INNOVATION ECOSYSTEMS AND THE QUADRUPLE HELIX APPROACH IN THE ROMANIAN CONTEXT

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Abstract: The study explores the collaboration between government, industry, higher education and societal based innovation ecosystem users (QH model) having as main purpose to critically explore the perceptions (focusing on the drivers of success and failure) of the above mentioned stakeholders, previously or currently involved in Quadruple Helix initiatives in the Romanian context. Generating innovations and achieving performance implies effective collaboration and stakeholders' engagement. As a consequence, this study addresses the key positive and negative aspects of the stakeholders' engagement in the QH collaboration in Romania, through a qualitative study. Both the literature review and the qualitative research acknowledged the need of in-depth investigations for the scientific research in order to establish and confirm models of effective collaborations for the innovation ecosystems, with a prioritization framework for each stakeholder in order to surpass possible emerging problems. Additionally, collaboration between actors must be improved. The contributions of the article are: (1) to improve the connection between HEI, business, government and the society (major actors within the QH approach); (2) to establish the real perception of QH stakeholders with focus on strengths, weaknesses and tensions emerging from their collaboration.

Keywords: Quadruple Helix concept; innovation ecosystem; stakeholder; academia; government; industry; society.

1   INTRODUCTION

The study explores the collaboration between government, industry, academia and societal based innovation ecosystem users (QH model) having as main purpose to critically explore the perceptions (focusing on the drivers of success and failure) of the above mentioned stakeholders previously or currently involved in Quadruple Helix initiatives in the Romanian context.

The interplay between government, HEI, business and civil society is perceived as being of critical importance in innovation ecosystems due to its major impact on economic growth (Musari & Fathorrazi, 2021; Medeiros, Marques, Galvão & Braga, 2020) and also due to its ability to generate social and public value (Urbano & Guerrero, 2013; Kholiavko, Zhavoronok, Shaposhnykov, Krylov, Morozova & Babiak, 2021).

Additionally, the pandemic crisis forced governments, HEIs, businesses and citizens to discover new paths in order to stimulate social innovation (Morawska-Jancelewicz, 2021). In this vein can be mentioned the new visions of Society and Industry 5.0 (Carayannis, Dezi, Gregori & Calo, 2021), which acknowledge the necessity "to re-think existing working methods and approaches toward innovation and to focus them on developing human-oriented solutions and social innovation" (Morawska-Jancelewicz, 2021, p. 2).

Generating innovations and achieving performance implies effective collaboration and stakeholders' engagement. As a consequence, this study raises the following research question: 'What are the key positive and negative aspects of the stakeholders' engagement in the QH collaboration?'

The necessity for further researches on the innovation ecosystems by using the QH model was underlined by several researchers. Thus, there are authors (Vallance, Tewdwr-Jones & Kempton, 2020) which focus on the true functioning of these collaborations as they should not be presumed as real. Therefore, they argue in favor of "a need for empirical studies that can elucidate these processes in all their inherent complexity, including the role played by intermediary actors"(Vallance et al. 2020, p. 329).

In addition, other scholars see the research on QH as still developing (Galvao, Mascarenhas, Marques, Ferreira & Ratten, 2019), meanwhile others consider that there are visible gaps at the micro-level, and by consequence the need "to address this deficit by focussing on the fundamental research question how value is collectively created, captured, and enhanced at the micro level of the quadruple helix" (Cunningham, Menter, and O'Kane 2018, p. 136). In order to address these inconsistencies, the current article aims at exploring the perceptions (focusing on the drivers of success and failure) of the stakeholders involved in Quadruple Helix initiatives in the Romanian context.

What differentiates this research from previous studies is that the focus of this analysis is on the coming together of the four helixes based on users' of the innovation ecosystems in the Romanian context.

The study is organized as follows: the first section is an introduction to the research subject and the identification of its central constructs. Further on, the second section provides a framework of academic literature focusing on innovation ecosystems and the Quadruple Helix approach. A particular emphasis is given to the collaboration dynamics between the four organizational spheres of the QH model. Further on, the third section illustrates a quantitative research, highlighting the methodology used. The outcomes of the research are presented in the fourth section, considering also possible implications for scientists and specialists. Lastly, the final section sums up the main conclusions and recommendations, also providing research limitations and possible future researches.

2 LITERATURE REVIEW. FROM THE INNOVATION ECOSYSTEM TO THE QUADRUPLE HELIX MODEL

This section focuses on the key constructs: innovation ecosystems and the Triple and Quadruple Helix Models.

2.1 Innovation ecosystems

According to Walrave, Talmar, Podoynitsyna, Romme & Verbong (2018) the construct of innovation ecosystem is seen "as a network of interdependent actors who combine specialized yet complementary resources and/or capabilities in seeking to (a) co create and deliver an overarching value proposition to end users, and (b) appropriate the gains received in the process." At the same time, de Vasconcelos Gomes Facin, Salerno & Ikenami, (2018) performed "a systematic literature review from 1993 to 2016" on the same concept and

discovered that at the core of this construct stand two major characteristics: value creation and collaboration. More recently, Granstrand & Holdersson (2020) provided in their research a new synthesized definition, stating that "an innovation ecosystem is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors. In this definition artifacts include products and services, tangible and intangible resources, technological and non-technological resources, and other types of system inputs and outputs, including innovations."

The construct of innovation ecosystem is currently embraced by many scholars and practitioners, not only due to its importance but also due to advantages and added-value that it brings forward.

2.2 The Triple Helix Model and the Quadruple Helix Model

The Quadruple Helix model emerged from the Triple Helix model, as its extension and a paradigm shift needed by all involved actors. Therefore the approach in this article will be chronological.

2.2.1 The Triple Helix Model

According to Leydesdorff & Etzkowitz, (1998) the Triple Helix model refears to the fact that, "the institutional spheres of university, industry, and government, in addition to performing their traditional functions, each assume the roles of the others, with universities creating an industrial penumbra, or performing a quasi-governmental role as a regional or local innovation organizer"(1998, p. 197). Therefore, all three are equal partners in this collaboration (Pique, Berbegal-Mirabent & Etzkowitz, 2018).

Therefore, the pillars of this model in developing the innovation ecosystem are: universities, government, and the industry (Figure 1).
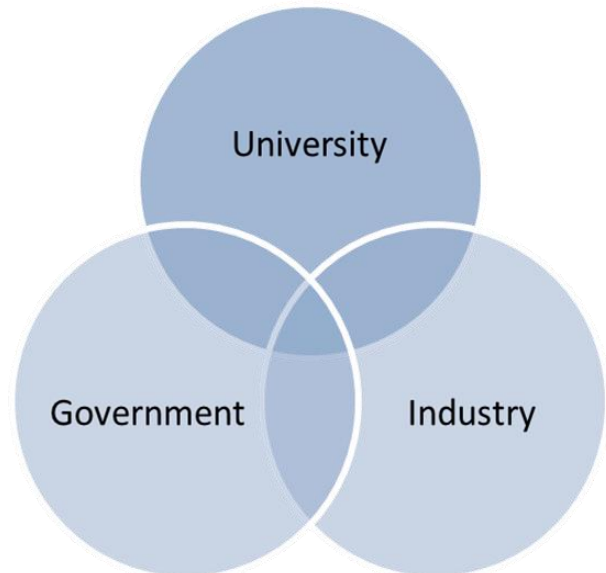

Figure 1. The Triple Helix Model

In this context, the University represents, in a generous context, activities involving education and research. The government plays a key role, referring both to central and local authorities, who issue public policies and regulations. As far as the industrial sector is concerned, it incorporates all social initiatives. This model represents the most traditional approach being a consolidated framework for scholars, government and business. At a certain point, scholars and practitioners stated that just three actors were not sufficient for long-term growth (Kimatu, 2016). Indeed, Kimatu confirmed the researchers' openness to new ideas that could increase the profitability of the helixes and therefore concluded that "the creation and simulation of better synergies among economy, society, environment, and democracy in the digital era might take its use to other levels" (Kimatu, 2016, p. 7).

2.2.2　The Quadruple Helix Model

The authors who first introduced and studied the Quadruple Helix model were Carayannis & Campbell (2009; 2010; 2012), who described it as a model that connects "(1) Industry, (2) Government, (3) University, and (4) Public" (Carayannis et al. 2021, p. 9), with the stipulation that the first three helixes were already present in another model, the Triple Helix (Etzkowitz & Leydesdorff 2000). Collaboration between these four organizational spheres represents the crux of the well-established Quadruple Helix Model (Figure 2).
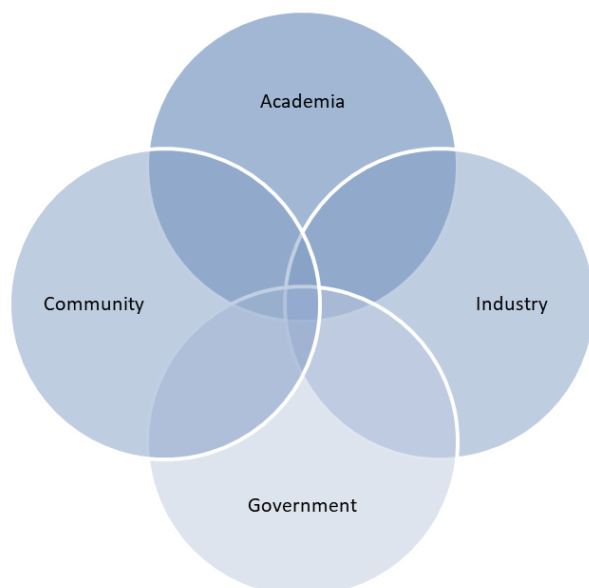

Figure 2. The Quadruple Helix Model

They explained their innovation by stating that, both economic growth and innovative development can only be driven by the efficacious collaboration of the above mentioned pillars. Consequently, the main roles of these entities are:

(1) HEIs – university knowledge generation and transfer as well as research and commercialization of innovations in the real economy;

(2) industry sector – investing in R&D, obtaining results from R&D, implementing these outcomes in production;

(3) government pillar – holds a regulatory role being the public entrepreneur and therefore offers regulatory support in the commercialization of the innovations; there are different levels of government, ranging from national to local; the role of the government is to facilitate the relation between university and industry with the main aim of maximizing public satisfaction;

(4) civil society – stands as a participant and co-owner of the resulted innovation products, also known as the end user (Hasche, Höglund, & Linton, 2020).

Another issue that also needs to be carefully looked into refers to the particular values which are co-created in each helix (Figure 3). These output values are: (1) research value (such as publications, patents, knowledge, books, awards, citations, academic reputation and other), (2) political value (e.g. democratic and efficient policy for people's rights, political support and power), (3) business value (e.g. brand awareness, market share, profit, knowledge capital, assets,), and (4) socio-ethical value (citizens' safety, justice, public well-being, participation).
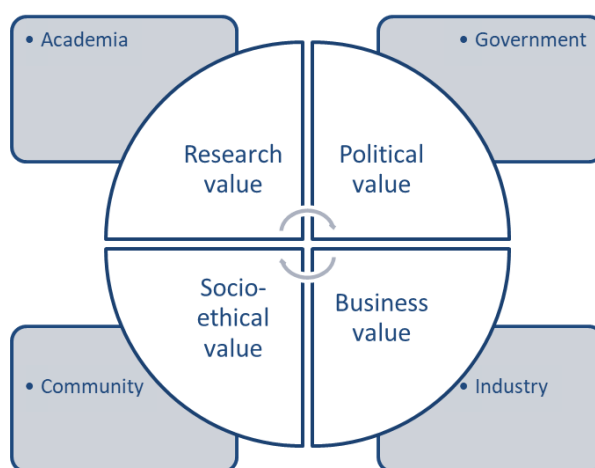

Figure 3. A processual model of the Quadruple Helix Model

Summing up, Academia refers to co-creation of research value thorough academic achievement (Dastoom, Ramzani Nezhad, & Sadeghi Boroujerdi, 2020); meanwhile the industry helix co-creates business value under the form of monetary, financial, economic and social assets directed towards customers (de Géry, Glaser, & Laviolette, 2021). The difference between academia and industry in this case is that, if, in the case of HEIs, "scholars are not directly paid for their academic output, in industry, products are exchanged at a price" (Popa, Blok, & Wesselink, 2020, p. 880).

The political values translate into achieving the people's will, the output representing not only fulfilling their will but also serving their best interest. Last, the public society helix co-produces social value. According to Garst, Blok, Branzei, Jansen & Omta "to respond to the grand challenges in society, firms require to produce innovations that comply to the dynamic and complex definition of what is societally desirable and ethically acceptable and, thus, continuously absorb knowledge on societal values from a wide set of stakeholders" (Garst et al., 2021, p. 1376).

All in all, currently "there is no consensus on what the fourth helix is comprised of, but most researchers tend to address the fourth helix in terms of the civil society, consumer, and end user" ((Hasche et al., 2020, p. 526)

However, recently, the efficiency of this framework has raised many debates (Nguyen & Marques 2021), as there are scholars who have proven the necessity to the extension of the construct. Thus, the Quintuple Helix Model emerged. This construct ads one more helix: sustainability. However, due to the focus of the current paper on the QH model, this will not make the subject of analysis.

In this study, the concept of QH model represents the theoretical and methodological basis along with the construct of innovation ecosystem with the main aim of establishing the real perception of QH stakeholders with focus on weaknesses and tensions emerging from their collaboration.

3 METHODOLOGY

3.1 Research Design

In terms of methodology, the collection of the primary data was done through 64 semi-structured interviews with the four stakeholders represented in the QH model: researchers from universities, firms' representatives, representatives of the public authorities, and associations. Due to the pandemic, the interviews were conducted virtually, via Skype, between February to June of 2021. The permission of the respondents' was received for recording the interviews. The participants who were not involved in research projects and clusters which implied the QH model of collaboration were eliminated, thus remaining only 42 valid interviews, which were further analyzed.

3.2 Sample characterization

The researchers were selected from three universities, also there were six firms' involved in the research, four representatives of the public authorities, from four city councils from Bucharest, and three associations. All participants were involved in research projects and clusters which implied the QH model of collaboration.

Table 1. Demographics of the sample

Helix	Representatives (No.)	%
University (3)	14	33%
Industry (6)	13	31%
Government (local and central) (4)	8	19%
Community/ Associations (3)	7	17%
TOTAL	42	100%

4 ANALYSIS

A key finding of the research revealed the fact that interaction between the stakeholders used to be limited mainly because "public authorities, firms and scholars are not natural partners" (Acad. 3, A.T.) within the quadruple helix and this had a negative impact on the development of the research innovation and its' further commercialization. The same aspect was underlined also by the industry participant, who stated that in his projects, "there was the least possible collaboration with academia, the public and authorities" (Ind. 5, M.V.). This brings forward that there is a sort of tension between the basic stakeholders, maybe due to a lack of common interest, but the truth is that this impacts the process of innovation. The only positive collaboration appears to exist between the Romanian public and the authorities, particularly since the public seems to embrace the public authorities' ideas of innovation. Therefore, the evidence suggests that in spite of the fact that the level of collaboration between the state, the industry and academia is limited, which leads to negative impacts on the commercialization of innovation. As a consequence, there was a "failure to integrate the different interests of the participants into a shared vision" (Gov. 2, N.A.) Another weakness observed was the "lack of well-defined, detailed processes" (Gov. 3, M.I.)

Several academics suggested that the public authorities hardly understand the challenges while pursuing innovations: "the innovations which come from our labs are fragile constructs, they cannot be simply taken and in less than half a year you cannot employ 50 people. It doesn't work like this" (Acad. 2, C. P.) Also, both academics and industry participants complained about bureaucracy, which slowed down the projects and about the government which represents the strongest of all stakeholders because "they can always withhold/withdraw the funds" (Ind. 1, D. B.). In addition, another participant stated that "there is a concerning lack of organization between various partners. There should be far more coordinated visions available. (Ind. 6, T. C.)

There were also voices which criticized the lack of correlation between public policies, which encourage on paper the QH collaborations but, in reality, the objectives and deadlines impede the development of successful innovations. As positive aspects were however noted: the political commitment present in the national middle-term and long-term strategies and the existence of public policies, in spite of their low efficiency.

Therefore, the power relation is a burden for both academia and industry. As far as the public involvement was concerned, all three stakeholders agreed on the importance of the local media which provided the local community with all the necessary data concerning the innovation.

Another issue mentioned by several participants from all four stakeholders, was the potential conflict of actors' interests in innovation ecosystems. This stands as a threat for the innovation ecosystem as each stakeholder might bring forward their own interest instead of a common interest, a common vision. As one of the community members suggested: "Partners involved in projects must not have hidden agendas, no matter if we speak about researchers, firm employees, public authorities or simple community members. We all must trust each other and trust needs to be built, particularly in a partnership" (Comm. 3, N. C.).

The ability to trust the other stakeholders was seen as essential not only for the cultivating future partnerships but also for converting knowledge into innovations and further commercialization and community sharing.

As seen above, empirical researches on innovation ecosystems and QH approach show major shortcomings indicating the necessity for further conceptualization and improvement. As observed, in innovation ecosystems, where there

are different actors involved through direct interaction, particularly in pandemic times, the emergence of unknown challenges is certain, therefore the identification and apprehension of these weakness and problems is a must.

For QH stakeholders to fully embrace their key roles in innovation ecosystems are needed more supportive tools which can facilitate academics, industry, end users and authorities to build relationships and improve their collaborations.

5   CONCLUSIONS

The analysis of innovation ecosystems models (TH, QH) proved that the research in the field has a dynamic aspect due to the continuous technological and pandemic changes and these very causes impose a continuous reinforcement of these constructs in order to make them appropriate for each project.

From the analysis of the interview data, several enablers and challenges were identified as far as the collaboration between stakeholders in the innovation ecosystems was concerned. Apparently the collaboration between stakeholders is often taken for granted, but there are many aspects which negatively impact the innovation ecosystem and commercialization.

Our findings advance the idea that a limited cooperation between the four helices translates into low interactions of participants, a lack of transparency between the actors and a negative impact on the overall projects. As a solution to this problem, we argue that it is of the utmost importance for all stakeholders to consciously engage themselves in the projects, to make efforts to involve the rest of their partners in their activities to build trust, raise awareness and increase credibility over time. However, as a future work, we consider the necessity to undergo extensive researches on projects of success and failure with regards to the QH model and create guidelines considering best practices and practices to be avoided.

We conclude that the complexity of the innovation ecosystems models forces the stakeholders to define their multi-level priorities in each project, to collaborate to increase their strengths and diminish their weaknesses in order to accomplish the projects envisaged.

Based on the mentioned major positive and negative aspects identified, further studies can proceed towards the minimization of the weaknesses and the exploitation of the strengths, so that, in the end a thorough guide of best practices can be drawn. Also, strong organizational instruments and strategies aiming at achieving efficient innovation ecosystems could make the object of future studies.

Additionally, future works should also pay closer attention to the tools that can aid maintain equilibrium in the power relationships of the four helixes in innovation ecosystems, this also leading to successful commercialization of the innovations.

This research contributes to a better understanding of the real perception of QH stakeholders with focus on strengths, weaknesses and tensions emerging from their collaboration, highlighting the importance of collaborations among them for the innovations ecosystem.

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