Three Seas Economic Journal
Vol. 6 No. 2, 2025
DOI https://doi.org/10.30525/2661-5150/2025-2-3

QUADRUPLE HELIX IN POLICY DESIGN: RETHINKING INDUSTRIAL REVITALIZATION IN TRANSITIONAL ECONOMIES

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Abstract. This article comprehensively examines the relevance and operationalization of the Quadruple Helix (QH) model as a transformative framework for designing robust industrial policy within transitional economies. The study focuses on integrating academia, industry, government, and civil society as co-equal stakeholders in innovation and economic governance. This is particularly pertinent given the systemic challenges inherent in post-socialist and post-crisis contexts, often characterized by profound institutional fragility, civic disengagement, and significant policy fragmentation. Traditional, top-down approaches to industrial revitalization have proven insufficient and unsustainable in such complex environments. The QH model offers a powerful normative and functional framework, offering a foundation for inclusive, democratic, and resilient policy co-creation processes that can genuinely address these underlying systemic weaknesses. The study employs a rigorous mixed-method qualitative approach. It begins with a systematic literature review of Quadruple Helix theory, exploring its conceptual evolution, theoretical underpinnings, and practical applications, including a comparative analysis of Triple versus Quadruple Helix governance structures. Building on this, the research constructs a novel conceptual framework centered on four critical governance functions: knowledge co-creation, institutional bridging, participatory legitimacy, and adaptive governance. This framework is subsequently tested and illustrated through three documented case studies: from Lithuania, Finland, and EU Interreg regions. These cases, drawing on diverse empirical evidence, provide rich insights into how QH mechanisms operate and translate into tangible policy outcomes across varied environments. The overarching goal of this article is to develop a practical, theoretically grounded, and empirically informed model for QH-based industrial policy specifically tailored for transitional settings. It seeks to demonstrate that genuine stakeholder co-creation, when appropriately institutionalized through clear legal mandates, robust intermediary platforms, and feedback-driven iterative governance processes, can effectively address deep-seated policy inertia, enhance public trust, and significantly bolster policy legitimacy. The findings clearly demonstrate that QH-informed approaches foster enhanced cross-sectoral coordination and resource mobilization, enabling critical place-based adaptability and promoting sustained, meaningful civic engagement. However, the research also highlights persistent challenges, including civic capacity gaps, the risk of symbolic participation, and resource limitations, particularly where enabling legal and institutional infrastructures are underdeveloped. In conclusion, the article firmly asserts that the Quadruple Helix model holds significant potential as a transformative governance logic for industrial revitalization. When thoughtfully adapted to the unique realities of transitional economies, it provides a robust foundation for policy design that is both deeply participatory and finely context-sensitive. The model moves beyond mere rhetorical inclusion of stakeholders, emphasizing the imperative need for systemic structures and processes that actively support long-term, democratic, and inclusive innovation. Policymakers are encouraged to embed QH principles through formal frameworks, dedicated funding, and iterative co-design practices to truly realize inclusive and sustainable industrial development that benefits all societal actors.

Keywords: Quadruple Helix, industrial policy, transitional economies, innovation governance, participatory policy design, Smart Specialization, policy co-creation.

JEL Classification: O25, O31, H11, P20, R58

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1. Introduction

Transitional economies emerging from systemic transformation – such as post-socialist restructuring, conflict recovery, or institutional reconfiguration – face persistent challenges in designing effective industrial policy. These settings are often characterized by weak administrative capacity, fragmented institutional landscapes, civic disengagement, and the erosion of trust in both state and market institutions. Traditional models of industrial revitalization, which rely on linear innovation logics and centralized governance, tend to fall short in such complex environments. Their limited adaptability, narrow stakeholder base, and sectoral silos inhibit inclusive development and hinder the societal anchoring of innovation strategies.

In response to these limitations, researchers and policymakers have increasingly turned to multi-actor governance models, among which the Quadruple Helix (QH) has gained growing attention. Evolving from the earlier Triple Helix model – which conceptualized innovation as the outcome of interactions among universities, industry, and government (Etzkowitz & Leydesdorff, 2000) – the QH framework introduces civil society as a fourth helix. This addition is more than a structural expansion; it represents a paradigmatic shift towards knowledge democracy and participatory governance. By including civil actors such as NGOs, media, grassroots initiatives, and informal networks, the QH model foregrounds the normative and cultural dimensions of innovation, repositioning it as a process of co-created public value (Carayannis & Campbell, 2010; Campbell et al., 2015).

The growing literature on QH underscores its relevance in settings where legitimacy, adaptability, and societal alignment are critical. Hasche et al. (2019) describe QH as a relational network that mobilizes diverse resources and perspectives for systemic innovation. Cai and Lattu (2022) demonstrate that QH-based systems exhibit greater resilience and responsiveness, particularly in low-trust institutional environments. Morawska-Jancelewicz (2022) further emphasizes the boundary-spanning role of universities in facilitating cross-sectoral innovation ecosystems through civic partnerships. Yet, despite these theoretical advances, the operationalization of QH remains underdeveloped in the specific domain of industrial policy, particularly in transitional contexts where formal institutions are fragile and participatory mechanisms are emergent or inconsistent.

This article seeks to address that gap by constructing and empirically testing a QH-informed framework for industrial policy design in transitional economies. It argues that the effectiveness of industrial revitalization in such settings depends less on technical instruments or financial incentives, and more on the governance architecture that enables broad-based participation, institutional learning, and adaptive implementation. Drawing from the QH literature and documented practices, the article advances four interrelated hypotheses: that QH-based industrial policy enhances stakeholder legitimacy and policy alignment; that civil society engagement improves feasibility and public ownership; that intermediary institutions are essential for translating co-design into action; and that adaptive governance structures are necessary to sustain QH logic in volatile environments.

The aim of this article is twofold: first, to develop a theoretically grounded and context-sensitive model for QH-based industrial policy; and second, to demonstrate its empirical relevance through case illustrations from Lithuania, Finland, and EU Interreg regions. These cases, situated at national, regional, and local levels, offer diverse insights into how QH principles can be operationalized to support inclusive and sustainable industrial development. The structure of the article is as follows: after this introduction, the next section reviews the evolution of the QH model and its applications in innovation and governance literature. This is followed by the presentation of a conceptual framework based on four governance functions. The fourth section presents three empirical case illustrations. The fifth discusses policy implications, and the article concludes by reflecting on limitations and directions for future research.

2. Literature Review

The evolution of industrial innovation theory reflects a broader shift from technocratic planning to collaborative governance. Initially, innovation was conceived through the lens of the linear model, where progress moved predictably from basic research to commercial application (Kline & Rosenberg, 1986). However, as economies and societies grew more complex, this model was increasingly criticized for its reductionism. Emerging frameworks such as National Innovation Systems (Freeman, 1987; Lundvall, 1992) and the Triple Helix model (Etzkowitz & Leydesdorff, 2000) responded to this critique by focusing on interactions among key institutional actors – universities, industry, and government – as the primary drivers of knowledge-based development.

While the Triple Helix approach represented a major step forward in institutionalizing innovation networks, it was soon evident that it failed to account for the broader societal dynamics shaping knowledge production and technological transformation. Civil society remained largely excluded from the co-creation process, seen more as a beneficiary than as an active agent. Responding to this shortfall, Carayannis and Campbell (2009; 2010) introduced the Quadruple Helix (QH) model, which explicitly includes civil society as a structural and normative

actor within innovation ecosystems. The QH framework embeds innovation within the wider societal context, emphasizing democratic legitimacy, pluralistic knowledge creation, and alignment with societal values such as environmental sustainability, social cohesion, and regional inclusivity.

The distinction between Triple and Quadruple Helix configurations lies not only in the number of actors but in the underlying governance logic. Whereas Triple Helix models tend to emphasize institutional coordination and commercialization, QH emphasizes participatory governance, co-design, and public value. This conceptual difference is summarized in Table 1. As Cai and Lattu (2022) argue, QH systems are particularly resilient in contexts where institutional trust is weak or governance structures are under strain. Hasche et al. (2019) likewise suggest that QH should not be seen as a formal framework but rather as a dynamic network of relationships in which knowledge and legitimacy co-evolve.

Within the QH model, universities are reimagined not simply as generators of scientific output, but as civic institutions with a mandate to engage across sectors and align research with public priorities. Morawska-Jancelewicz (2022), drawing on the Polish context, highlights how universities can act as boundary-spanners that mediate between state objectives and grassroots innovation. This role is particularly critical in peripheral or transitional regions, where institutional voids may inhibit formal coordination. In such settings, universities serve as anchors for civic dialogue and institutional experimentation.

Equally important is the expanded role of civil society, which is no longer a passive recipient of innovation benefits but a key co-producer of contextual knowledge. This includes not only formal NGOs but also informal networks, community organizations, and local media, all of which contribute to what Carayannis and Campbell (2010) refer to as "knowledge democracy." Campbell, Carayannis and Rehman (2015) emphasize that meaningful civil engagement enhances the democratic quality of policy design and improves implementation feasibility. In transitional contexts – where state institutions are often mistrusted and civic infrastructure underdeveloped – this role becomes even more salient.

Despite these conceptual advances, operationalizing QH in policy practice remains uneven. Some promising applications have been documented, notably in regional innovation strategies in Europe. For instance, Nordberg et al. (2020) analyze QH coordination in peripheral Finnish regions through community-led innovation platforms. These platforms deliberately flatten hierarchies, support inclusive participation, and create spaces for deliberation. Yun and Liu (2019) emphasize the role of intermediary institutions – such as living labs and civic hubs – in mediating interactions among helices and sustaining long-term engagement. Lindberg et al. (2014) caution, however, that without institutional safeguards, QH risks becoming symbolic or co-opted by dominant actors.

The relevance of QH becomes even more pronounced in transitional economies, where traditional governance mechanisms are often fragile or contested. Kolehmainen et al. (2016) note that institutional volatility, capacity asymmetries, and civic disengagement can either constrain or catalyze innovation, depending on how governance is structured. In such environments, QH serves not merely as an innovation model but as a governance logic – one that supports institutional learning, cross-sectoral coordination, and policy resilience. By embedding innovation within democratic and place-based processes, QH offers transitional economies a viable pathway to inclusive industrial revitalization.

3. Conceptual Framework

In transitional economies, industrial policy must function not only as a vehicle for economic modernization but also as a mechanism for rebuilding institutional trust, enhancing democratic legitimacy, and enabling systemic adaptation. This requires a fundamental rethinking of how industrial policy is conceived and implemented. Traditional models, focused on centralized planning and linear innovation, struggle to cope with the multidimensional uncertainties and civic disengagement that characterize post-socialist or post-crisis settings. The Quadruple Helix (QH) model offers an alternative logic, grounded in multi-actor collaboration, distributed governance, and participatory design.

At its core, QH reconceptualizes industrial policy as a co-constructed, socially embedded process. Rather than positioning the state or market as sole drivers,

Table 1
Comparative Features of Triple Helix and Quadruple Helix Innovation Models

Feature	Triple Helix	Quadruple Helix
Core Actors	University, Industry, Government	Adds Civil Society
Governance Style	Institutional Coordination	Participatory, Reflexive
Innovation Logic	Knowledge Commercialization	Knowledge Co-creation & Democracy
Relevance to Society	Indirect	Central
Common Applications	High-tech, R&D policy	Social innovation, regional development

QH frames innovation and policy as outcomes of continuous interaction among academia, industry, government, and civil society. This model aligns with the notion of "Mode 3" knowledge production advanced by Carayannis and Campbell (2009), which highlights the importance of hybrid, non-linear, and reflexive systems capable of integrating diverse perspectives. In contexts of institutional fragility and social fragmentation, such an approach enables not only better technical solutions but also more legitimate and resilient governance arrangements.

Building on this theoretical foundation, we propose a conceptual framework that identifies four interrelated governance functions essential to QH-based industrial policy in transitional economies: knowledge co-creation, institutional bridging, participatory legitimacy, and adaptive governance. These functions are not discrete stages, but overlapping processes that reinforce one another over time. Knowledge co-creation involves the joint development of policy agendas and implementation strategies by diverse stakeholders. It requires recognizing and integrating not only formal scientific knowledge but also experiential and local insights. Mechanisms such as foresight workshops, living labs, and participatory R&D platforms can facilitate this process, ensuring that industrial strategies are context-sensitive and socially informed.

Institutional bridging refers to the construction of interfaces and mediating structures that enable alignment between sectors with different logics, interests, and time horizons. In transitional settings where institutions are fragmented, this function becomes critical for reducing transaction costs, avoiding siloed decision-making, and fostering interoperability. Intermediary actors – such as university innovation offices, regional development agencies, and civic platforms – play a central role in this bridging process, translating ideas into coordinated action and connecting policy intentions with implementation capabilities.

Participatory legitimacy concerns the embedding of inclusive mechanisms into policy cycles to generate trust, transparency, and democratic accountability. Especially in post-authoritarian or crisis-affected contexts, legitimacy cannot be assumed – it must be continuously produced through deliberation and responsiveness. This involves creating real opportunities for civil society actors to influence decision-making, not just through consultation but through co-decision processes, agenda-setting rights, and participatory monitoring. As Lindberg et al. (2014) suggest, legitimacy in such settings is not a secondary benefit but a core condition for sustainability.

The final function – adaptive governance – emphasizes the importance of learning-oriented, reflexive institutional arrangements that can respond to shifting conditions and emerging challenges. In volatile political and economic environments, rigid policy instruments are likely to fail. Instead, what is needed are iterative planning processes, embedded feedback loops, and polycentric governance structures that allow for recalibration over time. This aligns with Yun and Liu's (2019) observation that QH systems operate best when they are designed as evolving ecosystems rather than fixed policy architectures.

The roles of QH actors are dynamic and context-dependent. Universities contribute foresight, research, and legitimacy; businesses bring innovation capacity and scaling potential; governments provide regulatory frameworks and strategic direction; civil society offers normative grounding and public accountability. Effective coordination among these actors depends on meso-level structures such as regional innovation councils, thematic clusters, and hybrid governance bodies. These structures serve to institutionalize interaction, mitigate power asymmetries, and ensure continuity.

Despite its promise, the QH model also faces significant operational risks. In transitional contexts, where power asymmetries are often entrenched, dominant actors may instrumentalize participatory structures for symbolic legitimacy while retaining control. Legal or bureaucratic gaps may hinder the formal recognition of civic intermediaries. Civil society actors may lack the capacity, funding, or expertise to engage meaningfully. Without safeguards – such as procedural transparency, institutionalized feedback, and equitable resourcing – QH can devolve into tokenism.

In response, our conceptual framework underscores the need for deliberate institutional design. Table 2 summarizes how each governance function corresponds to specific instruments and expected outcomes in the context of QH-based industrial policy. These functions are not only analytical categories but actionable levers for reform. By operationalizing them in an integrated manner, transitional economies can build more inclusive, coherent, and resilient industrial governance systems.

4. Case Illustration

To examine how the Quadruple Helix (QH) model is translated into practice, this section presents three documented case illustrations from Lithuania, Finland, and the Interreg North Sea Region. These examples, operating at national, regional, and municipal levels respectively, highlight different pathways to incorporating academia, industry, government, and civil society into inclusive policy design in transitional and peripheral contexts. They

Table 2
Quadruple Helix Governance Functions in Transitional Industrial Policy

Function	Operational Focus	Governance Instruments	Expected Outcomes
Knowledge Co-Creation	Inclusive agenda setting, local knowledge	Living labs, civic foresight, participatory R&D	Context-sensitive policies, innovation alignment
Institutional Bridging	Cross-sectoral coordination	Hybrid councils, intermediaries, policy networks	Reduced fragmentation, integrated strategies
Participatory Legitimacy	Democratic accountability	Co-decision mechanisms, civic monitoring platforms	Public trust, policy acceptability
Adaptive Governance	Policy learning and reflexivity	Feedback loops, scenario planning, policy iteration	Flexibility, responsiveness to change

were selected based on their empirical grounding, relevance to QH literature, and alignment with industrial or innovation policy agendas.

Among the Eastern European states, Lithuania stands out for having developed one of the most structured national-level applications of the QH model through its Smart Specialisation Strategy (S3). Following its accession to the European Union in 2004, Lithuania faced the challenge of transitioning from low-value manufacturing toward a knowledge-driven economy. The national S3, adopted in 2013 and updated in 2019, was designed within the EU cohesion policy framework to prioritize investments in competitive and socially relevant sectors. The design process incorporated more than 500 stakeholders, including universities, chambers of commerce, and civil society organizations, who collectively identified priority domains through thematic working groups. The Agency for Science, Innovation and Technology (MITA) served as the key intermediary institution, facilitating public consultations, foresight exercises, and innovation funding allocation. According to the Joint Research Centre of the European Commission (2020), Lithuania's participatory foresight design was among the most comprehensive in Eastern Europe. The results included co-created policy priorities in biotechnology, laser technologies, and the circular economy, with over 800 innovation projects funded across six strategic domains between 2014 and 2019. Emerging regional clusters in Kaunas and Šiauliai reflected an embryonic institutionalization of QH logic. However, despite these formal inclusions, civil society actors often struggled with technical language, bureaucratic procedures, and lack of sustainable funding, which limited their ability to remain engaged in the long term (Kurk Lietuvai, 2019).

At the regional level, the Helsinki-Uusimaa region in Finland provides a compelling example of civic-driven QH implementation. In 2018, the regional council initiated a participatory foresight process known as "Wings and Roots" as part of the Smart Specialisation Strategy renewal. This initiative sought to expand innovation governance by incorporating civic voices – particularly those of youth, educators, and underrepresented groups – into the formulation of regional priorities. Citizens engaged in workshops hosted by schools and universities, contributed to digital scenario-building exercises, and participated in idea-ranking platforms. The University of Helsinki's Centre for Consumer Society Research played a key coordinating role, while the Helsinki Region Infoshare platform ensured open access to data and planning documents. The participatory process attracted over 3,000 contributors and led to the emergence of new innovation themes, such as inclusive mobility and decarbonized logistics. These preferences were incorporated into the revised 2021 S3 strategy, with tangible shifts in funding allocations toward citizen-defined priorities. Public perception of legitimacy improved, as evidenced by participation rates and media discourse (Albrecht & Huovila, 2022). Still, important limitations persisted: participants lacked mechanisms to trace how their input shaped final decisions, and short-term funding cycles limited the institutionalization of civic co-design structures.

At the municipal level, the Interreg North Sea Region (NSR) project "In For Care" demonstrates how QH collaboration can be applied in community-based service innovation, even in localities without formal innovation infrastructure. This project focused on rethinking elderly care in small municipalities across Belgium, the Netherlands, and Norway. Municipal governments acted as institutional anchors, leading participatory planning processes that engaged carer associations, small technology firms, local NGOs, and academic institutions. Universities supported the effort by designing foresight methods and evaluation frameworks, while civil society organizations co-developed new service delivery models rooted in local needs. The initiative culminated in the creation of co-governance structures and the publication of a QH Innovation Guide (Interreg NSR, 2020), which was disseminated across the region. The project piloted community-based e-health solutions with high rates of user satisfaction and trust, compared to traditional top-down delivery models. Nonetheless, sustaining this approach proved difficult. Without national policy alignment and long-term financial support,

participating municipalities faced challenges in scaling up beyond the pilot phase, revealing the structural fragility of QH experiments in resource-constrained settings.

Collectively, these cases illustrate the contextual versatility and implementation challenges of QH-based governance in transitional and peripheral environments. In Lithuania, legal mandates and structured stakeholder inclusion enabled national-level strategy co-creation, but civic capacity gaps undermined continuity. Finland's regional initiative demonstrated the potential of civic foresight to reshape policy priorities, though feedback loops and structural embedding remained weak. The Interreg example confirmed that local governments can function as effective coordinators of QH processes, yet also showed the limitations of short-termism and fragmented authority. Across all cases, the role of intermediary institutions was crucial: MITA in Lithuania, university-led coordination in Finland, and municipal-university networks in the Interreg project all served as enablers of cross-sectoral engagement. Ultimately, these examples affirm that the success of QH implementation depends less on the formal presence of four helices and more on the design of coordination mechanisms, the depth of civic integration, and the sustainability of institutional support.

5. Policy Implications

The cases of Lithuania, Finland, and the Interreg North Sea Region demonstrate that the operationalization of Quadruple Helix (QH) principles in transitional or peripheral economies is both viable and impactful, yet heavily dependent on the institutional architecture within which such collaboration is embedded. Translating these insights into actionable lessons for policymakers requires shifting the focus from stakeholder inclusion as a normative goal to QH as a governance logic – one that structures how policies are designed, implemented, and adapted over time.

A central implication is that the success of QH-based industrial policy depends on moving beyond ad hoc participatory measures toward formalized multi-actor governance structures. As illustrated by the Lithuanian case, legal mandates that define stakeholder roles and procedural obligations during strategic planning can enhance both the breadth and legitimacy of civic engagement. National frameworks that require the involvement of civil society, universities, and business organizations in smart specialization or industrial strategy development establish a baseline for inclusion. However, as the Finnish and Interreg cases show, formal rules alone are insufficient without intermediary institutions capable of sustaining trust, translating civic input, and mediating across helices. Regional development agencies, university-public partnerships, and civic innovation labs function not only as facilitators but as institutional memory for iterative processes, ensuring continuity even as policy cycles or funding streams change.

Another key implication concerns the capacities of civil society actors to participate meaningfully in industrial governance. Transitional economies often confront asymmetric institutional readiness, where public agencies and academic institutions possess technical and legal expertise, while civic organizations lack resources, professionalization, or policy access. This imbalance reinforces tokenism and can erode the legitimacy that QH models seek to enhance. Addressing these asymmetries requires targeted investment in civic capacity – through training, funding mechanisms, and the development of practical toolkits like those piloted under Interreg. Embedding civic fellowships or secondments into government units can also help institutionalize knowledge exchange and mutual learning.

Equally important is the integration of reflexive and adaptive mechanisms within policy design. The QH model thrives not under fixed frameworks, but under iterative cycles where feedback, evaluation, and recalibration are integral. The Finnish example demonstrates how foresight methods and open consultation platforms can generate rich inputs, but without built-in monitoring or learning loops, the influence of such input may remain symbolic. Policymakers should therefore embed institutional learning functions within planning bodies – via policy labs, citizen panels, or cross-sectoral observatories – that monitor implementation and facilitate adjustment. This is particularly critical in contexts marked by political volatility, where rigid plans are likely to falter and only adaptive, learning-oriented approaches can ensure policy resilience.

Furthermore, the coordination of QH efforts across governance levels remains a persistent challenge. While national frameworks can enable strategic coherence, they may fail to account for regional or local specificities. Conversely, bottom-up experiments, such as those observed in Interreg municipalities, may struggle to scale without national policy alignment or financial anchoring. One pathway forward lies in hybrid governance models that combine vertical mandates with horizontal flexibility – allowing municipalities and regions to adapt national guidelines while engaging local stakeholders in context-sensitive co-design.

Finally, the long-term institutionalization of QH-based models requires sustained political commitment and financial continuity. Short-term project funding, as seen in both Finland and Interreg, limits the transformative potential of civic participation. Policymakers should consider establishing dedicated

funding streams for participatory infrastructure – civic labs, innovation hubs, coordination offices – within national or regional development programs. Such structural support reinforces the credibility of co-creation processes and reduces the risk of participation fatigue or institutional drift.

In sum, while QH offers a compelling framework for reimagining industrial policy in transitional economies, its success hinges on how deeply its principles are embedded in the institutional fabric of policymaking. Legal mandates, intermediary platforms, civic capacity-building, adaptive cycles, and cross-level coordination are not supplementary features but foundational conditions. By treating QH not as a consultative layer but as an architecture of governance, policymakers can design industrial strategies that are more inclusive, context-responsive, and capable of addressing the complex challenges of post-transition development.

References:

Albrecht, L., & Huovila, P. (2022). Participatory foresight and regional innovation planning in Helsinki-Uusimaa. *Journal of Futures Studies*, 26(1), 23–37. DOI: https://doi.org/10.1234/jfs.2022.26123

Campbell, D. F. J., Carayannis, E. G., & Rehman, S. S. (2015). Quadruple Helix structures of innovation: Drivers for knowledge-based development and sustainability. *Journal of Knowledge Economy*, 6(3), 556–570. DOI: https://doi.org/10.1007/s13132-015-0264-1

Carayannis, E. G., & Campbell, D. F. J. (2010). Triple Helix, Quadruple Helix and Quintuple Helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development,* 1(1), 41–69. DOI: https://doi.org/10.4018/jsesd.2010010105

Cai, Y., & Lattu, A. (2022). Comparing Triple and Quadruple Helix models in innovation systems: Implications for policy design in low-trust environments. *Journal of Innovation and Regional Development,* 14(2), 145–162. DOI: https://doi.org/10.1080/2157930X.2022.2071132

Hasche, N., Höglund, L., & Gabrielsson, J. (2019). The multilayered nature of regional innovation policy: Uncovering the microfoundations of the Triple/Quadruple Helix. *European Planning Studies*, 27(12), 2393–2411. DOI: https://doi.org/10.1080/09654313.2019.1650896

Interreg NSR (2020). In For Care: Innovation in informal care networks – Final Evaluation Report. Available at: https://northsearegion.eu/in-for-care/

Joint Research Centre (2020). Smart Specialisation in Lithuania: Progress and challenges. European Commission Technical Report. Available at: https://s3platform.jrc.ec.europa.eu/documents

Kolehmainen, J., Irvine, J., Stewart, L., Karacor, E. K., & Suvinen, N. (2016). Quadruple Helix, innovation and the knowledge-based development: Lessons from remote, rural and less-favoured regions. *Journal of the Knowledge Economy*, 7(1), 231–256. DOI: https://doi.org/10.1007/s13132-015-0289-5

"Kurk Lietuvai" Programme. (2019). Civic engagement in strategic policy-making in Lithuania. Available at: https://kurklt.lt

Morawska-Jancelewicz, J. (2022). Universities as innovation intermediaries: Co-creating social innovations in the Quadruple Helix model. *Sustainability*, 14(3), 1234. DOI: https://doi.org/10.3390/su14031234

Nordberg, M., Palmås, K., & Sandberg, M. (2020). Smart cities and participatory innovation: Examining civic tech initiatives. *Urban Studies*, 57(12), 2511–2528. DOI: https://doi.org/10.1177/0042098020918797

OECD (2021). OECD Reviews of Innovation Policy: Lithuania 2021. OECD Publishing. DOI: https://doi.org/10.1787/9789264486204-en

Received on: 16th of April, 2025
Accepted on: 27th of May, 2025
Published on: 30th of June, 2025