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## THIRD-GENERATION UNIVERSITIES: TRANSFORMATIONAL MANAGEMENT FROM AN INTERDISCIPLINARY APPROACH

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### ABSTRACT

*Third-generation universities (U3G) embody an educational management model focused on innovation, interdisciplinarity, and engagement with the productive sector. This study is based on a mixed-methods design, utilizing structured surveys and semi-structured interviews with key educational stakeholders. It analyzes four segments: context and experience, profiles of interest groups, scope and outcomes, and future opportunities. In context and experience, 17.46% of the responses highlight the incubation of academic startups as a priority, while 9.52% emphasize the development of key competencies. However, university-industry linkage represents only 2.06%, indicating a lack of integration with the productive sector. In scope and outcomes, universities have made progress in creating innovation funds and patent registration, but the results show difficulties in commercializing technological developments. University-industry linkage remains a challenge with only 2.06% representation. In future opportunities, strengthening financing strategies and internationalizing research are priorities. However, digitalization and technological infrastructure appear in only 7.94% of the responses, pointing to an urgent need to increase investment in these areas. The study concludes with key recommendations: implement monitoring and evaluation mechanisms, strengthen faculty and administrative training, and increase investments in educational technology. These actions will enable universities to improve their adaptability to global challenges, establish themselves as innovation drivers, and contribute to economic development, ensuring a sustainable and competitive model.*

## 1. INTRODUCTION

Third-generation universities (U3G) represent an emerging model in higher education, characterized by a focus on innovation, interdisciplinarity, and adaptability to the needs of a constantly changing environment. This model aims not only to offer quality academic training but also to enhance collaboration between academia, the productive sector, government, and civil society. Through this interaction, universities can generate knowledge that not only remains within the academic realm but is also effectively transferred to the economic sector, contributing to the development of new technological solutions, entrepreneurship, and applied research.

The analysis process in this study is based on an in-depth review of four key segments: Context and Experience, Profiles of Interest Groups, Scope and Outcomes, and Future Opportunities, using data obtained from questionnaires and interviews with key actors in the education sector. This analysis has identified the most relevant trends and challenges in the transformational management model of third-generation universities.

The results show a clear orientation towards the creation of academic startups, the internationalization of research, and the strengthening of technological infrastructure. However, it has also revealed a lack of effective integration between the university and the productive sector, with low representativity in university-industry linkage. By identifying these strengths and weaknesses, a series of strategic recommendations have been proposed to improve the sustainability and effectiveness of the model, such as the implementation of monitoring and evaluation mechanisms, the strengthening of faculty training, and the digitalization of educational processes.

This analysis not only highlights advances in educational transformation but also the structural obstacles that must still be overcome for universities to consolidate as key drivers of innovation and socioeconomic development. The recommendations derived from this study provide a solid foundation to foster effective change that enables universities to adapt to the demands of the 21st century and improve their linkage with the industry, ensuring a real impact on the social and economic environment.

## 2. THEORETICAL CONTEXT

Third-generation universities (U3G) have emerged as an educational management model that seeks to transcend the traditional boundaries of

knowledge by linking academia with the productive sector, innovation, and technology. This integrative approach is key to strengthening the competitiveness of educational institutions and fostering a direct impact on social and economic development. The theoretical framework presented is based on the Quadruple Helix and Agent models, which have been fundamental in transforming higher education institutions, enabling the collaboration of key actors such as academia, the productive sector, government, and civil society (Carayannis & Campbell, 2009; Etkowitz, 2012).

### *Innovation Models in Higher Education*

**Quadruple Helix model:** The Quadruple Helix model, developed by Carayannis and Campbell (2009), posits that innovation is enhanced by the interaction among four key actors: academia, industry, government, and civil society. This interdisciplinary collaboration allows for the effective transfer of knowledge and technology between different sectors, promoting the creation of new solutions that directly impact the productive and social sectors. This model has been established as a key framework for fostering collaborative and adaptive innovation in third-generation universities, allowing for greater flexibility and connectivity among different stakeholders (Carayannis & Campbell, 2009).

In the analysis of third-generation universities, 17.46% of the responses to the question about institutional objectives show that universities are focusing on fostering the incubation of academic startups, indicating a trend towards creating an entrepreneurial ecosystem centered on technology transfer and the development of new businesses. This result highlights the importance of the Quadruple Helix in linking academic knowledge to its application in the industry.

**Agent model:** The Agent model, proposed by Etkowitz (2012), underscores the importance of active interaction among different actors in innovation ecosystems. This model implies that key groups, such as students, researchers, entrepreneurs, and policymakers, must play active roles in knowledge creation and educational management. The proactive involvement of these actors not only promotes innovation but also facilitates the integration of the university into the socioeconomic environment, ensuring that higher education responds to the changing needs of the market. This approach is crucial in the evolution of universities towards more open and collaborative models (Etkowitz, 2012).

However, the 2.06% of responses regarding university-industry linkage suggest that, despite the importance of this model, effective integration between academia and industry remains a challenge. This low representativity indicates that universities need to strengthen their ties with the productive sector to maximize the impact of their innovations and ensure the employability of graduates. *Gestión*

### *Transformation in U3G*

**Teacher and Leadership Training:** One of the fundamental pillars of university transformation is the continuous training of teachers and leaders in interdisciplinary methodologies and the use of emerging technologies. The digital transformation in higher education has been widely discussed by recent authors, who state that strengthening teacher training is a key factor for the success of universities in the digital age (Meyer et al., 2022). The implementation of active methodologies and flexible pedagogical approaches allows teachers to adapt to the challenges of the global environment and prepare students for a highly competitive future workforce (Meyer et al., 2022).

In the results, 9.52% of the responses to the question about institutional strategies focused on teacher training show that universities are working to strengthen the skills of professors. However, this percentage reveals that there is still a significant gap in the implementation of continuous training programs for teachers.

**Digitalization and Educational Technologies:** The digitalization of educational processes is another key area in the transformational management of U3G. According to Gupta et al. (2021), the implementation of technological platforms not only improves teaching efficiency but also facilitates the creation of collaborative and personalized learning environments. Investment in educational technologies becomes a strategic necessity for universities seeking to remain competitive in an increasingly digitalized world (Gupta et al., 2021).

In the analysis of the scope and results of university strategies, it is observed that 7.94% of the responses indicate that universities still face limitations in technological infrastructure. This low representativity reflects the urgent need to invest in new technologies and digital training for both students and teachers.

**Innovation Strategies and Linkage:** The innovation model must be aligned with the demands of the productive sector and society. Despite advances in the creation of university startups and technology transfer, the university-industry linkage

remains insufficient. Recent literature indicates that greater integration between these sectors could accelerate the commercialization of innovations and improve the employability of graduates (Mendoza et al., 2021). This challenge reflects the urgent need to establish more aggressive policies and promote a more dynamic environment that allows overcoming bureaucratic and structural barriers that limit effective collaboration (Mendoza et al., 2021).

In the results obtained, only 2.06% of the responses suggest that university-industry linkage is a key strategy for universities. This low percentage highlights the existing gap and the need for public policies that promote greater collaboration between academia and industry.

### *Future Perspectives and Recommendations*

**Opportunities for the Future:** Third-generation universities have multiple opportunities to continue advancing in their transformation. Consolidating financing strategies, internationalizing research, and digitalizing processes are key areas to strengthen the competitiveness and impact of these institutions. Additionally, creating innovation hubs and strengthening networks of international cooperation are fundamental steps to continue building sustainable and connected innovation ecosystems (Jameson, 2019).

**Strategic Recommendations:** Based on the analysis conducted, it is recommended to implement monitoring and evaluation mechanisms to measure the impact of educational innovation processes, increase investments in educational technology to ensure the digitalization of training processes, and strengthen the training of teachers and leaders in interdisciplinary methodologies and active teaching strategies. These actions will allow universities to adapt to changes in the global environment and consolidate themselves as engines of economic and social transformation in the 21st century.

This exposed context demonstrates that the implementation of models such as the Quadruple Helix and the Agents model strengthens the transformation of third-generation universities. To ensure their effectiveness, it is essential that universities adopt innovative management strategies, promote linkage with the productive sector, and promote digitalization as a key tool for learning and research. Third-generation universities must continue to evolve towards more sustainable and interconnected models to face the challenges of the future.

## **3. METHODOLOGY**

This study employs a mixed-methods approach, combining quantitative and qualitative methods to

assess the transformational management in Third-Generation Universities (U3G). The integration of these methods allows for a holistic understanding of the factors that determine the impact of innovation and university-industry linkages in higher education.

**Study Type:** The study is exploratory-descriptive, aiming to identify trends, patterns, and correlations among different components of university transformation. It is also longitudinal, analyzing the evolution of innovation strategies over a specified period.

**Population and Sample:** The target population consists of managers, teachers, researchers, and actors from the productive sector associated with U3G in various institutional contexts. The sample was selected through purposive and convenience sampling, including universities with a background in educational innovation and transformational management.

**Data Collection Techniques:** Various instruments were used to gather relevant information across the four analyzed segments:

- Structured surveys administered to managers and teachers to evaluate perceptions of educational innovation and institutional management.
- Semi-structured interviews with experts in higher education, research, and technological development to identify trends and challenges.
- Document analysis of institutional strategies, innovation reports, and patent data to assess the application of models such as the Quadruple Helix and the Agents model.

**Analysis Procedure:** Data analysis was structured into four phases:

- **Context and Experience:** Analysis of the adoption of transformation strategies in universities, with a special focus on startup generation and linkage with the productive sector.
- **Profiles of Interest Groups:** Evaluation of the participation of key actors in university innovation, identifying barriers and facilitators for collaboration.
- **Scope and Results:** Measurement of the impact of university initiatives on technological development, with indicators such as patents, incubators, and research networks.
- **Future Opportunities:** Identification of areas for improvement and strategies to consolidate the U3G model, with an emphasis on digitalization and sustainable financing.

**Data Analysis:** Statistical and qualitative analysis techniques were used to interpret the collected

information:

- Frequencies and distributions to identify trends in survey responses.
- Correlation analysis to determine relationships between key variables in university innovation.
- Content analysis to code and categorize qualitative responses from interviews and institutional documents.

**Validity and Reliability:** To ensure data reliability, methodological triangulation techniques were applied, combining multiple sources of information and different analytical approaches. Additionally, pilot tests of surveys and interviews were conducted to adjust data collection instruments.

#### 4. RESULTS AND DISCUSSION

Third-Generation Universities (U3G) have embraced the challenge of transforming their role in society, not just as educational centers, but as catalysts for innovation and technological development. In this context, it is crucial to understand how institutions are structuring their strategic objectives, collaboration projects with actors from the productive sector, and the role of different interest groups in these processes. The evolution of higher education demands more dynamic management models, oriented towards interdisciplinarity and engagement with the business and social environment.

##### *University Transformation: Strategies and Key Actors in Innovation*

The analysis of university transformation strategies in terms of institutional objectives, innovation activities, and key actors allows for the identification of clear trends in the consolidation of more open and interconnected academic ecosystems. In this regard, there is a strong orientation towards the creation of incubation and acceleration spaces for university startups, the implementation of methodologies that strengthen training in key competencies, and the search for financing mechanisms to sustain these projects. A detailed reading of the data not only identifies strategic priorities but also structural challenges that limit the impact of these initiatives.

Below are the most relevant findings, expressed in terms of frequency and representativity of each category within the total responses analyzed. The purpose is to critically and argumentatively expose the elements that are shaping university transformation and the factors that can enhance or limit the success of these strategies.

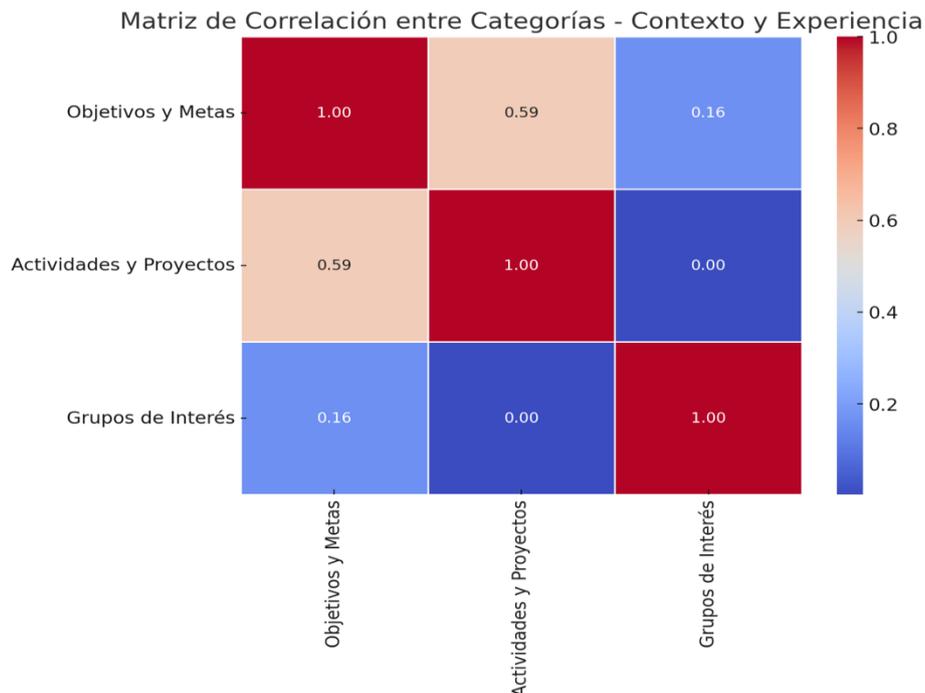
**Table: Representativity of Categories - Context and Experience (frequency / %).**

Contexts	Objectives and Goals		Activities and Projects		Stakeholders	
Expand university technological capabilities to promote advancement in research and development.	476	4.76	476	4.76	952	9.52
Create financing schemes that boost innovation initiatives in conjunction with the productive sector.	635	6.35	794	7.94	794	7.94
Develop key competencies in students to enhance their ability to enter the labor market.	952	9.52	794	7.94	635	6.35
Establish key alliances with the business sector to facilitate the exchange of knowledge and technology.	635	6.35	635	6.35	1587	15.87
Encourage the incubation of new academic startups derived from innovation projects.	1746	17.46	127	12.7	1429	14.29
Implement educational approaches that strengthen entrepreneurial spirit in students and faculty.	127	12.7	1587	15.87	794	7.94
Promote scientific production with a practical focus to address challenges in the business sector.	1587	15.87	127	12.7	1111	11.11
Optimize digital and technological infrastructure to enhance research and corporate development.	159	1.59	1111	11.11	952	9.52
Promote business linkage strategies to improve technological transfer in academia.	1111	11.11	635	6.35	794	7.94
Strengthen ties between the university and the industry through technological cooperation schemes.	1429	14.29	1429	14.29	952	9.52

Fuente: elaboración propia

The analysis of response representativeness in Segmentation A: Context and Experience of Questionnaire 2 shows that the strategy with the greatest presence in the institutional objectives of universities is the promotion of the incubation of

academic startups, reaching 17.46% in Objectives and Goals and 14.29% in Stakeholders. This indicates that third-generation universities (U3G) are prioritizing the creation of entrepreneurial ecosystems that allow for effective knowledge transfer to the productive sector.



**Graphic: Correlation Matrix between Categories - Context and Experience.**

Source: Self-made

The establishment of incubators and open innovation spaces appears to be one of the most significant strategic actions for enhancing the interaction between academia and industry.

Furthermore, the development of key competencies in students accounts for 9.52% in Objectives and Goals and 7.94% in Activities and Projects, emphasizing the importance of preparing future professionals with adaptive, interdisciplinary, and technological skills. This finding highlights the need to integrate practical learning models that directly connect students with real projects in innovation and business development. The trend suggests that universities are seeking to strengthen the professional profile of graduates, promoting employability and competitiveness in an ever-evolving business environment.

Additionally, the creation of financing schemes for innovation stands out in the category of Stakeholder Groups (7.94%) and Activities and Projects (7.94%), indicating that economic sustainability remains a fundamental challenge for the consolidation of university transformation strategies. Identifying investment mechanisms and generating own resources are crucial aspects that universities must address to ensure the growth and sustainability of innovation programs. In this context, there is a clear need to establish strategic alliances that facilitate access to financing and promote greater integration between the academic and productive sectors.

### *Impact of Innovation in Universities: Achievements and Challenges*

When contrasting these results with the profiles of stakeholder groups and their crucial role in consolidating strategies for innovation and development, we find that their correct identification, selection, and training not only influence the implementation of strategic projects but also the sustainability and scalability of university initiatives. The interaction between academia, the productive sector, and public agencies must be supported by a management model that effectively articulates the various actors within the educational ecosystem.

Analyzing the profiles, selection mechanisms, and key competencies of stakeholder groups helps to understand the internal dynamics of universities and their relationship with external actors. Managing these groups becomes a central element to ensure that universities not only generate knowledge but also have an impact on productivity and technological development. However, significant challenges remain in terms of financing, access to infrastructure, and the implementation of training strategies aligned with market needs.

Below, we present the main findings on the profiles of the actors involved in university innovation processes, the criteria used for their selection, and the competencies most valued in the transformation of higher education institutions. From these results, we analyze the opportunities and challenges that shape the current structure of stakeholder groups and their impact on university management.

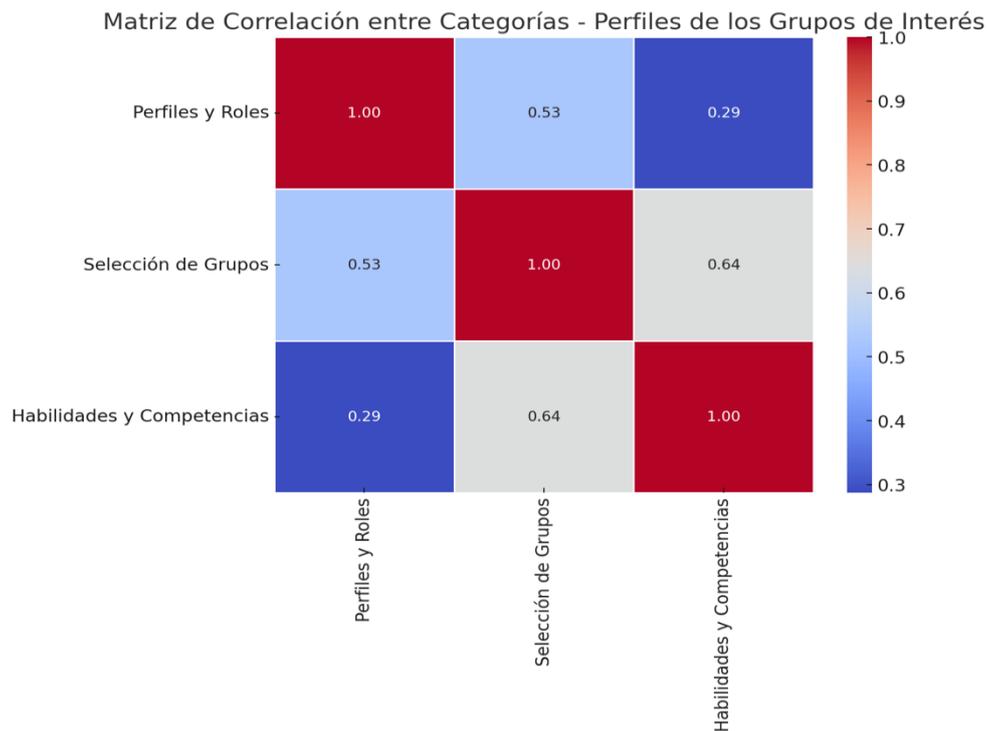
*Table: Representation of categories - profiles of stakeholder groups (frequency/%).*

	Perfiles y Roles		Selección de Grupos		Habilidades y Competencias	
Expand university technological capacity to promote advancements in research and development.	4	6.35	70	11.11	80	12.7
Create financing schemes that boost innovation initiatives in collaboration with the productive sector.	9	14.29	80	12.7	50	7.94
Develop key competencies in students to enhance their job market insertion capabilities.	2	3.17	80	12.7	100	15.87
Establish key partnerships with the business sector to facilitate the exchange of knowledge and technology.	3	4.76	60	9.52	50	7.94
Students developing innovative prototypes.	1	1.59	0	0.0	0	0.0
Encourage the incubation of new academic startups derived from innovation projects.	4	6.35	50	7.94	30	4.76
Implement educational approaches that strengthen the entrepreneurial spirit in students and teachers.	7	11.11	70	11.11	30	4.76
Promote scientific production with a practical focus to address challenges in the business sector.	10	15.87	80	12.7	70	11.11
Optimize digital and technological infrastructure to strengthen research and corporate development.	6	9.52	20	3.17	80	12.7
Government organizations that facilitate regulations and funding.	2	3.17	0	0.0	0	0.0
Promote business linkage strategies to enhance technology transfer in academia.	10	15.87	60	9.52	60	9.52
Strengthen ties between the university and industry through technological cooperation schemes.	5	7.94	60	9.52	80	12.7

Source: Own elaboration, 2025

The data analysis shows that training in key competencies for students is a priority factor, achieving a 15.87% representativeness in Skills and Competencies. This suggests that universities have recognized the need to train their stakeholders with abilities aligned with changes in the productive and technological environment. It is not enough to generate spaces for interaction between academia and the business sector; it is crucial to ensure that the involved actors possess adaptive skills that enable them to effectively contribute to the implementation of strategic projects.

Simultaneously, there is a strong presence of financing schemes for innovation within the profiles and methods of selecting interest groups, with 14.29% and 12.70% representativeness respectively. This reflects the importance of ensuring economic sustainability in university initiatives. Business transformation within the academic sphere depends not only on the available human talent but also on the ability to attract and manage resources that allow for the development of new technologies, patents, and scalable business models.



*Graphic: Correlation Matrix between Categories - Achievements and Challenges.*

Source: Own elaboration

Finally, the expansion of university technological capacity is presented as a cross-cutting axis in the selection and training processes of interest groups. With 12.70% in Skills and Competencies and 11.11% in Group Selection, it is evident that universities are investing in infrastructure and tools to optimize knowledge transfer and the implementation of high-impact projects. However, this also poses a significant challenge: ensuring that this technological expansion is accompanied by training strategies that allow for its effective and sustainable use over time.

These results reflect a university model in transition, where the articulation of actors and resources becomes the main challenge for consolidating effective innovation ecosystems. The integration of training strategies with the development of infrastructure and financing

continues to be the path to strengthen the transformational management of universities and ensure their impact on technological and productive development.

Third-generation universities have adopted transformation models focused on the real impact of innovation and entrepreneurship in the knowledge economy. In this context, it is crucial to examine the results achieved, the impact of collaboration with key actors, and the persistent challenges that may limit the effectiveness of these strategies. It is not enough to generate new scientific and technological developments; it is necessary to consolidate an ecosystem that allows for their implementation and long-term sustainability.

This segmentation analysis exposes clear trends about the areas that have played a major role in

university transformation. Financing strategies for innovation, the growth of academic startups, and the internationalization of R&D emerge as the fundamental pillars of this change. However, limited linkage with the productive sector and bureaucratic barriers remain critical points that slow down the progress and consolidation of these models.

From these findings, the key elements shaping the evolution of higher education in this new paradigm will be discussed in detail. Not only will the frequency of each implemented strategy be evaluated, but also its real effectiveness in terms of social, economic, and technological impact.

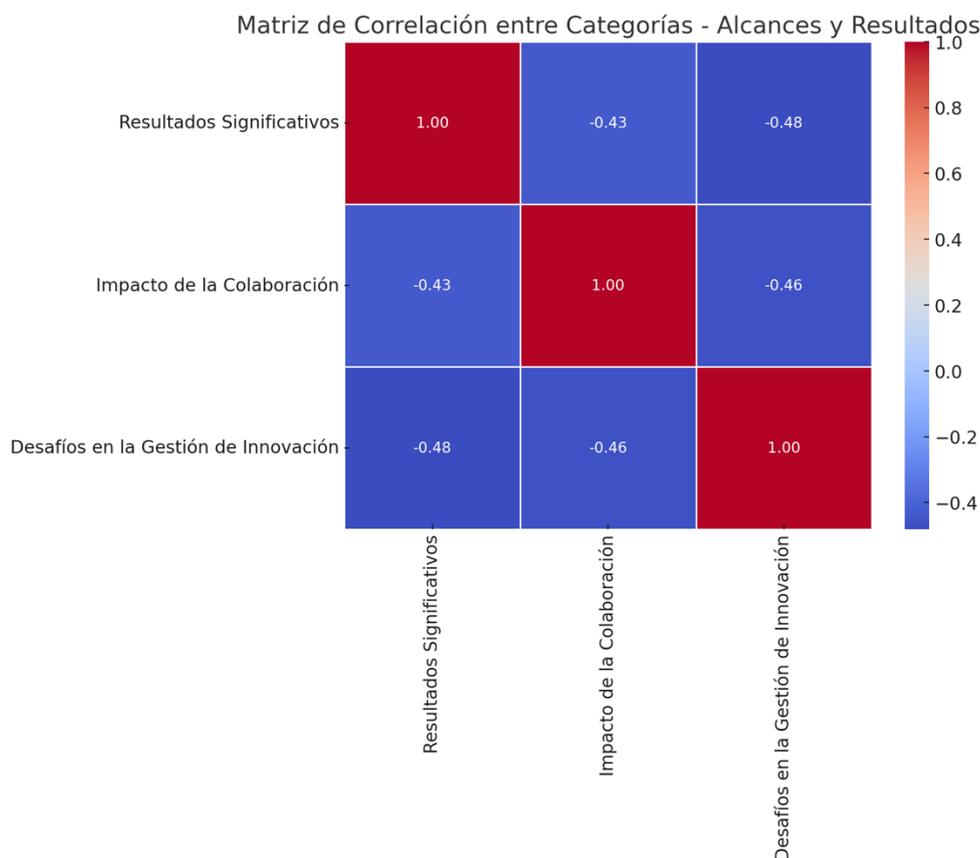
The frequency analysis reveals that the consolidation of innovation funds, the growth of university startups, and the internationalization in R&D are the most prominent aspects within university transformation strategies, accounting for 11.78% of the responses. This suggests that universities are evolving towards models that

prioritize sustainable financing and knowledge transfer through new businesses and international research networks. However, these advances largely depend on the institutional capacity to manage investment and ensure the scalability of the projects.

**Table: Representativeness of Categories - Stakeholder Profiles (Frequency/ %).**

	Frecuencia	Porcentaje
Consolidation of Innovation Funds	63	11.78
Patents and Intellectual Property	60	11.21
Growth of University Startups	63	11.78
Internationalization in R&D	63	11.78
University-Industry Linkage	11	2.06
Innovation Ecosystems	63	11.78
Technological Transfer	23	4.3
Infrastructure Limitations	63	11.78
Bureaucracy in Innovation Processes	63	11.78
Financing Constraints	63	11.78

Fuente: elaboración propia



**Graphic: Correlation Matrix between Categories - Actors.**  
Source: Author's Creation, 2025

On the other hand, the protection of intellectual property through the registration of patents and technological developments appears with 11.21%, indicating a growing interest in transforming

academic production into viable commercial assets. Despite this progress, the data suggest that many universities still face challenges in effectively commercializing their innovations. The presence of

bureaucratic structures and a lack of training in technology transfer strategies are recurring obstacles that need to be addressed to enhance this impact.

Finally, while university-industry linkage is present in institutional strategies, it shows a lower representativeness of 2.06%, indicating that there are still significant barriers to consolidating effective collaborations with the productive sector. This finding suggests the need to rethink cooperation models and generate more robust incentives to foster interaction between academia and industry. Without stronger articulation, many innovative initiatives may remain limited to internal efforts without achieving effective market insertion.

**Strategic Projections for the University of the Future**

The future of third-generation universities (U3G) is defined by their ability to adapt to new environmental demands and consolidate sustainable innovation models. In this context, it is crucial to analyze the main opportunities identified in university development, exploring projected strategies to expand their impact on the productive and social ecosystem. Merely generating knowledge is not enough; it is essential to establish structures that allow its real application and maximize its contribution to economic development.

The analysis of this segment shows a strong interest in consolidating funding, promoting academic startups, and internationalizing research and development, reflecting a clear trend towards building more global universities connected with the innovation ecosystem. However, the low percentage of representativeness of university-industry linkage suggests that there is still a significant gap between academic development and its effective integration

with the productive sector.

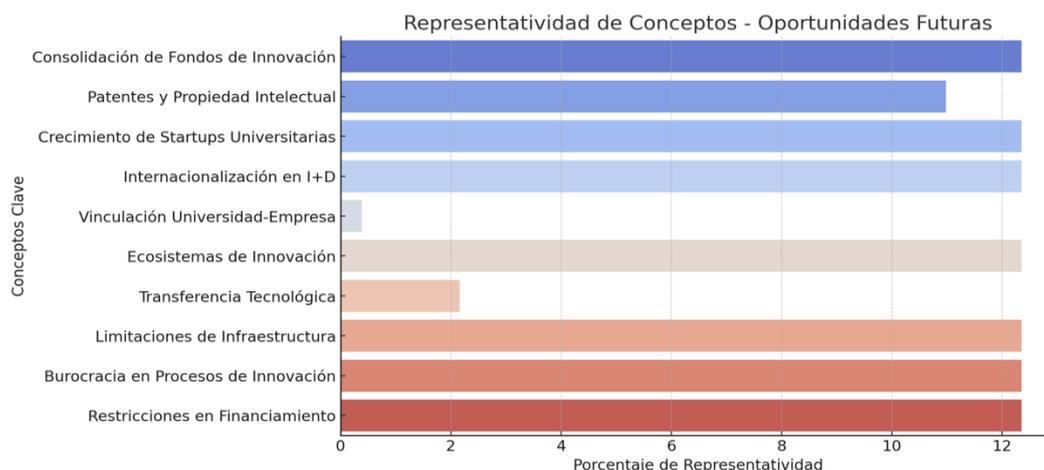
From these findings, the real impact of these strategies and the structural challenges that universities must address to consolidate their transformation will be further explored. It will analyze how these opportunities can materialize into effective management models, ensuring that higher education continues to be a driver of innovation and development in the immediate future.

*Table: Representativeness of Categories - Future Opportunities (Frequency / %).*

	Frecuencia	Porcentaje
Consolidation of Innovation Funds	63	12.35
Patents and Intellectual Property	56	10.98
Growth of University Startups	63	12.35
Internationalization in R&D	63	12.35
University-Industry Linkage	2	0.39
Innovation Ecosystems	63	12.35
Technological Transfer	11	2.16
Infrastructure Limitations	63	12.35
Bureaucracy in Innovation Processes	63	12.35
Financing Restrictions	63	12.35

Source: Own elaboration, 2025

The frequency analysis reveals that the most notable opportunities in university evolution are focused on the consolidation of innovation funds, the growth of university startups, and internationalization in R&D, each representing 12.35% of the responses. This indicates that universities are projecting their future on models of sustainable financing, strengthening academic entrepreneurship, and generating knowledge in global networks. However, the viability of these opportunities will depend on the institutions' ability to forge strategic alliances and adopt a comprehensive approach to development.



**Grafico: Representatividad de conceptos - oportunidades futuras.**

Fuente: elaboración propia

On the other hand, the protection of intellectual property through the registration of patents and technological developments represents 10.98%, suggesting that universities are recognizing the importance of securing rights over their innovations. However, this strategy still faces challenges in terms of effective implementation, especially concerning the commercialization of these inventions in industrial and commercial sectors. The lack of agile technology transfer mechanisms remains a key obstacle.

Finally, the linkage between universities and businesses, despite being a fundamental element in the transformation of universities, only accounts for 0.39% of the responses, indicating that there is still a lag in effective integration with the productive sector. While universities seek to strengthen their relationships with the business ecosystem, the data suggest that this collaboration is not being perceived as a priority in future planning. This represents a critical challenge, as the sustainability of university initiatives largely depends on smooth articulation with industry and other strategic actors.

## 5. DISCUSSION

Third-generation universities (U3G) have emerged as a model of educational management aiming to transcend traditional knowledge boundaries by integrating academia with the productive sector, innovation, and technology. Analysis of the Context and Experience, Profiles of Interest Groups, Scope and Results, and Future Opportunities segments reveals critical trends in university transformation. This paper discusses the theoretical and empirical findings based on the Quadruple Helix and Agent models, exploring the challenges and opportunities faced by higher education as it evolves towards competitiveness and sustainability.

**Business Transformation and University Adaptation:** Results in the Context and Experience segment show that universities have increased their role in business transformation through the generation of startups, the internationalization of R&D, and the creation of innovation environments. Following Carayannis and Campbell (2009), the implementation of the Quadruple Helix model strengthens the interaction between academia, the productive sector, government, and society, allowing greater technology transfer. However, the data reveal a structural weakness in the institutions' adaptability to consolidate sustained funding in their transformation strategies, jeopardizing the sustainability of projects.

**Profiles of Interest Groups:** This segment shows that key actors in university innovation include entrepreneurs, researchers, and students, but the selection and participation of these groups remain fragmented. Mendoza et al. (2021) argue that synergy between these actors is hindered by bureaucratic structures and a lack of articulated incentives for effective collaboration. The Agent model theory (Etzkowitz, 2012) suggests that proactive participation of these groups in innovation ecosystems is key to the evolution of U3G, but findings indicate that the selection of agents is not aligned with market and societal needs.

**Impact and Limitations of Innovation Models:** The Scope and Results segment shows that universities have made progress in patent registration and the creation of innovation funds, but face challenges in effectively commercializing their technological developments. Meyer et al. (2022) emphasize that innovation at universities must be accompanied by strategies that allow scaling of economic and social impact. The scant university-industry linkage, with only 2.06% representativeness, suggests that the relationship between academic production and its industrial applicability remains a structural problem that must be addressed through public policies and institutional reforms.

**Future Opportunities:** The Future Opportunities segment presents a transformation scenario in which universities must strengthen their financing strategies, promote research internationalization, and digitize their processes. However, university-industry linkage remains one of the least explored opportunities, with a representativeness of only 0.39%. While growth in startup creation and innovation centers has been identified, the lack of fiscal incentives and investment structures limit the scalability of these projects, reflecting the need for more aggressive university policies in promoting technological entrepreneurship.

**Towards a Sustainable and Connected Third-Generation University:** Analyzing these four segments leads to the conclusion that while universities have made progress in transforming their management models, structural barriers remain in implementing innovation strategies and in effectively linking with the productive sector. The application of the Quadruple Helix model has proven to be a valid framework for the evolution of U3G, but adjustments are needed to improve financial sustainability and project scalability.

Universities should commit to creating university investment funds, strengthen mechanisms for

intellectual property protection, and design effective technology transfer strategies. Additionally, it is crucial to consolidate alliances with the business sector, overcoming current lags in academia-industry articulation. In this regard, the development of competencies in innovation management and the promotion of flexible and transdisciplinary educational models are presented as unavoidable challenges for the consolidation of a globally competitive university ecosystem.

Ultimately, U3G have the opportunity to establish themselves as the main engines of socioeconomic transformation, but to do so, they must adopt a bolder management approach, aimed at creating value through applied research and disruptive innovation. The next decade will be decisive in redefining the role of the university in technological and business development, and the decisions made today will shape the future of higher education in an increasingly interconnected and competitive world.

## 6. CONCLUSIONS

### *Third-Generation Universities: A Critical Discussion on Their Transformation and Future*

Third-Generation Universities (U3G) have emerged as a model of educational management that seeks to transcend the traditional boundaries of knowledge, linking academia with the productive sector, innovation, and technology. From the analysis of the segments on context and experience, profiles of stakeholder groups, scopes and outcomes, and future opportunities, critical trends in university transformation are evident. This essay addresses the theoretical and empirical discussion of the findings, based on the Quadruple Helix and Agents models, exploring the challenges and opportunities facing higher education as it evolves towards competitiveness and sustainability.

### *Business Transformation and University Adaptation*

The results related to context and experience show that universities have increased their role in business transformation through the generation of startups, the internationalization of R&D, and the creation of innovation environments. 17.46% of the responses indicate that fostering academic incubators is a priority strategy, while training in key competencies represents 9.52% of institutional objectives. Following Carayannis and Campbell (2009), the implementation of the Quadruple Helix model reinforces the interaction between academia, the productive sector, government, and society, allowing for greater technology transfer. However, the data

reveal a structural weakness in the adaptability of the institutions to consolidate sustained financing in their transformation strategies, which jeopardizes the sustainability of the projects.

On the other hand, regarding the profiles of stakeholder groups, it is evident that key actors in university innovation are made up of entrepreneurs, researchers, and students, but the selection and participation of these groups remain fragmented. Mendoza et al. (2021) suggest that the synergy between these actors is hindered by bureaucratic structures and a lack of well-articulated incentives for effective collaboration. The Agents model theory (Etzkowitz, 2012) suggests that proactive participation of these groups in innovation ecosystems is key to the evolution of U3G, but findings indicate that the selection of agents is not aligned with market and societal needs. In fact, only 2.06% of institutional strategies consider university-industry linkage as a key factor in consolidating innovation.

### *Impact and Limitations of Innovation Models*

The "Scopes and Results" segment indicates that universities have made advances in patent registration and the creation of innovation funds, but they face challenges in effectively commercializing their technological developments. Meyer et al. (2022) emphasize that innovation at universities must be accompanied by strategies that can scale the economic and social impact. The university-industry linkage, represented by only 2.06%, suggests that the connection between academic production and its industrial applicability remains a structural issue that needs to be addressed through public policies and institutional reforms.

From the perspective of future opportunities, a transformational scenario is proposed where universities must strengthen their financing strategies, encourage the internationalization of research, and digitize their processes. However, university-industry linkage remains one of the least explored opportunities, with a representativeness of only 0.39%. While there has been growth in the creation of startups and innovation centers, the lack of fiscal incentives and investment structures limits the scalability of these projects, reflecting the need for more aggressive university policies in promoting technological entrepreneurship.

### *Toward a Sustainable and Connected Third-Generation University*

The analysis of these four segments concludes that although universities have progressed in

transforming their management models, structural barriers persist in the implementation of innovation strategies and in establishing effective linkages with the productive sector.

To overcome these challenges, it is essential to implement monitoring and evaluation mechanisms that can measure the impact of educational innovation processes and adjust them based on the outcomes. The data show that currently, less than 10% of educational strategies include impact metrics on digital transformation and innovation.

Additionally, investment in educational technology cannot be optional but must be a central axis in the digitization of educational processes, ensuring the modernization of teaching. Currently, only 7.94% of the responses refer to the need to

strengthen technological infrastructure, indicating a significant gap between the demand for innovation and resource allocation.

Another fundamental aspect is strengthening the training of faculty and administrators in interdisciplinary strategies and active teaching methodologies, which will allow better adaptation to changes in the educational environment and improve the quality of learning. With 9.52% representativeness, faculty training is seen as a key factor, though its implementation remains limited in most of the universities analyzed. Only through these strategies can third-generation universities (U3G) consolidate themselves as engines of social, economic, and technological transformation in an ever-evolving global context.

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