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# Quintuple helix approach: The case of the European Union

# Pristup peterostruke uzvojnice: Primjer Europske Unije

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## Abstract

European Union (EU) is fostering the quintuple helix approach as it recognizes sustainable development and innovation as important development priorities. The quintuple helix represents a new framework which includes new knowledge, more stakeholders with sustainable development at its center. The EU has put in place different policy measures, regulations and funds to support designing and implementation of innovation strategies and sustainable development in all Member States. The objective of this paper is twofold as it includes identifying key features of helix innovation model and its evolution over time, and exploring EU efforts to transform to the quintuple helix system. The purpose of this paper is to explain the new context of development where innovation and sustainability should be considered as key elements. Using the example of the European Union, this paper studies policies and measures that the EU has put in place in order to support innovations as well as inclusive, smart and sustainable development, which are significant parts of the quintuple helix approach.

**Keywords:** European Union, innovation, sustainable development, quintuple helix
**JEL classification:** F2

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## Sažetak

Europska unija (EU) aktivno promiče pristup peterostruke uzvojnice prepoznajući održivi razvoj i inovacije kao važne razvojne prioritete. Potreban je novi razvojni okvir koji bi uključivao nova znanja, više dionika i mjere za održivi razvoj. EU je donijela različite mjere i propise te uspostavila fondove za podršku dizajniranju i provedbi strategija poticanja inovacija i održivog razvoja u svim zemljama članicama. Cilj ovog rada je dvojak te uključuje identifikaciju ključnih značajki inovacijskog modela uzvojnica i njegov razvoj, te istraživanje napora EU za transformaciju prema peterostrukoj uzvojnici. Svrha ovog rada je objasniti novi kontekst razvoja u kojem inovativnost i održivost treba smatrati jednim od najvažnijih elemenata. Koristeći primjer Europske unije, ovaj rad proučava politike i mjere koje je EU poduzela kako bi podržala inovacije kao i inkluzivan, pametan i održiv razvoj, a koji su okosnica modela peterostruke uzvojnice.

**Ključne riječi:** Europska unija, inovacije, održiv razvoj, peterostruka uzvojnica
**JEL klasifikacija:** F2

## 1. Introduction

Poverty and inequality, within and among countries, have been rising; at the same time, unsustainable consumption and production patterns have resulted in economic and social costs, deepening development gap and leaving ecological footprint. Achieving sustainable development requires appropriate global actions towards economic and social progress, which depend upon growth and employment, and simultaneously, strengthening of environmental protection. As society is facing various challenges, long-term effective, integrated,

positive and "green" thinking and acting is becoming imperative. New solutions are necessary to meet constantly changing societal, economic and ecological needs. What is more, it is necessary to move forward from technological innovation and focus on social innovation that create public value.

The quintuple helix model can be proposed as a framework for transdisciplinary (and interdisciplinary) analysis of sustainable development and social ecology (Carayannis and Campbell, 2010). The European Commission has identified the socioecological transition as a major challenge for the future roadmap of development (Carayannis, Barth and Campbell, 2012). It has placed innovation as one of the most important elements of its' development strategies. Innovations are seen as a way of promoting regional growth and development. However, former innovation policies have mainly been dominated by a traditional view of innovation process through the triple helix model based on the collaboration among the academic sector, the government and the industry (Leydesdorff and Etzkowitz, 1996; Leydesdorff, 2000). Due to the regional context of integration and institutional settings, regional level was seen as the appropriate geographical level for innovation processes to occur (Doloreux and Parto, 2005). Today, the concept of smart specialization is a part of the Directive developed by the European Commission (2012) for European regions to develop their research and innovation smart specialization strategies (RIS3) in order to become more competitive and to promote development. However, a critique has been directed towards current innovation systems in Europe as being too biased and undemocratic due to their exclusion of civil society (Campbell, Carayannis and Rehman, 2015). In order to become a more sustainable society the inclusion of new stakeholders into the current innovation systems is indispensable. Therefore, a new framework is needed which would include new knowledge, more stakeholders, new policies and more focus on sustainable development. Since 2015, the EU and its Member States have promoted inclusive sustainable growth and decent jobs in developing countries, as well as social protection. The priority has been to support development of policy frameworks for inclusive and sustainable economic development (European Commission, 2019).

The objective of this paper is twofold as it includes identifying key features of helix innovation model and its evolution following changes in the environment, and exploring EU efforts in transformation to the quintuple helix system. The purpose of this paper is to explain the new context of development where innovation and sustainability should be considered as one of the most relevant elements. Using the example of the European Union this paper studies policies and measures that the EU has put in place in order to support innovations, inclusive, smart and sustainable development, which are at the center of the new 2030 agenda.

## 2. Theoretical background: evolution of innovation models

Today, innovations are seen as an important source of growth and countries are building their innovation systems in order to create favorable framework for promotion of innovation. Different innovation models describe and explain the role and expansion of knowledge in a society over time. The knowledge society puts forth the role of politics in society and governance (Hohmann, 2016). Helix models of innovation are often used as policy-making tool for economic growth and regional development. The helix approach to innovation has been evolving over time in accordance with changes in the environment, perception of knowledge and technological progress.

The need for cooperation and communication between different stakeholders has been the leverage for the original "double helix" concept, which has been expanded and adapted over the years. The double helix model involves collaboration between the academic community and entrepreneurs and implies a linear linkage. Later, with the development of information and communication technologies the role of knowledge increased and the concept a knowledge society emerged. There was also the need for new relationships involving more stakeholders, namely the government. The "triple helix" is a spiral model of innovation, unlike the classic linear one, and tries to explain innovation as a reciprocal link within an institutional environment consisting of the public

sector, industry and academia, at different levels of capitalization of knowledge. It explains the need for collaboration among the public sector, industry and the academic sector in order to align the educational system with the labor market needs, but also to foster innovation. The particularity of this concept is shifting the positions of stakeholders, from isolated or bilateral, even trilateral forms of cooperation, to the spiral multilateral dimensions of collaborative relationships. Over the years it has become increasingly clear that the institutional arrangements in the triple helix model have to be modified to better fit new trends and global challenges, especially the social innovation process. Ahonen and Hämäläinen (2012), for example, argued that the triple helix model needed to be complemented with what could be described as a fourth element which includes the third sector organizations, users, citizens or others, based on an open-innovation logic. An extended version of the triple helix model is known as the "quadruple helix". It involves the collaboration of the public, private and scientific sector with the additional helix, civil society. The newest extension of the helix model is the "quintuple helix", and besides the already mentioned elements, the environment is added as the fifth element of the model.

Conclusively, the triple helix system relates to the emergence of the knowledge economy, the quadruple helix system relates to the knowledge society and knowledge democracy, whereas the quintuple helix system refers to a broader perspective of socioecological transformations and natural environment (Campbell, Carayannis and Rehman, 2015).

Most countries are in the phase of moving from the triple to the quadruple helix system. The most important element of the quadruple helix is knowledge, circulating between different subsystems of society and thus influencing innovation and knowledge creation. The quadruple helix analyses cooperation and exchange of knowledge through the following four subsystems (Carayannis and Grigoroudis, 2016):

1. Educational system, includes the academic community, faculties, the higher education system and schools,
2. Economic system, includes the industry, enterprises, services and banks,
3. Political system, determines the country direction and the legislative framework,
4. Civil society, media culture that combines and integrates two types of capital: a public-cultural, based on traditions, values and the like, and public media capital including television, newspapers, the Internet and the like.

Technological progress is the key driver of improvements in income and standards of living. But new knowledge and technologies do not necessarily develop everywhere nor at the same time. Therefore, the way technology spreads across countries is central to how global growth is generated and shared across countries (Aslam et al., 2018). However, technological progress has brought dissatisfaction for some people because of the rapid increase in automation. Automation has been questioned recently as an activity that destructs the middle class and takes away jobs from the society. Indeed, if automation replaces some jobs, this means that the social and economic development criteria of sustainable development are not fulfilled.

However, many authors have a different viewpoint when it comes to automation. Automation is closely related to the modern need for sustainable development in the 21st century. One of the principles of sustainability is "doing more with less" which in other words, is also one of the goals of automation. By replacing the routine part of human labor with the use of machines, automation not only increases productivity and the quality of products beyond what can be achieved by humans but also frees space, time and energy for humans to deal with the new, non-routine challenge of developing innovative and more advanced technologies (Kongloli, 2016). This cycle in which established developments are automated and the free resources are used to develop newer technologies that are subsequently automated is one of the most successful recipes for the human race towards the goal of sustainable development (Kongoli, 2016). Innovations in terms of products and services provided by industries or countries are geared to meeting the needs of citizens and imply the socio-economic growth of a particular area. This process entails at least two elements: an effective

interaction between the scientific sector and the industry and the contribution of citizens to the innovation system. This implies a transition from technological to social innovation (Yawson, 2009).

## 3. Sustainable development and social innovation as a part of the quintuple helix model

The quintuple helix model represents a system where innovation goals and strategies should be able to integrate public opinion in processes of knowledge creation, creative industries, politics, lifestyles, culture, values and norms, based on close discourse with citizens (MacGregor, Marques-Gou and Simon-Villar, 2010: 173-190). In transformation processes knowledge is the fundamental resource, while the quintuple helix model establishes nature as a central component for innovation and knowledge production necessary in the transformation to a bio based society (Carayannis, Barth and Campbell, 2012). The quintuple helix model emphasizes the socio-ecological transition of the society and the economy in the twenty-first century and is considered to be an environmentally sensitive model. The model emphasizes that biological and ecological systems are a source of evolutionary innovations and that many economic, social and technological innovations are actually a result of adapting or imitating the effects of nature. The quintuple helix model includes relationships among the academic community, industry, public sector, civil society and natural environment. Within the quintuple helix model, it is emphasized that the natural environment is a driver of knowledge production and innovation, thus creating opportunities to strengthen the knowledge economy.

Numerous international development organizations and policy-makers have recognized that human development and progress throughout history has been based on changes in social practices and cultures, regardless of whether they followed the top-down approach or were changes introduced slowly, resulting from the everyday way of life and adaptation of needs and changing environment.

Achieving sustainable development is an imperative in the era of globalization, digitalization and fast technological progress. A dynamic equilibrium is required that would ensure the process of interaction between a population and the carrying capacity of its environment such that the population develops to express its full potential without producing irreversible, adverse effects on the carrying capacity of the environment upon which it depends.

The concept of sustainable development can be interpreted in many different ways, but at its core is an approach to development that looks to balance different, and often competing, needs against an awareness of the environmental, social and economic limitations. Sustainable development involves the following (National Round Table on the Environment and the Economy, 2012):

- anticipation and prevention, which involves the avoidance of environmental degradation at all planning and developmental stages including conservation considerations,
- full cost accounting, which reflects the environmental and social costs as well as the regular market costs,
- informed decision making which considers long term planning and gains, instead of the more usual biased short term planning returns; this must include effective public participation,
- living off the interest, which treats natural resources as natural capital; it must be replaced as it is depleted, reused or recycled to reflect the principle of sustainability,
- quality of development over quantity which reflects a change of focus to stress product durability, energy efficiency and recycling,
- respect for nature and the rights of future generations which is a recognition that quality of life considerations, both now and in the future, must be included in all decision making processes, including the knowledge that all flora and fauna not only have the right to exist, but are vital to the health and well-being of humans.

Sustainable development is based on three main pillars, as commonly accepted: economic growth, environmental preservation and social inclusion which carry across all sectors of development, from rapid urbanization to agriculture, infrastructure, energy development and use, water availability and transportation.

It is important to analyze the three pillars of sustainability because each of these pillars has to to be stable enough for the whole system to be sustainable. Firstly, the economic pillar which represents consumers, assumes large population which demands high-consumption lifestyle. Meaning that we consume more than our "fair share", and the best way to keep this pillar feasible is to establish a system that has a fair distribution and efficient allocation of resources as a whole. This pillar ensures that economic growth maintains a healthy balance with the ecosystem. Moreover, an economically sustainable system must be able to produce goods and services constantly, maintain government and external debt, and reduce imbalances which harm agricultural production.

Second pillar which refers to social perspective, represents all concepts related to human rights and reinforces poverty, social injustice and inequality. To make this pillar strong, establishing and supporting peace and social justice would be the first step. In broad terms, social pillar are public policies that support social issues. These social issues are connected to our wellbeing and include aspects like healthcare education, housing and sanitation. Therefore, a socially sustainable system must achieve fairness in distribution and opportunity, adequate provision of social services including health and education, gender equity, and political accountability and participation (Harris, 2003).

Thirdly, environmental pillar aims to improve human welfare through the protection of natural capital (e.g. land, air, water, minerals). This means that the environmental system has to avoid over-usage of renewable resource systems which can help in ensuring a stable resource base. This pillar strives to support renewable energy, sustainable agriculture, farming and recycling. The main idea of this pillar is to keep the earth as free from waste and pollution so as to keep our system and society sustainable. All the pillars are intersected with each other and both the economic pillar and the social pillar need the environmental pillar to be thriving. It is challenging to keep all the pillars strong because they tend to be affected negatively.

Achieving sustainable development implies meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. In this respect, besides technological innovations and other instruments, social innovations can be considered as an important instrument for achieving sustainable development. Their role is already recognized in developed countries, but they are also becoming a part of strategies and innovation policies in developing countries (Millard, 2018). Social innovations encourage cooperation, help meet social needs through new practices and put emphasis on users. When considering the transition towards sustainable economic growth, the main challenge remains in addressing innovation not only from an economic and environmental, but also from a social perspective. Social, ecological and economic aspects of sustainability can be linked to the performance of the society and innovations in several ways (Hansmann, Mieg and Frischknecht, 2012; Piccarozzi, 2017). The social aspect of sustainability can be seen through: maintaining cultural and social values, health protection, education and personal development, security, equality and justice. Furthermore, the ecological sustainability aspect is reflected in the need for environmental protection, responsible use of renewable resources, reduction of the use of non-renewable resources, protection from ecological disasters, and protection of biodiversity. In order to achieve economic sustainability at the organizational level, it is necessary to create jobs, reduce costs, stimulate innovation, strengthen human capital and take into account the welfare of future generations.

Moreover, social innovation, as an innovative way of performance or a source of innovation can be understood as an effective and sustainable application of new products, services or business models that have positive effects on the wider social level. Social innovations are in fact the natural consequence of entrepreneurial activities for the purpose of sustainable development (Storey and Tether, 1996). The relationship between social innovations and social sustainability should be based on equality in meeting needs, governance and social participation, as well as on social learning processes and the production of new knowledge

for sustainability. Social innovations and social sustainability are complementary, but they also act as a stimulant to each other and strengthen their actions, seek jointly sustainable social norms and actions that will lead to sustainable social transformations (Parra, 2013).

Based on the abovementioned, the quintuple helix model can be seen as a framework for transdisciplinary analysis of sustainable development and social ecology. It explains how socio-ecological transition is possible by applying and combining production of knowledge and innovation (Sunina and Rivza 2016). Sustainable development requires modernization of production processes, which will lead to an increase in economic efficiency and reduction of harmful emissions, more efficient use of natural resources and less waste. In addition, it can lead to increased efficiency, improvement of living conditions (Sergeeva and Zakirova, 2017) and reducing inequalities in quality of life. The application of the "best available techniques" in production (Martynenko and Vershinina, 2018) is recommended. The concept emerged in 1984, and implies the application of the most advanced achievements in science and technology, which should provide the least ecological damage, safety for people and efficiency from an economic point of view. The best available manufacturing techniques are to protect the environment from negative industrial performance and their application is considered to be profitable for companies that adopt them.

## 4. European Union and the quintuple helix approach

Fostering innovation and sustainable development has been recognized as a central element of European development policies. To promote a more resource efficient, greener and more competitive economy it is clear that the future plans need to include significant innovation: sustainable growth needs to be aligned with smart growth in order for the EU and its citizens to reap the full benefits of transformation to the green economy. Over the years, the European Commission has made available different policy measures, legal measures, funds and regulations to its Member States to encourage investment and innovation and is continuously working on the development of incentive instruments. Regional policy of the EU is one of the instruments for fostering innovation that responds to the challenges of sustainable energy, climate change and the use of natural resources. It can play a pivotal role in strengthening both the sustainability and competitiveness of European regions (European Union, 2012). The European Union has included smart specialization as a part of its regional innovation policies and strategies since 2012. Member States can design and implement smart specialization (RIS3) in the form of autonomous strategic framework or it may be included in the national or regional innovation policy. Moreover, smart specialization strategies are to be developed through the involvement of national or regional government authorities and interested parties such as universities and other higher education institutions and economic and social partners in the discovery process. Smart specialization is not a top-down strategy but includes companies, research centers and universities that collaborate to identify areas of specialization in the Member States or regions that promise the most potential but also to identify the weaknesses that make innovation more difficult in these areas.

The basic logic of developing a smart specialization strategy in all Member States lies in the fact that by concentrating scientific resources and connecting them with a limited number of priority economic activities a country or a region can become and remain competitive in the global economy. Although more developed countries are further along in implementing RIS3 and are, in general innovation leaders, developing EU countries have also made progress in designing RIS3 and national innovation systems. Smart specialization is the essential feature of promoting sustainable, smart and inclusive growth and the EU places sustainable development as its fundamental and overarching goal.

Through Framework Programs (FP) the EU has launched and stimulated various initiatives for the development of innovations. Innovation Union and the Horizon 2020 are some of the most known initiatives thus far. The new FP9 program for the

following period will be designed in a way that promotes value creation, contributes to research, development and strengthening of national innovation activities without their duplication. This will be possible by encouraging private investment and the inclusion of enterprises of all sizes with the emphasis on funding for small and medium-sized enterprises (Department for Business, Energy & Industrial Strategy, 2018).

Inclusion of social innovations in EU official policies has triggered a number of changes and adjustments to the regulatory framework with significant impact on the promotion of the third sector and social economy. One of the first initiatives was the Social Business Initiative (European Commission, 2011), which emphasized the importance of social entrepreneurship with great benefits for platforms and networks that promote it. Innovation Union was the EU's response to the global financial crisis. It was a way of creating jobs and growth through research and innovation. It was also one of the seven main initiatives of the Europe 2020 strategy for smart, green and inclusive growth adopted in 2010. The importance of the educational system that encourages young creators to express and improve their skills is well-known and guides them towards creative activities (European Commission, 2013). Most Member States have launched initiatives to build partnerships between government and industry in order to put creative activities at the heart of their development strategies. Digital social innovations are another important step towards encouraging social innovations, as technological innovations and start-ups are directed towards addressing social challenges. Unemployment and other social challenges facing Europe are to a large extent the result of relatively modest growth, which is the consequence of untapped potential in terms of employment and productivity. The Social Investment Package was adopted in 2013 to assist Member States in rebuilding the social protection system by investing in people during their lifespans, especially at critical moments (childhood, job search, parenting, etc.). As economic and social progress are interconnected, the establishment of the European Pillar of Social Rights, which is oriented towards strengthening European competitiveness and boosting investment, job creation and social cohesion, should be a part of more comprehensive efforts to build a more inclusive and sustainable growth model.

By reviewing other policies and initiatives the following resources and actions are available and necessary to promote social innovations and sustainability in the EU.

From the abovementioned it is evident that the EU has put social progress, innovation and sustainable development at the top of its development priorities. EU is aiming to move from linear to circular economy to correct the imbalances in the

**Table 1** Resources and necessary actions for promotion of social innovation and sustainable development in the EU

| Dedicated resources | Key actions |
|---|---|
| • financial resources: funds from the European Structural and Investment Funds (ESI), the European Agricultural Fund for Rural Development, the EU Employment and Social Innovation Program, Horizon | • provide regular reporting of the EU's progress<br>• collecting and disseminating information |
| • resources to create visibility and reputation: fairs, conferences, initiatives to create a stimulating legislative environment | • take the implementation of the 2030 Agenda forward with EU governments, the European Parliament, other European institutions, international organizations, civil society organizations, citizens and other stakeholders |
| • networking and knowledge: through various platforms (the most famous is the Social Innovation Europe Platform), financing of skills and capacity development initiatives, publication of manuals, organization of seminars and more, microfinance initiatives | • launch a high-level multi-stakeholder platform, supporting the exchange of best practices on implementation across sectors at national and EU level<br>• continue creating a stimulating environment |
| | • launching a longer term vision with a post 2020 perspective |
| | • put into practice the Broadband Cost Reduction Directive,<br>• "Digital Europe investment programme" |

**Source:** Sabato et al. (2015); Pisano et al. (2015); European Commission (2019a).

food system, future-proofing energy, buildings and mobility. To accomplish the goal of sustainable Europe by 2030 all the actors are to be involved across various policy domains, such as education, finance, corporate social responsibility, trade, governance, and external policy.

## 5. Conclusion

Since innovations are recognized as the key element of growth they have received much attention in the literature. Over time, different innovation theories and models have emerged and transformed as new knowledge became available. The helix model is important because it emphasizes the need for collaboration among different stakeholders in order to support and enable research, development and innovation with the final goal of promoting growth and development. Besides technological innovation, today more attention is given to social innovation as the focus is not only on economic but social goals as well. Civil society and nature have recently been accepted as important parts of the helix model. Their significance in the innovation system is indisputable since they represent major elements of sustainable development. New trends and constantly changing environment require new and adaptable solutions to different social, economic and ecological challenges. Therefore, strategies and policies need to be comprehensive and synergetic and include new actors. As stated in the helix innovation model, there is a need for a partnership between small organizations, individuals or groups that create new ideas, that are agile and respond quickly to changes on the one hand, and large organizations, government and non-profit organizations that are not as creative but have solid establishment and the implementation capacity, on the other. Social change and sustainability are the result of this alliance. In view of new developments and challenges that the EU is encountered with, it is necessary to constantly make efforts in developing and modifying policies, strategies and measures that support innovation and encompass the need for a more sustainable society and preservation of the natural ecosystem. The EU has prepared the new agenda for sustainable development and its intent is to comply with the highest environmental standards and to involve and coordinate all the stakeholders in this process. With these new agenda goals, EU is working on transformation to the quintuple helix approach. The potential challenge will rise in the implementation phase of those measures and goals in all Member States since the integration is heterogeneous. However, so far evidence have shown that all countries have made progress to support innovation and sustainable development. While this paper describes the new context for considering innovation and sustainable development, the main limitation is in the fact that it is based on a theoretical framework and it focuses on the integration level. This is due to the fact that there are still scarce data on the process of transformation to quadruple or quintuple helix approach. When available, it would be interesting to compare the pace of and the results of this transformation among the EU countries.

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