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Developments on Helix Theory: Exploring a Micro-Evolutionary Repositioning in Stra.Tech.Man Terms

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Abstract

This study explores a potential reposition of the triple helix model of university-industry-government relations in terms of micro-level analysis. In this direction, we evaluate the development of helix theory over time, by reviewing the relevant literature divided into three successive phases: the phase of theoretical foundation, the phase of conceptual expansion, and the phase of recent developments and systematic attempts of implementation. In this conceptual study, we estimate that a refocused triple helix model in terms of local development, by placing at the center of analysis the "living organization's" dynamics in Stra.Tech.Man terms (synthesis of Strategy-Technology-Management), can be a possible direction of analytical enrichment.

Keywords: Helix theory; Competitiveness approaches; Micro-level analysis; Stra.Tech.Man analysis.

1. Introduction

The helix theory acquires gradually increasing acceptance for the articulation of policies to foster innovation and competitiveness by studying the linkages of universities, industries, and governments. The need for articulating an integrated, multilevel industrial policy (Dopfer *et al.*, 2004), which gives the ability to the socioeconomic systems to evolve (Peneder, 2016), establishes possibly helix theory as a "research hub" for enriching the study of systemic institutional complexity and development (Acemoglu and Robinson, 2012; Siltaloppi *et al.*, 2016; Vermeulen *et al.*, 2016; Vlados *et al.*, 2019a).

In the current phase of crisis and restructuring of globalization (Bhattacharya *et al.*, 2017; Laudicina and Peterson, 2016; Rodrik, 2011; Sapir, 2011), the research field of socioeconomic spatial sciences enters into a phase of substantial repositioning (Briant *et al.*, 2010; Crespo *et al.*, 2014; Jokela *et al.*, 2015; Lazzeretti *et al.*, 2014; Majava *et al.*, 2016). In these new approaches the research focus shifts from the perspective of traditional economic geography and regional analysis to the study of local dynamics, which seems able to synthesize all the partial spatial levels (Boschma and Frenken, 2009; Cameron and Macy, 2017). A sort of "paradigmatic change"—in Kuhn terms (Kuhn, 1962)—seems to take place in this field gradually; a change where the methodologies and interpretations of different approaches reposition the analytical spectrum of the thematic into an interdisciplinary view, while elements from the whole spectrum of socioeconomic sciences are utilized (Augsburg, 2010; Mainzer, 2011). In this context, the reproduction of local development or under-development at the micro-level (Abro *et al.*, 2009; Pae and Lee, 2017; Vlados and Katimertzopoulos, 2018) creates new evolutionary trajectories (Andreoni and Scazzieri, 2014; Chabault, 2010; Dosi, 1982) and transformed dynamics, for all the participant socioeconomic systems.

We argue that the contribution of helix theory, by connecting methodologically and observing the possible cooperation of universities, firms, and governmental interventions can be a fruitful platform for examining the dynamics of local development. Specifically, in this article, we explore the helix theory in evolutionary and micro-environment terms (with a new evolutionary epicenter), in order to articulate more effective policies that foster local development (Andersson and Henrekson, 2015; Dewangan *et al.*, 2017; Iskanius and Pohjola, 2016; Swords, 2013).

In this regard, the present article explores the following research question: based on the evolution of helix theory, to what extent can we deepen it in terms of local development dynamics (Pike *et al.*, 2017; Rodríguez-Pose, 2013), by placing at the analytic center the evolution of the "living organization", understood in micro terms (Geus, 1997; Kucia and Gravett, 2014; Meyer and Davis, 2003; Moore, 1993; Wolfe, 2011;2012)?

2. Methodology and Structure of the Paper

In this conceptual study, in order to find out how we can reposition the helix theory into an evolutionary epicenter of the "living organization" dynamics in evolutionary terms (Andersen, 1996; Boulding, 1981; Heinzel, 2013; Hodgson, 2002), we have structured our research as follows:

(a) A brief literature review of helix theory divided into three phases: phase of theoretical foundation, phase of conceptual expansion, and phase of recent developments and systematic attempts of implementation
(b) A critical evaluation of helix theory evolution
(c) Conclusions and counter-proposal; the Stra.Tech.Man approach as direction for potential enrichment of helix theory.

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3. The Development of Helix Theory

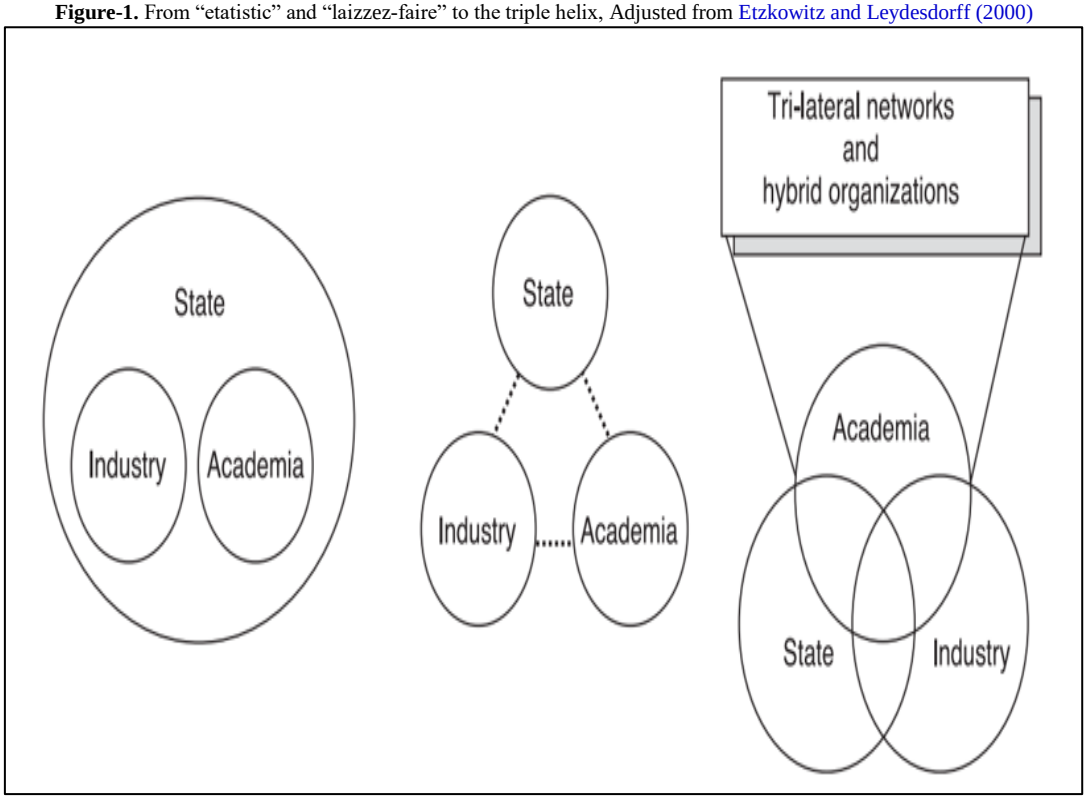
The triple-helix theory explores the phenomenon of development from the perspective of knowledge production by investigating the cooperation of universities, industries, and governmental policy. Below, we present and analyze briefly the main published articles that we distinguished from the relevant literature, which we think offer significant progress regarding the conceptual evolution of helix theory[1].

By classifying in chronological order these publications about helix theory, we were able to imprint the development of the theory into three consecutive phases: (a) phase of theoretical foundation (1995-2000), (b) phase of conceptual expansion (2001-2010), and (c) phase of recent developments and systematic implementation attempts (2011-2018).

3.1. The Phase of Theoretical Foundation (1995-2000)

The helix theory gets founded as "a laboratory for knowledge-based economic development," which conceptualizes the different institutional actors to be responsible for creating the conditions for a thriving innovation environment, particularly at the regional level. This knowledge-based development causes the phenomenon of "endless transition" where the triple helix institutionalized spheres are "locked into" a regime of technological innovation and continuous organizational reform. The triple helix institutions, from an evolutionary perspective, are conceptualized as flexible and, therefore, every institution can take the role of the other. The triple helix model differs analytically from alternative models of knowledge creation and innovation, such as Mode 2[2] and National Systems of Innovation[3]. In conclusion, this first conceptual phase attempts to explain innovation as a result of co-evolving inter-institutional linkages. Indicatively, the approach of Etzkowitz and Leydesdorff (2000) reflects this phase of development in helix theory where the triple helix system differs from the "etatistic" (state-oriented) or the laissez-faire (market-oriented) model because it includes tri-lateral networks and hybrid organizations (see Figure 1).

Figure-1. From "etatistic" and "laizzez-faire" to the triple helix, Adjusted from Etzkowitz and Leydesdorff (2000)



[1] We studied approximately 150 scientific publications that we found by searching the keyword "Helix Theory" in Google Scholar, focusing particularly on conceptual papers.

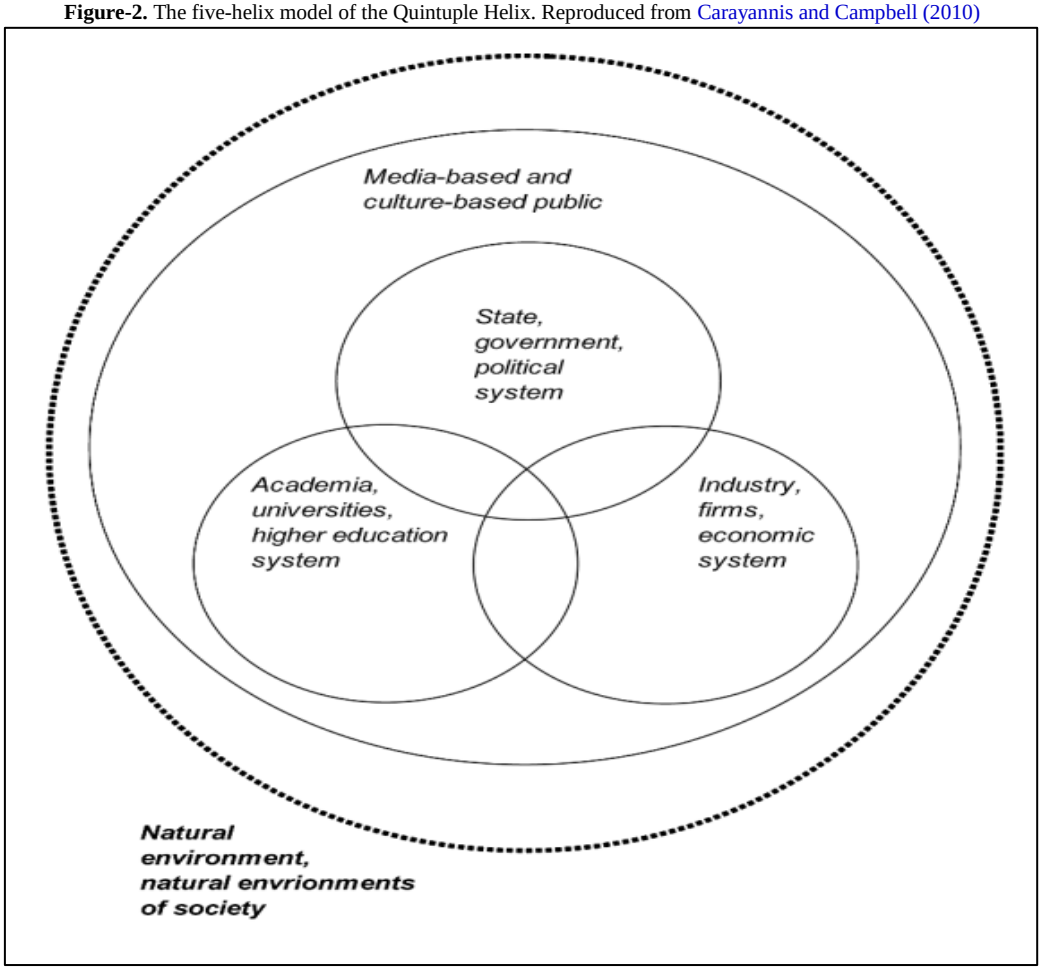
[2] In this analytical perspective, Gibbons *et al.*,(1994) have argued that a new Mode of knowledge production is emerging (Mode 2), which is interdisciplinary and differs from the traditional mode of knowledge (Mode 1). Therefore, a transformation into a new mode of knowledge production is underway, which replaces the old paradigm for the established institutions, scientific disciplines, practices and policies. This to a great extent is also related to a different perception in the phenomenon of socioeconomic crisis, passing from a conjunctural or superficial understanding to an evolutionary and correlative perception of the actual structural crisis Vlados *et al.* (2018b). Towards an Evolutionary Understanding of the Current Global Socio-Economic Crisis and Restructuring: From a Conjunctural to a Structural and Evolutionary Perspective. *Research in World Economy*, 9(1): 15–33.

[3] The National Systems of Innovation represent the flow of information and technology between people, enterprises and institutions, which is critical for the development of innovation at the national level. According to this theory, which was introduced in the late 1980s Freeman,(1987) , Lundvall,(1992) , innovation and technology development results from the complex relationships between the actors in the system, specifically between enterprises, universities and government research institutes.

3.2. The Phase of Conceptual Expansion (2001-2010)

In this phase of theoretical development, the triple helix model gets repositioned and expanded into new conceptual directions. Along with the search for more than three helices to the system, the triple helix analysis is increasingly focused on how to achieve knowledge-based regional development in specific socioeconomic systems. Several micro-level analyses of universities-industry collaboration strategies, not only for developed but also for developing countries, also signify the conceptual expansion of helix theory. The introduction of "Quadruple" and "Quintuple" helices add the "media-based" and "culture-based" public helix to the former, and the "inter-disciplinary" and "trans-disciplinary" framework of analysis of the natural environment to the latter. In conclusion, we understand from this conceptual expansion phase that helix theory has the potential to involve all the participant actors, from all socioeconomic systems, in the process of development. Indicatively, the approach of Carayannis and Campbell (2010), who introduced the "Quintuple Helix" as an inter-disciplinary and trans-disciplinary framework of analysis of sustainable development and social ecology, reflects this phase of helix theory (see Figure 2).

Figure-2. The five-helix model of the Quintuple Helix. Reproduced from Carayannis and Campbell (2010)



3.3. The Phase of Recent Developments and Systematic Attempts of Implementation (2011-2018)

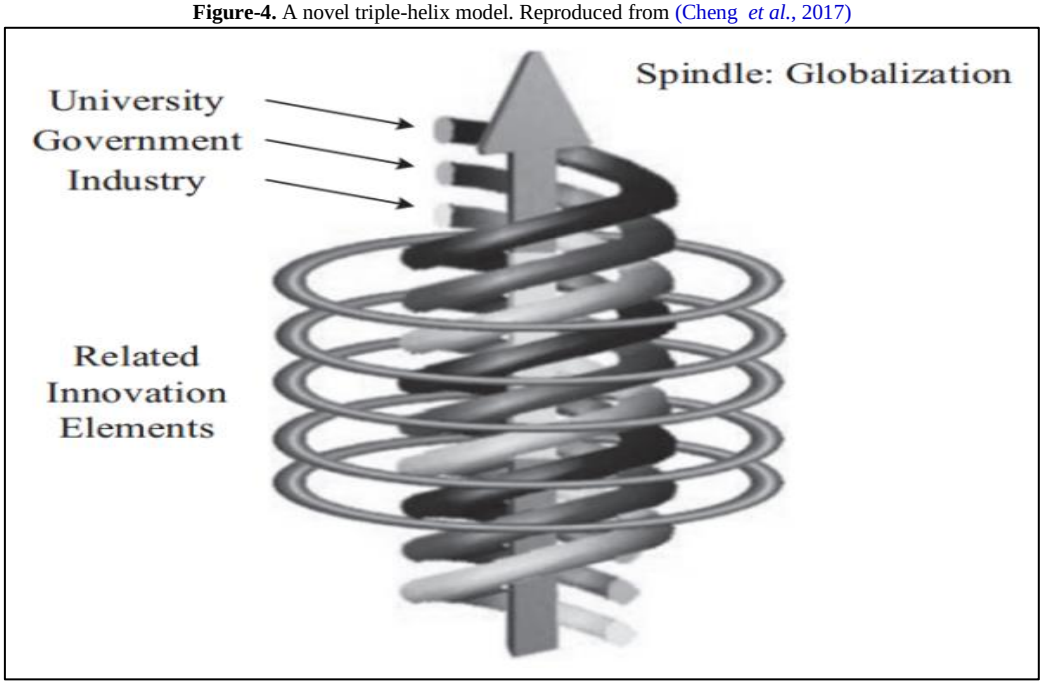
In the third chronological period, the triple helix model's potential is systematically exploited through implementation attempts—such as the "Triple Helix Arenas" (Fogelberg and Thorpenberg, 2012), the triple helix analysis of intermediary organizations such as the "Offices of Research Innovation and Commercialisation (ORIC)" (Altaf *et al.*, 2018) or the "Centres for Science, Engineering and Technology (CSETs)" (Ryan *et al.*, 2018)—and specific local and urban development and innovation policies. Rather than a macro-level perspective, a micro-level dynamics perspective seems progressively more suitable for analyzing the triple helix model of local development. We also observe recent conceptual developments to the helix theory, such as the introduction of the concept of "open innovation diplomacy" as a strategy in the context of the quadruple and quintuple innovation helices. There are also approaches arguing that to move beyond the triple helix requires substantive specification and operationalization and, therefore, we should be cautious in generalizing beyond the triple helix model to an "N-tuple" of helices. In conclusion, we understand from this last phase that the triple helix model has the potential to be implemented for specific innovation policies, at local, regional, national and even more at international and transnational level. Indicatively, two essential approaches reflect this phase of helix theory development. (Yang *et al.*, 2012) compare four triple helix frameworks in terms of outset, characteristic, and analytical focus (see Figure 3). (Cheng *et al.*, 2017), from the case study of China International Nanotech Innovation Cluster, propose a triple helix model to analyze the globalization of China's nanotechnology innovation, concluding that the leading entities in the

globalization process, that is, governments, universities, and industries should take advantage of the influential, innovative elements flowing in from abroad (see Figure 4).

Figure-3. Outset, characteristic, and analytical focus for different helix models of innovation, according to Yang *et al.* (2012)

	Outset	Characteristic	Analytical focus
Triple helix	Enhancing the role of universities in innovation	Places a particular emphasis on tri-lateral networks and hybrid organizations: university–industry–government	Knowledge infrastructure unstable tri-lateral networks
Triple helix twins	Introduce a missing element (public) into the model, while retaining the dynamic properties of a *tertius gaudens*	Emphasizes a need for public participation to ensure innovation is not harming environment and health: innovation triple helix of university–industry–government Sustainability triple helix of university–government–public	Tensions between industry (presumed economic interest) and public (presumed social and environmental interest)
Quadruple helix	Public reality is crucial for a society to assign top-priorities to innovation and knowledge	Emphasizes that culture and media-based public is as important as university, industry and government to be the fourth actor in innovation	Co-evolution and cross-integration of different knowledge modes
N-tuple helices	Complexity of innovation and diversity of actors	Break state, market and civil society into as many subsystems as possible	A plurality of agents, actors and organizations are involved

Figure-4. A novel triple-helix model. Reproduced from (Cheng *et al.*, 2017)



4. Conclusions and Implications

4.1. A Critical Review of Helix Theory Evolution

After presenting a synopsis of the conceptual evolution of helix theory, from its theoretical foundation to this day, we estimate that the triple helix model is still in its first stages of development. Below, we present some of the significant conceptual contributions we have distinguished from the related literature (see Table 1).

Table-1. Significant conceptual developments/contributions to helix theory – from 1995 to 2018

The phase of theoretical foundation (1995-2000)	Introduction of the triple helix model as a laboratory for knowledge-based economic development (Etzkowitz and Leydesdorff, 1995)
	The triple helix analysis can be extended at the regional level, to incorporate governmental and academic actors, who play an increasing role in creating the conditions for a thriving regional innovation environment (Etzkowitz, 1996)
	The world has entered into a phase of "endless transition." The complex dynamics of social relations between institutionalized spheres are "locked into" a regime of technological innovation and organizational reform (Etzkowitz and Leydesdorff, 1998)
	The triple helix framework as a recursive model of how an overlay of communications, that is the market selections, the innovative dynamics, and the

	network controls, operates on the underlying institutions. The triple helix institutions can be flexible in temporarily assuming the roles of other institutions (Etzkowitz and Leydesdorff, 1998)
	The triple helix model can be interpreted either as neo-corporatist, focused on reaching a consensus among the triple helix institutions or as neo-evolutionary, focused on specific local contexts of triple helix institutions that are learning to encourage economic growth through generative relationships (Viale and Ghiglione, 1998)
	Comparison of the triple helix model with alternative models for explaining the current research system in its social contexts, such as Mode 2 and National Systems (Etzkowitz and Leydesdorff, 2000)
	Summary: The methodological foundations are introduced, with emphasis on the co-evolution of the triple helix institutions that produce innovation and new knowledge
The phase of conceptual expansion (2001-2010)	A repositioning of the theory of new production of scientific knowledge—such as the helix theory—is necessary in order to contribute something enduring to scholarship and practice; otherwise, it may end up in an unproductive frenzy (Shinn, 2002)
	When the academia-industry relations are shaped by regulation and market forces (the case of the US) and not by the direct intervention of government and public bodies (the case of the EU), the best science and technology output is possible (Viale and Campodall'Orto, 2002)
	The ability of individuals and groups to express themselves freely without permission from the state is a necessary condition for the development of triple helix dynamics. Therefore, "the public" (or civil society), is narrowed into another private sphere as the fourth helix (Leydesdorff and Etzkowitz, 2003)
	Instead of adding a fourth helix, we can conceptualize Triple Helix as a set of two triple helices or Triple Helix twins: introduction of a Sustainability Triple Helix of university-public-government as a complement to the Innovation Triple Helix of university-industry-government (Etzkowitz and Zhou, 2006)
	Universities are drivers of knowledge-based regional development, by exploring a triple helix analysis of a lagging region in Wales (Huggins *et al.*, 2008)
	The emergence of an entrepreneurial university in the evolution of triple helix in China by government-pulled and industry-university collaborations (Zhou, 2008)
	Analysis of a micro-level perspective of universities-industry collaboration strategies, by studying the population of university departments and SMEs involved in collaborative research projects sponsored by a new governmental program in Denmark (Bjerregaard, 2009)
	Analysis of how a triple helix strategy can promote SME development by studying the case of an intermediary organization in the developing economy of Thailand (Yuwawutto *et al.*, 2010)
	Introduction of Mode 3 knowledge production of the co-existence and co-evolution of different knowledge and innovation paradigms. Introduction of the Quadruple Helix that integrates the perspective of the media-based and culture-based public (Carayannis and Campbell, 2009)
	Introduction of the Quintuple Helix, which is an inter-disciplinary and trans-disciplinary framework of analysis of sustainable development and social ecology (Carayannis and Campbell, 2010)
	Summary: Expansion of the triple helix theory as a strategy for innovation for both developed and developing economies. Introduction of the Quadruple and Quintuple Helix
The phase of recent developments and systematic attempts of implementation (2011-2018)	The evolutionary model of the triple helix can be used to investigate the level of knowledge of an urban economy while studying the support for innovation provided by the civil society (Etzkowitz, 2011)
	Four modifications to the triple helix innovation model are proposed: (a) the introduction of society as a fourth strand, (b) to refer to the strands as binomials, (c) to conceive the binomials in a hierarchical form and (d) the helix theory processes can be temporary segmented phases (Marcovich and Shinn, 2011)
	Introduction of "Open Innovation Diplomacy" as a novel strategy in the context of the quadruple and quintuple innovation helices, which bridges the distance and other divides (cultural, socioeconomic, technological) with focused initiatives to connect ideas and solutions with markets and investors (Carayannis and Campbell, 2011)
	Analysis of the "Triple Helix Arenas," which is an innovation policy in Sweden; it

	is concluded that there is a distance between the "ideal-type" of triple helix processes and the actual actors' view of the development process (Fogelberg and Thorpenberg, 2012)
	To move beyond the triple helix requires substantive specification and operationalization in terms of potentially relevant data. Therefore one should be cautious in generalizing beyond the triple helix model to an "N-tuple" of helices (Leydesdorff, 2012)
	Four triple helix frameworks in terms of outset, characteristic and analytical focus are compared, in order to find which framework is more suitable for the analysis of eco-innovation dynamics: the triple helix, the triple helix twins, the quadruple helix, and the N-tuple helices (Yang *et al.*, 2012)
	The triple helix model can be used for local development policies. A triple helix analysis of a small Portuguese municipality concludes that some territories do not have the resources needed to emulate the trajectories of places such as Silicon Valley (Rodrigues and Melo, 2013)
	From the case study of the China International Nanotech Innovation Cluster, there is a triple helix model to analyze the globalization of China's nanotechnology innovation. The main entities in the globalization process, that is, governments, universities, and industries should take advantage of the influential, innovative elements flowing in from abroad (Cheng *et al.*, 2017)
	Analysis of the triple helix perspective in the context of rural entrepreneurship: a micro-level dynamics perspective is more suitable to analyze the aspect of technological innovation that favors regional development, rather than a macro-level perspective (Sá *et al.*, 2018)
	The role of an intermediary organization in Pakistan is studied in terms of triple helix interactions and in terms of providing a framework that facilitates the triple helix culture of innovation (Altaf *et al.*, 2018)
	Analysis of the micro-foundations of firms' explorative innovation capabilities within the triple helix framework. If we use a "micro-foundational" lens, then we can have a deeper understanding of how triple helix programs influence the capabilities of firms for explorative innovation (Ryan *et al.*, 2018)
	Summary: The triple helix theory is further deepened into the micro-level factors, by the systematic exploitation of an increasing number of local, regional and national case studies

Overall, we think that the co-evolutionary institutional perspective of the triple helix model (academia-industry-government) can reposition the theory and practice of innovation and the overall aspect of socioeconomic development within the current crisis and restructuring phase of globalization (Laudicina and Peterson, 2016; Rodrik, 2011). In this direction, we think that the triple helix model of institutional linkages, in its foundational definition as a "laboratory for knowledge-based economic development" (Etzkowitz and Leydesdorff, 1995), can act as innovative mechanism for all the partial and interdependent socioeconomic systems and within the today's era of overwhelming new knowledge production (Barradas *et al.*, 2016; Carayannis and Campbell, 2009; Morabito *et al.*, 2018). We also agree that all socioeconomic organizations nowadays, to all their operating dimensions, seem to have entered into a phase of endless transition because of the complex dynamics of social relations between institutionalized spheres is increasingly "locked into" a complex regime of continuous technological innovation and organizational reform (Etzkowitz and Leydesdorff, 1998).

Therefore, the evolutionary triple helix interactions, where the institutions can be flexible in temporarily assuming roles of other institutions, can be operationalized in every national socioeconomic system and advance to some extent the previous approaches to the national systems of innovation (Etzkowitz and Leydesdorff, 2000; Freeman, 1987; Lundvall, 1992). Is the triple helix model extendable to more complex formations and systems (quadruple, quintuple, n-helices) (Leydesdorff and Etzkowitz, 2003; Leydesdorff, 2012)? We suggest that as long as the socioeconomic systems' dynamics is valorized primarily at the micro-level, then the helix theory can analyze more validly the macro-environmental dynamics (e.g., the natural environments of the quintuple helix; (Carayannis and Campbell, 2010) and be increasingly operational.

However, we think that the helix theory perspective also has some limitations. Specifically, it seems that some helix theory approaches assume that technology creation happens to some extent automatically because supposedly the emerging knowledge-based society is independent of the inescapable economic problem of finite resources, which creates the need for strategy and politics (Daoud, 2010; Martins, 2011). For example, we observe a trend of "unlocking" the helix theory from politics: "*In a knowledge-based economy—as against a political economy—the structure of society is continuously upset by transformations which originate from the technosciences*" (Leydesdorff, 2012).

Also, contrary to Schumpeter's theory of creative destruction, which shows how outmoded economic regimes disappear, some scholars argue that the Triple Helix systems delineate how new regimes appear through "creative reconstruction" (Etzkowitz and Leydesdorff, 2000; Ranga and Etzkowitz, 2013): on the contrary, we think that all

aging socioeconomic organizations decline naturally and, therefore, no system can avoid the inevitable "destructiveness".

Nevertheless, the contemporary analytical convergence of many helix theory approaches to studying the micro-level dynamics (Ryan *et al.*, 2018; Sá *et al.*, 2018), we think it offers significant progress to the theoretical schema of "triple/quadruple/quintuple/n-tuple" helix. It applies a comprehensive view to how the various actors create new knowledge, within any partial socioeconomic system. In this context, we suggest that micro-level socioeconomic features can enrich the helices and, therefore, the theory can draw more elements from the practice and build more accurate scientific hypotheses and effective policies.

4.2. Theoretical Counter-Proposal and Enrichment of the Triple Helix Model in Stra.Tech. Man Terms

We suggest that the helix theory can benefit in terms of analytic clarity if being developed and deepened into, mainly, three levels:

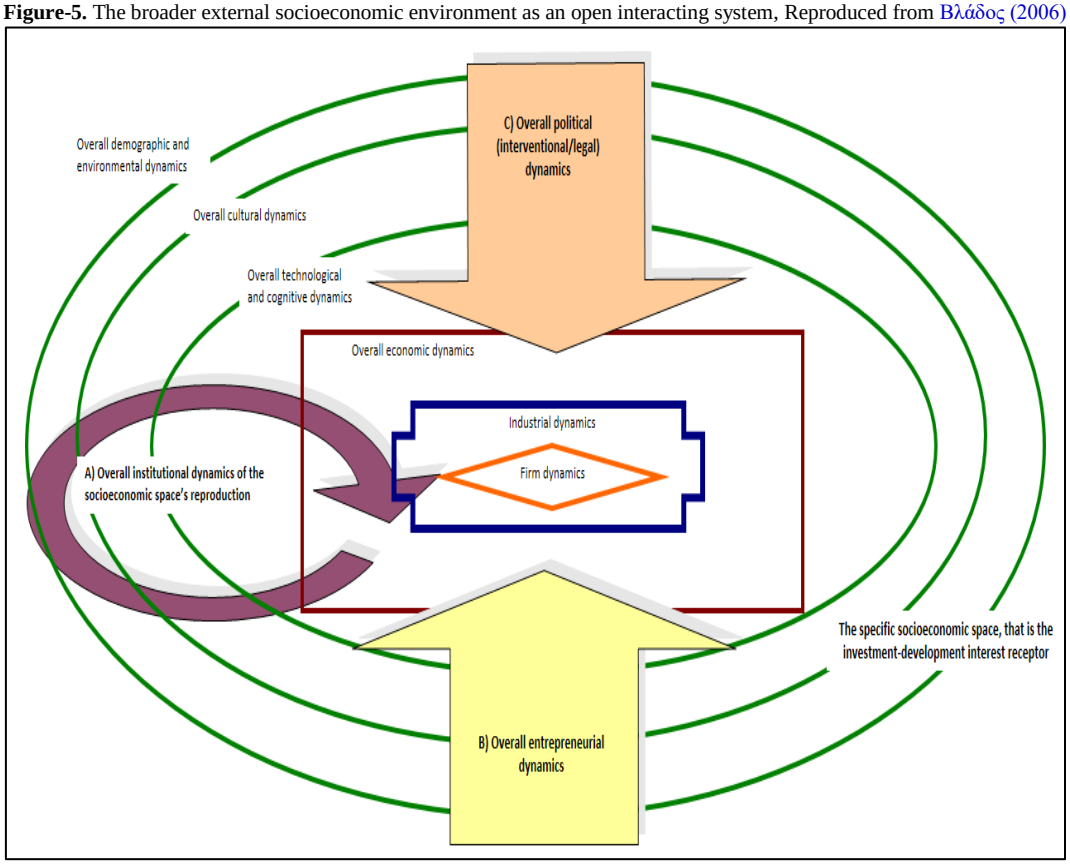
i. Into comprehending the systemic socioeconomic structure of every system that hosts, implements, assimilates, and reproduces the triple helix, under the constraints set by the always historically specific development trajectory.

ii. Into perceiving the ever-denser linkages between every local system in the structurally evolving trajectory of global dynamics; therefore perceiving the triple helix spheres more broadly than their narrow national or local expressions.

iii. Moreover, most of all, into understanding how critical is the locally established entrepreneurship—that is, the cell processor of innovation and development—that receives and generates at the micro-level the triple helix actions.

These dimensions lead to a repositioned conceptual framework, which can be an enriching element to the helix theory and an integrated development proposal, for any socioeconomic system. Primarily, we estimate that the helix theory can assimilate an integrated systemic socioeconomic base. Every socioeconomic system, in every spatial level, constitutes an evolutionary synthesis of hierarchic and interacting social, economic, industrial, and firm dimensions (see Figure 5).

Figure-5. The broader external socioeconomic environment as an open interacting system, Reproduced from Βλάδος (2006)



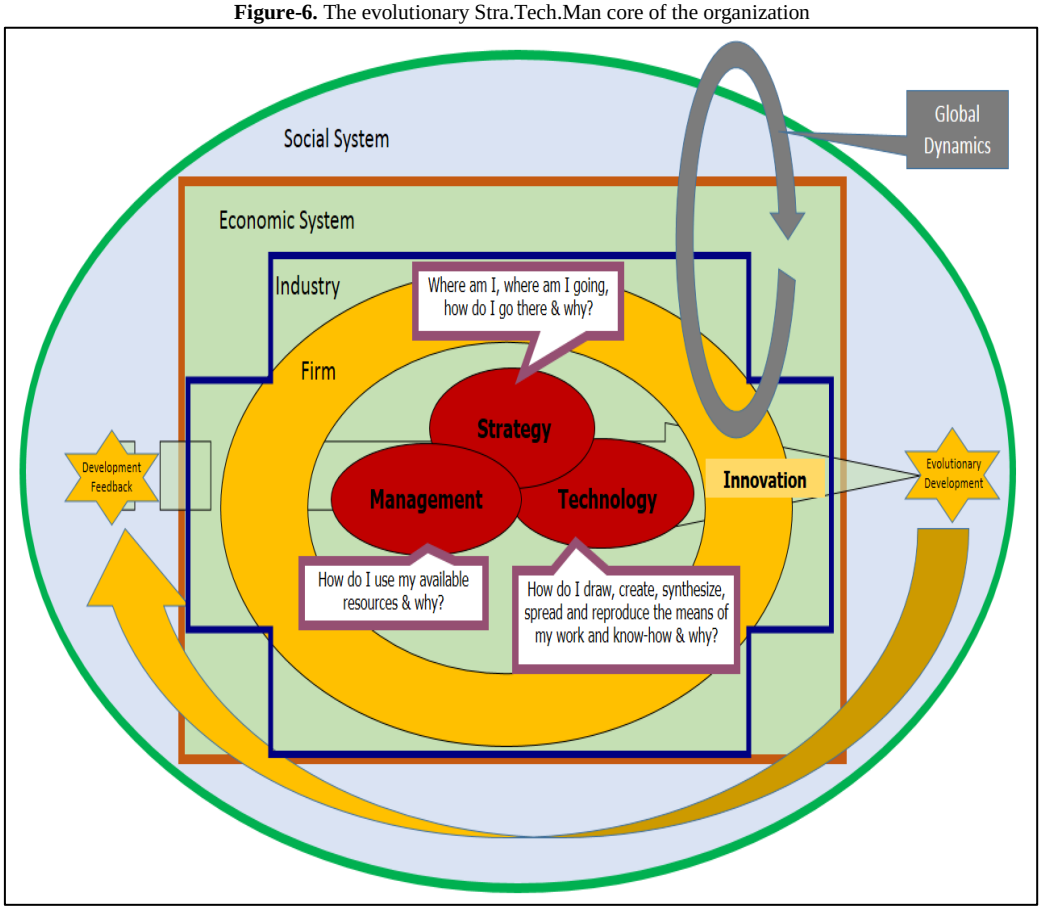
In this context, three significant forces always modify and re-modify the external socioeconomic environment: the multi-leveled reproduction of established institutional settlements, the multi-leveled entrepreneurial dynamics of innovation, and the multi-leveled interventional and regulatory dynamics. Ultimately, what regulates the overall open interacting external environment endogenously is the capitalist firm and the mechanisms that the firm at the center of the system draws to articulate its actions.

In particular, according to Vlados (2005); Vlados (2004); Vlados and Chatzinikolaou (2019) and Vlados *et al.* (2019b), a socioeconomic organization can be perceived as a complex evolutionary entity that structurally synthesizes in its core three co-evolving spheres: its Strategy (Stra), Technology (Tech), and Management (Man). By

responding to a threefold set of profound questions—always and necessarily—every organization advances its specific Stra.Tech.Man dynamic potential of innovation:

i. The answers to the set "where am I, where am I going, how do I go there and why?" corresponds to Strategy
ii. The answers to the set "how do I draw, create, synthesize, spread and reproduce the means of my work and know-how and why?" corresponds to Technology
iii. The answers to the set "how do I use my available resources and why?" corresponds to Management (see Figure 6)

Figure-6. The evolutionary Stra.Tech.Man core of the organization



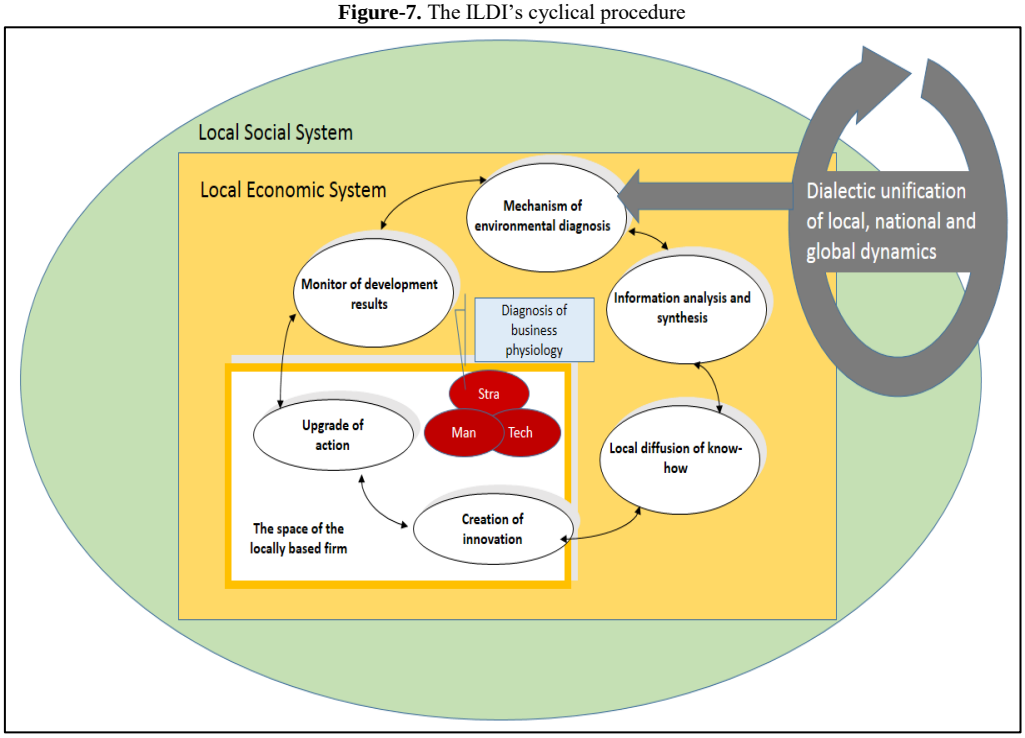
The "Stra.Tech.Man" is an approach of strategic management origin, observing the firm as a "living socioeconomic organism" (Geus, 1997; Kucia and Gravett, 2014; Meyer and Davis, 2003; Moore, 1993; Wolfe, 2011;2012) within an evolutionarily structured system that is being reproduced at all spatial levels—from local to global and vice versa. The process of innovation generates socioeconomic development conditions, which feed and determine in turn the developmental substrate and specific trajectory for every spatial level.

In particular, with the term "living" for a socioeconomic organization—by drawing elements from the biological perspective in economic science (Hammerstein and Hagen, 2005; Hannon, 1997)—we understand that the nature in its operations does not make any jump ("non facit saltum") (Marshall, 1890) and that the evolutionary trajectory of development depends on the particular history, for every socioeconomic organization. This condition, of course, is opposite to the general mechanistic and static view of mainstream neoclassical economics, where the firm is only a "black box," a passive receptor of inputs and where business strategy and innovation are considered exogenous dimensions (Boulding, 1981; Heinzel, 2013; Loasby, 2015). Having these in mind, we can argue that the view of the organization in Stra.Tech.Man terms can be useful for recognizing the overall developmental prospects, of any spatial socioeconomic system.

In this context, we also understand that the "living" socioeconomic organizations co-evolve with each other by developing complex parallel relationships of competition and cooperation, based on their evolutionary prospects and restraints. Therefore, an entrepreneurial ecosystem (Acs *et al.*, 2017; Moore, 1993), that is, a set of mutually developing organizations at a spatial socioeconomic system at the local, regional or national level, hosts different cross-industrial Stra.Tech.Man dynamics which determine the overall developmental prospects.

In this direction, according to Katimertzopoulos and Vlados (2017); Vlados *et al.* (2018a), there is a new business ecosystems policy proposal called "Institutes of Local Development and Innovation" (ILDI). The authors propose to establish these institutes in the Greek regions. The ILDIs have the aim to link public and private actors at the regional level, who are to some extent uncoordinated (banks, chambers of commerce, universities, and any other actor that can stimulate local development). This kind of government policy is both top-down and bottom-up since the "living firm" is the cellular element in Stra.Tech.Man terms of the local business ecosystem, which operates at the same time as a receptor of the policy intervention and as a generator of the development procedure (see Figure 7).

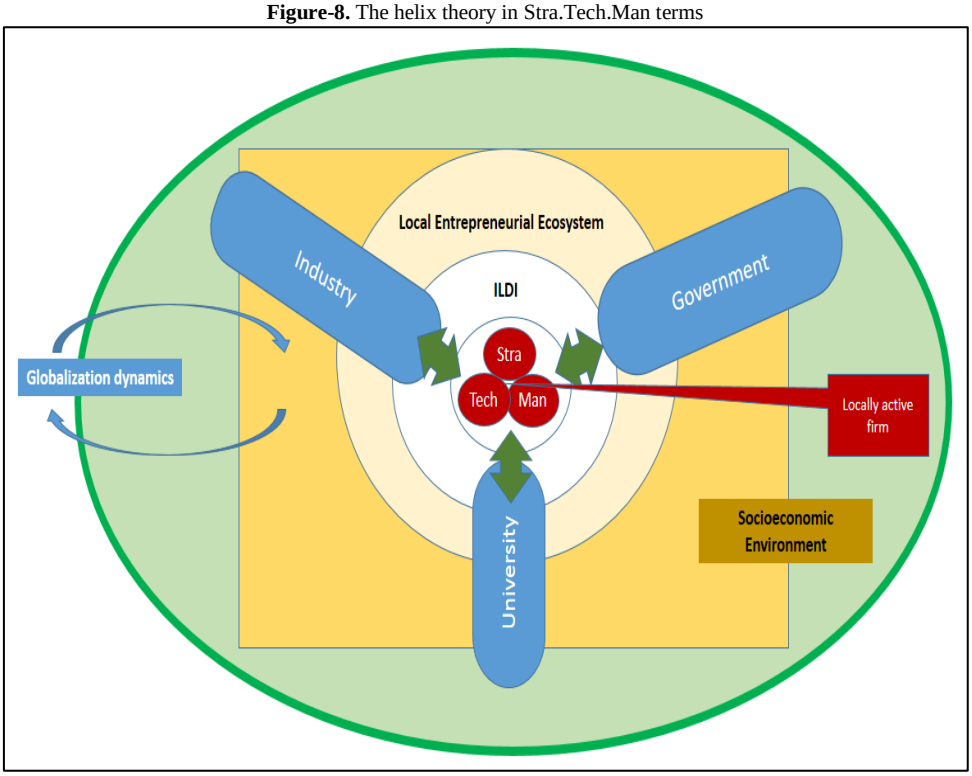
Figure-7. The ILDI's cyclical procedure



The ILDI, which resembles examples of intermediary organizations in triple helix systems (Altaf *et al.*, 2018; Yuwawutto *et al.*, 2010), follows a cyclical procedure. At the center, it diagnoses the organization's innovative prospects in Stra.Tech.Man terms (business "physiology"), provides a comprehensive framework of business consulting and advisory services, in the effort to upgrade the innovative potential of local entrepreneurship, while it activates mechanisms of feedback and monitoring of development results. The ILDI's action relies upon and can unify all the dialectic co-determined levels—local, national, global—that the "living firm" transforms with Stra.Tech.Man innovation.

In this context, we propose to incorporate the triple helix system of university-industry-government relationships in a Stra.Tech.Man micro-level analysis as a methodological framework of connecting the systemic institutional actors in a socioeconomic system (see Figure 8).

Figure-8. The helix theory in Stra.Tech.Man terms



In particular, the living organization (in Stra.Tech.Man terms) operates at the center of the socioeconomic system as the interactive and unifying epicenter of the helix mechanism. In parallel, the ILDI intermediary organization draws and disseminates know-how dynamic from the three helices, while the overall socioeconomic

environment, with the social, ideological, symbolic and political dimensions—the "civil society" in a quadruple helix theory context—participates in the developmental or under-developmental trajectory of the system within the current restructuring dynamics of globalization.

In conclusion, of course, this approach has not been fully operationalized yet, nor it has been tested empirically, although we think that it can provide a useful cohesive conceptual framework, both for the advancement of helix theory and the articulation of local, regional and national development policies.

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