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Measuring Innovative and Entrepreneurial Networks Performance

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***Abstract*—**Nowadays innovation represents a challenge crucial to remaining globally competitive. This study seeks to develop a conceptual model aimed at measuring the dynamic interactions of the triple/quadruple helix, balancing innovation and entrepreneurship initiatives as pillars of regional competitiveness – the Regional Helix Scoreboard (RHS). To this aim, different strands of literature are identified according to their focus on specific regional competitiveness governance mechanisms. We put forward an overview of the state-of-the-art of research and are duly assessed in order to develop and propose a framework of analysis that enables an integrated approach in the context of collaborative dynamics. We conclude by presenting the RHS for the study of regional competitiveness dynamics, which integrates and associates different backgrounds and identifies a number of key performance indicators for research challenges.

***Keywords*—**Entrepreneurship, KPIs, innovation, performance measurement, regional competitiveness, regional helix scoreboard.

I. Introduction

SUSTAINABILITY has to be approached within a perspective combining the environmental, economic and social dimensions [1]. From the perspective of regional development, the competitive production of companies determines the levels of earnings and employability at the level of the regional business environment while demand is determined according to relative costs [2].

According to [2], competitiveness is productivity, the main determinant in the long run of an economy's standard of living. However, [3] argues that competitiveness needs to be viewed in a balanced way, allowing a focus on the sustainable development orientation. Acs and Amorós define competitiveness as a result weighted by the behaviour of the different variables making up the Global Competitiveness Index (GCI) published annually by the World Economic Forum (WEF) [4], where the pillars of innovation and business sophistication are included. In a more territorial approach, progressive regions have a competitive advantage in attracting opportunities for development, capturing high-tech companies and talent, ensuring greater wealth creation and employability [5]–[7].

According to the Regional Innovation Scoreboard (RIS) published by the EU, innovation is a key factor determining productivity and economic growth [8]. In parallel, the interest in regional innovation and regional innovation systems as a source of competitive advantage has grown significantly over the past three decades [9]–[11].

The concepts of creativity and innovation are often used as synonyms in the literature, although some authors emphasize the distinction: creativity results in the creation of new ideas; innovation requires its implementation in practice [12]. From the perspective of Porter and Stern, there is a set of factors transversal to the economy that support innovation and including: the human and financial resources allocated to scientific and technological advances, the level of technological sophistication, the public policies affecting innovation related activities, intellectual property protection, fiscal incentives for innovation and enacting and effectively implementing antitrust and abuse of power legislation [13].

Several experts have been advocating innovation and entrepreneurship as determinants of competitiveness and regional development [13]–[15]; creating new jobs and territorial wealth [16].

Overall, there is a significant relationship between business activities, networking and productivity, not forgetting the importance of entrepreneurship and innovation capacity in the context of competitive aggressiveness [16]. The cooperation networks play today an important role in regional development ecosystems, allowing synergies at the level of inter-company collaboration, access to new sources of financing, as well as new skills levels. The access to foreign markets also improved, and the Increase of efficiency when it can share, within these collaborative dynamics, centralized structures of supply [18], [19].

Cooperation networks are important for the competitive development of the regions, or through the creation of wealth and employment sites, or through increased sophistication of business, by increasing the quantity and quality of local and regional suppliers.[13]; [17]; including the emergence of new dynamics between triple helix actors, with a positive impact on the territorial competitiveness[18].

As a tool for measuring performance, Kaplan and Norton [19] developed the Balanced Scorecard; now used worldwide as a strategic management tool [20]–[31]. However, some limitations are recognized to the model itself including not being able to respond effectively to all situations under analysis. To meet the changing demands to measuring performance resulting from alliances between institutions and projects management for regional development, new models of performance measurement have now been developed from the original BSC model [25], [32], [33]. Unfortunately, the traditional BSC and its upgrades are neither totally appropriate nor useful to measure the performance of the Triple Helix

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regional interactions (Academia - Industry - Government), in the regional context of innovation, entrepreneurship and competitiveness. Therefore, this paper proposes a RHS model to measure the A-I-G interactions and thereby enriching the literature in this area. Our purpose here is therefore to address four research questions: Question 1. In regional networking, are knowledge and technology transfer and R&D significant for competitiveness?; Question 2. Do the A-I-G collaborative networks play an important role in innovation and entrepreneurship?; Question 3. What is the role of the government in A-I-G networks? Question 4. How can we measure the impact of A-I-G collaborative networks in regional competitiveness?

This study aims to develop an integrative conceptual model aimed at measuring the dynamic interactions of the triple helix, balancing innovation and entrepreneurship initiatives as pillars of the competitiveness of regions – the "RHS".

The article is structured as follows: firstly, we carry out a literature review on innovation, entrepreneurship, competitiveness and the emergence of the triple helix system and its dynamics. Secondly, we set out a RHS model for regional competitiveness. Finally, we put forward our concluding remarks.

II. Cooperation and Collaborative Networking: The Triple Helix Approach

In the current regional policy, business and cooperation networking are increasingly seen as the key to success [34]. Networks of R&D cooperation are assumed to be real organizational and economic contexts where companies join other institutions (companies, research centres, universities or others), creating umbrella networks to various locations in order to develop technological projects that can positively affect competitiveness, also here inserting public institutions aimed at promoting the development of their technology policies, sometimes supported by public framework programs to promote the establishment of networks for the development of R&D projects [35]. Organizations need to establish networks with external entities in order to acquire or have access to resources not otherwise available, especially the acquisition of technological resources, access to infrastructure and technological know-how or the establishment of agreements to comply with financial, economic and legal issues or at the level of knowledge transfer [36].

For many people, the terms "cooperation" and "collaboration" are indistinguishable. Cooperation involves communication and information exchanges; the complimentary goals and aligning activities; the compatibility of goals, individual identities and working apart [30], [37]. Meanwhile, collaboration adds joint goals, joint identities, creating together and joint responsibility - corresponding to a higher level of integration and maturity. Backing up this perspective on how regional competitiveness and development determine the productive capacity of companies and regional levels of income and employability [2]; other authors highlight the predominance of relationships between academia – industry – government (state, regional or local) and specific local activities in determining the best business results and outcomes [18]. Etzkowitz argues that the interactions of the triple helix are the key to innovation in societies increasingly based on knowledge, helping students, researchers and policy makers to respond to certain questions [38]: How do we strengthen the role of academia in economic and social development at the regional level?, How can governments encourage citizens to take an active role in promoting innovation?, How can firms collaborate with academia and government? The metaphoric model of the Triple Helix focuses on A-I-G interaction dynamics, including the transfer of knowledge through the development of Research, Development and Innovation (RD&I) between the network partners, facilitating access to new forms of financing, still managing an increase of production and market access synergies [39]. Various evolutionary stages need accounting for in terms of the many interactions between the triple helix spheres [38]–[40]. The evolution of innovation systems and the current dispute over which path is most appropriate for university – industry relationships effects the different institutional agreements in terms of the overall A-I-G relationships [41].

The Triple Helix emerges from regional areas of knowledge, innovation and consensus and thus can play an important role in regional development and competitiveness, through the interaction between the different institutional spheres in a networking logic [41]–[43]. Ozman further underlines that networks indisputably play an important innovation role [44]. Consistent to this interpretation, a series of academic studies has recognised that cooperation between the three institutional spheres (A-I-G) is fundamental to improving regional and national innovation systems [39]-[41], [43], [45]–[47].

The stability of interactions A-I-G takes on an important role in RD & I capacity and also in production competitiveness [39], [41]; Etzkowitz, and proving fundamental to boosting regional innovation systems [18], [43], [48], [49].

Regional policies of the last decades have been fostering the emergence of spin-off companies, resulting from the knowledge transfer mechanisms and A-I technology. The science and technology park represent an organizational innovation, capable of supporting these spin-offs and the business community in general, tend to be organized in sectoral clusters. Incubators and accelerators companies have come even to facilitate reinforced cooperation network between companies, and between them and the Academy and the political decision [50].

Applying the conceptual model of the Triple Helix to the problem of competitiveness of territories, highlighting the need to increase the levels of innovation and development of local businesses prove the starting point for a better theoretical understanding [51], [52].

After the emergence of the metaphorical concept of Triple Helix, some authors advocate the extension of the model to the fourth helix, introducing the participation of civil society in the context of collaborative dynamics for the development of

the regions [53], [54] fostering regional competitiveness and development [55], [56]. Innovation is assumed by Porter and Stern, as the decisive challenge able to ensure global competitiveness [13]. The dynamics of interaction A-I-G to facilitate the caption of public and private investment, while time seeking to strengthen the RD & I, otherwise the micro and small businesses do not have access. The sharing of infrastructure and technical knowledge, or strengthening of synergies in terms of product offering on the market, are also a priority [54]; [57].

III. Finding a Tool for Measuring A-I-G Network Performance Levels

As proposed by Kitson in 2004, regional competitive advantage furthermore inherently requires articulated involvement and action across a multi-level scenario, within which feature the different variants of capital [58]. By strengthening the RD&I; of human and creative capital stimulus; improvement of productive capital; capture of finance capital; or reorientation of policy options to support innovation and entrepreneurship, it becomes possible to increase the business sophistication and increased competitive position in the global market [59].

Lawton Smith focuses on entrepreneurship and the geography of talent directly linked to economic performance and also constituting a strong contribution to the sustainable development of the regions [60]. Other authors argue that entrepreneurial activity is an important mechanism for regional development through job creation and creating local wealth, whether it comes from the transfer of knowledge and technology from academia or simply through the creation of new businesses [50], [61].

According to Van Looy, the logic of "university ventures" is tightly bound up with the existence of shortcomings in the innovation market [62].

According Carayannis, sustainability should also be perceived within a three-dimensional approach: environmental, economic-financial and social, thereby boosting the competitive advantage of regions [63]. Harris in 2009 point out how ethics and entrepreneurship remain inherently bound up and of particular relevance within the framework of entrepreneurial activities and regional development.

The triple helix spheres, while set out contextualised within their external environment (the political, economic, social, cultural and technological contexts), describe the dynamic and interactive movements of partnerships, supported by and in the format of cooperative networks striving to boost competitiveness [64]–[66].

The increasing levels of local intellectual capital and institutional support enable the development of an interactive group of private and public interests, acting through a network of organisational and institutional agreements and fostering the dissemination of knowledge, technologies and regionally located innovation skills and capacities [43].

Aiming to answer the basic research questions formulated, and based on the literature review conducted, we found the need to measure the performance of the resulting A-I-G network interactions in order to make it possible to measure their impact on regional competitiveness (see Fig. 1).

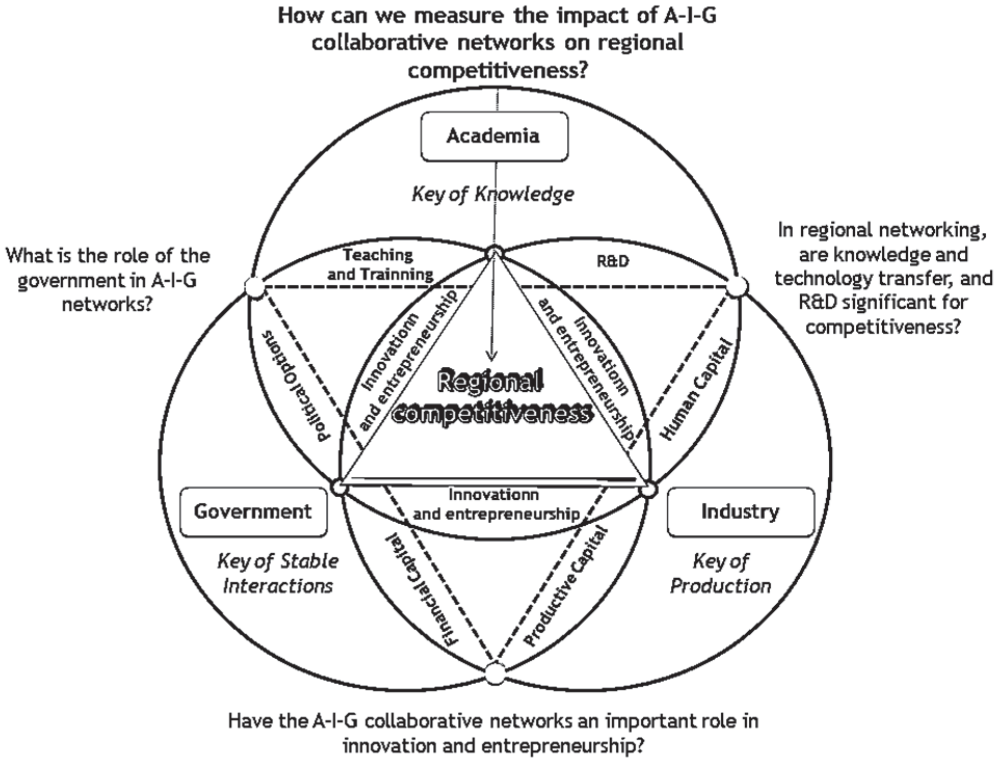

Fig. 1 The triple helix dynamics

The balanced scorecard (BSC) was developed by Kaplan & Norton [19], to give managers a balanced view of organizations working with other important strategic factors - from continuous improvement and partnerships to teamwork and global scale, besides the classical financial measurements. The BSC seeks to provide answers to four basic questions:

- How do customers see us? (Customer perspective)
- What must we excel at? (Internal business perspective)
- Can we continue to improve and create value? (Innovation and learning perspective)
- How do we look to shareholder? (Financial perspective).

Targeting a new impulse to the implementation of the BSC, an article published in the Harvard Business Review set out three case studies applying the scorecard to measure performance and strategy [19], [67].

The BSC developed by Kaplan & Norton [19], is today used globally as a strategic management tool for measuring performance [20]–[23], [25]–[27], [29]–[33]. However, some limitations are recognized as to the model itself and identified as unable to respond effectively to all situations under analysis [22], [25], [30], [32], [33].

IV. Data Collection and Method

Having defined the general framework of innovation, entrepreneurship, competitiveness and the dynamics of the triple helix, we performed a systematic review of the literature about BSC and BSC for networking performance measurement. Such a literature review establishes the state of the art in a specific field [68].

Our objective is to analyse the state of the art on BSC to measure the performance of networks of cooperation and collaboration between different agents. To this end, we applied the following procedure. We first identified all the relevant research published on BSC from 1990 to 2013. We carried out an extensive search through the titles and abstracts of published, peer-reviewed articles held in the bibliographical database Thomson Reuters (ISI) Web of Knowledge, using a predetermined series of keywords (BSC; Cooperation BSC; Collaborative BSC; and Networking performance measuring). We subsequently performed a manual search of the journals with the highest article citations over the past 21 years (1992-2013), filtering the records of the 50 most cited articles in that time period from the around 1,000 articles identified.

Analyzing the trend towards a greater increase in publications about BSC, we encountered a boom between 2010 and 2013. For performing the literature review search, we followed a constructivist methodological approach consisting of the identification of a problem of practical relevance, its theoretical connections and the acquisition of its main postulates [69], [70]. Thus, we decided to apply a filter adjusted to this time period under analysis - we filtered the records with the most cited articles from 2010 to 2013 achieving a synthesis with the 25 most cited articles in ISI journals. This composed a summary table providing a comparison between the articles within the historical perspective of the 50 most cited and the most recent trend of the 25 most cited (see Table I). Having completed this stage, and better understanding trends in the usage of the BSC performance measurement within networks of cooperation and collaboration, we again applied a filter to our database. This time, restricted to the keywords "cooperation BSC; collaborative BSC; and networking performance measurement", applied to the period prescribed between 1992 and 2013. After content analysis, we attained a list with the 10 most cited articles, which establish the basis for the development of our model (see Table II).

In the range of selected articles, we find works applied to different areas or sectors of activity, from health, management or science of computing, and applying different methodological approaches.

TABLE I
Synthesis of Articles Most Cited by Time Series

Journal	No. of articles	Citations	Journal	No. of articles	Citations
1992 - 2013: Top 50 - times cited (historical perspective)			***2010-2013: Top 25 - times cited (most recent trend)***		
Accounting Organizations and Society	6	382	Omega - International Journal of Management	3	16
Harvard Business Review	5	2072	Accounting Review	2	6
Accounting Review	4	351	Expert Systems with Applications	2	9
Long Range Planning	3	201	Environmental Monitoring and Assessment	1	21
Expert Systems with Applications	3	157	Technological and Economic Development of Economy	1	20
California Management Review	2	171	Journal of The Royal Society Medicine	1	11
International Journal of Operations & Production Management	2	171	International Journal of Hospitality Management	1	9
Computers & Industrial Engineering	2	148	Evaluation and Program Planning	1	7
European Journal of Operational Research	2	114	Plos Medicine	1	6
Journal of Operational Research	2	114	Clinical Psychology-Science and Practice	1	5
Computers in Industry	2	101	Journal of Operations Management	1	4
Others	17	1301	Others	10	26
Sum	*50*	*5283*	*Sum*	*25*	*140*

Source: Own elaboration

TABLE II
BSC FOR NETWORKING PERFORMANCE MEASUREMENT: TOP 10-TIMES CITED

Author(s)	Journal	Title	Methodology / Method	Year	Citations
Alfaro et al. [69]	International Journal of Computer Integrated Manufacturing	Business process interoperability and collaborative performance measurement	Conceptual	2009	8
Stanley et al. [71]	Contemporary clinical trials	Development and implementation of a performance measure tool in an academic pediatric research network	Case study	2010	2
Herath et al. [72]	Journal of Accounting and Public Policy	Joint selection of balanced scorecard targets and weights in a collaborative setting	Mathematical programming models/Simplex Method	2010	2
Ioppolo et al. [33]	Land Use Policy	Developing a Territory Balanced Scorecard approach to manage projects for local development: Two case studies	Two case studies	2012	2
Perkmann et al. [73]	R&D Management	How should firms evaluate success in university-industry alliances? A performance measurement system	Conceptual	2011	2
Verdecho et al. [74]	Omega - International Journal of Management	A multi-criteria approach for managing inter-enterprise collaborative relationships	Case study/Analytic Network Process (ANP)	2012	1
Verdecho al. [70]	Decision Support Systems	Prioritization and management of inter-enterprise collaborative performance	Quantitative/Analytic Network Process (ANP)	2012	1
Wu and Chang [31]	Decision Support Systems	Using the balanced scorecard in assessing the performance of e-SCM diffusion: A multi-stage perspective	Quantit./struct. equation modelling (SEM)	2012	1
Chytas et al. [20]	International Journal of Information Management	A proactive balanced scorecard	Fuzzy logic/Fuzzy Cognitive Maps (FCMs)	2011	1
Al-Ashaab et al. [35]	Production, Planning & Control	A balanced scorecard for measuring the impact of industry-university collaboration	Two case studies	2011	1

Source: Own elaboration

V. REGIONAL HELIX SCOREBOARD

Collaboration amongst enterprises is a common strategy deployed to increase competitiveness. Therefore, this requires the measuring of the performance of these business processes under a strategic approach from an inter-enterprise perspective, defining and using performance measurement/management frameworks composed of performance related factors (objectives, performance indicators, etc.) that facilitate the management of activities as well as monitoring strategy and processes [33], [70]-[74], [76].

Promoting high quality research networks inherently requires the establishment of evaluation tools for measuring performance and the corresponding definition of metrics and performance indicators [7]. While companies increasingly engage in formal alliances with universities, there is a lack of tools for evaluating the results of these collaborations [73].

The BSC is considered such a strategic measurement tool. Various companies have applied it to measure four key perspectives of their organisation's performance: financial, customer, internal business processes and learning and growth. However, this original model was not developed to measure the impact of collaborative research projects ongoing under an open innovation strategy [32]. In order to meet these new measuring performance requirements resulting from collaborative alliances between institutions, new performance measurement models were developed out of the original balanced scorecard [27], [25], [32], [33]. Al–Ashaab put forward a balanced scorecard for measuring the impact of industry–university collaboration – the collaborative BSC, and Ioppolo developed the Territory BSC to manage local development projects [32], [33] (see Table III).

The KTForce is a project supported by the INTERREG IVC Capitalisation Programme, co-financed by the European Regional Development Fund (ERDF), and its aim is to improve the effectiveness of regional development policies in the fields of innovation and the knowledge economy. This involves eleven partners from six regions, covering "modest and moderate innovator" regions (Lithuania, Portugal and Romania) and "innovation follower and leader" regions (France, Germany and Ireland) [8], [75]–[77]. For the measuring of innovative performance, the KTForce project comprises a set of indicators, distributed by pillars "Technology licensing", "Spin-offs creation and entrepreneurship" and "University-Industry relations".

The quality and abilities of the labour force (human capital); the extension, depth and focus of social and institutional networks (social/institutional capital), the range and quality of infrastructure as well as cultural assets (cultural capital), the presence of a creative and innovative class (knowledge/creative capital) and the quality of infrastructural policies and results (infrastructural capital) are all deemed to be critical factors in supporting and determining regional economic outcomes [16], [78]–[80].

Recent developments saw concerted efforts by emerging countries to transform their industrial-based economy into post-industrial knowledge-based economy. The growth of science and technology is necessary to support this economic transformation strategy.

Seeking to fill some of the gaps in the literature on a global model for A-I-G interaction performance measurement, we now proceed with setting out a new conceptual model, based upon the Triple Helix model, as defended by a vast range of authors [38], [40], [41], [81], focused on innovation and entrepreneurship as critical factors to regional competitiveness through their capacities to stimulate new investment and job creation, thus driving economies to attain new standards of

competition [59]. In this context, we present the RHS (see Fig. 2).

TABLE III
CHARACTERIZATION OF DIFFERENT PERFORMANCE MEASUREMENT MODELS

Author	Metrics								
	Networking view								
	Inter-enterprises		*Academic research network*				*A-I Collaboration*		*Intern. Cooper. Projects*
	Inter-enterprises business process interoperability	Collaborative enterprise network	General contributions	Intellectual development	Project implementation	Timely project completion	Inputs; In-process activities; Outputs; Impact	Competitiveness; Sustainable Development; Innovation; Strategic Knowledge Partnerships; Human Capital; Internal Business Processes	Internal Processes; New Public Governance; Learning & Innovation; Territory Strategic Development
Alfaro et al. [69]	X								
Stanley et al. [71]			X	X	X	X			
Verdecho, Jua-Jose Alfaro-Saiz, et al. [30]		X							
Verdecho, Jua-Jose Alfaro-Saiz, et al. [74]	X								
Perkmann et al. [73]							X		
Al-ashaab et al. [32]								X	
Ioppolo et al. [33]									X

Source: Own elaboration

Adjusted to the dynamics of the Triple Helix, and designed from the various inputs identified in the literature review, the THS derives from the initial BSC model from Kaplan and Norton, focuses on perspectives about "Innovation and entrepreneurship" and "Competitiveness and regional development" in order to measure the performance of the A-I-G interactions [19]. Thus, for each of the perspectives, the model proposes a set of pillars of sustainability, which are the defined strategic objectives, KPIs, targets and initiatives and collectively aiming to answer the central research question: how do innovation and entrepreneurship linked to the dynamics of the triple helix contribute to increasing regional competitiveness and development? In this perspective, "innovation and entrepreneurship" are identified through three main pillars of sustainability: "entrepreneurial initiative", "innovation effort", and "people employment". Regarding the perspective "regional competitiveness and development", the following pillars of sustainability were selected: "economic and financial", "knowledge and skills", and "strategic development". For each perspective and for each pillar of sustainability, strategic objectives and KPIs are defined and subject to adjustment in accordance with the nature of the respective innovation and competitiveness network.

Some of the most relevant **"Innovation and entrepreneurship"** strategic objectives and KPIs are:

- Strategic objectives / KPIs:
  - Increase in new collaborative projects / new business / new companies
    - *Number of new companies created*
    - *Number of technology based companies created (spin-off)*
    - *Number of companies created > 250 employees*
    - *Number of grants funding start ups*
    - *Total number of value propositions developed*
    - *Total number of new business plans developed*
    - *Number of successful proposals developed collaboratively to obtain public funding.*
  - *Increase* in new products / new technology
    - *Number of patent requests and patents*
    - *Number of industrial property licenses*
    - *Number of intangibles resulting from collaborative projects in the form of patents, licenses, copyright or trademarks.*
  - *Increase in jobs*
    - *Number of jobs created*
    - *Number of skilled jobs created.*

For "**Competitiveness and regional development**":

- Strategic objectives / KPIs:
  - Profitability
    - *Turnover*
    - *Sales*
  - Cost reduction
    - *Percentage of cost savings thanks to alliances*
    - *Percentage of cost savings thanks to university-based research.*
  - Internationalization
    - *Export volume percentage*

- *Linkages between international cluster networks.*

o Learning and knowledge dissemination

- *R&D spending*
- *Number of joint publications in scientific journals or conferences*.

o Environment, safety and quality of life improvement

- *Number of projects developing new models and/or methods to improve sustainability practices: health and safety, recycling methods, sustainable construction, etcetera*
- *Percentage of component reutilisation*
- *Number of collaborative projects that environmentally or socially improved any region or facility.*

Finally, so that evaluative conclusions may be drawn about performance, the definition of future target values and Initiatives with targets to meet are proposed.

We would note that depending on the nature of the A-I-G interaction (A-I collaborative projects; regional clusters, science parks and technology business incubators, etcetera), attention should be paid to appropriately adjusting the strategic objectives and KPIs.

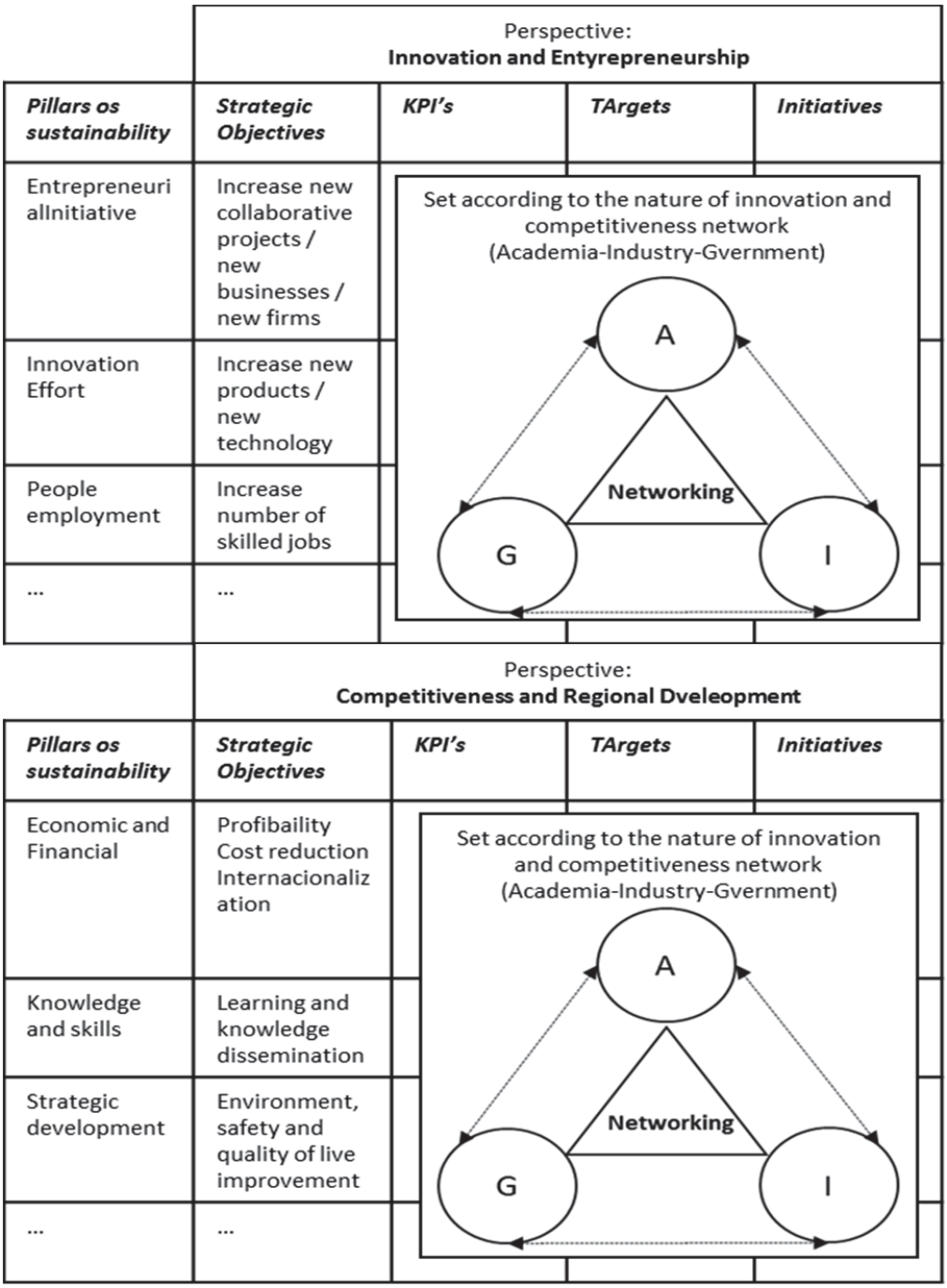

Fig. 2 RHS model

VI. Conclusion Remarks

This study puts forward an integrative conceptual model displaying a dynamic and interactive triple helix model able to clarify the role of innovation and entrepreneurship as factors of regional competitiveness. Entrepreneurship is defined in the literature as a high risk dynamic and with an especially high binomial level of effort-reward. Companies need to be able to innovate in the global marketplace, designing, producing and commercialising new products and evolving faster than their rivals.

The development of regions may correspondingly be segregated into exogenous development and endogenous development [43]. The triple helix model focuses on interactions ongoing between universities – industry – government as the key to improving the conditions necessary to innovation, based on changing the paradigm from industrial societies to knowledge based societies. Strengthening this perspective on regional competitiveness and development, the productive private sector capacity determines the prevailing levels of regional earnings and employability [17]. From the Global Entrepreneurship Monitor perspective, the launch of new companies results in investment inflows, new jobs and driving overall competitiveness and development [59].

The TH relational model reflects the interaction of relationships ongoing between three institutional spheres (university – industry – government) designed to secure regional competitive advantage within the framework of actions interrelated across a multi-level scenario. The TH model thereby serves as the point of departure for designing and implementing empirically based studies, susceptible to providing responses to the questions raised relative to the interactions taking place in the different spheres. This is, in turn, based on the assumption of a positive relationship between the dynamics of innovation and entrepreneurship for regional competitiveness and development that needs empirical validation with recourse to the appropriate research methodologies (quantitative and/or qualitative). Our model, in the context of the dynamics of regional areas of the triple helix, seeks to answer the research questions presented in the introduction to this chapter and thus provides a mechanism for measuring the impact of these networks on regional competitiveness.

Considering the pertinence of developing this theme in future research, and irrespective of the prevailing economic conjuncture – with recessionary pressures at the global level and reflecting in the rescaling and postponement of new investment projects despite the corresponding need for job creation within the framework of a globalised and competitive economy in which innovation stands out as a key factor for competitiveness, all combine to ensure the priority attributed to regional development and its associated competitiveness. This inherently requires the dissemination of knowledge and technology through a sustainable inter-organisational network. Based on this assumption, as future lines of research, we would suggest the empirical testing of the RHS as a tool for measuring the performance of triple/quadruple helix dynamics created from the Balanced Scorecard model and its developments in the fields of territorial and inter-organization collaborative relationships, now adjusted to the specific interactions of the triple helix.

Finally, we suggest studies which combine quantitative and qualitative research, with the creation and validation of instruments for collecting data through observation and document analysis, field notes, interviews and questionnaires in order to most fully test the RHS here developed.

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References

[1] K. Gopalakrishnan, Y. Y. Yusuf, A. Musa, T. Abubakar, and H. M. Ambursa, "Sustainable supply chain management: A case study of British Aerospace (BAe) Systems," *Int. J. Prod. Econ.*, vol. 140, no. 1, pp. 193–203, 2012.

[2] L. Budd and K. Hirmisf, "Conceptual Framework for Regional Competitiveness," *Univ. Bus.*, vol. 3, no. December, pp. 1015–1028, 2004.

[3] Y. Jiang and J. Shen, "Measuring the urban competitiveness of Chinese cities in 2000," *Cities*, vol. 27, no. 5, pp. 307–314, Oct. 2010.

[4] Z. Acs and J. Amorós, "Entrepreneurship and Development: The Role of Clusters," *Small Bus. Econ.*, vol. 39, no. 3, pp. 561–574, 2015.

[5] D. B. Audretsch, A. N. Link, and I. Peña, "Economics of Innovation and New Technology Academic entrepreneurship and economic competitiveness: introduction to the special issue," no. October, pp. 5–7, 2012.

[6] D. B. Audretsch and M. Keilbach, "Entrepreneurship and regional growth: An evolutionary interpretation," *J. Evol. Econ.*, vol. 14, no. 5, pp. 605–616, 2004.

[7] S. Singhal, S. McGreal, and J. Berry, "Application of a hierarchical model for city competitiveness in cities of India," *Cities*, vol. 2011, Jun. 2012.

[8] E. Commission, "European Competitiveness Report 2014: Helping Firms Grow," Belgium, 2014.

[9] B. T. Asheim and L. Coenen, "Knowledge bases and regional innovation systems: Comparing Nordic clusters," *Res. Policy*, vol. 34, no. 8, pp. 1173–1190, 2005.

[10] B. T. Asheim, O. Ejermo, and A. Rickne, "When is Regional 'Beautiful'? Implications for Knowledge Flows, Entrepreneurship and Innovation," *Ind. Innov.*, vol. 16, no. 1, pp. 1–9, Feb. 2009.

[11] B. T. Asheim, H. L. H. Smith, and C. Oughton, "Regional innovation systems: theory, empirics and policy," *Reg. Stud.*, vol. 45, no. 7, pp. 875–891, 2011.

[12] A. Osterwalder and Y. Pigneur, *Business Model Generation: A Handbook for visonairies, Game Changers and Challengers*. Hoboken, New Jersey, 2010.

[13] M. E. Porter and S. Stern, "Innovation: Location Matters," *MIT Sloan Manag. Rev.*, vol. 42, no. 4, pp. 28–36, 2001.

[14] P. K. Wong, Y. P. Ho, and E. Autio, "Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data," *Small Bus. Econ.*, vol. 24, no. 3, pp. 335–350, Apr. 2005.

[15] M. Nordqvist and L. Melin, "Entrepreneurial families and family firms," *Entrep. Reg. Dev.*, vol. 22, no. 3–4, pp. 211–239, 2010.

[16] R. Huggins, H. Izushi, D. Prokop, and P. Thompson, "Regional competitiveness, economic growth and stages of development*," *Zb. Rad. Ekon. Fak. u Rijeka*, vol. 32, no. 2, pp. 255–283, 2014.

[17] L. Budd and A. Hirmis, "Conceptual Framework for Regional Competitiveness," *Reg. Stud.*, vol. 38, no. 9, pp. 1015–1028, 2004.

[18] H. Lawton Smith and S. Bagchi-Sen, "The research university, entrepreneurship and regional development: Research propositions and current evidence," *Entrep. Reg. Dev.*, vol. 24, no. 5–6, pp. 383–404, 2012.

[19] R. S. Kaplan and D. P. Norton, *The Strategy-Focused Organization: How Balanced Scorecard*. Harvard Business School, 2001.

[20] P. Chytas, M. Glykas, and G. Valiris, "A proactive balanced scorecard,"

Int. J. Inf. Manage., vol. 31, no. 5, pp. 460–468, Oct. 2011.
[21] S. Dror, "The Balanced Scorecard versus quality award models as strategic frameworks," *Total Qual. Manag. Bus. Excell.*, vol. 19, no. 6, pp. 583–593, Jun. 2008.
[22] G. K. Kanji and P. M. e Sá, "Kanji's Business Scorecard," *Total Qual. Manag.*, vol. 13, no. 1, pp. 13–27, Jan. 2002.
[23] V. Lazzarotti, R. Manzini, and L. Mari, "A model for R&D performance measurement," *Int. J. Prod. Econ.*, vol. 134, no. 1, pp. 212–223, Nov. 2011.
[24] P. Mendes, A. C. Santos, F. Perna, and M. Ribau Teixeira, "The balanced scorecard as an integrated model applied to the Portuguese public service: a case study in the waste sector," *J. Clean. Prod.*, vol. 24, pp. 20–29, Mar. 2012.
[25] S. Philbin, "Process model for university-industry research collaboration," *Eur. J. Innov. Manag.*, vol. 11, no. 4, pp. 488–521, 2008.
[26] H. Sundin, M. Granlund, and D. A. Brown, *Balancing Multiple Competing Objectives with a Balanced Scorecard*, no. June 2012. 2009.
[27] J. Taylor and C. Baines, "Performance management in UK universities: implementing the Balanced Scorecard," *J. High. Educ. Policy Manag.*, vol. 34, no. 2, pp. 111–124, 2012.
[28] N. G. Theriou, E. Demitriades, and P. Chatzoglou, "A proposed framework for integrating the balanced scorecard into the strategic management process," *Oper. Res.*, vol. 4, no. 2, pp. 147–165, May 2004.
[29] M.-L. Tseng, "Implementation and performance evaluation using the fuzzy network balanced scorecard," *Comput. Educ.*, vol. 55, no. 1, pp. 188–201, Aug. 2010.
[30] M.-J. Verdecho, J.-J. Alfaro-Saiz, R. Rodríguez-Rodríguez, and A. Ortiz-Bas, "The analytic network process for managing inter-enterprise collaboration: A case study in a collaborative enterprise network," *Expert Syst. Appl.*, vol. 39, no. 1, pp. 626–637, Jan. 2012.
[31] I.-L. Wu and C.-H. Chang, "Using the balanced scorecard in assessing the performance of e-SCM diffusion: A multi-stage perspective," *Decis. Support Syst.*, vol. 52, no. 2, pp. 474–485, Jan. 2012.
[32] A. Al-Ashaab, M. Flores, A. Doultsinou, and A. Magyar, "A balanced scorecard for measuring the impact of industry–university collaboration," *Prod. Plan. Control*, vol. 22, no. 5–6, pp. 554–570, Jul. 2011.
[33] G. Ioppolo, G. Saija, and R. Salomone, "Developing a Territory Balanced Scorecard approach to manage projects for local development: Two case studies," *Land use policy*, vol. 29, no. 3, pp. 629–640, Jul. 2012.
[34] K. Semlinger, "Cooperation and competition in network governance: regional networks in a globalised economy," *Entrep. Reg. Dev.*, vol. 20, no. 6, pp. 547–560, Nov. 2008.
[35] N. Arranz and J. C. Fdez. de Arroyabe, "The choice of partners in R&D cooperation: An empirical analysis of Spanish firms," *Technovation*, vol. 28, no. 1–2, pp. 88–100, Jan. 2008.
[36] Y. Awazu, "Managing technology alliances: The case for knowledge management," *Int. J. Inf. Manage.*, vol. 26, no. 6, pp. 484–493, Dec. 2006.
[37] A. Al-ashaab, M. Flores, A. Doultsinou, and A. Magyar, "A balanced scorecard for measuring the impact of industry – university collaboration," *Prod. Plan. Control*, vol. 22, no. 5–6, pp. 554–570, 2011.
[38] H. Etzkowitz, *The Triple Helix: University–Industry–Government Innovation in Action*, 1st ed. Oxon: Routledge, 2008.
[39] H. Etzkowitz, "Innovation in Innovation: The Triple Helix of University-Industry-Government Relations," *Soc. Sci. Inf.*, vol. 42, no. 3, pp. 293–337, Sep. 2003.
[40] H. Etzkowitz, J. M. C. de Mello, and M. Almeida, "Towards 'meta-innovation' in Brazil: The evolution of the incubator and the emergence of a triple helix," *Res. Policy*, vol. 34, no. 4, pp. 411–424, May 2005.
[41] H. Etzkowitz and L. Leydesdorff, "The dynamics of innovation: from National Systems and '"Mode 2"' to a Triple Helix of university – industry – government relations," *Sci. Technol.*, pp. 109–123, 2000.
[42] L. Leydesdorff and M. Fritsch, "Measuring the knowledge base of regional innovation systems in Germany in terms of a Triple Helix dynamics," *Res. Policy*, vol. 35, no. 10, pp. 1538–1553, Dec. 2006.
[43] A. Hira, "Mapping out the Triple Helix: how institutional coordination for competitiveness is achieved in the global wine industry," *Prometheus*, vol. 31, no. 4, pp. 271–303, 2013.
[44] M. Ozman, "Inter-firm networks and innovation: a survey of literature," *Econ. Innov. New Technol.*, vol. 18, no. 1, pp. 39–67, Jan. 2009.
[45] L. Leydesdorff, W. Dolfsma, and G. Vanderpanne, "Measuring the knowledge base of an economy in terms of triple-helix relations among 'technology, organization, and territory,'" *Res. Policy*, vol. 35, no. 2, pp. 181–199, 2006.
[46] L. Leydesdorff and M. Meyer, "Triple Helix indicators of knowledge-based innovation systemsIntroduction to the special issue," *Res. Policy*, vol. 35, no. 10, pp. 1441–1449, Dec. 2006.
[47] E. Nissan, M.-Á. Galindo Martín, and M.-T. Méndez Picazo, "Relationship between organizations, institutions, entrepreneurship and economic growth process," *Int. Entrep. Manag. J.*, vol. 7, no. 3, pp. 311–324, Jun. 2011.
[48] L. Farinha, J. Ferreira, and B. Gouveia, "Networks of Innovation and Competitiveness: A Triple Helix Case Study," *J. Knowl. Econ.*, vol. 7, no. 1, pp. 259–275, 2016.
[49] H. L. Smith and S. Bagchi-Sen, "University–Industry Interactions: the Case of the UK Biotech Industry," *Ind. Innov.*, vol. 13, no. 4, pp. 371–392, 2006.
[50] E. Salvador, "Are science parks and incubators good 'brand names' for spin-offs? The case study of Turin," *J. Technol. Transf.*, vol. 36, no. 2, pp. 203–232, Feb. 2010.
[51] Y. Kim, W. Kim, and T. Yang, "The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S.," *Res. Policy*, vol. 41, no. 1, pp. 154–166, Feb. 2012.
[52] Y. Kim, W. Kim, and T. Yang, "The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S.," *Res. Policy*, vol. 41, no. 1, pp. 154–166, Feb. 2012.
[53] L. Leydesdorff, "The Triple Helix, Quadruple Helix, …, and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy?" *J. Knowl. Econ.*, vol. 3, no. 1, pp. 25–35, 2012.
[54] S. P. MacGregor, P. Marques-Gou, and A. Simon-Villar, "Gauging Readiness for the Quadruple Helix: A Study of 16 European Organizations," *J. Knowl. Econ.*, vol. 1, no. 3, pp. 173–190, Jul. 2010.
[55] D. B. Audretsch, M. Belitski, and S. Desai, "Entrepreneurship and economic development in cities," *Ann. Reg. Sci.*, vol. 55, no. 1, pp. 33–60, 2015.
[56] D. B. Audretsch, A. N. Link, and I. Peña, "Academic entrepreneurship and economic competitiveness: introduction to the special issue," *Econ. Innov. New Technol.*, vol. 21, no. 5–6, pp. 427–428, 2012.
[57] D. B. Audretsch and M. Keilbach, "Entrepreneurship capital and regional growth," *Ann. Reg. Sci.*, vol. 39, no. 3, pp. 457–469, 2005.
[58] M. Kitson, R. Martin, and P. Tyler, "Regional Competitiveness: An Elusive yet Key Concept?," *Reg. Stud.*, vol. 38, no. 9, pp. 991–999, Dec. 2004.
[59] D. J. Kelley, S. Singer, and M. Herrington, "The Global Entrepreneurship Monitor 2011 Global Report," 2011.
[60] H. Lawton Smith, J. Glasson, and A. Chadwick, "The geography of talent: entrepreneurship and local economic development in Oxfordshire," *Entrep. Reg. Dev.*, vol. 17, no. 6, pp. 449–478, 2005.
[61] M. Nordqvist and L. Melin, "Entrepreneurial families and family firms," *Entrep. Reg. Dev.*, vol. 22, no. 3–4, pp. 211–239, May 2010.
[62] B. Van Looy, P. Landoni, J. Callaert, B. van Pottelsberghe, E. Sapsalis, and K. Debackere, "Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs," *Res. Policy*, vol. 40, no. 4, pp. 553–564, May 2011.
[63] E. G. Carayannis, T. D. Barth, and D. F. Campbell, "The Quintuple Helix innovation model: global warming as a challenge and driver for innovation," *J. Innov. Entrep.*, vol. 1, no. 1, p. 2, 2012.
[64] A. Bernasconi, "University entrepreneurship in a developing country: The case of the P. Universidad Católica de Chile, 1985–2000," *High. Educ.*, vol. 50, no. 2, pp. 247–274, Sep. 2005.
[65] Y. Kim, W. Kim, and T. Yang, "The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S.," *Res. Policy*, vol. 41, no. 1, pp. 154–166, 2012.
[66] A. Bernasconi, "University entrepreneurship in a developing country: The case of the P. Universidad Católica de Chile, 1985–2000," *High. Educ.*, vol. 50, no. 2, pp. 247–274, 2005.
[67] R. S. Kaplan and D. P. Norton, "Transforming the Balanced Scorecard from Performance Measurement to Strategic Management: Part I," *Account. Horizons*, vol. 15, no. 1, pp. 87–104, Mar. 2001.
[68] P. D'Este and M. Perkmann, "Why do academics engage with industry? The entrepreneurial university and individual motivations," *J. Technol. Transf.*, vol. 36, no. 3, pp. 316–339, Feb. 2010.
[69] J. J. Alfaro, R. Rodriguez-Rodriguez, M. J. Verdecho, and A. Ortiz, "Business process interoperability and collaborative performance measurement," *Int. J. Comput. Integr. Manuf.*, vol. 22, no. 9, pp. 877–889, Sep. 2009.
[70] M.-J. Verdecho, J.-J. Alfaro-Saiz, and R. Rodriguez-Rodriguez, "Prioritization and management of inter-enterprise collaborative

performance," *Decis. Support Syst.*, vol. 53, no. 1, pp. 142–153, Apr. 2012.
[71] R. Stanley, K. a Lillis, S. J. Zuspan, R. Lichenstein, R. M. Ruddy, M. J. Gerardi, and J. M. Dean, "Development and implementation of a performance measure tool in an academic pediatric research network.," *Contemp. Clin. Trials*, vol. 31, no. 5, pp. 429–37, Sep. 2010.
[72] H. S. B. Herath, W. G. Bremser, and J. G. Birnberg, "Joint selection of balanced scorecard targets and weights in a collaborative setting," *J. Account. Public Policy*, vol. 29, no. 1, pp. 45–59, 2010.
[73] M. Perkmann, A. Neely, and K. Walsh, "How should firms evaluate success in university-industry alliances? A performance measurement system," *R&D Manag.*, vol. 41, no. 2, pp. 202–216, Mar. 2011.
[74] M.-J. Verdecho, J.-J. Alfaro-Saiz, R. Rodriguez-rodriguez, and A. Ortiz-bas, "A multi-criteria approach for managing inter-enterprise collaborative relationships," *Omega*, vol. 40, pp. 249–263, 2012.
[75] R. Sternberg, "Do EU Regional Policies Favour Regional Entrepreneurship? Empirical Evidence from Spain and Germany," *Eur. Plan. Stud.*, vol. 20, no. 4, pp. 583–608, 2012.
[76] European Commission, "Innovation Union Scoreboard," Brussels, 2014.
[77] L. Farinha, J. J. Ferreira, and J. B. Gouveia, "Innovation and Competitiveness: A High-Tech Cluster Approach," *Rom. Rev. Precis. Mech. Opt. Mechatronics,* vol. 45, pp. 41–48, 2014.
[78] I. Lengyel and J. Rechnitzer, "Drivers of Regional Competitiveness in the Central European Countries," *Transit. Stud. Rev.*, vol. 20, no. 3, pp. 421–435, 2013.
[79] N. Čučković, K. Jurlin, and V. Vučković, "Measuring regional competitiveness: the case of Croatia," *Southeast Eur. Black Sea Stud.*, vol. 13, no. 4, pp. 503–523, 2013.
[80] A. Balkyte and M. Tvaronavičiene, "Perception of competitiveness in the context of sustainable development: Facets of 'sustainable competitiveness,'" *J. Bus. Econ. Manag.*, vol. 11, no. 2, pp. 341–365, 2010.
[81] R. Viale and H. Etzkowitz, *The Capitalization of Knowledge: A Tripla Helix of University-Industry-Government*, 1st ed. Cheltenham, UK: Edward Elgar Publishing, 2010.