

Measuring the Real Impact of Entrepreneurial Support Programs in Morocco: A Conceptual Framework through the Quintuple Helix Model and Artificial Intelligence Integration

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Abstract

Despite the growing mobilisation of public and private resources to support entrepreneurship in emerging economies, the absence of rigorous, systemic evaluation frameworks constitutes a major gap in the academic literature on entrepreneurial policy particularly in the MENA region, where fragmented monitoring systems and short-term output metrics prevail. This article addresses this gap by proposing an integrated conceptual framework that combines the Quintuple Innovation Helix (QIH) model (Carayannis & Campbell, 2010) with Artificial Intelligence (AI) to evaluate the real impact of entrepreneurial support programs in Morocco. Drawing on a systematic literature review and comparative framework analysis, the study maps each of the five helices (university, industry, government, civil society, and natural environment) to specific evaluation dimensions and corresponding AI tools (natural language processing, predictive analytics, sentiment analysis, remote sensing). The resulting QIH–AI framework provides a multi-dimensional, dynamic evaluation architecture capable of capturing economic, social, and ecological outcomes simultaneously. The article concludes with strategic recommendations for policymakers and a research agenda for empirical validation of the framework.

Keywords: Entrepreneurship; Morocco; Quintuple Helix; Artificial Intelligence; Support Programs; Impact Evaluation; Innovation Ecosystems; Sustainable Development

JEL Classification: O31; O38; L26; Q01; O55

Article type: Conceptual/Theoretical

Résumé

En dépit de la mobilisation croissante de ressources publiques et privées en faveur de l'entrepreneuriat dans les économies émergentes, l'absence de cadres d'évaluation rigoureux et systémiques constitue une lacune majeure dans la littérature académique en particulier dans la région MENA, où les systèmes de suivi restent fragmentés et centrés sur des indicateurs de réalisations à court terme. Cet article comble ce vide en proposant un cadre conceptuel intégré qui combine le modèle Quintuple Helix de l'Innovation (QIH) et l'Intelligence Artificielle (IA) pour évaluer l'impact réel des programmes d'appui à l'entrepreneuriat au Maroc. En s'appuyant sur une revue systématique de la littérature et une analyse comparative de cadres, l'étude propose une architecture d'évaluation multidimensionnelle et dynamique incluant un tableau de mappage QIH–IA et des indicateurs clés de performance (KPIs) par hélice. Les résultats contribuent au sous-champ de l'évaluation d'impact dans les économies émergentes et offrent une feuille de route pratique pour les décideurs marocains.

Mots-clés : Entrepreneuriat ; Maroc ; Quintuple Helix ; Intelligence Artificielle ; Programmes d'appui ; Évaluation d'impact ; Écosystèmes d'innovation ; Développement durable

Classification JEL : O31 ; O38 ; L26 ; Q01 ; O55

Type d'article : Conceptuel/Théorique

1. Introduction

In recent years, the debate on how societies can foster innovation while addressing pressing social and environmental challenges has intensified. Emerging economies, in particular, face the dual imperative of stimulating entrepreneurial activity and ensuring that such growth contributes to sustainable development. Morocco represents a telling case: substantial public and private resources have been mobilised to nurture entrepreneurship, yet questions remain about the long-term effectiveness, equity, and sustainability of these initiatives. Despite the proliferation of support programs ranging from national financing schemes such as the Programme Intégré d'Appui et de Financement de l'Entrepreneuriat (PIAFE) to incubators and international development partnerships their actual impact remains poorly understood. Current evaluation practices are often limited to surface-level indicators such as the number of startups created, without addressing more systemic outcomes such as survival rates, innovation quality, or social and ecological value creation.

The need for more sophisticated frameworks of assessment is clear. Traditional models of entrepreneurial ecosystems, while valuable, have not fully captured the multidimensional interactions between innovation, society, and the natural environment. Morocco's relevance as a case study here is not coincidental. As an upper-middle-income economy at the intersection of sub-Saharan Africa and the MENA region, Morocco combines institutional diversity, recent policy ambition, and documented data gaps in a way that makes it particularly representative of the broader challenges facing emerging markets seeking to align entrepreneurship policy with sustainable development goals (World Bank, 2021; OECD, 2021). The country's experience thus offers transferable lessons for comparable economies in the region.

It is in this context that the Quintuple Innovation Helix (QIH) model offers a particularly relevant lens. Initially introduced by Carayannis and Campbell (2010) as an extension of the Triple and Quadruple Helices, the model incorporates five spheres university, industry, government, civil society, and the natural environment into a dynamic framework of knowledge and innovation production. The inclusion of the environment as a fifth helix signals a paradigmatic shift toward sustainable, responsible, and socially inclusive innovation. However, the QIH's power to diagnose and evaluate multi-actor ecosystems can only be fully realised when paired with analytical tools capable of processing the complex, real-time, and multisource data these systems generate. This is precisely where Artificial Intelligence (AI) becomes critical: whereas QIH provides the systemic architecture, AI through machine learning, natural language processing, sentiment analysis, and predictive analytics supplies the methodological means to operationalise it.

Against this background, this article addresses the following central research question: *How can an integrated QIH–AI framework provides a more rigorous and systemic basis for evaluating the real impact of entrepreneurial support programs in emerging economies, with Morocco as a case study?*

Three subsidiary questions structure the analysis:

- What are the main dimensions along which entrepreneurial support programs should be evaluated, and how do they map onto the five helices of the QIH model?
- Which AI tools are best suited to operationalise each evaluation dimension?
- What institutional conditions and data infrastructure are required for implementing such a framework in the Moroccan context?

This article makes three original contributions to literature. Theoretically, it advances helix-based innovation theory by demonstrating how AI modalities can be systematically embedded within the

QIH architecture, thereby extending the framework toward empirical operationalisability. Methodologically, it introduces a mapping matrix between helices, evaluation dimensions, and AI tools, together with a set of key performance indicators (KPIs) per helix a contribution to the subfield of impact evaluation in emerging economies. From a policy standpoint, it provides a concrete, structured blueprint for Moroccan authorities and development partners seeking to modernise their evaluation systems in line with national strategic documents (New Development Model, 2021; Vision 2035).

The article begins by situating research within the existing literature, examining entrepreneurial support programs in emerging economies, the theoretical evolution of helix models of innovation, and the growing role of artificial intelligence in policy evaluation. The conceptual methodology underpinning the framework construction is then presented, followed by a detailed exposition of the integrated QIH-AI evaluation framework. The article subsequently discusses the practical implications, implementation challenges, and inherent limitations of the proposed approach, before concluding with strategic recommendations for policymakers and a research agenda to guide future empirical validation.

2. Literature Review

2.1 Entrepreneurial Support Programs in Emerging Economies

Entrepreneurship has been widely recognised as one of the central engines of economic transformation in both advanced and emerging economies. For developing countries, in particular, entrepreneurship is often framed as a vehicle for addressing structural challenges such as youth unemployment, regional inequalities, and the need for economic diversification (Isenberg, 2011; Audretsch & Link, 2019). As a result, national governments, international development agencies, and private sector actors have devoted considerable resources to designing and implementing entrepreneurial support programs.

Despite this growing attention, literature consistently points to shortcomings in how these programs are evaluated. Too often, impact assessments are limited to narrow indicators – such as the number of firms created, the volume of funds disbursed, or the number of participants trained – while more complex and systemic dimensions are overlooked (Criscuolo et al., 2012; Mason & Brown, 2014). This creates an incomplete picture of program effectiveness, since entrepreneurship is not only about firm creation but also about long-term survival, innovation capacity, employment quality, and socio-environmental value creation.

In the MENA region, these challenges are compounded by weak institutional coordination and limited access to longitudinal data. Comparative work on innovation systems in the region reveals that while governments such as Morocco, Jordan, and Tunisia have launched ambitious entrepreneurship strategies, evaluation frameworks remain fragmented and insufficiently aligned with sustainability goals (Schiffbauer et al., 2015; Hertog, 2010). In Morocco specifically, the persistent gap between policy ambitions and measurable outcomes has been documented by several scholars (Belghiti & Berrada, 2021; Sekkat, 2014). Support structures frequently operate in silos, and coordination across ministries, agencies, and private actors remains weak. This situation reflects a broader global pattern in which the discourse around entrepreneurship as a driver of inclusive and sustainable growth is far more advanced than the empirical evidence base underpinning it.

Recent contributions have therefore emphasised the need for holistic evaluation frameworks that move beyond simplistic output metrics and instead capture systemic, multidimensional outcomes

(Grillitsch & Sotarauta, 2020). It is precisely in this search for more comprehensive models that multi-helix frameworks of innovation have gained relevance.

2.2 Evolution of Multi-Helix Models of Innovation

The quest to better understand and manage innovation systems has given rise to a family of conceptual models known as helix models of innovation. The earliest and most influential of these is the Triple Helix, proposed by Etzkowitz and Leydesdorff (2000), which focused on the dynamic relationships between universities, industry, and government. Carayannis and Campbell (2009) expanded the model into the Quadruple Helix by adding civil society and media-based culture as a fourth dimension. The next conceptual leap came with the Quintuple Helix (QIH), introduced by Carayannis and Campbell (2010), which added the natural environment as a fifth helix.

While these models have been widely applied, scholars have not been uncritical. Park (2014), in an interview with the model's founders, raised important questions about the operationalisation of helix interactions in empirical research, noting the risk of analytical complexity that may hinder practical application. Markard et al. (2012) similarly argues that multi-actor innovation frameworks must be complemented by socio-technical transition theory to account for the systemic lock-ins that prevent sustainable innovation from diffusing. Hekkert et al. (2007) propose technological innovation system (TIS) theory as a complementary lens, emphasising functional dynamics knowledge creation, entrepreneurial experimentation, market formation that are largely absent from helix models. These critical perspectives suggest that while the QIH provides a valuable systemic architecture, its contribution is strongest when coupled with empirically grounded analytical tools a role this paper assigns to AI.

2.3 Artificial Intelligence and the Transformation of Policy Evaluation

AI encompasses machine learning, deep learning, natural language processing, computer vision, and predictive analytics. What distinguishes AI from traditional data analysis is its capacity to detect patterns in vast, heterogeneous datasets, to learn from new information, and to provide real-time insights into dynamic systems (Brynjolfsson & McAfee, 2017). In the domain of entrepreneurship and innovation policy, AI is increasingly recognised as a transformative tool.

In the specific context of public governance and policy evaluation, Janssen et al. (2020) identify algorithmic governance as a paradigm shift, emphasising how AI-based decision-support tools can enhance transparency, accountability, and responsiveness in public administration when properly governed. Misuraca and van Noordt (2020), in their comprehensive review of AI in European public services, document a growing range of applications in monitoring, prediction, and citizen engagement, while also flagging risks of algorithmic bias and the need for robust ethical frameworks. These contributions point to both the transformative potential and the governance conditions required for AI to add genuine value in policy evaluation conditions that the proposed QIH-AI framework explicitly incorporates.

2.4 Toward a QIH-AI Integrated Framework

Recent scholarships have begun to explore explicitly the synergies between the Quintuple Helix model and AI. Carayannis et al. (2024) argue that embedding AI within helix interactions represents a critical step toward the realization of Industry 6.0 and Society 6.0 paradigms that emphasise human-centred, resilient, and sustainable innovation. By serving as an enabling modality within the helix framework, AI enhances knowledge flow, supports collective intelligence, and strengthens the reflexivity of innovation systems.

The critical gap in existing literature, however, is the absence of a structured operationalisation framework that specifies, for each helix, the evaluation dimensions to be assessed, the AI tools best suited to measure them, and the performance indicators that would enable monitoring over time. This paper proposes to fill this gap by developing such a framework for the Moroccan context, with transferable implications for comparable emerging economies.

3. Methodology

3.1 Conceptual Orientation and Epistemological Positioning

This study adopts a conceptual and exploratory research design, aiming to construct a theoretical framework for evaluating entrepreneurial support programs in Morocco through the combined lens of the QIH and AI. The research is situated within a critical realist epistemological paradigm (Bhaskar, 1978; Yin, 2018): it acknowledges the existence of underlying causal mechanisms (helix interactions, AI-enabled feedback loops) that are not directly observable but can be modelled through theoretical abstraction and conceptual synthesis. Critical realism is particularly appropriate for conceptual research that aims to bridge existing theoretical gaps while remaining anchored in empirical realities, since it accepts both the necessity of abstraction and the ultimate criterion of explanatory power (Jaakkola, 2020).

Conceptual research is particularly suitable when the objective is to bridge theoretical gaps, integrate emerging paradigms, and propose new frameworks for policy and practice (Gilson & Goldberg, 2015; Jaakkola, 2020). The rigour of such research is judged not by statistical validity but by internal coherence, theoretical parsimony, and transferability criteria this paper addresses explicitly.

3.2 Literature Review and Synthesis

A systematic literature review was conducted across three thematic domains: entrepreneurial support programs in emerging economies, with particular attention to Morocco and the MENA region; helix models of innovation; and AI applications in policy evaluation.

The databases used were Scopus, Web of Science, IEEE Xplore, and ScienceDirect. Search terms included combinations of: (“entrepreneurial ecosystem” OR “support programs”) AND (“evaluation” OR “impact assessment”); (“Quintuple Helix” OR “innovation helix”); (“artificial intelligence” OR “machine learning”) AND (“policy evaluation” OR “governance”). The search covered publications from 2000 to 2026, with a focus on peer-reviewed articles, book chapters, and official institutional reports. Initial screening yielded 312 documents; after applying inclusion criteria (relevance to at least one of the three thematic domains, minimum quality threshold of indexed peer-reviewed journal), 87 sources were retained for full analysis. Table 1 summarises the selection process.

Table 1: Literature selection process (adapted from PRISMA guidelines)

Stage	Records identified	Records excluded	Records retained
Initial database search	312	—	312
Title/abstract screening	312	178 (not relevant)	134
Full-text review	134	47 (insufficient quality or relevance)	87

Source: Authors (2026)

3.3 Comparative Framework Analysis

Following the literature synthesis, the study conducted a comparative analysis of four existing conceptual frameworks used to evaluate entrepreneurial ecosystems: the Triple Helix evaluation model (Etzkowitz & Leydesdorff, 2000), limited to university-industry-government interactions; the ecosystem scorecard approach (Isenberg, 2011), which covers nine domains but lacks an ecological dimension; the Mission Economy framework (Mazzucato, 2020), which emphasises directionality and public investment but does not provide evaluation granularity; and the QIH model (Carayannis & Campbell, 2010), which is the only framework to explicitly integrate the natural environment. Assessed along five criteria scope, ecological dimension, AI compatibility, operational granularity, and applicability to emerging economies this comparative analysis confirmed the superiority of the QIH as a foundation, subject to the operationalisation enhancements proposed in this paper (see Table 2 in Section 4).

3.4 Framework Development

Based on the synthesis and comparative analysis, the research developed a QIH–AI conceptual framework for entrepreneurial support evaluation through a four-stage process: mapping the five helices of the QIH model to the main dimensions of entrepreneurial support program evaluation; associating each helix with relevant AI tools and techniques; identifying key performance indicators (KPIs) per helix; and ensuring that the framework captures both short-term outputs and long-term systemic outcomes.

3.5 Relevance to the Moroccan Context

While the methodology is conceptual, it is firmly grounded in the empirical realities of Morocco's entrepreneurial ecosystem. The framework was tailored to address specific challenges including: limited availability of reliable longitudinal data; institutional fragmentation and weak coordination; and the need to align entrepreneurship policy with the New Development Model (Royaume du Maroc, 2021) and Vision 2035 (Ministère de l'Industrie et du Commerce, 2009).

3.6 Validation Strategy

While empirical validation falls outside the scope of this conceptual article, the proposed framework is designed with future validation in mind through a three-stage strategy: expert validation via a Delphi method engaging policymakers, academics, and civil society representatives; pilot implementation in two or three Moroccan regions with contrasting ecosystems (e.g., Casablanca-Settat vs. Souss-Massa); and longitudinal data collection over three to five years to test the framework's predictive validity.

4. Conceptual Framework: QIH–AI Integration for Impact Assessment

4.1 Foundations of the QIH–AI Approach

The proposed conceptual framework builds on the QIH model (Carayannis & Campbell, 2010; Carayannis, Barth & Campbell, 2012) and recent scholarship integrating AI as a strategic enabler of innovation ecosystems (Carayannis et al., 2024). Its central premise is that entrepreneurship support programs can only be meaningfully evaluated when they are situated within the systemic interactions of the five helices, and when these interactions are monitored and analysed using the analytical capacities of AI.

AI can function as a “nervous system” of the helix framework, continuously processing data, detecting patterns, and generating insights that inform decision-making across helices. This conception goes beyond the idea of AI as a data-processing tool: it positions AI as a strategic modality that strengthens the reflexivity and adaptability of innovation systems, thereby addressing one of the main limitations identified by Park (2014) namely, the difficulty of operationalising helix interactions in practice. The distinction between the present framework and Carayannis et al.’s (2024; 2025) foundational work lies in the latter’s broad theoretical articulation of AI–QIH synergies at a macro level, whereas this paper provides a structured, helix-by-helix operationalisation matrix with specific AI tools, evaluation dimensions, KPIs, and data sources tailored to the Moroccan context.

4.2 Mapping Helices to Evaluation Dimensions and AI Tools

To operationalise the QIH–AI framework for evaluating entrepreneurial support programs, each helix is mapped to specific evaluation dimensions, AI applications, key performance indicators (KPIs), and data sources. This mapping informed by the empirical literature on helix-specific outcomes (Etzkowitz & Leydesdorff, 2000; Carayannis et al., 2012) and AI applications in public governance (Janssen et al., 2020; Misuraca & van Noordt, 2020) is presented in Table 2.

Table 2: QIH–AI Evaluation Matrix for Entrepreneurial Support Programs in Morocco

Helix	Evaluation Dimension	AI Application	Key KPIs	Data Sources
University	Knowledge transfer, training quality, research spin-offs	NLP on feedback; ML for academic–industry collaboration mapping	Spin-offs; training satisfaction scores; co-publication index	University databases, ANAPEC surveys, Scopus
Industry	Firm growth, job creation, sectoral innovation	Predictive analytics on firm performance; big data on competitiveness	3-year survival rate; job quality index; patent applications	OMPIC, HCP, Ministry of Industry
Government	Policy coherence, inclusiveness, resource allocation	AI policy simulations; decision-support systems; optimisation algorithms	% budget aligned to NDM goals; processing time; regional equity index	Ministry reports, World Bank data
Civil Society	Social equity, accessibility, public trust	Sentiment analysis of social media; community priority clustering	% women/youth beneficiaries; trust index; accessibility score	Social media APIs, NGO reports, HCP surveys
Environment	Green entrepreneurship, resource efficiency, ecological impact	Remote sensing; AI-based sustainability metrics	Carbon footprint per startup; resource efficiency ratio; green certification rate	ONEE, Ministry of Environment, satellite data

Source: Authors (2026), adapted from Carayannis & Campbell (2010) and Janssen et al. (2020)

4.3 Systemic Integration and Feedback Loops

A critical strength of the QIH–AI framework is its ability to establish continuous, bidirectional feedback loops across helices. These loops are not merely illustrative: they represent the systemic mechanism through which the framework generates adaptive governance. Figure 1 (described below) depicts the complete inter-helix interaction model.

In this model, AI serves as the integrative layer that processes data flows from all five helices in near real-time. Four types of feedback loops are specified. First, a societal legitimacy loop connects civil society (sentiment analysis) to government (policy adaptation), enabling responsive

policymaking that reflects citizen priorities. Second, a knowledge-market loop links university outputs (NLP-tracked knowledge transfer) to industry performance (predictive analytics), supporting technology transfer and spin-off creation. Third, a sustainability loop connects environmental monitoring (remote sensing) to industrial strategy (green innovation targets), ensuring ecological accountability. Fourth, a whole-system loop integrates all helix data through an AI-powered dashboard into a national observatory that generates foresight and scenario-based recommendations for policymakers.

Figure 1: Systemic QIH–AI Framework for Entrepreneurial Support Evaluation

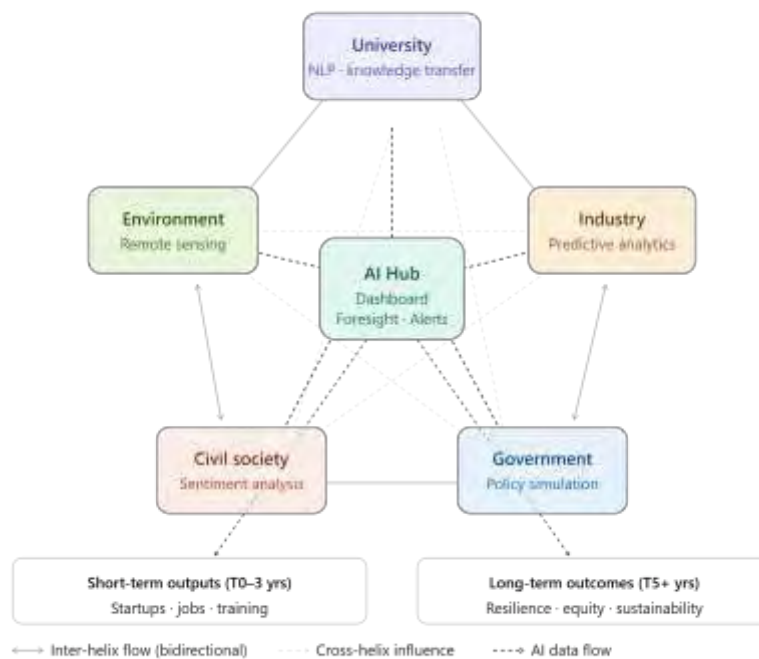


Figure 1 — Source: Authors (2026)

4.4 Application to the Moroccan Context

Applying this framework to Morocco highlights both challenges and opportunities. On the one hand, the country faces constraints in terms of data availability, institutional silos, and limited technical capacity for AI deployment. On the other hand, Morocco has expressed strong political commitment to digital transformation through its Digital Morocco strategy and to sustainable development through the New Development Model (Royaume du Maroc, 2021) and Vision 2035. Concretely, implementation could begin with a national observatory of entrepreneurial ecosystems integrating data from ministries, incubators, universities, and civil society platforms. Three phased steps are proposed. In a first phase (years 1–2), pilot the framework in the Casablanca-Settat and Souss-Massa regions, where incubator density and data infrastructure are relatively developed. In a second phase (years 3–4), refine the KPI system based on pilot findings and extend to four additional regions. In a third phase (years 5+), scale nationally and connect to a real-time dashboard accessible to policymakers and the public.

4.5 Theoretical and Practical Contributions

The conceptual framework makes contributions at both theoretical and practical levels. Theoretically, it advances the literature by integrating QIH and AI into a coherent evaluation model, responding directly to calls for more systemic, sustainability-oriented approaches to entrepreneurship assessment. The framework also extends the AI–QIH synthesis initiated by Carayannis et al. (2024) by providing helix-specific operationalisation not previously available in the literature. Practically, it offers policymakers and stakeholders a structured, technology-enabled tool to evaluate program impact. While tailored to Morocco, the framework has potential applicability to other emerging economies in the Global South.

5. Discussion

5.1 Implications for the Moroccan Entrepreneurial Ecosystem

The Moroccan case illustrates both the promise and the limitations of current entrepreneurial support programs. National strategies such as PIAFE and regional incubators demonstrate strong political will; yet evaluations remain narrowly focused on short-term outputs. The proposed QIH–AI framework offers a path forward by embedding evaluation within a systemic, multidimensional architecture. Critically, what distinguishes this framework from existing practice is not merely the adoption of AI tools, but the systematic linkage between evaluation dimensions, governance actors, and ecological accountability – a linkage that responds to the documented disconnect between Morocco’s sustainability ambitions and its measurement systems.

Several comparative experiences from the MENA region lend empirical support to this approach. Jordan’s National Innovation System evaluation (OECD, 2021) and Tunisia’s startup ecosystem assessment (World Bank, 2020) both struggled with the same core challenge: the absence of longitudinal data and the dominance of output-based metrics. Both cases suggest that the institutional pre-conditions for a QIH–AI framework – inter-ministerial data sharing, civil society inclusion, and environmental monitoring – are achievable through phased reform, as documented in Morocco’s own New Development Model.

5.2 Opportunities of the QIH–AI Framework

The integration of QIH and AI provides several concrete opportunities beyond what existing frameworks offer. The framework’s holistic assessment capability integrating economic, social, institutional, and ecological dimensions responds to the documented failure of output-based evaluation (Criscuolo et al., 2012). Its real-time monitoring dimension, enabled by AI, addresses the temporal lag inherent in traditional ex-post evaluations. The explicit inclusion of civil society as a helix, analysed through sentiment analysis, operationalises inclusivity in a way that participatory evaluation frameworks rarely achieve in practice (Janssen et al., 2020). Finally, the environmental helix and AI-based sustainability metrics directly support Morocco’s climate commitments and its integration of the circular economy into its national development agenda.

5.3 Challenges, Limitations, and Critical Reflections

Despite its potential, implementing the QIH–AI framework presents significant challenges. Data availability and quality remain the primary constraint; Morocco’s statistical systems are still fragmented. Institutional coordination, technical capacity, and ethical concerns about AI transparency also require attention.

Beyond implementation challenges, it is important to acknowledge the inherent limitations of the QIH model itself. Park (2014) has highlighted the risk of analytical overextension when adding helices beyond the Triple Helix, arguing that increased systemic complexity may reduce rather than enhance explanatory power. The model's normative architecture – premised on harmonious collaboration across five spheres may underestimate power asymmetries between helices, particularly in contexts where state actors dominate policy design (Asheim et al., 2011). Furthermore, the QIH's presupposition that ecological sustainability can be fully integrated into an innovation framework without fundamentally questioning growth imperatives may be contested from a degrowth or post-development perspective. These are genuine limitations of the theoretical foundation that future empirical applications must address.

5.4 Theoretical Implications and Propositions for Future Research

From a theoretical perspective, this paper contributes to the literature on innovation systems by demonstrating the value of integrating QIH with AI-enabled modalities. More specifically, it advances three theoretical propositions that future empirical research should test. First, the operationalisation proposition: frameworks that combine systemic helix architecture with AI-based measurement tools will produce more accurate and more comprehensive impact assessments than either helix-only or AI-only approaches. Second, the feedback proposition: in contexts where AI-driven feedback loops between helices are institutionalised, entrepreneurial support programs will demonstrate higher rates of adaptive policy reform. Third, the transferability proposition: QIH–AI frameworks developed in upper-middle-income MENA economies exhibit sufficient structural commonality to be adapted, with contextual adjustments, to sub-Saharan African and South Asian contexts.

6. Conclusion and Recommendations

This paper has proposed an integrated QIH–AI framework for evaluating the real impact of entrepreneurial support programs in Morocco. The argument rests on the diagnosis that existing evaluation approaches dominated by output-based indicators fail to capture the systemic, multidimensional nature of entrepreneurship. Three original contributions have been made. First, theoretically, the paper advances helix-based innovation theory by providing a structured operationalisation of AI within the QIH, extending Carayannis et al.'s (2024) macro-level synthesis toward helix-specific evaluation matrices. Second, methodologically, it introduces a PRISMA informed literature selection process, a comparative framework matrix, and a KPI table per helix that collectively strengthen the rigour of conceptual entrepreneurship research. Third, practically, it provides a phased implementation blueprint for Moroccan policymakers that is aligned with national strategic documents.

Based on the proposed framework, several strategic recommendations can be advanced.

- **Establish a National Observatory for Entrepreneurial Ecosystems:** This observatory would integrate data from universities, incubators, firms, civil society, and environmental agencies, analysed through AI dashboards to provide real-time insights.
- **Develop a National AI Strategy for Policy Evaluation:** AI should be institutionalised as a cross-cutting tool for governance and impact assessment, requiring investment in data infrastructure, technical capacity, and ethical regulatory frameworks.
- **Foster Cross-Sectoral Collaboration:** Mechanisms of coordination across helices must be strengthened; universities could act as conveners of interdisciplinary observatories.

- **Integrate Sustainability Metrics:** Support programs should adopt indicators measuring environmental performance and social outcomes, facilitated by remote sensing and sentiment analysis.
- **Pilot and Scale:** Begin with Casablanca-Settat and Souss-Massa as pilot regions, then scale nationally based on lessons learned.

As a conceptual paper, this study is subject to limitations. It does not provide empirical validation, and the KPIs proposed are indicative rather than tested. The QIH model's own limitations its normative assumptions, potential complexity overload, and contested integration of ecological concerns within a growth-oriented paradigm (Park, 2014) must be addressed in future empirical applications.

Future research should prioritise the following directions. First, empirical validation of the framework through case studies in two or three Moroccan regions, testing whether the proposed KPIs are measurable and whether helix interactions produce the feedback dynamics hypothesised. Second, comparative studies between Morocco and Jordan, Tunisia, or Senegal to test the transferability proposition. Third, investigation of the governance conditions under which AI-based evaluation tools enhance rather than undermine democratic accountability in public administration. Fourth, exploration of how degrowth and post-development critiques might inform a revised version of the environmental helix, particularly in contexts where ecological vulnerability challenges growth-centric innovation models.

The integration of QIH and AI offers a promising pathway for rethinking how entrepreneurial ecosystems are evaluated and governed. In contexts such as Morocco, where entrepreneurship is both an economic necessity and a strategic priority, such frameworks are particularly urgent. By combining systemic thinking with digital intelligence, the QIH–AI approach provides not only a tool for more rigorous evaluation but also a vision for more inclusive, sustainable, and adaptive governance of innovation ecosystems. Entrepreneurship is reframed not merely as a driver of firm creation but as a lever for systemic transformation connecting knowledge production, industrial development, public policy, civil society participation, and environmental stewardship.

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