosopher and statesman *Johan Vilhelm Snellman's university concept* as revived by Tuunainen, Miettinen and Esko (2020). The concept presents that "education and academic freedom are linked to the responsibility for the important challenges and problems of the world and society" and that "they are realised in different interactions between researchers and societal actors" (Tuunainen, Miettinen & Esko, 2020, 105, 124). Snellman's university concept states that the so-called "understanding of critical realism about the double determination of knowledge guides scientific work", and the researcher is "simultaneously motivated by the creation of knowledge, pursuit of truth, and participation in solving societal problems" (ibid., 105).

As early as 1840, Johan Vilhelm Snellman wrote about academic studying and required students to provide "information that would enable them to solve an important social issue that is based on a field of science that the student has studied based on their profession" (ibid., 111). Intrinsically, higher education is based on an in-depth understanding of the dynamics of teaching, learning, and education as well as their societal significance. Thus, the starting point for our examination is that this competence also promotes learning in innovation ecosystems as well as the creation, utilisation, and critical assessment of innovations that are important to society or have negative externalities.

According to the current understanding, the precondition for the development, introduction, and emergence of future innovations is that there are curious, critically thinking citizens who can change their perspe-

ctives and are prepared to change their behaviour when needed. For this reason, the task of researchers is *"also to provoke, inspire ideas, and teach students to think"* (Väliverronen 2020, 54). In addition to providing students with new knowledge and practical capabilities to act as an innovator or citizen scientists, "(..) higher education teaches citizens to always look at life and the world with new eyes, new perspectives, and critically" (Kivistö and Philström 2018). To mature, capabilities and critical thinking require time and the opportunity to apply what has been learned in RDI projects and to reflect on the observations and lessons from them. That is why we are also considering the possibility of integrating science, research, and innovation into learning.

Snellman's idea of independent and responsible science and education as described above is an ideal that may not be achieved in the real world, but it gives an idea of the objectives that the actions of an enabler-orchestrator should strive for.

Open innovation ecosystem as an operating environment

The second starting point of the article is to focus only on such open innovation ecosystems that use science and innovation activities to anticipate and tackle extensive societal challenges and to prevent possible negative externalities of emerging solutions. Their objective is to use multi-stakeholder co-creation to produce multiple solutions that create value for ecosystem actors and promote the ecosystem's well-being (Reypens, Lievens, Blazevic 2016). In such an ecosystem, higher education institutions work together with companies and public institutions to create shared value (Porter & Kramer 2011) or produce social benefits (Calhoun 2009) in the form of sustainable wealth and the well-being of humanity. In these ecosystems, Snellman's idea of education and academic freedom are linked to the key challenges and problems of the world and society (Tuunainen, Miettinen and Esko 2020).

In an ideal situation, the enabler-orchestrator aims to promote the resolution of shared challenges of the ecosystem and the overall well-being of the innovation ecosystem through multi-stakeholder co-creation. At the same time, it considers differences in the operating logic of science and innovation as well as the differences in the values, ethos, priorities and motives of the institutions involved in co-creation.

For universities that rely on public funding, this means two things: On the one hand, they must be flexible to serve the *plurality of interests of stakeholders and funders* and thus demonstrate the legitimacy of their existence in the cross-pressure of ambiguous expectations. On the other hand, they must defend *the fundamental ethos of their existence: independent and reliable science and education serving humanity.* (Gumport 2019)

In this way, the orchestrator's challenge is not only the universities' immediate societal impact. In addition, they must include independent science in the strategic multi-actor cooperation in a way that does not jeopardise the long-term independence of science and excellence of education or its impact on the future of humanity and the planet. Universities, research funding organisations (RFOs), and ecosystem orchestrators will have to consider such issues as: In general, is it possible to reconcile the differences and tensions? If so, how do orchestrators and financiers organise the inter-institutional cooperation in practice in a way that safeguards the everyday activities of independent science and autonomous universities? Or, how does orchestration help higher education institutions that must repeatedly prove the legitimacy of their existence (Gumport 2019) without compromising the independence and excellence of science and education (see e.g. the vision and criteria for European University Initiative)?

3.2.2. Market metaphor shedding light on the different operating logics of the Research Markets

In her article, Ylijoki (2020) dismantles the expectations and conflicting pressures that science faces both within the science system and in an innovation-driven policy in which science is seen as merely a socio-economic factor (see Hirvikoski 2021, 2022). Ylijoki uses *market logic* and the concept of *academic capitalism* by Sheila Slaughter and Larry Leslie to discuss the problems related to the transformation of research into a project-based activity. In this article, we use the market metaphor described by Ylijoki as a heuristic tool to understand the different operating logic of the various markets. In addition, the metaphor directs our thinking and ideas related to the multi-stakeholder co-creation orchestration.

According to academic capitalism, "universities, faculties, research groups, and individual researchers are constantly on the market, competing for funding and also seeking direct profits through licences, patents and corporate spin-offs. More indirectly, the market logic manifests as competition for the top position, such as high positions on ranking lists, the recruitment of top experts, and success in bibliometrics in publications. The assumption is that success through these indicators will increase prestige, visibility, and credibility, which will then improve market positions in competition for funding (ibid. 135-136)."

Ylijoki (2020, 137-147) utilises academic capitalism to distinguish various *Research Markets*, i.e. Academic markets, Business markets, Policy markets, Professional markets and Public markets. The independence of science is assigned in different forms in each market. In different markets, the funding base and objectives of the research are different. Researchers working in these markets cooperate with different parties and direct their research results to different audiences. Or more precisely, as Ylijoki writes: "Different markets operate according to different rules, target different audiences and compete for different rewards. Different operating logics aim to guide research in different directions which creates friction and tensions in everyday research (ibid. 162–163)." She also reminds us that scientific disciplines are located in many different ways in research markets and that in practical research, the boundaries between markets are blurred.

In the next section, we summarise Ylijoki's description of the features of each market and supplement the description of their funding base with the latest funding instruments.

Academic market - features and funding base

The academic market relies on the ideal of scientific freedom through which the scientific system justifies its autonomy and defends its boundaries (Ylijoki 2020, 138). Using scientific criteria, the academic market operates within the scientific community, promoting science, defending the autonomy of science and producing contributions to scientific debate. The objective is excellent science evaluated by the international scientific community. The topic selection is based on scientific criteria and cooperation takes place within the academic world. Peer-reviewed results are published on scientific forums. (Ibid. 137-140.)

Basic funding for higher education institutions and academic funders, such as the Academy of Finland, the European Science Council (ERC) and various foundations, form the main funding basis for those operating in the academic market. - "However, not money, but scientific reputation and honour are the criteria for credibility within the scientific community and the currency of cooperation as well as the basis for career development" (ibid. 137).

From the perspective of multi-stakeholder co-creation, it is important to keep in mind that also academic research is either utilised or funded in almost all EU funding programmes.

Business Market - features and funding Base

The business market of knowledge resides at the intersection between research and business. On it, the objective of new knowledge is to produce commercial benefits for companies. Companies also guide and fund research and act as partners for researchers. Companies or research groups commercialise research results. The research results are kept confidential, so they usually do not generate JUFO articles, and the H index does not increase. Success is measured by money, innovations, inventions, product development, and financial profit. (Ylijoki 2020, 140-141.)

Traditionally, the business market primarily cooperates with technical research, so talking about innovation activities has the best fit for this market (ibid., 141).

The business market offers funding, research and technology infrastructures and equipment for researchers. It also creates opportunities for researchers to promote their businesses. (Ibid., 141.)

Other funding sources for multi-stakeholder co-creation include for example Business Finland and similar national funders in other countries, or Horizon Europe, the Eurostars programme, Single Market Programme, CERV, ERDF, EMFF, ESF, Innovation Fund, ISF, LIFE, Creative Europe, Rural Development Programme, Justice Programme, Digital Europe and Global Europe.

Policy market - features and funding base

The policy market produces researched knowledge and evidence for decision-makers. In Finland for example, the preparation, making, and implementation of public administration and political decisions must be based on research knowledge. For this, foresight, monitoring, and evaluation studies are needed. They are carried out, especially in social sciences and medicine. The results are published in public research and study reports. (Ylijoki 2020, 141-143.)

In the policy market, sources of funding include for example The Finnish Strategic Research Programmes and Horizon Europe work programmes that tackle wicked problems (ibid., 141-142). Also, the EC missions jointly agreed upon with the Member States, such as the green and digital twin transition, are funded by Horizon Europe. The European Commission's calls for tenders and the nationally decided ESF and ERDF programmes also fund studies that create knowledge supporting political decision-making.

Competition for funding in the policy market occurs between sectoral research institutes, universities, think tanks and consulting agencies. Success requires a strong expert role and continuous interaction with public administration at regional, national, and international levels. (Ibid. 142-143.)

Professional market - features and funding base

The professional market is based on the internal link between science and the profession. Medicine, law, education, social work, nursing science and administrative science, among others, have a strong professional link. The objective of the research is to produce knowledge, tools and methods that can be used to develop and reform professional practices. When selecting research topics, the wishes and needs of the professional field are taken into account. The results are published as reports, manuals, and articles in professional publications and textbooks. (Ylijoki 2020, 143-145.)

The professional market lacks a significant source of funding, whereas the professional field as a research audience is important to the researchers. (Ibid. 144) In addition, the professionals are key informants and partners for the innovators.

Many research funding schemes promote the objectives of the professional market and multi-stakeholder co-creation, such are for example LITERACY of the Finnish Strategic Research Council, many ESF/ERDF

programmes, and the Erasmus+ programme. Also, the European Commission's funding schemes succeeding the Science with and for Society (SwafS) and Science Education provide funding for researchers operating in the professional market.

Public market - features and funding base

On the public market, knowledge is produced for the general public, ordinary people, and civic society. Research is used to improve people's well-being, deepen understanding of phenomena and create empowering experiences. In addition to one-way publishing in popular magazines, two-way research processes involve citizens. Action research and Citizen Science enable citizens to take initiative and participate in the selection of research topics, the collection of observations and research data, the interpretation of the results and the sharing and utilization of results and knowledge. An increase in the level of education in society contributes to the democratisation of science. (Ylijoki 2020, 145-147)

"Public science in the public market is fragile in a sense that it barely has its own funding instruments. However, many research financiers have begun to require the widespread sharing of research results" (ibid., 146).

In the context of multi-stakeholder co-creation, public market research is funded with similar schemes as the research on the professional market.

3.2.2. Multi-stakeholder co-creation Orchestration in different Research Markets

In this sub-chapter, we utilise relevant literature and experiences from Finland and elsewhere in Europe to discuss the potential benefits of bringing research in various markets into collaboration. We also highlight both challenges and opportunities associated with each market. Finally, we present examples of such co-creation orchestration services, mechanisms and activities that could reconsolidate the differences and contradictions in the principles of the research markets and innovation ecosystems.

Based on our observations, co-creation is wrongly assumed to limit merely to co-creation workshops. Like any creative thinking and innovative work, multi-stakeholder co-creation also includes and alters between working together and alone, and multi-stakeholder co-creation is by no means the only or even the best approach to every stage of an innovation process. The multi-stakeholder co-creation makes progress in many different ways in dynamic and iterative processes over long periods. They consist of a variety of overlapping stages during which multi-stakeholder co-creation is occasionally strongly present, while other stages focus on independent work or basic research, experimentation and commercialisation, or innovation launch, transfer and scale up to other reference groups.

We need to keep in mind, that without the continuous enabling mechanisms and supporting criteria created by national bodies and the EC, the integration of independent science into value co-creation may prove difficult or even impossible. For example, the EC Open Science Policy Group (European Commission 2018b) has introduced such mechanisms through its recommendations to the Commission, the Member States, RFOs, and universities, to develop their funding and incentives as well as criteria for the recruitment and meritocracy of researchers.

Finally, the lack of funding restricts the capability of higher education institutions to participate in innovation ecosystems or orchestrate them themselves. For this reason, it is worth remembering that the sources of funding described in the previous chapter are highly competitive and restricted to project-based collaboration. Most of them are only suitable for the interaction of international ecosystems whereas many of

them fail to bridge the regional and national ecosystems into international research and innovation activities.[3] Naturally, the funding of individual projects covers the project consortium's internal and operational coordination or orchestration work. However, when the objective is to promote long-term interaction between higher education institutions and ecosystems, orchestration should also be seen as a strategic and long-term activity that covers all the activities and stakeholder connections of the higher education institution and requires high-profile expertise.

An orchestration service that could safeguard long-term[4] social benefits or the objective of a national innovation strategy[5] would require a permanent funding base at the national and regional levels[6]. For permanent funding, a new business model would be needed. - Universities that have received European University Initiative funding from the ERASMUS+ are in a good position in the sense that they have the financial resources to include the orchestration mechanism in the governance model of their alliances. Maybe in the future, the European Commission, municipalities, states and companies as natural beneficiaries could jointly contribute to the orchestration costs.

Next, we discuss the benefits and challenges associated with each research market and their interaction with innovation ecosystems tackling wicked problems and other research markets. In addition, we discuss the enabler-orchestrator's work in each market.

Academic market in the work of an enabler-orchestrator

Benefits of interaction between research markets and innovation ecosystems

Societal interaction between science and other innovation ecosystem stakeholders helps researchers operating in the academic market to identify and justify research topics and innovation challenges that are relevant to humanity. Collaboration among researchers operating in different markets enables new ways of solving multidimensional research questions related to societal challenges. Whereas cross-sectoral collaboration may also generate breakthrough innovation based on scientific outputs. Moreover, interdisciplinary research and science in general help innovators and decision-makers to identify and anticipate also the negative externalities of research outcomes and innovations.

In an ideal world, cooperation between various research markets and innovation ecosystems increases the funding opportunities for both autonomous science and innovation activities and thus helps to ensure the excellence and impact of science. Cooperation is assumed to create societal relevance and impact for example in the form of new meaningful jobs or an increase in commercial profits and tax revenues.

Multi-stakeholder co-creation in innovation ecosystems and cooperation with various research markets produces not only new research topics but also quantitative or qualitative observation data for scientific use. Multi-actor cooperation also helps to share research results, promote the dissemination and utilisation of scientific knowledge, and increase citizens' interest in science. The integration of academic teaching into participatory RDI activities and citizen science are concrete tools for achieving these objectives.

3 Ylijoki (2020), among others, describes challenges related to research that has become project-like and cumulative problems that, in the long term, have a negative impact not only on the quality of science but also its societal impact.
4 According to Enqvist (2020), the quarter of basic research is at least 25 years, and its impacts on humanity in the short and long term are diverse. In addition to the desired results, research generates unplanned victories or "collateral damage". Enqvist (Ibid.) reminds that at the time, no committee or factory owner could place an order to researchers for an innovation called electricity, yet we utilise the scientific knowledge that enabled electricity every day.

5 "Finland will be the most competent and attractive innovation and experimental environment in 2030" (Ministry of Employment and the Economy 2021. Kasvuekosysteemit uuden elinkeino- ja innovaatiopolitiikan välineenä [Growth ecosystems as a tool for a new business and innovation policy]. *https://tem.fi/ekosysteemit*)

6 For Finnish social welfare and health innovation platforms, see Äyväri & Hirvikoski 2021.

As an example, social sciences and humanities undertaking research and testing innovative solutions using the citizens and ongoing stakeholder engagement activities would help to better understand their success factors. Using real-life regional environments or cities as research infrastructures would allow us to explore and experiment with new innovative ways of engaging citizens and stakeholders in transformative processes and to feed this information back to the regions and communities.

Interaction related challenges to be considered in the orchestration

A professional orchestrator is well-aware of the current challenges in academic research. Such challenges are as follows: Competition in the academic market and various rankings have already led to the self-censorship among researchers and for them to avoid all kinds of risk-taking, which in turn "strengthens the mainstream of science" and "limits the boundaries of scientific freedom" (Ylijoki 2020, 139). This is also reflected in innovation activities, as over time these factors narrow our understanding of the world, and consequently, the innovation capacity of future generations will decrease.

Another challenge for orchestrators is that cooperation with the innovation ecosystem does not progress the researcher's career in the scientific community. Consequently, there are no incentives and thus no motivation to collaborate.

Research market interaction from the orchestrator's point of view

In the absence of incentives and funding, participating in joint innovation activities is more difficult for the scientists operating in the academic market than for researchers operating in e.g. professional or public market. The orchestrator must therefore accept that co-creation with scientists takes place mainly intermittently or with indirect mechanisms. To be successful, the orchestrator should utilize the university services, such as technology and knowledge transfer and scientific communications.

Orchestration is like a two-way door. It secures the movement of different types of knowledge and information and ensures the learning between all ecosystem actors and the knowledge co-creation (see Äyväri 2021). The enabler-orchestrator is therefore required not only to be able to read the operating environment but also to continuously monitor the results of different disciplines, new research plans, and the interests of researchers. In the orchestration team, there also should be access to deep epistemological understanding and knowledge (see Hirvikoski et al. 2021). For these reasons, it is difficult to imagine how the ecosystem would work without an intermediary party that understands the operating logic and value system of universities and science.

The orchestrator competencies include a grant writing ability, i.e. to apply for external funding not only for innovation activities but also for self-correcting science in different disciplines. Moreover, the orchestration mechanisms together with stakeholder cooperation should generate salary funding and create labour markets for researchers and doctoral students made idle by the polarisation of science funding (the so-called Matthew effect[7]).

7 "The Matthew effect as shaped by Robert Merton in classical science emphasises: Those who have, receive more; and those who do not, get the little they have taken away. "The effect consists in the accruing of greater increments of recognition for particular scientific contributions to scientists of considerable repute and the withholding of such recognition from scientists who have not yet made their market." (Ylijoki, 2020, 138)"

Business market in the work of an enabler-orchestrator

Benefits of interaction between research markets and innovation ecosystems

To explore the RDI activities related to the business market, the following concepts, STI and OI2, and their basic logic, the linear and bilateral vs cyclic and multi-actor, are commonly utilised. In the business market, research and innovation activities can be either linear, following the STI model (Science Technology Innovation) or cyclic, following the Open Innovation 2.0 (OI2) model. The STI model is often applied in bilateral collaboration whereas OI2 is used in a multi-stakeholder co-creation setting. (For full explanation, see Hirvikoski et al 2021, 2022)

The objective of the business market is to provide companies with direct economic benefits and society with indirect benefits. Alastalo (in Ylijoki 2020) calls competitive science in these markets "innovation science". Technical sciences are commonly seen as the most desirable partner in these markets. Often wicked problems or societal challenges that need to be addressed through research and innovation are too complex to be overcome by a single scientific discipline. Technical solutions are often preconditions for new outcomes or transformation but in themselves insufficient to have a meaningful impact. The lasting societal impacts are often equally reliant on insights from social sciences and the humanities. To be able to create complementary services or social innovations supporting technological innovations the orchestrator is naturally forced to expand the original innovation team towards the other desired fields of science and social sectors.

Wicked problems are also an inexhaustible business opportunity and research subject. But as said earlier, no one organisation or small team is capable of tackling them alone. Therefore, intermediary orchestration mechanisms can be used to extend the business markets' bilateral (company and researcher) interaction with the public, third and fourth sectors. This improves the chances of tackling wicked problems and creating solutions benefiting all parties. The co-creation approach stems from the assumption that the knowledge, resources and risks needed to solve the challenges, as well as the value and benefits generated by them, are shared fairly among contributors. The orchestrator ensures that the share is fair between all parties.

Orchestrating all ecosystem levels from the micro to the macro level would allow the business market actors to benefit from the systemic mission-driven innovation process. In which, different elements of the European innovation policy could be utilised, including diverse international funding and market creation mechanisms, Open Science principles, various Research infrastructures (RIs) and Technology infrastructures (TIs), as well as integration of scientific, market and user information, FAIR data, and the Living Lab approach. Through these mechanisms, the commercial RDI processes can benefit from the authentic and large-scale co-creation, testing, demonstration and validation environments consisting of the European Single Market with the top 447 million most educated citizens in the world. Through cooperation, companies, researchers and society can save on research, innovation and product development costs and reduce the time from science to innovation and from innovation to the market and tax revenue. The European Universities Initiative is one practical way of achieving these objectives.

The objective of the interaction between various research markets and the innovation ecosystem is to enhance sustainable business model development and market creation. Hence, all stakeholders including entrepreneurs and companies, as well as citizens, civil society, academics, experts, social partners, policy-makers, and other relevant actors can benefit both from scientific knowledge and business know-how. This would promote social benefits while creating commercial and social innovations without jeopardising scientific independence and excellence.

Interaction related challenges to be considered in the orchestration

Due to the increasing power of the business market, the difference between independent research and business-oriented product development is becoming blurred and independent research becomes narrower. Innovation science and top science set conflicting expectations and pressures for researchers. Consequently, researchers may have to give up their scientific interests when acting as subcontractors for industry or balancing the conflicting pressures of innovation science and top science. (Ylijoki 2020)

Research market interaction from the orchestrator's point of view

Professional orchestration maintains a dynamic balance, reconciles or utilises conflicts between various markets and ecosystems and aims for a win-win-win situation that benefits all parties. The orchestrator recognises the need for the necessary direct participation of researchers and the right moment to participate in co-creation. The orchestrator also finds direct or indirect ways of integrating, brokering and curating scientific results at different stages of the innovation process. All this could take place in cooperation with degree programmes or with PhD and Master level students. Ensuring the independence of science and researchers' dedication to their scientific interests are factors that benefit also the interests of companies and society, which is why they are also the starting point for orchestration.

Policy market in the work of an enabler-orchestrator

Benefits of interaction between research markets and innovation ecosystems

Research-based decision making is based on the foresight, monitoring and evaluation studies produced by the policy market. Moreover, their outcome improves the predictability and stability of the operating environment of all actors, researchers, innovators and those commercializing their outcomes.

Thanks to the increased funding schemes integrating multidisciplinary research and innovation activities, the scientific outcomes in the academic market have benefited the RDI activities in the policy and business market. Apart from the more obvious impact on innovation, the blue sky research has created knowledge on the emerging challenges that would either require further research or proactive political decision-making. Discipline-specific research on the academic market can also help assess the likely impacts of political decision-making. As an example, beneficial interaction between different research markets and innovation ecosystems is taken place in the transformation to climate resilience. However, the utilisation of academic and business markets' outputs in political decision-making requires both two-way communication and continuous curation of research data.

Correspondingly, blue sky science and researchers operating in other research markets benefit from the policy market. The benefits materialise in the form of research funding, an increase in job opportunities for experts, and opportunities for science to influence decision making (Ylijoki 2020). In addition, researchers and innovators operating in other markets can utilise the research papers and technical reports from the policy market to form an understanding of the societal impacts and networks related to their research activities. Research on the policy market provides also arguments to justify funding for academic science.

Interaction related challenges to be considered in the orchestration

Ylijoki (2020) discusses the challenges related to the growing role of the policy market in the academic world. For example, the objectives and value-driven principles of policymakers do not correspond to the ob-

jectives of the scientific community or the researchers' values, the conception of what is to be a human, and their worldview. Due to the influence of the policy market, the power to define research questions easily shifts beyond the scope of scientific freedom. Another challenge for the orchestrator trying to integrate different types of research and innovation activities is that the merits created in the policy market are not noted in the academic market.

Research market interaction from the orchestrator's point of view

The enabler-orchestrator maintains continuous learning, curates information and secures the flow of information in a two-way dialogue between the scientific and innovation communities and other interest groups including those responsible for the preparation, decision-making and implementation of various policies and funding programmes. A professional orchestrator assists in the preparation of research-based expert opinions and policy briefs or the dissemination and exploitation of the research results. Orchestration service helps scientists to direct and describe scientific results and recommendations to political decision-makers and their voters.

Moreover, the university's orchestration services should help researchers and innovators to navigate the EU's Funding and Tenders Portal. The portal is a single entry point for applicants, contractors and experts in funding. Apart from the appropriate funding schemes, support would help the researchers to become expert group members in evaluating or writing new working programmes with the European Commission.

Professional market in the work of an enabler-orchestrator

Benefits of interaction between research markets and innovation ecosystems

Ylijoki (2020, 144) states that "interaction between scientific research and professional practice can become stronger in an environment that emphasises the impact of science, as the development of professional practices provides a good and rhetorically credible method of demonstrating the impact of the discipline." Hence, research in the professional market (e.g. medical science) in principle enables mutual benefit with professional practice.

In collaboration with the professional market and professional practice, the innovators receive information on the needs of the professionals. Through authentic professional environments, for instance, hospitals and related joint agile pilots or demonstrations, innovators have both harnessed professionals' feedback and scaled up innovation (see Äyväri & Hirvikoski 2021). Professionals' observations and opinions indicate the need for radical innovation or incremental improvements and help researchers to identify factors preventing the uptake of innovations.

Interaction related challenges to be considered in the orchestration

Ylijoki (2020, 144) discusses the core challenges related to the professional market and argues: "The efforts of the professional field to guide and direct research make the work of a researcher more difficult and restrict the independence of science". The orchestrator mechanism should deal with this problem by creating clear rules for collaboration and providing services to prevent the problem.

Research market interaction from the orchestrator's point of view

Numerous guidebooks on innovation, living labs, and testbeds have provided instructions on how to use professionals' observations and feedback in innovation activities or how to arrange quick trials and agile pilots.

However, in terms of the interaction between different research markets, the guides should be supplemented with orchestration methods and instructions on how to balance the needs of the professional field and professional education and the independence of researchers.

An experienced enabler-orchestrator also acquires funding that promotes also independent science and directs research to the international scientific community, thus strengthening the credibility of the discipline within science. Multi-stakeholder co-creation related funding can also be used to create jobs for researchers in higher education institutions, trade unions or working-life organisations.

In addition to the professionals, an experienced orchestrator integrates higher education students into multi-stakeholder co-creation and uses pedagogical methods to activate also other stakeholder groups in collaboration with RDI operations. An orchestrator familiar with higher education and the research can allocate meaningful learning assignments suitable for each stage of education, the results of which can be utilised in research and innovation. If the aim is to provide the students with the enabler-orchestrator skills, students should be trained to identify and utilise immaterial and material "prefabs[8]". In other words, they can learn by curating the outputs of previous RDI projects, public data repositories, and strategic hints of ongoing working programmes in order to come up with innovative ways of utilising technical reports in new projects.

Public market in the work of an enabler-orchestrator

Benefits of interaction between research markets and innovation ecosystems

The participation of ordinary citizens in the public market RDI activities supplements all kinds of scientific knowledge with experiential knowledge or observations, hence contributing also to the objectives of the innovation ecosystem in many different ways and at different stages. The citizens and end-users provide practice-based knowledge and feedback or concrete help in developing and testing innovations. Citizens and citizen observatories produce large amounts of comparable observation data on phenomena that are difficult to study cost-effectively.

Alongside operational objectives of citizen engagement, the increase in learning and knowledge and the development of critical thinking and creativity in society are equally important, as they increase the ability of society, organisations and individuals to apply and adapt knowledge and innovations. The possibility to participate in and understand the research phenomena is likely to increase citizens' motivation to change their behaviour if necessary. Indirectly, citizens' participation also increases the appreciation of science and the legitimacy of its funding. As citizens' interest in science and societal issues increase also evidence-based decision-making will increase in society.

Interaction related challenges to be considered in the orchestration

Concerning the public market, Ylijoki (2020) lists potential challenges to be tackled by the researchers and the orchestrator supporting them. Firstly, competition for publicity is important in the public market, but it is poorly suited to the ideals of a traditional university researcher. A publicity-oriented researcher can be easily labelled as non-serious with dismissive popular sayings such as: "some random docents". Secondly, the media and the general public only favour certain topics which might narrow down the independence of science. As

8 "Prefab is short for "prefabricated," which means "made beforehand," and not "before fabulous." Prefab things are made in sections that can be easily shipped and put together to form a finished product. Some buildings and houses are prefab." *https://www.vocabulary.com/dictionary/prefab*

the success in the public market is not taken into account in the academic meritocracy, it is more difficult for the orchestrator to motivate them to collaborate with other stakeholders.

Even though it is evident that citizens generate value for science and companies, citizens' immaterial rights and recognition of their merits are not yet fully realised. This is another challenge to be solved by the orchestration mechanism.

Research market interaction from the orchestrator's point of view

Particularly in the public market, the orchestrator has many communication tasks, such as the interaction, communication and marketing activities supporting individual researchers and promoting the visibility of the research topic in public. At the same time, the orchestrator trains the general public and decision-makers and helps the media to also take note of less trendy research topics. Often, the enabler-orchestrator acts as a buffer of science against misinformation or the doubts of the general public and the dismissive popular sayings like "some random docents". With the help of the orchestrator, researchers can cost-effectively participate in the knowledge transfer and interaction with the public market, saving valuable time and preserving their scientific reputation. Knowledge transfer and dissemination are mandatory to secure research funding. Visibility in the public market safeguards also universities' basic funding.

A professional enabler-orchestrator can support the researcher by identifying funding instruments enabling RDI activities that at the same time enhance his or her academic merits and protect citizens' immaterial rights.

3.3. SUMMARY AND DISCUSSION

This paper explored the idea of a European higher education institution as an enabler-orchestrator in open innovation ecosystems. We discussed the benefits and challenges associated with the interaction between innovation ecosystems and different scientific markets, and we addressed the enabler-orchestrator's work in each market. In line with Äyväri (2021, 2022) we analysed universities' role as enabler-orchestrators, using Ylijoki's (2020) research market metaphor. Based on literature and experiential knowledge, we listed examples of various mechanisms, methods, tasks, and services that the university orchestrator can use to promote shared value creation without compromising scientific independence and excellence.

Äyväri (2021, 2022) suggested the concept of an enabler-orchestrator for non-profit higher education institutions. In this paper, we found JV Snellman's concept of independent and responsible science complementary to the enabler-orchestrator approach when the aim is to integrate science into innovation activities without jeopardising their independence. The combination of the two concepts brings clarity to the general discussion on innovation ecosystems and helps to distinguish the different intentions of ecosystems and higher education institutions.

In addition, we found Ylikoski's (2020) research market metaphor suitable as a heuristic tool that supports reflection on the internal variation of operating logic within science and research. It helped to develop new, albeit partly overlapping, ideas on what the enabler-orchestrator should take into account when working in different research markets. The results of our conceptual exercise should be tested in real life and used as a hypothesis for further research. By applying and modifying the ideas introduced in this paper, the orchestrators can further develop their activities and services to best support researchers and other cooperation actors so that they will not lose their intrinsic value and the ultimate task or become mere instruments or assistants for others.

At the macro-level, the policy programmes and funding schemes should pay attention not only to different academic, commercial and societal activities but also to the impacts of different levels of ecosystems on each other. Orchestration at the micro-level alone is unlikely to work, and it needs to be supported by the system-level actions and funding.

In line with Äyväri (2021), we recommend that the university enabler-orchestrator role is also developed and studied as part of *a circle of mediators or a multi-stakeholder orchestrator team*. *The circle of mediators* concept has been co-created and tested together with the city of Helsinki. The circle of mediators is a team of orchestrators in a given innovation ecosystem that together leads, supports, and coordinates co-creation in the ecosystem. As a member of an orchestration team, the higher education institution can best promote the ecosystem's joint objectives together with other actors. Depending on the aim of the collaboration, other orchestration team members can represent expertise e.g. in scientific communication, user information, citizen engagement and citizen science, behavioural transformation, teaching and learning, impact assessment, innovation launching and diffusion, commercialisation of innovation, market creation, business modelling, legislation, funding, or politics.

Nevertheless, we argue that the proposed orchestration services can credibly be provided only by an organisation with good knowledge of how science works. As a mechanism, orchestration seeks a balance between the objectives of the independence of science, the autonomy of higher education, and other objectives in society, the task is highly demanding and may also prove impossible in practice if not supported by the policymakers in the EU and national governments. Hence, this paper suggests that the orchestration mechanism should be further developed and tested within the European University Initiative (EUI) supported by the EC ERASMUS+ programme. The precondition to receiving funding for a EUI alliance is that the alliance has a joint governance system. *We argue that enabler-orchestration should be part of the governance system.* It would enable alliances to offer synergy benefits between universities' education, research, innovation and social service.

An ideal trial environment for the orchestration mechanism could be e.g. a regional innovation ecosystem or a city as a living lab that tackles wicked problems and solves societal challenges reciprocally with independent scholars. This would be in line with the objectives of the European University Initiative (Council of the European Union 2021; Erasmus+ 2021; European Commission 2021b). In the EUI alliances, higher education institutions and their thousands of associated partners form different types of thematic and place-based ecosystems operating at different societal levels. In their local ecosystems, universities work in cooperation with multiple innovation stakeholders, and at the same time, form and connect extensive Pan-European networks.

Apart from testing the orchestrator services and mechanisms, the EUI alliances could be seen as environments for development and impact research. This means that the EUI networks and their ecosystems could be operated as European Research Infrastructures[9] (RI) or even Technology Infrastructures (TI)[10]. Based on Action research and Impact research methodologies, new orchestration mechanisms could be developed and assessed to evaluate how they enhance cooperation between different research markets and ecosystems and what is their impact on innovation, excellence in science and high-quality education. A more specific research topic would be how scientific universities and universities of applied sciences complement each other when exploiting the expertise of various research markets and ecosystems.

On a practical level, the EUI alliances can orchestrate Pan-European large scale pilots co-creating and testing knowledge across national, sectoral and organisational borders. According to the ERASMUS+ cri-

9 European Reseach Infrastrutures explained
https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures_en

10 European Technology Infrastrutures *https://ec.europa.eu/info/publications/technology-infrastructures_en*

teria, universities should create new learning, employment, job rotation and career opportunities for tens of thousands of students, researchers and teachers as well as for European experts from cities, businesses and other organisations. Operating as RIs and TIs, the EUI alliances would provide us valuable knowledge on how using enhancing technologies and innovative pedagogy would support the enabler-orchestrators in engaging large groups of citizens in both open science and open innovation. Another research topic would be how cooperation between ecosystems can mitigate the adverse effects of brain drain or labour shortages in different European regions.

For the practitioners, we suggest the following enabler-orchestrator's checklist of cost-effective measures aimed at securing the knowledge transfer between all research markets and innovation ecosystems:

- Start by creating a system that motivates researchers, teachers and students to join the collaboration. For example, check that the synergy benefits and revenue arising from the orchestration are directed towards ensuring independent science and education and their excellence. Secure that researchers, teachers, and students have enough time to reflect on what they have learned and write academic papers and policy briefs.
- Utilise the participatory research approach and comparative methods to create a framework for international orchestration. A continuous comparative approach allows universities operating in different countries to identify challenges and opportunities in their legislation, culture, market mechanisms, and regional conditions as well as in their core values and strategies. The orchestration services to be co-created should recognise these differences.
- With your partners, co-create and test the specific orchestration services and concrete operating activities to enable students to learn in various research markets (Ylijoki 2020) and European ecosystems. Similarly, co-create and test services and technology-enhanced solutions enabling the knowledge transfer, FAIRdata and the mobility of experts between ecosystems and research markets.
- Rely on the universal education and learning expertise created by the higher education institutions to maximise the learning results of all ecosystem actors whilst co-creating new shared knowledge and strengthening stakeholders' capabilities in multi-stakeholder co-creation activities. Similarly, utilise the business and market expertise of the business associates to develop a sustainable business model for the university's international orchestration services.
- When co-creating the orchestration services and mechanisms, utilise the university's ongoing services and technological solutions, such as communication and innovation services, knowledge and technology transfer, and digital services and platforms used for information brokering and curating scientific knowledge.
- Create services that help scientists interpret the epistemic understanding of different disciplines and faculties, and provide them with a stable research environment and an opportunity for meaningful usage of the scarce working hours. While ensuring the ethically and scientifically sound usage of research results, provide services allowing the ecosystem stakeholder to access the latest research knowledge and tangible outcomes, data repositories, or the latest research ideas.
- Utilise the expertise of the universities of applied sciences to effectively arrange access to user panels consisting of professionals and citizen scientists. Due to their legislative duties, universities of applied sciences would also be the intermediary between theory and business. At the same time, safeguard the synergy and equal benefits for all partners.

- Co-create proper brokering and curating mechanisms for all kinds of knowledge and data incl. e.g. scientific, statistical and market data as well as scientific and experiential knowledge. Curated information enhances understanding of complex challenges and the negative externalities. Moreover, curated information cost-effectively facilitates innovation, agile pilots, and the dissemination of knowledge and innovation across Europe.
- Involve the university's extensive international networks and mobility programmes in cross-border research and innovation activities. They will provide RDI actors access to innovation testbeds, RIs, and TIs as well as various landing platforms and distribution channels worldwide. Moreover, they enhance the rapid scale-up of ecosystem results and products. Ensure that science, researchers and universities will get a fair share of the outcome.

In conclusion, despite the long history of open innovation ecosystems, it seems that the linear knowledge transfer is still dominating and the cyclic and continuous interaction between science and innovation is still in its infancy. This is understandable due to the logical conflicts of the fundamentals between commercially-oriented innovation and independent science. However, in line with the research results by Gumport (2019), we trust that *positive reconciliation of logical conflicts is possible* also in practice. Case studies from the USA and Europe prove the possibility of harmonious coexistence of diverse and conflicting institutional logics that have impacted higher education institutions for a long time. Higher education institutions have found different creative and successful solutions for this coexistence. According to Gumport, those universities that have succeeded in balancing the fundamental values of education and science with the imperatives of society and the economy share three features. Firstly, successful universities have institutionalised their universal societal role deeply into their organizational structures and in the professional interests of the higher education institution. Secondly, their funding has been sufficient, alternatively, their resilience and creativity have enabled the development and implementation of new unpredictable operating methods. Thirdly, to succeed, creative and resilient universities used imagination, they were persistent, and they were in a continuous reciprocal dialogue with all their stakeholders. Consequently, we argue that the universities' enabler-orchestrator role can be associated with the above-mentioned features and therefore, it should be used in line with the European University Inviative.

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INFO BOX 1
COUNCIL OF THE EUROPEAN UNION CONCLUSIONS (8658/21) ON THE EUROPEAN UNIVERSITY INITIATIVE

European Council conclusions (8658/21):

"The initiative started by EU leaders in 2017 will be fully implemented during the EU funding period 2021-2027. Students, teachers and researchers should, within the framework of the alliances of European universities, be able to move seamlessly between partner institutions for studying, teaching and research.

In their conclusions, ministers encourage Member States and the Commission to ensure that the initiative plays a key role in the building of the European education area by 2025, inspires the transformation of higher education in the EU, and helps to achieve an ambitious vision of an innovative, globally competitive and attractive European education area and a European research area. In order to support the development of European universities, the Council calls on Member States to make use of all available funding opportunities, including the recovery and resilience instrument (EU's post-crisis budget instrument).

In order to remove obstacles to cooperation at the European level, ministers also recommend increasing cooperation between education authorities, higher education institutions and stakeholders. With this in mind, they propose examining whether general European qualifications would be appropriate and feasible within the framework of the European Universities alliance. European universities should promote a step-by-step approach in joint recruitment programmes for teachers and researchers aimed at an effective 'multidirectional' and 'balanced' rotation of competence across Europe, and at strengthening responsible research and teaching skills, especially for young researchers.

The ministers also emphasised that the initiative is beginning to show results, as according to a recent survey, 17 representatives of the first European Universities alliance felt that the alliance helped them cope with the corona crisis and that combining resources and strengths would speed up recovery."

Source: European Council conclusions 8658/21.

LAUREA

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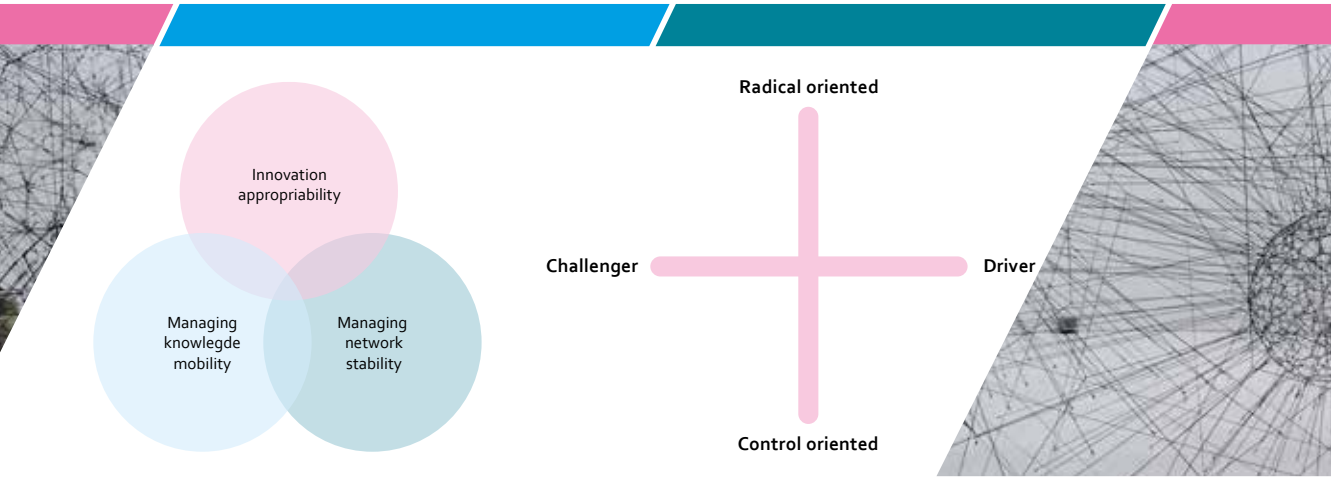

This publication discusses the role of universities at the crossroads of European research, innovation and higher education policies when the aim is to tackle large societal problems in collaboration with multiple innovation ecosystem actors. It introduces the idea of higher education institutions as an 'enabler orchestrator' supporting the effective and impactful implementation of these policies. The underlying idea of this publication is that the newly created European University alliances operate as Pan-European meta-networks liaising and orchestrating value co-creation with and across regional and thematic innovation ecosystems.

The interconnected European universities innovate, educate, conduct research and serve society in diverse economic, political, cultural, and geographical contexts and situations. Hence, this publication sees the European University alliances as potentially strong Pan-European innovation orchestrators. As orchestrators, they would enable local innovation actors and researchers to liaise with other regions in the most effective way, and facilitate joint learning and value-added in accelerated input-output relationships

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