

THE TRIPLE HELIX MODEL APPLICABLE TO THE ROMANIAN UNIVERSITY SYSTEM: STRUCTURAL CHALLENGES AND IMPLEMENTATION PERSPECTIVES

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Abstract

The Triple Helix model, developed by Henry Etzkowitz and Loet Leydesdorff in the late 1990s, proposes a reconfiguration of the relationships among universities, the business sector, and public authorities in order to support innovation and the development of a knowledge-based economy. This article examines the extent to which this model can be applied within the Romanian university system, taking into account the institutional, legislative, and cultural particularities of the national academic environment. It also presents examples of good practices from European universities such as the University of Twente, Lund University, and British higher education institutions. The paper discusses the main barriers limiting the convergence of the three spheres, including excessive bureaucracy, insufficient research funding, limited mobility of personnel between academia and industry, and the absence of a well-established culture of academic entrepreneurship. Furthermore, it identifies strategic directions for strengthening university-industry-government partnerships, with particular emphasis on the role of regional universities in supporting local economic development.

Key words: higher education, innovation, Romanian university system, Triple Helix model, university-industry-government partnership

JEL Classification: I23, O31, O38

I. INTRODUCTION

The transition towards a knowledge-based economy has required a reconsideration of the role of universities, which are no longer viewed exclusively as institutions for transmitting knowledge, but increasingly as active actors in the process of economic and social innovation. In this context, the Triple Helix model, initially formulated by Etzkowitz and Leydesdorff (2000), provides an analytical framework for understanding the interactions among universities, industry, and government, emphasizing that each of the three institutional spheres may partially assume the roles of the others, thus generating hybrid structures such as business incubators, science and technology parks, and technology transfer centers.

Unlike linear models of innovation, in which government coordinates the relationship between research and industry, the Triple Helix model assumes a trilateral and relatively symmetrical relationship in which the university acquires an increasingly active role, approaching what Etzkowitz (2003) describes as the “entrepreneurial university.” For university systems in transition, such as the Romanian one, the implementation of this model raises legitimate questions regarding institutional readiness, the capacity to finance applied research, and the willingness of economic actors to invest in long-term partnerships with academia.

The objective of this article is to critically analyze the potential and limitations of applying the Triple Helix model within the Romanian university system, with particular emphasis on universities located outside major metropolitan centers, which face additional challenges related to limited access to private capital and research infrastructure.

II. THEORETICAL FRAMEWORK OF THE TRIPLE HELIX MODEL

The Triple Helix model originated from analyses of innovation dynamics in advanced economies, where Etzkowitz and Leydesdorff (2000) observed a gradual shift from the “statist” model, in which the state controls both universities and industry, toward a model in which the three institutional spheres, namely academia, industry, and government, maintain their distinct identities while interacting within an overlap space that generates innovation. Etzkowitz and Leydesdorff (1998) described this process as an “endless transition,” in which the boundaries between institutional spheres become increasingly permeable without any of them losing its own identity.

A central element of the model is the concept of a “spiral” of interactions: each institutional sphere not only fulfills its traditional function but also gradually adopts attributes of the other two. The university thus becomes an economic actor through the commercialization of research results, industry acquires an academic dimension through its own research and development activities, and government assumes the role of a “public venture capitalist” by financially supporting innovation initiatives situated at the interface between research and the market (Etzkowitz, 2008). The mechanisms through which academic knowledge is transformed into economic value, including licensing, spin-offs, and research contracts, are extensively analyzed by Viale and Etzkowitz (2010) in their work on the “capitalization of knowledge.”

Ranga and Etzkowitz (2013) subsequently expanded the analytical framework of the model by distinguishing between institutional components (the actors themselves) and functional components (knowledge generation, innovation, and regulation), arguing that the effectiveness of a Triple Helix system depends on the balance between these two dimensions. Later contributions to the literature proposed extending the model to a “Quadruple Helix” through the inclusion of civil society and the cultural environment as a fourth institutional sphere, and further to a “Quintuple Helix,” which incorporates the natural environment in order to align innovation processes with sustainable development goals (Carayannis & Rakhmatullin, 2014).

Within the literature focusing on the Romanian economic environment, Miron (2008) analyzed the convergence between the “double helix” of learning and work and the “triple helix” of university-industry-government relations, highlighting the conceptual limitations of the model when applied to academic systems with limited experience in economic partnerships. This observation remains highly relevant today, given the relatively slow pace of institutional reforms within Romanian higher education.

III. BEST PRACTICES IN EUROPEAN UNIVERSITIES

An analysis of European experiences demonstrates that the implementation of the Triple Helix model does not follow a single formula but rather adapts to the institutional, economic, and cultural specificities of each national higher education system. The case of the University of Twente in the Netherlands is frequently cited as an example of a regionally oriented entrepreneurial university. As highlighted in HEInnovate case studies, the university has developed over several decades a local ecosystem of spin-offs and research-based companies, supported through close collaboration with regional authorities and the business community of the Twente region (CHEPS, 2019).

Lund University in Sweden provides both a relevant example and a critical perspective on the model. Göransson, Chaminade, and Bayuo (2022), based on interviews with university leaders, researchers, and students, show that the institutional logic of the Triple Helix model, centered on university-industry-government collaboration for national economic competitiveness, has been increasingly challenged by internal and external pressures requiring universities to assume broader social responsibilities beyond direct industrial applications. The Lund case therefore illustrates the tension between a narrow interpretation of the university’s “third mission” and its expansion toward social innovation.

Within the British higher education system, Sánchez-Barrioluengo, Uyarra, and Kitagawa (2016) analyzed the evolution of Triple Helix interactions using data from the Higher Education Business Community Interaction Survey (HEBCI), identifying persistent heterogeneity between research-intensive universities and institutions with a stronger teaching orientation. The authors emphasize that the way British universities configure their “third mission” varies significantly according to institutional type, external partners, and regional context, suggesting that the success of the Triple Helix model depends largely on its alignment with the specific profile of each institution rather than on the uniform application of standardized policy measures.

Relevant examples can also be found among medium-sized universities located in less-developed European regions. Natário et al. (2014) document the role of the Polytechnic Institute of Guarda, Portugal, in regional innovation dynamics, demonstrating that interaction among universities, enterprises, and local authorities can contribute to territorial development even in the absence of a large-scale research ecosystem, provided that effective cooperation mechanisms exist among the three spheres. Likewise, research conducted at Babeş-Bolyai University by Pop, Beleiu, Mihăilă, and Crişan (2017) emphasizes the importance of clearly defining the university mission within the Triple Helix context as a prerequisite for strategic positioning in relation to industry and public authorities.

A common conclusion emerging from these cases is that the effectiveness of the Triple Helix model does not depend exclusively on the size or reputation of a university but rather on the institutional continuity of collaborations, the existence of dedicated interface structures connecting academia and industry, and the university’s ability to clearly define its role in relation to the regional community it serves. These elements can provide valuable guidance for the reform of the Romanian university system.

IV. STRUCTURAL CHARACTERISTICS OF THE ROMANIAN HIGHER EDUCATION SYSTEM

The Romanian higher education system operates within an institutional environment that presents both opportunities and constraints for the implementation of the Triple Helix model. While policy discourse increasingly emphasizes innovation, entrepreneurship, and knowledge transfer, the structural conditions necessary for sustained university-industry-government interaction remain only partially developed (Etzkowitz & Leydesdorff, 2000; Ranga & Etzkowitz, 2013).

A first determinant concerns research funding. Compared with European innovation leaders, Romanian universities continue to operate under constrained financial conditions, limiting investments in research infrastructure, technology transfer capabilities, and applied research activities. Data published by the European Innovation Scoreboard indicate that Romania remains among the lowest-performing European innovation systems, particularly regarding public and private investments in research and development (European Commission, 2025). Likewise, Eurostat statistics show that Romania's expenditure on research and development remains significantly below the European Union average, affecting universities' capacity to participate effectively in innovation ecosystems (Eurostat, 2025).

A second challenge relates to institutional culture. Historically, Romanian universities have been organized around the traditional academic missions of teaching and research. Although recent reforms have encouraged greater engagement with industry and society, entrepreneurial activities frequently remain peripheral to institutional strategies (Etzkowitz, 2003). As a result, technology transfer mechanisms are often weakly integrated into university governance structures and depend heavily on project-based funding. Similar challenges have been identified by Popescu and Mandru (2019), who argue that technology transfer structures in Romanian universities often lack long-term institutional sustainability.

Regional disparities constitute a third structural characteristic shaping Triple Helix implementation. Universities located in major academic centres benefit from stronger innovation ecosystems, larger labour markets, higher concentrations of research institutions, and greater access to industrial partners. Conversely, regional universities often operate in environments characterized by weaker knowledge-intensive industries and lower levels of private investment in research and development. However, these institutions possess a potential comparative advantage through their proximity to local communities and stakeholders (Natário et al., 2014).

A further constraint emerges from the regulatory environment governing research commercialization and academic entrepreneurship. Despite efforts to modernize the legislative framework, administrative complexity and institutional uncertainty continue to constrain the development of university spin-offs, research contracts, and intellectual property management practices. Such challenges have also been identified in studies focusing on innovation governance in Central and Eastern Europe (Miron, 2008; Ilie, 2022).

Taken together, these structural characteristics suggest that the Romanian higher education system remains in a transitional phase, moving progressively from a predominantly teaching-oriented model toward a more integrated innovation-oriented framework.

V. TRIPLE HELIX IMPLEMENTATION IN ROMANIA: EMERGING PRACTICES AND STRUCTURAL CONSTRAINTS

Evidence gathered from institutional developments across Romanian universities indicates a gradual progression toward Triple Helix-oriented governance arrangements. Technology transfer centres, innovation hubs, entrepreneurship laboratories, and university-business partnership programmes have become increasingly visible components of the higher education landscape (Popescu & Mandru, 2019; Ilie, 2022).

European funding programmes have played a particularly important role in this transformation. Participation in Horizon Europe projects, European Structural Funds initiatives, and regional development programmes has enabled universities to strengthen research infrastructure, support innovation-oriented activities, and foster partnerships with external stakeholders (European Commission, 2025). Such initiatives have contributed to the emergence of hybrid organizational structures that facilitate knowledge transfer and promote collaboration among academic, economic, and governmental actors, a process described by Etzkowitz (2008) as a defining feature of entrepreneurial universities.

The most advanced examples of Triple Helix implementation can be observed in universities that have succeeded in integrating research activities, entrepreneurial support services, and external stakeholder engagement into coherent institutional strategies. The experiences of the University of Twente and Lund University illustrate how sustained collaboration among institutional actors can generate dynamic innovation ecosystems (CHEPS, 2019; Göransson et al., 2022).

Nevertheless, the findings reveal that the institutionalization of Triple Helix interactions remains uneven. A persistent challenge concerns the limited alignment between the supply of academic knowledge and the

innovation needs of industry. Similar observations were reported by Sánchez-Barrioluengo et al. (2016), who found substantial variation in university-industry engagement depending on institutional profiles and regional contexts.

Another significant barrier is the relatively weak mobility of human capital between academia and industry. International evidence consistently demonstrates that knowledge transfer is facilitated by the circulation of researchers, professionals, and entrepreneurs across institutional boundaries (Ranga & Etzkowitz, 2013). In Romania, however, academic and private-sector career trajectories remain largely separate, reducing opportunities for mutual learning and collaborative innovation.

The analysis also identifies governance fragmentation as a major constraint. Innovation policy, higher education policy, and regional development policy are frequently implemented through separate institutional channels, creating coordination challenges and limiting policy coherence. Consequently, Triple Helix initiatives often depend on individual leadership or temporary project financing rather than stable institutional mechanisms.

These findings suggest that Romanian universities are increasingly participating in innovation ecosystems but have not yet achieved the level of institutional integration characteristic of mature Triple Helix systems.

Table 1. Romania versus European Union: Selected Indicators Relevant to Triple Helix Development

Indicator	Romania	EU Average	Relevance for Triple Helix
Summary Innovation Index (EU=100)	37.7	100	Reflects overall innovation performance and systemic innovation capacity.
Innovation Classification	Emerging Innovator	EU Average Benchmark	Indicates Romania's position within the European innovation landscape.
R&D Expenditure (% GDP, 2023)	0.52%	2.26%	Measures national commitment to knowledge generation and innovation.
Population with Tertiary Education (indexed to EU=100 in EIS 2025)	0	100	Reflects human capital available for research and innovation activities.
International Scientific Co-publications (indexed to EU=100)	25.5	100	Indicates international research integration and collaboration capacity.
Public Sector R&D Expenditure (indexed to EU=100)	13.3	100	Measures public support for research and knowledge production.
Digital Skills Above Basic Level (indexed to EU=100)	21.3	100	Reflects workforce readiness for knowledge-based economic activities.
High-Speed Internet Access (indexed to EU=100)	127.5	100	Represents digital infrastructure supporting innovation ecosystems.

Source: European Commission, Eurostat (2025)

Romania's innovation performance remains substantially below the EU average, with the European Innovation Scoreboard 2025 classifying the country as an *Emerging Innovator* and assigning a Summary Innovation Index of 37.7 (EU=100). The largest deficits are observed in research funding, human capital development, international scientific collaboration, and public investment in research. However, digital infrastructure performance is comparatively strong, suggesting the presence of technological foundations that may support future innovation-driven growth.

VI. DISCUSSION AND POLICY IMPLICATIONS

The results indicate that the future development of Triple Helix dynamics in Romania will depend less on the creation of additional structures and more on the strengthening of institutional relationships among existing

actors. The challenge is therefore not merely organizational but systemic, requiring a shift from episodic collaboration toward long-term strategic partnerships (Etzkowitz & Leydesdorff, 2000).

From a university perspective, a key priority involves the reconfiguration of incentive systems. Academic performance metrics continue to focus predominantly on publications and teaching activities, providing limited recognition for technology transfer, entrepreneurship, or industry engagement. Broadening evaluation frameworks could encourage greater participation in innovation-oriented activities and strengthen universities' contribution to regional development (Etzkowitz, 2003; Viale & Etzkowitz, 2010).

A second implication concerns the strategic role of intermediary organizations. Technology transfer offices, innovation centres, incubators, and entrepreneurship support structures represent critical mechanisms through which universities interact with external stakeholders. Their effectiveness depends not only on financial resources but also on institutional legitimacy, professional management, and integration into broader university strategies (Popescu & Mandru, 2019).

The findings further suggest that public authorities play a decisive role in shaping innovation ecosystems. Effective policy intervention extends beyond funding and includes regulatory simplification, support for university spin-offs, facilitation of collaborative research programmes, and the development of regional innovation strategies (European Commission, 2025; Ilie, 2022).

Particularly noteworthy is the role of regional universities. Conventional approaches often assess institutional performance primarily through research output indicators. However, universities operating in peripheral or less-developed regions frequently generate value through alternative mechanisms, including workforce development, entrepreneurship support, social innovation, community engagement, and regional capacity building (Natário et al., 2014).

The proposed Regional Triple Helix Framework responds to this challenge by conceptualizing regional universities as anchor institutions that connect local communities, businesses, and public authorities within place-based innovation ecosystems. Such a perspective is especially relevant for Romania, where regional disparities continue to represent a major development challenge.

Overall, the analysis suggests that Romania has entered a transition phase characterized by increasing institutional awareness of innovation and collaboration. However, further progress will require coordinated efforts from universities, policymakers, industry representatives, and regional stakeholders.

VII. CONCLUSIONS

This study has examined the applicability of the Triple Helix model within the Romanian higher education system through a comparative and institutional perspective. The analysis indicates that Romania possesses many of the fundamental elements required for Triple Helix development, including an expanding higher education sector, increasing participation in European research programmes, and growing policy interest in innovation-driven development (European Commission, 2025).

However, the transition toward a mature Triple Helix ecosystem remains constrained by several structural challenges. Insufficient research investment, limited technology transfer capacity, fragmented governance arrangements, weak cross-sectoral mobility, and pronounced regional disparities continue to restrict the development of sustainable university-industry-government partnerships (Eurostat, 2025; European Commission, 2025).

The comparative evidence demonstrates that successful Triple Helix systems are characterized not only by adequate financial resources but also by strong institutional coordination, a culture of collaboration, and the presence of effective intermediary organizations (Etzkowitz, 2008; Ranga & Etzkowitz, 2013). These factors appear more influential than institutional size alone in explaining innovation performance.

The principal contribution of this article lies in highlighting the strategic importance of regional universities within the Romanian innovation landscape. Rather than reproducing the development trajectories of large metropolitan universities, regional institutions may create value through their embeddedness in local socio-economic contexts and their capacity to stimulate place-based innovation processes (Natário et al., 2014; Göransson et al., 2022).

From a policy perspective, strengthening Triple Helix interactions requires coordinated action by universities, public authorities, and private-sector actors. Universities must further develop entrepreneurial capabilities and external engagement mechanisms; government institutions must improve policy coherence and support collaborative innovation; and businesses must assume a more active role in knowledge generation and technology development processes.

Future research should build upon these findings through empirical investigation of innovation networks, university-industry partnerships, and regional ecosystems across different Romanian regions. Such analyses would contribute to a deeper understanding of the mechanisms through which Triple Helix interactions foster innovation, competitiveness, and sustainable territorial development.

The framework suggests that regional innovation performance emerges from the dynamic interaction among three institutional spheres. Universities contribute through education, research, entrepreneurship, and community engagement; industry provides innovation demand, investment opportunities, and commercialization channels; while governmental actors ensure regulatory support, funding mechanisms, and regional development coordination.

The overlap space generated by these interactions creates a regional innovation ecosystem comprising technology transfer centres, incubators, science parks, start-ups, collaborative research projects, and lifelong learning programmes. The expected outcomes include enhanced regional competitiveness, greater commercialization of academic knowledge, increased employment opportunities, entrepreneurial growth, and sustainable regional development. The framework is particularly relevant for Romanian universities operating outside major metropolitan centers, where proximity-based networks may compensate for resource constraints and facilitate localized innovation processes. (Author's conceptualization based on Triple Helix theory and regional innovation literature.)

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