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Chapter

# Knowledge and Technology Transfer in Latin American University Contexts

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## Abstract

Latin American regions face great challenges to improve their competitiveness and economic progress due to their dynamic, complex and emerging conditions, which demand new technological practices, innovation systems and new knowledge. For this reason, the process of knowledge transfer through collaborative university-business-state relations becomes a key to accessing the international market, competitiveness and sustainable local development. The objective of this study is to analyze the perspective of technology and knowledge transfer in Latin American university contexts, from the heterogeneity and diversity characteristic of developing countries, through a documentary review of the most successful transfer models worldwide. Currently, universities are making a great effort to establish collaborative research relationships from emerging, diverse and homogeneous countries, which makes this region a natural scientific field to create and disseminate new knowledge aimed at territorial, regional and sustainable development.

**Keywords:** knowledge transfer, technology, university-business-state relations, sustainable development, university context

## 1. Introduction

Latin American societies confront great challenges for development and sustainability that promote innovation, progress in knowledge, and science and technology, with uncertainty being the most predominant characteristic; for this reason, the only opportunity to be at the forefront is the production of knowledge. The consequence of this is that markets are constantly changing and new technological needs, competitors and products or services arise. At the same time, it is necessary for each organization or company to become a creator of new knowledge, which is a process of personal and organizational renewal that transforms the company according to the demands and innovation [1].

Within knowledge management, the transfer of technology and scientific knowledge is a key factor for development and innovation, with collaborative relations between universities, the state and business being an important aspect of the process, since universities are the producers of knowledge, through their research centers, they are able to transfer technology and scientific knowledge [2]. Moreover, the role

of universities is to produce and transfer knowledge and technology for economic growth [3]. For this reason, universities have used scientific research centers as a strategy to generate collaborative relationships with various organizations and channels for knowledge transfer [4].

Since globalization, universities and research centers have formed international alliances through global networks that facilitate the transfer of knowledge and technology at a worldwide level, which has led to the emergence of diversity among university centers of knowledge production, allowing for quality, effectiveness and speed in the transfer of knowledge. In Latin American contexts, these research networks are crucial since universities in developing countries must establish collaborative relationships with research centers in developed countries in order to be able to project themselves in the global market, that is, to transfer technology and knowledge to the business sectors and the state, which allows for economic growth and sustainability over time [4].

On the other hand, these links between university-business, industry and science play a determining role in the processes of innovation and commercialization of innovative products or services that impact economic growth and investment in knowledge management. In turn, there are a variety of benefits such as: academic reputation, the establishment of communication channels between organizations, increased financial returns from patents and licenses; improving the quality of technology, the environment, health and benefits to private investment [5]. From this point, the purpose of the research is to analyze the perspective of technology and knowledge transfer in Latin American university contexts, from the heterogeneity and diversity characteristic of developing countries, through a documentary review of the most successful transfer models worldwide.

## **2. Literature review**

### **2.1 Knowledge management**

It is important to recognize the importance of knowledge in the functioning of organizations, which is why scientific knowledge management has been at the forefront of academia, as it has been proven that it can bring multiple benefits. For this reason, organizations are committed to harnessing knowledge to produce a particular value; knowledge management allows companies to take advantage of the differentiated knowledge possessed by their employees to integrate it into the organization's operations. It is also defined as the processes and operations that help companies manage their intellectual assets and achieve competitive value based on knowledge [6]. However, it comes from a variety of sources, which can be located in individuals, routines, technologies and practices. For their part, organizations can organize knowledge into structures and routines, whereby the production of new knowledge occurs through strategic alliances with other organizations [7]. In addition, knowledge management is oriented to several areas that in an integrated way guarantee the success of its application, which refer to social-cultural, organizational, technological and administrative aspects [2, 6].

This process can occur through collaborative relationships with university research centers [2] that help economic development and solve complex problems as one of the objectives of knowledge and technology transfer [4]. Currently, the university has expanded its role to the dissemination or transfer of knowledge for the sustainable

development of societies, which has detected several mechanisms where knowledge is materialized such as the creation of new companies, researchers, students, graduates and publications or patents that generate sustainable development [8].

On the other hand, knowledge as part of the competitiveness of countries has become an element that must be structured, formed and recreated from the interactions of social factors: university, business and state. What is important in these relationships is the sharing or exchange of knowledge that promotes the sense of belonging and responsibility of all organizations that function in a society [9, 10]. However, knowledge is a strategic resource in decision-making to achieve competitive advantage. It is the mass knowledge and willingness to learn that makes the difference in the international market. For this reason, knowledge management is responsible for managing knowledge as a key resource to meet organizational needs related to new models, new practices or procedures [11].

The need to manage knowledge as a strategic tool requires long-term plans for the development and exploitation of an organization's knowledge, which must expand its traditional coverage based on physical assets, financial assets, operations and markets, toward a strategic vision of knowledge needs, sources and processes to be operationally implemented in a social and organizational context. In turn, knowledge as strategy values the inclusion of an organization's knowledge as one of the objects of strategic planning and the elaboration of plans for knowledge management programs and activities [11].

This new perspective of knowledge management implies a forward-looking vision of not only focusing on what we know, but also having a forward-looking perspective of what we do not know yet but may need to know, which is important to dwell on the sources of knowledge required to appropriate methods or plans that need to be learned and implemented. For this reason, knowledge management, production and transfer have become essential factors in innovation and development [6, 11].

## **2.2 Knowledge and technology transfer**

Transfer is an active process, in which technology and knowledge are transferred between two different organizations; it also considers the following dimensions: actors involved, sources, recipients, intermediaries, the relationship between them, the object, the channels, transfer mechanisms and the context [12].

The transfer of knowledge between two organizations, i.e., sources or recipients, which can be individuals, business groups or organizations where the process is not unidirectional but involves reciprocity and feedback. In addition, the process can take various types of knowledge and technology appropriate to the characteristics of the context. The channels and mechanisms of transfer can be organizational or result oriented. The context involves the internal parameters of cost, duration, risk and uncertainty, and external parameters alluding to the environment [12]. On the other hand, university-business knowledge and technology transfer can involve various forms apart from patents and licensing of research outputs; it can also occur through technology-based start-ups, collaborative research, contract research, consultancy and other academic activities such as training, courses, meetings or conferences [5, 13, 14].

On the other hand, universities have based their role on teaching and research, which develop students' entrepreneurial skills and the dissemination of knowledge; however, there is a third mission that considers the results of scientific research to be the most important basis for the transfer of knowledge and technology between the

university and the company. In addition, this process has internal benefits for higher education institutions as research results improve the teaching performance of academics engaged in teaching, as they provide current and contextualized knowledge to socio-economic demands [14]. Furthermore, from the perspective of the business sector, knowledge transfer relationships with universities can bring new sources of information, skills and equipment that improve operations and foster sustainable development [13].

The process of knowledge dissemination is carried out with the interrelationships established with the research centers of the universities, as it is the epicenter of the production of new knowledge and innovation. In addition, they establish horizontal relationships with various entities, organizational, political, social or economic, educational activity, scientific and professional exchanges that effectively develop the transfer of new knowledge or technology, which generates skills, capabilities, actions and competitive practices for the entity that receives the information [15]. Also, it is important to note that globalization has required scientific research universities to engage through external research collaboration, service provision initiatives such as contract research, consultancy and executive education to generate a balance between research and financial income that promotes international projection and impact on society [13].

On the other hand, there is the perspective of knowledge creation as a system, i.e., regions at the global level are visualized as an ecosystem made up of agglomerations of organizations, institutions and stakeholders with conflicting socio-technical, socio-economic and socio-political aspects, as well as cooperative goals, priorities, expectations and actions pursued through entrepreneurship, development, exploration, exploitation and implementation reactions and interactions. This perspective of knowledge production and dissemination is conceived from agglomerations of interlocking organizations or entities with dynamic, complex and non-linear interactions, with a higher order learning structure and the ability to self-organize [16].

The above refers to the Triple Helix Innovation System model that involves the production of knowledge from the interactions between the university (Helix 1), business (Helix 2), government (Helix 3) and then, a fourth helix integrated by civil society (Helix 4) that refers to culture, values, creative entrepreneurship and lifestyle. This model focuses on cooperation and innovation, i.e., knowledge production processes are connected for cooperation, co-evolution and co-specialization within and between regions or sectors of innovation ecosystems that serve as a basis for smart specialization strategies toward user-centered systems. In other words, this model fosters the development of innovations that are satisfactory for civil society; people are the drivers of innovation processes [15, 16].

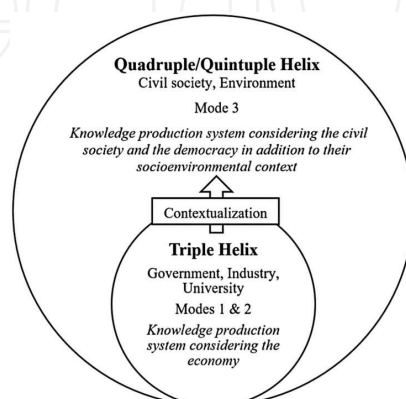
Helix 1 refers mainly to scientific research in universities and higher education institutions organized in a disciplinary structure aligned to innovation. Helix 2 focuses on the application of knowledge based on problem solving that meets the following requirements: knowledge produced in context, transdisciplinary, organizational diversity, social responsibility, reflexivity and quality control. Helix 3 is based on knowledge production involving innovation networks or clusters of knowledge for creation, dissemination and use that extends Helix 1 and 2. It is in turn a multimodal system shaped by intellectual and social capital and supported by financial capital. Finally, Helix 4 is a combination with the third helix that emphasizes an innovation ecosystem that promotes the co-evolution of different knowledge, in which the interaction between individuals or organizations plays a crucial role in the articulation and amplification of knowledge [16]. Subsequently, the quintuple helix model emerged

based on the triple and quadruple helix that adds the “natural environment” [16]. In this way, the model proposes a framework for transdisciplinary and interdisciplinary analysis of sustainable development [17]. Under the context of these theoretical and practical models, various strategic associations have been developed with the European region such as the European Union-Latin America and the Caribbean Foundation (EU-LAC) that was established in 2010 to generate intergovernmental associations with industry, academic and social sectors [18]. The dynamic interaction of the five spheres is characterized by the various agglomerations of stocks and flows of human, social, intellectual and financial capital, through which innovation is given through a continuous system of knowledge production and management, which also impacts the transfer process, as can be seen in **Figure 1**.

For this reason, the university is a key aspect in the cooperativity, production, dissemination and use of knowledge. Previously, the university was focused on its role of teaching, research and knowledge dissemination; however, the current model of the university has a more versatile role that depends on the various interactions with stakeholders, as the new purpose is to transfer knowledge and skills between the university, enterprises and community [16]. Therefore, the efficiency of the transfer process will depend on the characteristics of the university, the socio-economic demands and the local factors [14] that value the benefits of this model as it integrates these elements in the knowledge transfer process. It is also important to note that individual stakeholder boundaries play a key role in promoting information channels or flows across the various innovation groups and knowledge domains [15].

### 2.3 Knowledge transfer in Latin American contexts

Currently, due to technological advances and the presence of COVID-19, knowledge management has migrated to virtual environments thanks to the internet and the diversity of technological applications that have given rise to a boom in virtual communities that have facilitated efficiency and speed in the transfer of knowledge. Based on this situation, universities have increased their academic offerings from virtual environments, emerging a knowledge economy in which the production, dissemination and exchange of knowledge have been massive, breaking the barriers of time and geographical limits. For this reason, transfer models must adopt innovative



**Figure 1.** From the triple helix model to the Q/Q helix model. Note: This figure shows how the helices interact considering their actors and the impact on knowledge by Carayannis et al. [16]. The ecosystem as helix: an exploratory theory-building study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models. *R & D Management*, 48 (1).

mechanisms that are flexible and adaptable to changes that arise over time [19]. At the same time, the knowledge to be transferred must organize all social values in an equitable and sustainable balance so that it becomes a competitive attribute for organizations [20].

In the case of Latin American countries, the management and transfer of knowledge has been directed toward collaborative relationships, promoting and increasing university-business alliances. However, efforts have been apathetic and university research centers are the least relevant partners in the business and economic sector [21]. The low relevance of scientific knowledge is due to the fact that the economic base of these countries is centered on natural resources, as activities with slow technological evolution, where innovation is driven by suppliers of machinery and equipment; this results in a reduced potential to create and transfer knowledge to other fields. Currently, these regions have been experiencing changes that demand new contextualized knowledge challenges that open a range of opportunities for the application of knowledge and technology transfer models adapted to the economic-social dynamics characteristic of these countries [22].

For this reason, one of the alternatives to produce and transfer knowledge is to create models that intensify the exploitation of natural resources accompanied by global demands, which would develop a national or local knowledge industry. That is, the economic development of these countries would be focused on acquiring the necessary skills according to local resources, which subsequently requires new technological practices that emerge from scientific research conducted in the fields of knowledge related to local natural resources [21, 23].

Contexts with dynamic economies should be committed to a transfer from a broader and more holistic sense, considering the various ways in which the knowledge of universities and public research bodies can be used by the industrial sector with the aim of achieving social and competitive value. In addition, universities must become much more involved in alliances with a diversity of organizations or entities that massively disseminate the results of scientific research [23].

Today, initiatives to increase knowledge transfer have increased and become more complex, which is crucial for multifaceted, multi-stakeholder and multi-level efforts due to the resulting policy research that has expanded into partnerships with university, economic, industrial and regional policies that promote systematic impact and wider synergies [16]. From university autonomy, global dynamics, environmental and regional changes, transfer initiatives have been acquired not only from the state but also from public research organizations, which have transformed their actions to reflect each context of legislative, financial and cultural institutions. Likewise, transferring knowledge, technology and innovation in complex contexts such as the Latin American region implies acquiring a vision of constant change in knowledge, since companies do not possess it internally, they need to establish connections and interrelationships with entities or organizations outside of it [23].

For this reason, maintaining a vision of constant change and international outreach requires universities to establish research partnerships, collaborative research, contract research and consultancy. These are the key factors that must be taken into account in order to transfer knowledge and technologies in today's complex and dynamic societies [24]. This dynamic view of knowledge transfer can be observed in the Triple Helix model [16] as its systemic perspective allows for the integration of the multimodal and multifaceted. Based on the above, university contexts in developing countries such as those belonging to Latin America should aim their management, production and transfer of knowledge toward this holistic conception of the process

of disseminating new knowledge. This alternative allows adaptation to the new demands or emergencies that are characteristic of the globalization process and the great changes that are transforming lifestyles, as well as the needs of the various socio-economic sectors.

This panorama shows how much universities can offer from knowledge and human capital that are drivers of economic growth, inclusion and local development [9]; their contribution is amplified through social research and critical innovation that are important in times of challenges faced by regions and nations. The benefits of university-state-industry linkages [16] stem from interactions between organizations, entities and individuals that transfer technical knowledge promoting trust and common goals among diverse actors and interests. It is relevant to highlight that in the face of the uncertainty and volatility faced by higher education institutions related to the challenges to research, teaching and public activities in which they participate, the responses to this situation can emerge a diversity of ramifications in the field of regional development that are valuable for scientific studies [25].

From this perspective, the triple helix model [16] is of great value for those regions or nations with weak development and slow evolution and innovation whereby the university should pursue research in local fields that need to be strengthened through new knowledge, practices and new technology. For this reason, the importance of the fourth helix [16] is that it considers the cultural and civil society. Governance needs to be established in knowledge networks that promote new relationships between researchers and social groups that build trust and the transfer process that facilitates sustainable development, with people being a key aspect of the model [25].

The governance of knowledge networks is oriented toward new spatial, identity and regional imaginaries that emerge from collaborative research relationships between leading universities. The focus is on analysis and debates in regional studies on the concept of region, becoming active agents in shaping new mechanisms of regionalization with the state and other actors. University collaboration should develop regionalism through local partnerships that can deepen existing geographical inequalities in the higher education sector [25].

The new imaginary spaces are defined as mental representations of space that condition politics and organize everyday lifestyles [26]; they also refer to productivity, economics, and labor [27]. These demand trans-regional university alliances that involve institutional arrangements that cut across the traditional territorial boundaries of regions, have a selected membership where members come together on the basis of shared objectives, operate over indefinite periods of time, and can take multiple spatial and institutional forms. This shift in partnerships of higher education institutions allows researchers to connect with research that explores new fields or specializations of higher education praxis with theoretical debates of territorial development, relational approaches to conceptualize the region and change the structure of universities [25].

Globalization and emerging changes make this type of trans-regional alliance a response that promotes local development and has a positive impact on sustainable development. The growth of territorial and regional imaginaries reflects how universities through active participation revalue the locality through their own collaborative practices. In addition, they should aim to promote and invest in a diversity of regional logic to conceptualize new emerging regional worlds that enhance economies and foster sustainable development [28].

As can be seen, the objective of this work was to analyze the perspective of technology and knowledge transfer in Latin American university contexts, although it



is a literature review study where the achievements that have been presented in recent years are emphasized. However, there is still a long way to go, so it is imperative that universities present high-impact research projects related to the transfer of knowledge and technology that not only respond to local needs but also have a vision of global impact.

### **3. Conclusions**

The Latin American region is comprised of countries with a dynamic, changing and constantly uncertain functionality; however, these societies offer a range of opportunities for knowledge production and transfer in a variety of areas such as: climate change, organizational and institutional change, technology, governance, financial integration, inequalities, inequity and poverty, which force us to rethink basic assumptions and theories about the behavior of individuals, companies, organizations, markets and institutions. In other words, they are contexts that serve to test theories and build new ones due to their dynamic and changing institutional and economic conditions [29].

For this reason, the transfer of knowledge, technology and innovation must understand regional imaginaries in order to achieve the sustainable development of these societies [25]. The transfer models applicable to these regions must be holistic and systemic, involving collaborative relationships between university, business, state and civil society, such as the Triple Helix Model [30]. As homogeneous and diverse regions, research results are not very generalizable, which is why it is important to establish local research networks with an emphasis on the sense of regionalization that is adapted to contextual and local needs [28].

Based on this situation, Latin American universities must orient their actions toward the third mission of higher education, which considers the complexity and trans-regional collaborative research relationships that promote sustainable development [25]. New knowledge is the basis of all invention and innovation that allows access to the new economy, which universities in regions with emerging economies make a great effort to establish collaborative university-industry-state relationships [16] as a key to economic and social progress [31].

Emerging or developing societies are mainly technology-recipient regions because they are consumer countries [31]. However, universities are making a great effort to establish research relationships that enable knowledge transfer. The emerging, diverse and homogeneous nature of this region makes it a natural scientific field for producing new knowledge [29] aimed at territorial, regional and sustainable development. In other words, at a global level, universities are constantly reviewing their roles and relationships with local, regional, national and international entities [32].

Higher education institutions must be committed to interactions between industry and the community represented by business, government and localities. The new mission should be framed in the creation of innovation systems, entrepreneurship and promoting the attractiveness of regional investment, with the ultimate aim of generating international knowledge networks with access to local agents and improving productivity, competitiveness and social welfare [32]. On the other hand, universities through the transfer of knowledge or technology can obtain benefits such as licensing their intellectual property rights to partners in the business or industrial field in exchange for monetary rewards and fostering the creation of spin-offs that are business initiatives derived from the university's knowledge production for economic

and social development [31]. It is important within the field of higher education to adopt a holistic and malleable view of collaborative university-industry-state research relationships, as they must adapt to changes over time; knowledge is the key to socio-economic growth and development.

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