

# Leveraging Spin-offs and University Innovation as a Managed Competitive Advantage through Innovation Parks

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**Abstract:** *Innovation has been one of the determining factors in the competitiveness of companies; a competitive company influences the growth of the region in which it operates, generating sources of employment and a higher standard of living for the people who work for it, as well as impacting the educational level of the society in which it operates, since by constantly innovating, the organization will require an increasingly specialized and trained workforce. This way, universities play an important role since they are the ones who prepare the future human resource of the industry, whose role has changed as a result of technological change and globalization, therefore, it is necessary to learn to manage technology to strengthen its contribution to society. One of the instruments that some universities have to stimulate innovation are the technology parks that incubate and develop the so-called university spin-offs, which are companies created under the auspices of a university with the aim of exploiting their research results translated into advanced products and services. In the present study, the historical background and characteristics of the theories of innovation and competitiveness and their influence on university science parks were developed, delving into their evolution; this through a bibliographic review and scientific databases, until the realization of a state of the art on the present topic, carried out during the period 2010-2019 on the Technological Innovation Park of the Autonomous University of Sinaloa. As a conclusion, it was found that the correct linking of companies with universities and the production that they generate, derive in a broader knowledge of the needs of society and, therefore, in greater competitiveness in them.*

**Keywords:** *Competitiveness, Triple Helix, Spin-off, science parks, academic innovation.*

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## **I. Introduction**

In the modern knowledge-based economy, the traditional distinctions between the roles of universities, government and industry are becoming less clear. Industries are now also involved in research, training, and development activities, similar to universities (Etzkowitz & Klofsten, 2005, cited in NG, 2020), highlighting the crucial role of universities in promoting education focused on research and development. Developed countries are actively working towards establishing strong connections between universities, businesses, and government, recognizing that collaborative efforts among these entities are essential for fostering innovation, staying up-to-date, and achieving regional growth through the acquisition and application of knowledge (Medina, 2017). Most studies that explore the role of universities primarily concentrate on the economic development of a particular region, aiming to include generating new knowledge, nurturing new companies, and promoting innovation and advanced technologies (García, 2018).

In this sense, the Triple Helix model has demonstrated its effectiveness in university-industry-government collaboration. Etzkowitz and Leydesdorff (1995), the main proponents of the model, coined the term highlighting the importance of universities in providing education, promoting research, and establishing mutual relationships with industries. The interactions between universities and industries revolve around the research provided by universities, which serves as a basis for industrial activities. By partnering with the other two helices, universities aim to generate innovation, economic resources, and market growth opportunities, while also benefiting from the incentives derived from innovation-related public policies (Gutiérrez, Zúñiga & González, 2016).

In the Triple Helix model, the government plays a crucial role in facilitating the dynamics among academia, industry, and itself through legislation and fiscal instruments, promoting an environment that fosters collaboration and generates new knowledge, thereby strengthening the linkage between these entities and facilitating mechanisms such as university-industry cooperation and the establishment of incubators to enhance innovation and knowledge generation within this framework (García Fuentes, 2018; Herrera-Márquez, Salas-Navarro, & Torres-Saumeth, 2015; Etzkowitz & Ranga, 2013).

The constant changes in the world and the opening of markets demand the need for innovation, and to achieve it effectively, it is necessary to create favorable environments, such as the Triple Helix model. The theory of the Triple Helix, developed by Etzkowitz and Leydesdorff (1995), explains the interactions between academia, industry, and government, leading to the emergence of new intermediary institutions like technology transfer offices and scientific parks. This model fosters technology transfer, supports the incubation of technology-based companies such as spin-offs, and promotes active collaboration among academia, industry, and government.

In the study of the university-industry-government relationship, it is crucial to acknowledge the transition towards a knowledge-based society, as it forms the fundamental premise of this model (Etzkowitz and Klofsten, 2005; Carrillo, 2006). By harnessing the collective expertise and resources of academia, industry, and government, the Triple Helix model not only facilitates innovation but also drives social development, creating a collaborative ecosystem that fosters the generation and dissemination of knowledge (Etzkowitz and Leydesdorff, 1995).

Spin-offs are built upon scientific and technological knowledge generated by professors and researchers, and they are considered important vehicles for transferring research to society and the economy due to their innovative nature, high competitiveness, and market acceptance (Botero Villa, 2020; Cabrera-Segura & Pastor-Llorca, 2023). These initiatives are driven by the participation of universities in Regional Innovation Systems and National Innovation Systems, in response to policies promoting entrepreneurship (Arvizu, 2019; Castrillón, 2020).

This study examined the bibliography related to the Science and Technology Park of the Autonomous University of Sinaloa (PCT-UAS) during the period from 2010 to 2019. This analysis was based on previous research conducted by López Arellano & Plascencia Cuevas (2021), and López Arellano, Morales Avila & Romero Rubio (2020).

## **II. Development**

Innovation is considered necessary for the competitiveness of regions, and to achieve it, it is crucial to establish areas that foster a conducive environment. According to the Frascati Manual (2015), innovation "could be a project that replicates a previous result but with possible discrepancies found" (p. 49), and it "involves bringing new or significantly improved products to market or finding more effective ways (by implementing new or significantly improved processes and methods) to commercialize products" (p. 64).

Innovation can arise both within companies and through alliances between private institutions and academia. It is precisely this latter mechanism of collaboration that sparks interest in this research, as the cooperation between companies and universities promotes innovation and learning, thus improving organizational processes, since these improvements contribute to a higher quality of life and development in the society in which they operate (Porter, 2000).

Therefore, the question and objective that will guide the development of this study and lead to its conclusions arise: What are the historical background and characteristics of innovation and competitiveness theories related to university innovation parks? Hence, the objective of this research is to delve into the historical background and evolution of the characteristics of innovation and competitiveness theories, as well as the role of university science parks.

Next, a state of the art is conducted, which consists of a literature review and database search of notable studies on journal impact and citation counts, published in the last 10 years (2010-2019), addressing the topic at hand.

### **III. Research methods**

In the words of Hernández, Fernández & Baptista, “a theoretical framework is a written compilation of articles, books, and other documents that describe the past and current state of knowledge about the research problem. It helps us document how our research adds value to the existing literature” (2014).

As a result of this bibliographic review, the exploration of the state of the art is developed, which, according to Toro and Parra (2010), is equated with the review of background literature, proposing it as a methodological moment within any research that seeks to clarify the current state of a problem. The state of the art consists of studies whose purpose is to showcase the current state of knowledge in a specific field or topic. These studies present relevant and up-to-date knowledge, trends, major approaches or schools, similarities, differences, and relevant advancements in the subject of study (Bernal, 2010).

In this manner, a bibliographic review and exploration of the state of the art were conducted using the Conricyt databases, specifically the Thompson Reuters, Web of Science, and Elsevier Scopus publishers, as well as Google Scholar, focusing on topics related to Innovation Parks, universities, and competitiveness.

### **IV. Theoretical and conceptual framework**

The theoretical framework chosen for this study is systemic competitiveness, which emphasizes the importance of innovation and sets itself apart from other concepts through two key aspects. Firstly, it adopts a multi-level approach by considering four levels of analysis: meta, macro, micro, and meso. Secondly, it integrates elements from various disciplines such as industrial economics, innovation theory, and industrial sociology (Paz, 2017).

The systemic approach argues that industrial competitiveness does not spontaneously arise from macro-level changes, nor is it solely created through micro-level entrepreneurial spirit. Instead, it is the product of a complex and dynamic pattern of interaction between the state, businesses, intermediary institutions, and the organizational capacity of a society (Esser, Hillebrand, Messner & Meyer-Stamer, 1994).

On the other hand, regional competitiveness refers to the ability of an economy to generate and maintain a favorable environment for value creation and the promotion of regional or national development (Porter, 1998). It can also be understood as the management of resources and capabilities to sustainably drive business productivity and the well-being of the population in a region (Benzaquen, Carpio, Zegarra, & Valdivia, 2010). The evaluation of regional competitiveness is based on factors such as prices, costs, productivity, education, infrastructure, and specialization (Ordóñez, 2015).

Regional and business competitiveness are complementary because when a country or region has successful and competitive companies in international markets, they generate benefits for the overall population by creating jobs and improving the standard of living (Porter, 1990; Krugman, 1994). Incorporating the concept of business competitiveness is appropriate for this research, as it pertains to the ability to deliver products and services more effectively and efficiently than competitors (Enright, Francis & Scott, 1994).

Furthermore, both firm-level competitiveness and systemic competitiveness stem from a broader theory of competitiveness, which is essential for the growth and economic development of regions (Medeiros, Gonçalves & Camargos, 2019). The Global Competitiveness Index (GCI) is a tool used to measure country competitiveness, evaluating a country's talent attraction, investment generation, and retention capabilities (WEF,

2019). This aligns with Porter's (1998) concept that regional competitiveness is tied to an economy's ability to foster a conducive environment for value creation and development. Factors such as prices, costs, education, and infrastructure are considered when assessing regional competitiveness (Ordóñez, 2015).

Productivity theory is another important aspect of this research, focusing on the efficiency of production processes. Productivity measurement involves examining the conversion of resources into new goods through various production processes, as determined by the production function (Aroche, 2018).

According to Dess, Lumpkin & Eisner (2011), Adam Smith (1976) argues that productivity measures the ability to produce more using fewer resources. Additionally, in competitive scenarios, one agent is always more productive than the other, resulting in absolute advantage and wealth accumulation. On the other hand, David Ricardo's concept of comparative advantage suggests that countries benefit from specializing in goods where they have a production advantage. Porter (1990) contributes to the idea of the competitiveness diamond, stating that countries possess four attributes forming the national advantage diamond, which serves as the basis for strategic management in the international arena, highlighting the role of competitive firms in creating competitive regions.

From the above, it can be understood that a company functions as an open system, where the behavior of its members is interconnected and the subsystems and elements are well-interrelated and organized, allowing the company to achieve its overall objectives (Machuca, 1981, cited in Crespo, 2021). Furthermore, Senge (1990, cited in Navarrete & Sánchez, 2022) emphasizes the significance of companies expanding and enhancing their intellectual capital to gain competitive advantages in the knowledge era, giving rise to the concept of "learning organizations". These organizations facilitate knowledge flow, enabling adaptation to internal and external changes, continuous transformation, and improvement (Navarrete & Sánchez, 2022). It is worth noting that the objectives of knowledge management include increasing business opportunities, enhancing communication and current/future competitiveness, and improving market leadership and performance (Nieves & León, 2001).

Regarding innovation theory, there are various management models associated with it: Rothwell & Zegvel (1985), Rothwell (1994), Sarem (1984), Marquis (1969), Kline (1985), Chiesa, Coughlan & Voss (1996), and Velasco, Zamanillo & Gurutze (2008), which coexist in different forms (King & Anderson, 2003). The concept of innovation was initially coined by Schumpeter (1912, cited in Suárez, Erbes & Barletta, 2020) as "creative destruction". It entails the successful introduction of new products or productive practices into the market, replacing obsolete ones and fostering ongoing progress. Subsequent authors further refined this definition to primarily focus on technological innovation within companies, emphasizing that innovation involves something new and improved that enables resource efficiency and the development of new activities (Suárez et al., 2020). Additionally, Matthews & Brueggemann (2015) propose nine indirect measures that serve as indicators to better understand how to create and innovate.

## V. Literature review

Table 1 presents the key research findings and a concise summary of the most prominent studies based on the number of citations from major academic databases that are relevant to the current research topic, thereby reinforcing its significance.

**Table 1**

*State-of-the-art on studies of Innovation Parks and Applied Research*

	Article	Autors	Year	Cites	DOI	Topic
1	Relationship between cooperation networks and innovation performance of SMEs	Zeng, S. X.; Xie, X. M.; Tam, C. M.	2010	342	10.1016/j.technovation.2009.08.003	Innovación en las PYMES
2	Creating value in ecosystems: Crossing the chasm between, knowledge and business ecosystems	Clarysse, Bart; Wright, Mike; Bruneel, Johan; Mahajan, Aarti	2014	104	10.1016/j.respol.2014.04.014	Triple Hélice
3	Performance of Spanish universities in technology transfer: An empirical analysis	Caldera, Aida; Debande, Olivier	2010	86	10.1016/j.respol.2010.05.016	Transferencia tecnológica

4	The role of science parks and business incubators in converging countries: Evidence from Portugal	Ratinho, Tiago; Henriques, Elsa	2010	79	10.1016/j.technovation.2009.09.002	Parques científicos e incubadoras
5	Supporting innovation for tourism development through multi-stakeholder approaches: Experiences from Africa	Carlisle, Sheena; Kunc, Martin; Jones, Eleri; Tiffin, Scott	2013	74	10.1016/j.tourman.2012.05.010	Triple Hélice
6	Pathways to impact and the strategic role of universities: new evidence on the breadth and depth of university knowledge exchange in the UK and the factors constraining its development	Hughes, Alan; Kitson, Michael	2012	60	10.1093/cje/bs017	Transferencia tecnológica
7	Subsidy and networking: The effects of direct and indirect support programs of the cluster policy	Nishimura, Junichi; Okamuro, Hiroyuki	2011	48	10.1016/j.respol.2011.01.011	Políticas de clúster
8	Geographic proximity and firm-university innovation linkages: evidence from Great Britain	Abramovsky, Laura; Simpson, Helen	2011	41	10.1093/jeg/lbq052	Proximidad geográfica de la I+D
9	Policy principles for the creation and success of corporate and academic spin-offs	Gilsing, Victor A.; van Burg, Elco; Romme, A. Georges L.	2010	39	10.1016/j.technovation.2009.07.004	Spin-off

Source: Own elaboration.

In summary, the reviewed articles provide insights into the contribution of Innovation Parks to applied research worldwide. It can be concluded that such contribution is crucial for the long-term benefit of regions, companies, and universities. However, in several cases, there is a lack of synergy among the actors of the Triple Helix, hindering its effective functioning. It is worth noting that incentives for researchers and academics have played a key role in fostering the creation of spin-offs, and the presence of an innovation or scientific park has a positive impact on the commercialization of university research and projects. This, in turn, stimulates the interest in establishing innovative and high-tech companies, which positively influence the value of these projects. Furthermore, scientific and innovation parks help reduce costs associated with translating scientific findings into marketable processes or products developed within these parks.

## VI. Results

The analysis of regional development from the perspective of competitiveness, based on the aforementioned criteria, allows for a precise identification of environmental conditions, as well as strengths, weaknesses, risks, and, above all, opportunities with high potential for value creation. This is crucial in the knowledge-based economy.

We emphasize the importance of competitiveness not only at the country and regional levels but also within companies, as they are the foundation of national economic development. Intelligent organizations, as an integrated model of business and individuals, have a process for collectively detecting and correcting errors, leveraging learning and knowledge to enhance capacity for action, decision-making, and new leadership styles. Moreover, this knowledge can be transferred implicitly and explicitly to other members of the organization, thereby increasing business opportunities and translating them into innovation.

These aspects are directly related to university outreach, community engagement, and the generation of additional income through entrepreneurship. The relationships between companies and universities become extensive in terms of collaboration formality, the complexity of knowledge exchange, and the outcomes of new

theoretical and applied knowledge. In summary, competitiveness refers to a specific physical context and is closely related to the economic concept of productivity, where higher performance of natural resources, labor, and capital is an indispensable condition for increasing the competitiveness of a country or region.

## VII. Conclusions

A comprehensive literature review was conducted to analyze the state of the art regarding the topics of Innovation Parks and universities in the main academic databases. Over 150 documents published between 2010 and 2019 were examined, covering various areas of study. These studies served as the foundation for the theoretical framework, encompassing the key theories and prominent authors who have influenced and justified the relevance of the research over the years.

Regarding competitiveness, it is a crucial topic for analyzing economic growth in the global context. However, it is a concept that allows for multiple approaches, leading to differences in interpretation, understanding, and measurement. Different authors agree that competitiveness involves both static and dynamic components, and it can be measured using various indicators such as education, policies, technology and innovation, governmental and business efficiency, among others, which international organizations have established to accurately assess regional economic growth.

The aforementioned is closely related to the research topic at hand, as university outreach plays a vital role in community engagement and the generation of additional income through entrepreneurship. The relationships between companies and universities encompass a wide range of formalities in their collaboration, the complexity level of the knowledge exchanged, and the outcomes of both theoretical and applied new knowledge.

Regarding systemic competitiveness, it was found that for a region to be considered competitive, it must have productive companies. Moreover, regions must encourage companies to achieve their goals, which can be accomplished through appropriate collaboration where both parties pursue the same objectives, such as the well-being of the population and economic growth and development. Thus, a model like the Triple Helix, which facilitates the proper connection between companies, universities, and the government, could be a viable alternative for the growth of developing countries.

In the case of business competitiveness, it refers to the ability of companies to provide products and services more effectively and efficiently than their competitors, in other words, to innovate. Innovation entails not only the development of new products but also their improvement, as well as enhancing the processes, procedures, and services involved in their production. This is where intelligent organizations emerge, which find their origins in entities such as technology innovation parks.

The importance of innovation is emphasized not only within companies but also within the university and government environments for the development of public policies that benefit societies. Additionally, the different models of innovation analyzed demonstrate that the innovation generation process is intricate and depends on multiple elements, including management's willingness to create a culture of innovation, talent development, resources for innovation generation, space to unleash employees' creativity, and communication with the market, among others. In this regard, innovation parks are considered entities capable of fostering technology-based companies and academic production for the benefit of higher education institutions and society.

As for the Triple Helix theory or model, it is the most important pillar of this research, as it encompasses the essential actors for the economic growth of regions, namely government, universities, and companies. Thus, it can be argued that universities can utilize the Triple Helix model to establish stronger alliances or contacts with the government and industry sectors, facilitated through entities such as science parks. These alliances support the creation of university spin-off companies, providing them with greater opportunities for development and serving as a means to innovate products, services, or processes.

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