The Evolving Innovation Space: Variety of Innovations, Actors, Activities and Diffusion Mechanisms

Author(s): Kunttu, Leena; Kalliomäki, Helka; Kuusisto, Jari

Title: The Evolving Innovation Space: Variety of Innovations, Actors, Activities and Diffusion Mechanisms

Year: 2024

Version: Accepted manuscript

Please cite the original version:

Kunttu, L., Kalliomäki, H., & Kuusisto, J. (2024). The Evolving Innovation Space: Variety of Innovations, Actors, Activities and Diffusion Mechanisms. In J. Kuusisto, M. Meyer, S. Flowers, L. Kunttu, & H. Kalliomäki (eds.), *The Evolving Innovation Space: Policy and Impact Evaluation in a Changing World* (pp. 103-122). De Gruyter Studies in Innovation and Entrepreneurship, Vol. 7. De Gruyter. https://doi.org/10.1515/9783111188218-006

Evolving innovation space: variety of innovations, actors, activities and diffusion mechanisms

Leena Kunttu, Helka Kalliomäki, Jari Kuusisto

Abstract

New societal challenges are setting growing demands for innovation policy both on international and national levels. To address societal challenges and creating sustainable change in addition to achieving economic benefits, the innovation space is evolving and getting more complex. This chapter considers how the understanding of the innovation space has evolved from 1990s to today by using the definition of innovation and its related concepts in four editions of Oslo Manual (OM) published by OECD between 1992 and 2018. The topic of evolving innovation space is studied in three dimensions: 1) variety of innovations, 2) innovation actors and activities and 3) innovation diffusion and spillovers. The analysis of OM shows that understanding of innovation has evolved from technological and manufacturing innovations to cover almost all areas of society, including a central role of users and customers in the innovation processes. Also the innovation diffusion is shifting from purely commercial processes also to non-commercial processes. OM can also be seen as a means for forecasting innovation space evolvement and understanding how innovation activities are measured.

1. Introduction

The world is changing rapidly, and the new innovation space is characterized by complexity, constant evolution and interconnected development. Diverse range of societal challenges, including climate change, demographic pressures, urban congestion, social and economic inequality, conflicts, energy and pandemics have set new demands for innovation policy. The current policy has received criticism for remaining largely skewed and partial, failing to take into account the different activities and dimensions of the innovation system as well as their complex interlinkages (Borrás & Edquist, 2019). In the same time, the huge global challenges recognized in UN Sustainable Development Goals (SDGs) are aiming at ending poverty and other deprivations, and go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth. In the rapid phase of green transition, the topics related to green growth, sustainable and resilient energy and eco-innovation have caused new challenges to innovation policy work (Gault, 2020, p. 89). Thus, the practices, promises, and expectations of innovation activities and their contribution to socio-economic development are changing. In the same manner, politics, policies, and related instruments to govern innovation are constantly evolving. The theories that explain, legitimize, and evaluate innovation policy co-evolve with the changes of practice and policy (Kuhlmann & Rip, 2018).

As technological development and societal challenges cause varying and often contradictory pressures for change, the innovation space is constantly evolving. This, in turn, causes needs to address both societal and technological development and challenges in the innovation policy area (Diercks et al., 2019). The broad view of innovation, with focuses on ecological innovations and social innovations is not only an addition to the current thinking about science, technology and innovation policy, but it also necessitates a rethinking of it (Schot & Steinmueller, 2018). These new demands for innovation policy are coupled with evolving transformative efforts seeking to tackle societal challenges and creating sustainable change in addition to achieving economic benefits (Diercks et al., 2019). In the field of science and technology policy research, transformative innovation policies are currently one of the central focus areas. Thus, many recent articles have focused on transformative change in both policy-making and policy research (Arundel et al., 2019). As transformative innovation policy represents a new and emerging policy paradigm, the scholars have seen is as layered upon, but not fully replacing the earlier policy paradigms (Diercks et al., 2019). To understand the challenges and changes that lay the foundation for the transformation of innovation policies, it is useful to inspect how the innovation space has evolved.

One potential way for this is to study Oslo Manuals published by OECD. The Oslo Manual is based on the experience gained from collecting and analysing innovation data in both OECD and EU countries and non-member economies (OECD & Eurostat, 2018). Thus, the purpose of the Oslo Manual is to support the collection of representative and internationally comparable data on innovation in the business sector. The manual also provides internationally-accepted definitions of innovation and related concepts. As a key part of OECD innovation policy work, Oslo Manual has a central position as an instrument targeted to the definition, collection, analysis and use of data related to STI policy implementation (Arundel et al., 2019; Bloch, 2007). Thus, the manual is currently widely serving as an essential tool for statisticians and policy makers operating in the area of innovation.

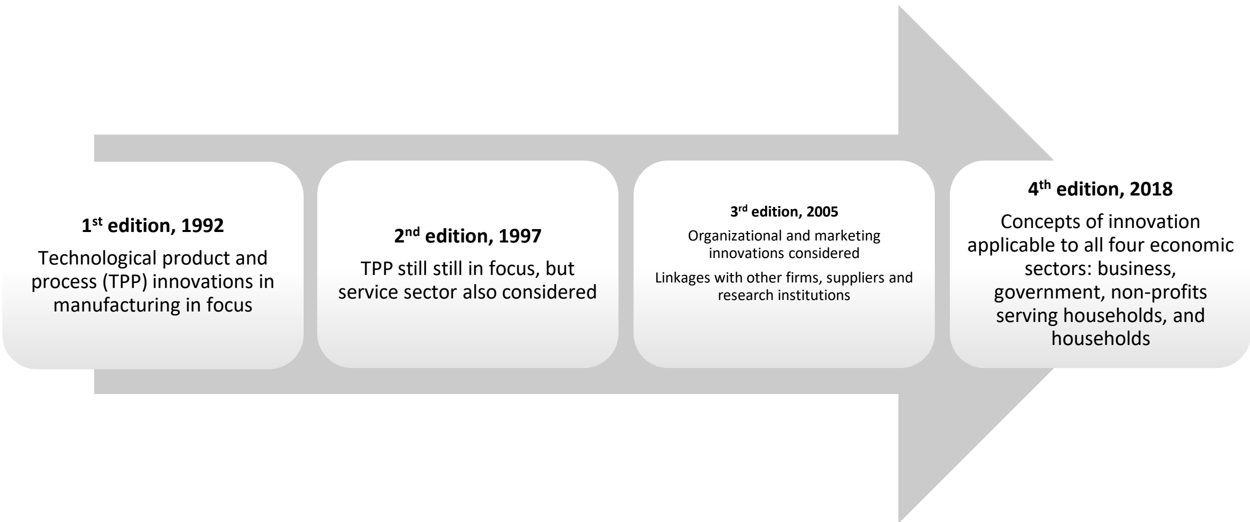

Figure 1. Key characteristics of four editions of Oslo Manual.

During its three decades of development, the Oslo Manual has became international standard applicaple worldwide (Gault, 2020). The first edition of Oslo Manual appeared in 1992, followed by editions in 1998, 2005, and most recently in 2018 (see Figure 1). The fourth and newest edition of the Oslo Manual, appeared in 2018, provides a universal definition of innovation that is applicable to all sectors, including consumers and households. The variety of actors and activities have evolved to cover not only the supply side, but also the demand side of innovation, where customer organizations and private consumers play a central role. Digitalization enables collaborative learning and co-creation of new innovative solutions in users' informal communities. The activity of the demand-side may also indicate that there are areas on supply side that cannot answer to the users' needs. This all means that non-commercial mechanisms have taken an increasing role in parallel with the traditional commercial approaches in innovation diffusion. In this edition, OECD presents a common framework for measuring innovation in a more inclusive manner across the economy, in government, in non-profit organisations and in households. Thus, this view of innovation emphasizes the active role of private citizens and users in innovation fields. The Oslo Manual can be seen as a bridge between users' needs for practical concepts, definitions and evidence on innovation, and the expert consensus on what can be robustly measured. In this manner, it is possible to see Oslo Manual as a representative perspective of contemporary innovation space in advanced, knowledge-intensive economies, and reflect the nature of evolving innovation space during last few decades (Kunttu et al., 2021, 2022).

The purpose of this chapter is to study evolving innovation space by analysing the definition of innovation and its related concepts in Oslo Manuals in its different editions appeared during last few decades. Thus, the chapter studies how the understanding of innovation space has evolved from 1990's to 2018 based on the four editions of the Oslo Manual. The main research method in this chapter is document analysis, in which four editions of Oslo Manuals (1992, 1997, 2005, and 2018) are used as empirical material. The researchers went through this material and made an extensive literature review on the state-of-the-art literature on transformative innovation policy development. A central idea of the study was to identify implications on the transformative change in the innovation definitions and related concepts, and based on the to make reflections to the state-of-the-at literature. In this manner, the chapter contributes to the literature of the STI policy research by showing how the innovation space is evolved based on the Oslo Manuals that represent current mainstream in innovation policies in OECD countries.

2. Evolving innovation space

To understand the innovation process, the framework of (Diercks et al., 2019, p. 890) illustrates that the key elements of transformative innovation policy concern 1) which actors are actively involved in the innovation process; 2) what types of activities are contributing to innovation; and 3) what are the different modes of innovation, which considers different modes of learning and forms of knowledge. These three key elements have been used to improve understanding on the evolvement of innovation space based on Oslo Manuals. The research focus of this article is approached by using three separate but somewhat overlapping dimensions in analysing the definition of innovation and its related concepts in each edition of Oslo Manuals:

1. Increasing the variety of innovations in subfields including products, services, processes and marketing,
2. Increasing the variety of innovation actors and activities including government, industry, and academia and non-profit organizations
3. Innovation diffusion and spill overs taking place in various ways: commercial, entrepreneurial, sharing, and others

In this section, the theoretical background for each of these dimensions is presented, and they are summarized in Table 1.

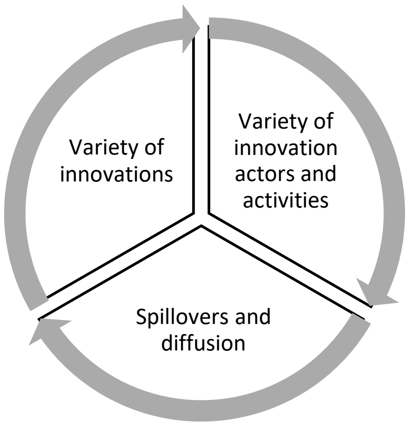

Figure 2. Three dimensions of analysis used in the framework.

Table 1. Summary of narrow and broad understanding of three dimensions

	Narrow understanding	*Broad understanding*
Variety of innovations	***TPP innovations*** *that have been gradually extended by the innovation categories related to e.g. services and marketing.*	*Besides TPP,* ***also non-technical innovations are considered.*** *These include e.g. social, institutional, open, and user innovations.*
Innovation actors and activities	*Focus merely on* ***supply side*** *of innovation process, where the innovation activities are driven by scientific and industrial advances. Key actors in the process belong to "triple helix" consisting of academia, industry and government*	*The focus is extended from the supply side to cover also the* ***demand side****, where the end users play a central role. The demand side contains actors ranging from non-profits, entrepreneurs and cities to users and households.*
Innovation diffusion and spillovers	*Commercialization process focuses on the* ***supply side*** *innovations*	*In addition to the supply side processes, the commercial and non-commercial mechanisms on the* ***demand-side*** *are based on users' and communities' desire to learn, share and support each other.*

2.1. Increasing the variety of innovations

In the 1970s, the innovations were typically seen as technological product and process (TPP) innovations, referring to the innovations involving with the implementation of technologically new products and processes and significant technological improvements in products and processes (Utterback & Abernathy, 1975). In this manner, the TPP-based innovation is directly linked to the manufacturing industry. During the following decades, the variety of technological innovations were gradually extended by the innovation categories related to services and marketing. In addition to these extensions made to the innovation concept, a broader understanding of innovation considers also the non-technical innovation modes that do not necessarily have direct links to technological development. The variety of non-technical innovations include social innovations (Moulaert et al., 2005; Terstriep et al., 2021), institutional innovation (Hargrave & Van de Ven, 2006), open innovation (Chesbrough, 2003) and user innovation (Von Hippel, 2017).

The concept of social innovation refers to innovation as a social phenomenon (Klievink & Janssen, 2014). These concepts have been used in topics that include innovation in public and business services, social entrepreneurship, open source innovation, complex adaptive systems, diffusion of innovations, collaborative approaches, and stakeholder involvement (Moulaert et al., 2005). Social Innovations focus lies in the interaction between people in their communities and networks. For example, open networks and communities of developers and users represent informal organizations, where new types of ideas and innovations are born (Morrison et al., 2000). The user innovators often operate at a grassroots level in a bottom-up way. They may choose to give away their innovative products for free unhindered by intellectual property rights and financial procedures. Digital platforms facilitated by Internet provide good basis for these online communities, which increasingly co-produce new types of innovative ideas that can be further developed to products or services. The further development can take place either separate from or in collaboration with firms. Thus, the motivation and aims of the private users and user communities do not only include financial gain (as in the case of firms), but also the users' desire to learn and contribute. It is usual that the user communities develop their ideas on voluntary basis without aiming at commercial products of services, but instead free sharing of the idea. An example of this kind of online community is Github, within which individual developers of open-source software freely share their code with other developers. This challenges the traditional producer-centered innovation and opens new avenues for widespread innovation, carried out often in informal ways, by an increasing range of people and communities located across the globe.

Relations within this 'innovation commons' (Potts, 2019), are typically informal, while the innovation activities in the user communities are performed during leisure time. Previous research on this field suggests that there are significant differences between innovation processes and outputs that occur in users' communities and other free innovation activities, and those that happen in firm-led environments (Flowers et al., 2017). On the other, despite the fact that the significance of the user-originated innovations is increasing in the innovation environment, the decision-makers seem to under-estimate their meaning for the innovation environment (Bradonjic et al., 2019). However, increase in variety of innovation sources, and this does not necessarily mean that earlier established forms of innovation are disappearing or becoming less important (Flowers et al., 2017, p. 14). For the research community, analyzing the emerging sources of innovation and their contribution to existing ones provides an interesting field of research

2.2. Increasing the range of innovation actors and activities

The variety of innovation actors and activities can be understood in a narrow or broad manner (Diercks et al., 2019, p. 890). In the narrow understanding, the innovation is considered as "commercialization of science" in which academia and industry play a key role. Governments and public policy makers contribute to the innovation process either by supporting it directly, or by facilitating the process indirectly. The collaborations are often taking place in "triple helix" model formed by universities, industry and government (Etzkowitz & Leydesdorff, 2000). In these kinds of networked collaboration models, universities are assumed to have a central role in the development of innovations and they are thus seen as engines of growth in society (Etzkowitz & Leydesdorff, 2000). In this manner, the narrow understanding sees the role of society as a passive user of the new inventions and innovations created by science and industry (Joly et al., 2010). Thus, the focus of the innovation activities is clearly on the supply side of the innovation process, where the scientific achievements and research results are seen as the main drivers of innovation, and the advances of science determine the rate and direction of innovation (Godin & Lane, 2013).

In contrary to the narrow view, the broad understanding does not consider only the supply side, but also the demand-side of the innovation process has direct links to the diffusion and end use of innovation (Diercks et al., 2019). New actors are joining to innovation policy arenas and public debates, and entering newly emerging spaces (Joly et al., 2010) as new innovation policy stakeholders (Kuhlmann & Rip, 2018). In the broad understanding, the households, consumers, and users include the new key target groups of the innovation. This is directly in line with the new definition of innovation in the fourth edition of Oslo Manual (OECD & Eurostat, 2018). The broad understanding means moving away from a singular focus on the “triple helix” model and involving also other types of relationships in the collaborative networks (Diercks et al., 2019). These innovation networks may include a wide variety of actors, such as entrepreneurs, non-profit organizations, cities, users and private citizens.

New Industry 5.0 paradigm is a practical example on the development where private citizens role in the industrial innovation processes is increasing. During the last decade, the Industry 4.0 framework became the overarching design paradigm for the development of digitalization in industry, including facilitators for smart production by means of robotics, Internet of Things (IoT) and advanced manufacturing, (Rosemann et al., 2021). Industry 5.0 paradigm that recently appeared to complement and replace Industry 4.0 promotes sustainable development goals such as human-centricity, socioenvironmental sustainability, and resilience (Grabowska et al., 2022; Javaid & Haleem, 2020). While the focus of Industry 4.0 was on production, Industry 5.0 concentrates on the time and the experiences during the consumption of a product (Ghobakhloo et al., 2022), with a special emphasis on sustainability and human centricity (Zizic et al., 2022). This kind of expansion from smart production to smart consumption with special emphasis on the end-users active role is facilitated by “continuous connectivity” between technology and service providers and consumers (Rosemann et al., 2021).

In general, Internet and its digital communication platforms have increased the number and variety of users (Gault, 2019; Schiavone et al., 2020). This all is related to the process of democratizing innovation (Von Hippel, 2005) in which non-traditional actors, such as dispersed individual users and online communities, play a growing role. These users and their informal communities often operate at a grassroots level in a bottom-up way and may choose to give away their innovative products for free unhindered by intellectual property rights and financial procedures (Gambardella et al., 2017; Von Hippel, 2017).

The active role of consumers as active participants of innovation processes is also visible in the smart city development. The concept of smart city represents new ways of organizing city functions and urban life for environmental purposes, based on digitalization (Rosemann et al., 2021). The ever-increasing transition towards smarter cities involves changing and evolving stakeholder role. In smart cities, citizens are not considered as passive users, but instead they are seen as active stakeholders who can act as participants, collaborators and developers in their own networks and communities (Caragliu et al., 2011). The process is highly interactive and collaborative, and it should involve all relevant stakeholders in the cities (Vanolo, 2014). A smart city concept inspired by the Industry 5.0 standard, “City 5.0” is a concept, where digital technologies enable collaborative learning and the co-creation of new, innovative solutions by users and their informal communities. The involvement of consumers, users and other target groups of collaborative networks is increasingly important for service provides and product manufacturers. The innovation networks may also involve a wide variety of other smart city actors, such as entrepreneurs, non-profit organizations, cities, and companies to freely organized communities of development and idea generation.

The user centric paradigm of Industry 5.0 challenges the established innovation models that are producer-centric and do not involve the end-users of the products. This paradigm also and opens up new avenues for widespread innovation carried out, often in informal ways, by an increasing range of people and communities located across the globe. Their key drivers for the user-centric view include the users' curiosity and the willingness to learn and share, rather than financial gain, which makes their efforts and products difficult to measure in financial terms (Gambardella et al., 2017). Moreover, despite the potential to pioneer innovations, innovative users that are sometimes called 'free innovators' often lack the interest and incentive to commercialize their products and services which reduces their value (Gault, 2019). However, when collaborating with producers and companies can address these challenges, which in turn holds the potential to lead to both increased producer profits and higher social value (Von Hippel, 2017). This changing innovation space does not nullify and crowd out the traditional role of firms and producers, but it does mean that the innovation landscape is likely to become more complex and the 'rules of the game' may need to account for this complexity. This has implications for existing markets and established producers who need to factor in the variety of innovations, actors and activities into their strategic decision-making (Flowers et al., 2017).

2.3. Innovation diffusion and spillovers take place in various ways

The evolving innovation space facilitates new ways of diffusing innovation that includes commercialization but also goes beyond it to other avenues and sectors of activity. Innovation processes are 'democratizing' (Von Hippel, 2005) especially in the areas where the demand side of innovation is involved, and digitalization enables continuous connectivity both between users and technology providers and also between communities. In addition, as the innovation resources are increasingly available, they have direct implications for diffusion and the creation of spillovers into new 'territory'. In this development, entrepreneurial forms of innovations are combined with commercial and non-commercial mechanisms which are based on users' and communities' desire to learn, share and support each other. The activities within the user communities usually take place on voluntary basis without desire to obtain immediate financial gain. This increased role of non-commercial individuals and online communities means that innovation activity can originate from these sources and propagate 'freely' to both commercial and non-commercial actors who may use the innovations for different purposes and in different ways that go far beyond established economic purposes.

Well-known examples of free sharing of user-based innovations include Open Source software development. Also the movement towards producing, sharing and utilizing open data in the government sector is increasing. Open data, aided by algorithmic tools, can be processed and analyzed to improve the performance and cost-effectiveness of government services and social well-being (Matheus, Janssen and Maheshwari, 2020). In addition, the open data sources provided by public and private sector actors provide opportunities for new business for companies. Several examples of this can be found in e.g. smart city context.(Matheus et al., 2020; Rosemann et al., 2021).

Establishing new ways to collaborate with producers and companies can address these challenges and holds the potential to lead to both increased producer profits and higher social value (Von

Hippel, 2017). Gault (2020, p. 66) lists three potential channels to make a user-based innovation to market: 1) providing a prototype or necessary knowledge to a producing firm; 2) starting a business to provide the product; or 3) making the product freely available for potential users as a peer group or community.

Regarding the first channel, the previous research has shown that the users have the potential to revise and re-innovate existing products launched by manufacturing firms, and in this manner, user-based innovation is able to complement manufacturer innovation (Kunttu & Neuvo, 2020; Schiavone, 2021). The user-manufacturer collaboration in the commercialization of user-based innovations creates synergies regarding innovation, marketing, and financials. It also enables the manufacturers to benefit from user innovations in its new product development, while the users benefit from improved tools (Block et al., 2016).

In the second channel, user entrepreneurship is an extending area of innovation diffusion for the user innovators, who wish to start their own business around the results of the free innovation activities (Escobar et al., 2021; S. Shah & Tripsas, 2016). Entrepreneurial users have commercialized their own innovations in several industrial areas, and especially digitalization has boosted this development (Schiavone 2020). In addition, many users are "accidental entrepreneurs" in that starting a for-profit company was not the initial motivation for their innovation, but rather the outcome of a journey inspired by their own needs (S. Shah & Tripsas, 2016).

In the third category, the diffusion of "free innovations" developed by individual users and their communities, is often a bottleneck. The users often lack incentive or means to commercialize their products and services, which reduces their value (Gambardella et al., 2017). It is also usual that the results of the free innovation activities are purposefully shared freely without desire to financial gain.

Policy-driven innovation research has shown that innovation can support governments to address societal challenges more effectively and efficiently using tools such as co-creation, citizen engagement, behavioral insights or service design theory (Arundel et al., 2019; Dan, 2021). Thus, innovative co-creation as a joint, mutually reinforcing mechanism between different stakeholder groups is at the core of the evolving innovation landscape. An actual example of this kind of development is crisis-driven innovation that starts from the premise that an unfortunate event (such as a conflict or pandemic) can lead to new inventions and ways of organizing (S. K. Shah & Tripsas, 2020) . They push the limits of existing arrangements that are unfit to respond to new challenging situations. For example, the trend of remote working, and "working from anywhere" during COVID-19 pandemic changed the innovation processes in both formal firm or university led networks and informal communities. Stakeholders' equal possibilities to participate the innovation processes independent of their geographic location has boosted networked innovation, and also introduced new ways of collaboration. In addition, in a crisis the diffusion and adoption of innovations are often more straightforward, and take place out of necessity. To the extent that regulatory, legal and ethical challenges are addressed, crises can lead to an accelerated diffusion that can unlock the potential of innovation to contribute with solutions to various societal challenges (Bessant et al., 2015).

3. Evolving innovation space in OECD Oslo Manuals

This chapter analyses the four editions of Oslo Manuals (1992, 1997, 2005, and 2018) to find implications on the change in the innovation definitions and related concepts presented in the four editions of Oslo Manuals, and reflect them to the relevant literature on the transformative change in innovation policy.

OECD Oslo Manual is based on an internationally recognized methodology for collecting and using innovation statistics, it is currently regarded as an essential worldwide tool for statisticians and policy makers concerned with innovation. In its current form, Oslo Manual includes definitions of basic concepts, data collection guidelines, and classifications for compiling innovation statistics. In this manner, it is useful to analyse Oslo Manual as one representative view to the contemporary innovation policies in industrialized countries. In this chapter, we consider the definition of innovation and related concepts from the three dimensions of our research framework. This section presents our findings in each dimension and each Oslo Manual edition. The findings are summarized in Figures 3 and 4.

3.1. Increasing the variety of innovations

The first edition of Oslo Manual (OECD, 1992) defined innovation as: "*Technological innovations comprise new products and processes and significant technological changes of products and processes. An innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). Innovations therefore involve a series of scientific, technological, organizational, financial and commercial activities*." In this definition, the focus was strongly in the TPP innovations in manufacturing industry, as the concept of innovation was limited to cover new or significantly improved technological products and processes. This edition also defines two main categories for the technological innovations, product and process innovations. The second edition of Oslo Manual (OECD, 1997) followed the first edition by focusing on TPP innovations and the same two categories of innovation. However, the second edition considered innovations in service sector as a separate activity that was introduced in parallel with TPP innovations in manufacturing industry. Thus, the service sector innovations represent non-technological type of innovations that were now discussed in Oslo Manuals for the first time.

The third edition of Oslo Manual, (OECD, 2005)defined innovation as: "*An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*." Thus, as the previous two editions, also the third edition included categories for product and process innovations. However, these innovation categories were not linked only to the production processes of goods manufacturing, but also equally to the innovations on the service sector. In addition to these innovation categories, the third edition introduces two new categories, marketing and organizational innovations. These new innovation types clearly extended the scope of the innovation also to the non-technological area that was omitted in the previous editions of Oslo Manuals. This extension is seen as the most significant change is the broadening the overall innovation concept in the third edition (Bloch, 2007). According to the third edition (OECD, 2005, p. 12), innovative marketing practices are often essential for the success of new products, and market research and contacts with customers can play a crucial role in product and process development through demand-led innovation (OECD, 2005, p. 12). Organizational innovations, on the other hand, are not only seen as supporting factors, but also as an important impact for the firm performance. This is because organizational innovations can improve the quality and efficiency of work, enhance the exchange of information and improve the firms' capabilities to learn, absorb and utilize new knowledge (OECD, 2005, p. 12). It is also notable that the third edition has a special emphasis in developing the innovation surveys to cover data collection in these new areas of innovation.

The fourth edition of Oslo Manual (OECD & Eurostat, 2018), published in 2018 defines innovation as follows: "*An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's* previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).*" In this definition, generic term "unit" can refer to any institutional unit in any sector, including households and their individual members. In this manner, the fourth edition covers innovation activities in all four economic sectors: business, government, non-profits serving households, and households. In the fourth edition, the list of four innovation categories (product, process, organizational and marketing) that was introduced in the previous edition, has been reduced to two main types: product innovations and business process innovations. One of the key reasons for this is the fact that the main emphasis of the discussion in the fourth edition is in the business sector innovations and their linkages within and outside of this sector.

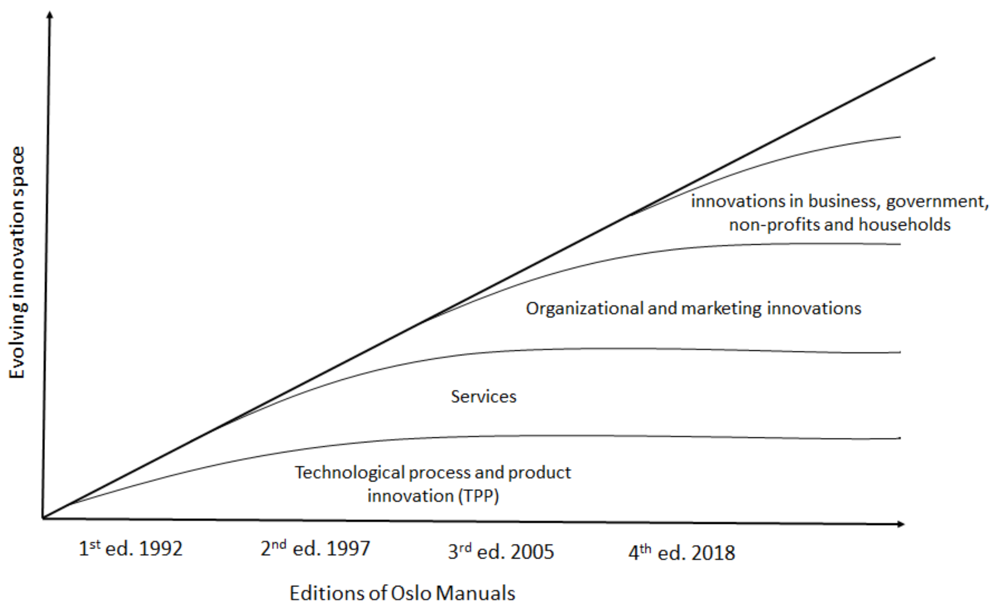

Figure 3. Evolving innovation space in Oslo Manuals.

3.2. Increasing the variety of innovation actors and activities

In the early versions of Oslo Manuals (1992 and 1997) the innovation actors and activities focused on TPP innovations manufacturing industries. Activities related to the TPP innovations were seen as involving a series of scientific, technological, organizational, financial and commercial activities that were primarily taking place in the industrial environments (OECD, 1997, p. 31). The innovation activities were focusing on the supply side of the process, and the partnerships and collaboration networks relied mostly in the “triple helix” type of collaboration structures. However, in the second edition (OECD, 1997), customers and service sector were mentioned for the first time. These actors were directly linked to the technological innovation processes in manufacturing. The third edition (OECD, 2005) defines innovation activities as “*all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations*.” In this manner, the innovations may also contain non-technological elements, but the focus is still on the supply side. This edition also extends the scope of actors and activities by underlining the links and networks between firms, suppliers and research institutions. These kinds of networks and ecosystem-type of thinking are able to extend the traditional view of triple helix collaboration.

The newest definition of innovation in the fourth edition (OECD & Eurostat, 2018), the innovation actors may include any institutional unit in any sector, including non-profit organizations, households and their individual members. This extends clearly the previous understanding of the innovation activities and actors, and also shifts the considerations on this area also to the demand side of innovation. The fourth edition also aims to address the ongoing digitalization and globalization of the economy and society in the innovation activities as well as reflect changing models of innovation, including those relating to open innovation, global value chains and global innovation networks (OECD and Eurostat, 2018).

3.3. Innovation diffusion and spillovers

In the first edition (1992), the focus of innovation diffusion lied in the technical development of new products and production techniques and their development towards production, and also to other firms and markets. The innovation diffusion process was primarily seen as a commercial supply side process within the networked collaboration in “triple helix”-types of structures. Also the second edition (OECD, 1997) was focused on the TPP-based innovations, but gave more emphasis to the innovation processes and knowledge flows between firms. The third edition (OECD, 2005) considered the knowledge flows between the actors in the innovation networks, and also reaching customers through marketing practices and suppliers. The fourth edition (OECD and Eurostat, 2018) focuses on the business innovations, and the innovation processes related to them. The fourth edition also pays special attention to the relationship between firms and their competitive environment. Thus, the fourth edition takes significant steps towards “democratizing” innovation processes by shifting the viewpoint of the innovation processes clearly to the demand side, where consumers, users and communities play a central role. On the demand side, however, the diffusion is not always taking place on commercial basis, since the users and their communities are willing to learn, share and support each other rather than to obtain immediate financial gain. The results and other outcomes of the users’ free innovation activities may proceed to further development in either commercial or non-commercial ways.

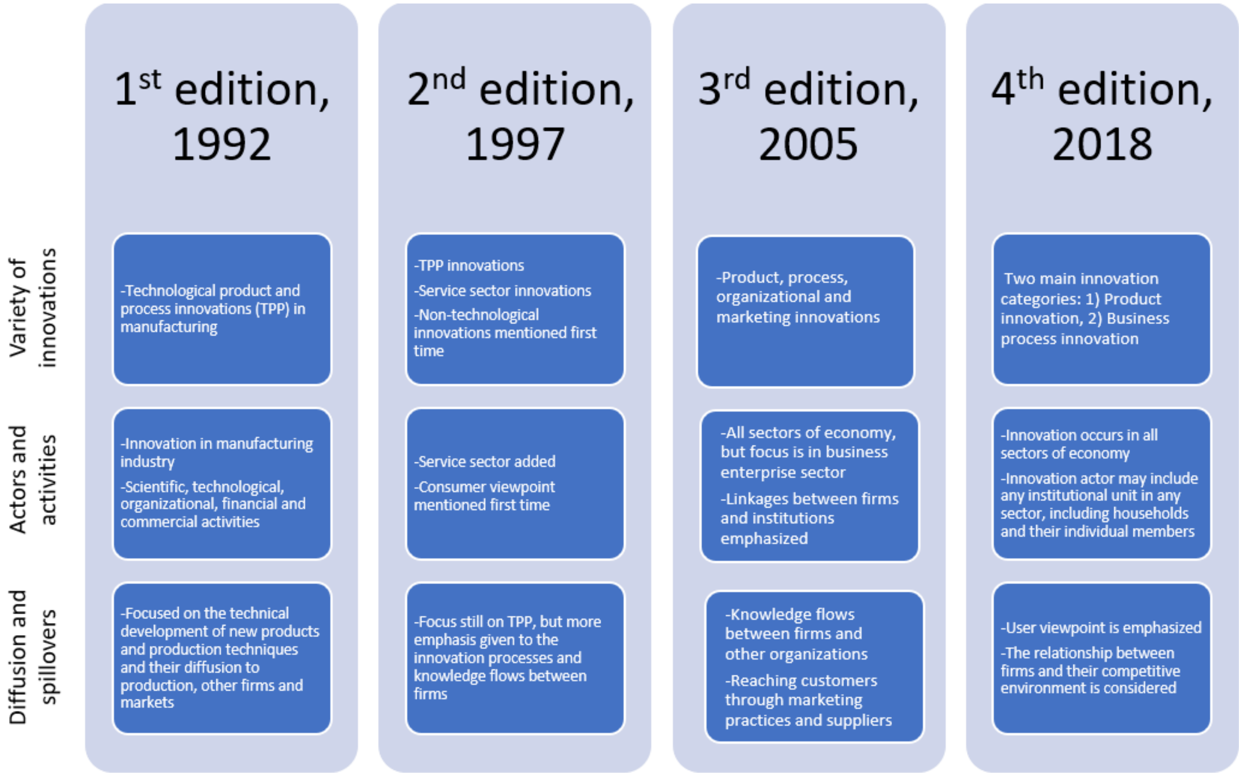

Figure 4. Summary of the findings in three dimensions and four editions of Oslo Manual.

4. Conclusions and future directions

This article has studied how innovation space has evolved during last three decades by analysing the definition of innovation and its related concepts in four editions of OECD Oslo Manual. As a framework, the analysis has used three dimensions, 1) variety of innovations, 2) innovation actors and activities, and 3) innovation diffusion and spillovers. The analysis shows that the innovation environment has gone through a significant change in all the dimensions, and this change is continuing. A general definition of innovation, introduced in the fourth edition of Oslo Manual, expands the domain of innovations to all economic sectors, not just the industry and business (Gault, 2019). Thus, the variety of innovations have evolved from TPP-based view to cover a wide variety of innovation types in the sectors that cover e.g. business, government, non-profits, and households (OECD & Eurostat, 2018). In the similar manner, the variety of actors and activities have extended to cover not only the supply side, but also the demand side of innovation. On the demand side, households and private consumers have a central role as active players in the new innovation space. As a consequence, non-commercial mechanisms have taken an increasing role in parallel with the traditional commercial approaches in innovation diffusion. Digitalization and continuous connectivity between producers, service providers and consumers include the main enablers of the increased role of the demand side in the innovation environment.

A central finding in our study was the increasing meaning of the users. Digitalization enables collaborative learning and the co-creation of new innovative solutions in open and creative networks of developers and users. Furthermore, internet-based platforms provide a sound basis for online communities of users, which increasingly co-produce products and services individually or in collaboration with companies. Their motivation and aims include financial gain and the desire to learn and contribute, often freely, to a particular community or cause. These kinds of free innovation activities of private users and their communities contribute to economic life in ways that challenge existing economic and business models that so far have relied heavily on the role of firms and producers. An example of the implementation of the digital transformation include new Industry 5.0 standard that underlines the user-centricity and continuous connectivity between producers and users (Grabowska et al., 2022; Javaid & Haleem, 2020). The active participation of the users and citizens in the joint innovation processes with companies and public sector actors is also in focus in the smart city development (Rosemann et al., 2021).The free innovation activities of users and user communities also support sustainable development by favoring re-use of existing solutions and recycling materials even without aiming at financial gain (Grabowska et al., 2022). I addition, the consuming habits of consumers are evolving to the direction that favors ecological and sustainable production. This kind of development calls for new kind of thinking in manufacturing, innovation and business development (Fletcher, 2021).

Despite the fact that the significance of the user-originated innovations is increasing in the innovation environment, the decision-makers seem to under-estimate their meaning for the innovation environment (Bradonjic et al., 2019). The new innovation space has a clear impact on the demand side of innovation space, and a central question is how the national innovation policies take this change into account. This requires that the policy makers should be able to form a real-time picture of evolving innovation space, facilitated by studies and surveys concerning the needs and expectations of users and other relevant stakeholder groups. Another key challenge in the innovation policy domain is to develop impact evaluation methods that take the demand-side of the innovation, better into account. It is also essential for company leaders to recognize the financial potential of the users' and communities' free innovation work. Furthermore, it would be beneficial for companies to come closer to the users by actively participating in the communities' interactions that are facilitated by internet-based platforms.

5. References

Arundel, A., Bloch, C., & Ferguson, B. (2019). Advancing innovation in the public sector: Aligning innovation measurement with policy goals. *Research Policy*, *48*(3), 789–798. https://doi.org/10.1016/j.respol.2018.12.001

Bessant, J., Rush, H., & Trifilova, A. (2015). Crisis-driven innovation: The case of humanitarian innovation. *International Journal of Innovation Management*, *19*(6), 1–23. https://doi.org/10.1142/S1363919615400149

Bloch, C. (2007). Assessing recent development in innovation measurement: The third edition of the Oslo Manual. *Science and Public Policy*, *34*(1), 23–34. https://doi.org/10.3152/030234207X190487

Block, J. H., Henkel, J., Schweisfurth, T. G., & Stiegler, A. (2016). Commercializing user innovations by vertical diversification: The user-manufacturer innovator. *Research Policy*, *45*(1), 244–259. https://doi.org/10.1016/j.respol.2015.09.007

Borrás, S., & Edquist, C. (2019). *Holistic Innovation Policy: Theoretical Foundations, Policy Problems, and Instrument Choices.* Oxford University Press.

Bradonjic, P., Franke, N., & Lüthje, C. (2019). Decision-makers' underestimation of user innovation. *Research Policy*, *48*(6), 1354–1361. https://doi.org/10.1016/j.respol.2019.01.020

Caragliu, A., del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, *18*(2), 65–82. https://doi.org/10.1080/10630732.2011.601117
Chesbrough, H. W. (2003). Open Innovation: Researching A New Paradigm. In *Harvard Business School Press*.
Dan, S. (2021). *All on Board the Innovation Lab? How Governments Build Governance Capacity for Public Sector Innovation, Submitted Manuscript.*
Diercks, G., Larsen, H., & Steward, F. (2019). Transformative innovation policy: Addressing variety in an emerging policy paradigm. *Research Policy*, *48*(4). https://doi.org/10.1016/j.respol.2018.10.028
Escobar, O., Schiavone, F., Khvatova, T., & Maalaoui, A. (2021). Lead user innovation and entrepreneurship: Analyzing the current state of research. *Journal of Small Business Management*, *00*(00), 1–18. https://doi.org/10.1080/00472778.2021.1955126
Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and "mode 2" to a Triple Helix of university-industry-government relations. *Research Policy*, *29*(2), 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4
Flowers, M., Meyer, M., & Kuusisto, J. (2017). *Capturing the Innovation Opportunity Space, Creating Business Models with New Forms of Innovation*. Edward Elgar Publishing.
Gambardella, A., Raasch, C., & Von Hippel, E. (2017). The user innovation paradigm: Impacts on markets and welfare. *Management Science*, *63*(5), 1–40. https://doi.org/10.2139/SSRN.2079763
Gault, F. (2019). User innovation in the digital economy. *Foresight and STI Governance*, *13*(3), 6–12. https://doi.org/10.17323/2500-2597.2019.3.6.12
Gault, F. (2020). *Innovation Everywhere*. Elgar.
Ghobakhloo, M., Iranmanesh, M., Mubarak, M. F., Mubarik, M., Rejeb, A., & Nilashi, M. (2022). Identifying industry 5.0 contributions to sustainable development: A strategy roadmap for delivering sustainability values. *Sustainable Production and Consumption*, *33*, 716–737. https://doi.org/10.1016/j.spc.2022.08.003
Godin, B., & Lane, J. P. (2013). Pushes and Pulls: Hi(S)tory of the Demand Pull Model of Innovation. *Science Technology and Human Values*, *38*(5), 621–654. https://doi.org/10.1177/0162243912473163
Grabowska, S., Saniuk, S., & Gajdzik, B. (2022). Industry 5.0: improving humanization and sustainability of Industry 4.0. *Scientometrics*, *127*(6), 3117–3144. https://doi.org/10.1007/s11192-022-04370-1
Hargrave, T. J., & Van de Ven, A. (2006). A collective action model of institutional innovation. *Academy of Management Review*, *31*(4), 864–888. https://doi.org/10.7551/mitpress/5906.003.0003
Javaid, M., & Haleem, A. (2020). Critical components of industry 5.0 towards a successful adoption in the field of manufacturing. *Journal of Industrial Integration and Management*, *5*(3), 327–348. https://doi.org/10.1142/S2424862220500141
Joly, P.-B., Rip, A., & Callon, M. (2010). Re-Inventing Innovation. In *M. J. Arentsen, W. van Rossum, & A. E. Steenge (Eds.), Governance of Innovation* (pp. 19–32).
Klievink, B., & Janssen, M. (2014). Developing Multi-Layer Information Infrastructures: Advancing Social Innovation through Public-Private Governance. *Information Systems Management*, *31*(3), 240–249. https://doi.org/10.1080/10580530.2014.923268
Kuhlmann, S., & Rip, A. (2018). Next-generation innovation policy and Grand Challenges. *Science and Public Policy*, *45*(4), 448–454. https://doi.org/10.1093/SCIPOL/SCY011
Kunttu, L., Dan, S., Kalliomäki, H., & Kuusisto, J. (2021). Assessing Evolving Innovation Space in Oslo

Manuals. *The ISPIM Innovation Conference – Innovating Our Common Future, Berlin, Germany on 20–23 June 2021.*
Kunttu, L., Kalliomäki, H., Kalliokoski, J., & Kuusisto, J. (2022). Evolving innovation space - Analyzing the changes in innovation domain to support policy learning. *Business Finland Policy Brief No. 3/2022*.
Kunttu, L., & Neuvo, Y. (2020). The role of academics, users, and customers in industrial product development. *Technology Innovation Management Review*, *10*(3). https://doi.org/10.22215/timreview/1337
Matheus, R., Janssen, M., & Maheshwari, D. (2020). Data science empowering the public: Data-driven dashboards for transparent and accountable decision-making in smart cities. *Government Information Quarterly*, *37*(3), 101284. https://doi.org/10.1016/j.giq.2018.01.006
Morrison, P. D., Roberts, J. H., & Von Hippel, E. (2000). Determinants of user innovation and innovation sharing in a local market. *Management Science*, *46*(12), 1513–1527. https://doi.org/10.1287/mnsc.46.12.1513.12076
Moulaert, F., Martinelli, F., Swyngedouw, E., & González, S. (2005). Towards alternative model(s) of local innovation. *Urban Studies*, *42*(11), 1969–1990. https://doi.org/10.1080/00420980500279893
OECD. (1992). *OECD proposed guidelines for collecting and interpreting technological innovation data - Oslo Manual* (First edit). http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=OCDE/GD(92)26&docLanguage=En
OECD. (1997). *Oslo Manual* (Second edi). http://books.google.com/books?id=Q132qLPtfsQC&pgis=1
OECD. (2005). Oslo Manual. In *OECD* (Third edit). http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Oslo+manual#0
OECD, & Eurostat. (2018). Oslo Manual 2018 - Guidelines for collecting, reporting and using data on innovation. In *Handbook of Innovation Indicators and Measurement* (Fourth edi). https://doi.org/10.1787/9789264304604-en%0Ahttps://www.oecd-ilibrary.org/science-and-technology/oslo-manual-2018_9789264304604-en%0Ahttps://www.oecd-ilibrary.org/science-and-technology/oslo-manual-2018_9789264304604-en
Potts, J. (2019). *Innovation Commons: The Origin of Economic Growth*. Oxford University Press.
Rosemann, M., Becker, J., & Chasin, F. (2021). City 5.0. *Business and Information Systems Engineering*, *63*(1), 71–77. https://doi.org/10.1007/s12599-020-00674-9
Schiavone, F. (2021). User Innovation: Interactions Between Users and Firms in Innovation Processes. In *Innovation Economics, Engineering and Management Handbook 1: Main Themes*.
Schiavone, F., Tutore, I., & Cucari, N. (2020). How digital user innovators become entrepreneurs: a sociomaterial analysis. *Technology Analysis and Strategic Management*, *32*(6), 683–696. https://doi.org/10.1080/09537325.2019.1696955
Schot, J., & Steinmueller, W. E. (2018). New directions for innovation studies: Missions and transformations. *Research Policy*, *47*(9), 1583–1584. https://doi.org/10.1016/j.respol.2018.08.014
Shah, S. K., & Tripsas, M. (2020). User entrepreneurs in times of crisis: Innovators you can count on. *Strategic Entrepreneurship Journal*, *14*(4), 566–569. https://doi.org/10.1002/sej.1384
Shah, S., & Tripsas, M. (2016). When do user innovators start firms? A theory of user entrepreneurship. In D. Harhoff & K. Lakhani (Eds.), *Revolutionizing innovation: Users, communities and open innovation* (pp. 285–307). MIT Press.

Terstriep, J., Krlev, G., Mildenberger, G., Strambach, S., Thurmann, J.-F., & Wloka, L.-F. (2021). Measuring social innovation. In J. Howaldt, C. Kaletka, & A. Schröder (Eds.), *A Research Agenda for Social Innovation* (pp. 263–286). Elgar.

Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. *The International Journal of Management Science*, *3*(6), 639–656.

Vanolo, A. (2014). Smartmentality: The Smart City as Disciplinary Strategy. *Urban Studies*, *51*(5). https://doi.org/10.1177/0042098013494427

Von Hippel, E. (2005). *Democratizing Innovation*. MIT Press.

Von Hippel, E. (2017). Free Innovation. In *The MIT Press*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2866571

Zizic, M. C., Mladineo, M., Gjeldum, N., & Celent, L. (2022). From Industry 4.0 towards Industry 5.0: A Review and Analysis of Paradigm Shift for the People, Organization and Technology. *Energies*, *15*(14). https://doi.org/10.3390/en15145221