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Entrepreneurial Universities and Start-up Ecosystems in Algeria: The Case of Mouloud Mammeri University of Tizi-Ouzou (UMMTO)

Cezayir'de Girişimci Üniversiteler ve Girişim Ekosistemleri: Tizi-Ouzou Mouloud Mammeri Üniversitesi (UMMTO) Örneği

Kahina Bechecker^a

^aAssist. Professor, University of Tizi-Ouzou, Algeria, kahina.bechecker@ummto.dz, ORCID: 0009-0004-1346-7037

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ABSTRACT

This paper analyzes the entrepreneurial transformation of Mouloud Mammeri University of Tizi-Ouzou (UMMTO) between 2017 and 2025, using quantitative institutional data. The study examines the evolution of entrepreneurship training, start-up creation, and patent filings within the university ecosystem, including the Entrepreneurship Center, the Development Center for Entrepreneurship (CDE), and the University Incubator. Results show a significant increase in trained project holders, the establishment of structured support mechanisms, and disciplinary diversification, although administrative delays and funding constraints limited some outcomes. Findings indicate that coherent leadership and alignment with national policy, particularly Ministerial Decision No. 1275, facilitate entrepreneurial activity and innovation outputs. Recommendations include reinforcing interdisciplinary entrepreneurship education, enhancing post-incubation support, and streamlining regulatory procedures. The study contributes to theory and practice by demonstrating how the Entrepreneurial University and Triple Helix frameworks can guide public universities in emerging economies toward effective institutional entrepreneurship.

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ÖZ

Bu çalışma, 2017–2025 yılları arasında Mouloud Mammeri Tizi-Ouzou Üniversitesi'nin (UMMTO) girişimcilik dönüşümünü, kurumsal nicel verileri kullanarak analiz etmektedir. Araştırma, üniversite ekosistemi içinde yer alan Girişimcilik Merkezi, Girişimcilik Geliştirme Merkezi (CDE) ve Üniversite Kuluçka Merkezi aracılığıyla yürütülen girişimcilik eğitiminin, start-up oluşumunun ve patent başvurularının gelişimini incelemektedir. Elde edilen bulgular, eğitilen proje sahiplerinin sayısında önemli bir artış olduğunu, yapılandırılmış destek mekanizmalarının oluşturulduğunu ve disiplinler arası çeşitliliğin arttığını göstermektedir. Bununla birlikte, idari gecikmeler ve finansman kısıtları bazı sonuçları sınırlamıştır. Bulgular ayrıca, özellikle 1275 sayılı Bakanlık Kararı ile uyumlu kurumsal liderliğin ve ulusal politika ile uyumun girişimcilik faaliyetlerini ve yenilik çıktılarının gelişimini kolaylaştırdığını ortaya koymaktadır. Çalışma, disiplinler arası girişimcilik eğitiminin güçlendirilmesi, kuluçka sonrası destek mekanizmalarının geliştirilmesi ve düzenleyici süreçlerin sadeleştirilmesi yönünde politika önerileri sunmaktadır. Ayrıca araştırma, Girişimci Üniversite ve Üçlü Sarmal (Triple Helix) yaklaşımlarının, gelişmekte olan ekonomilerdeki kamu üniversitelerinin etkili kurumsal girişimcilik geliştirmesine nasıl rehberlik edebileceğini göstererek teori ve uygulamaya katkı sağlamaktadır.

Introduction

In recent years, universities around the world have reshaped their goals in response to fast technological progress, globalization, and altering economic paradigms. Universities, which have traditionally been viewed as centers of knowledge creation through teaching and research, are increasingly expected to play a significant role in driving innovation ecosystems that boost economic growth and social progress (Etzkowitz & Leydesdorff, 2025). The entrepreneurial university notion embodies this transformative vision by emphasizing the institution's proactive role in transforming scientific discoveries and intellectual assets into commercial technologies, new companies, and societal benefits. Such universities are distinguished by their strategic integration of education, research, and entrepreneurship, which fosters environments conducive to innovation, technology transfer, and collaboration between universities, industries, and governments (Guerrero & Urbano, 2019).

This global trend toward entrepreneurial universities mirrors broader movements toward knowledge-based economies, in which innovation is a primary source of competitiveness and long-term development. In this scenario, higher education institutions are no more isolated ivory towers, but rather active participants in regional and national development efforts. They collaborate with external partners, including commercial companies and government organizations, to co-create value and address societal concerns through entrepreneurial initiatives. This enlarged role is especially important in emerging economies, where universities frequently act as key engines of structural reform, job creation, and technical upgrading (Guerrero et al., 2016).

Algeria is an example of a country attempting to diversify an economy that has traditionally relied on hydrocarbons by using the inventive potential of its universities. Recognizing the limitations of extractive sectors for long-term prosperity, Algerian politicians have implemented changes to encourage entrepreneurship, innovation, and knowledge commercialization in higher education. Ministerial Decision No. 1275, adopted in 2022, is a critical policy effort that establishes a novel link between the awarding of university diplomas and the successful development of start-ups or patent applications resulting from student graduation projects. This strategy represents a formal commitment to embedding entrepreneurship within academic programs and institutional mandates, incentivizing students and researchers to engage in innovation-driven economic activity (Khoualed et al., 2024).

Despite its strategic importance, there has been little systematic empirical research into how this policy has been implemented at the university level or its practical effects on entrepreneurship outcomes. The implementation of such a transformational mission necessitates difficult institutional reforms, resource mobilization, and cultural change inside universities. These issues are exacerbated by Algeria's limited resources, regulatory environment, and variations in institutional capacity throughout the higher education system. Additionally, individual-level factors such as gendered perceptions of entrepreneurial risk can influence student engagement in start-up initiatives, affecting the overall success of academic entrepreneurship programs (Boukhedimi, 2024).

Mouloud Mammeri University of Tizi-Ouzou (UMMTO) provides a compelling case study for delving deeper into these dynamics. Over the last decade, UMMTO has started on an ambitious path to institutionalize entrepreneurship by establishing specialized support structures such as the Entrepreneurship Center, Development Center for Entrepreneurship (CDE), and University Incubator. These organizations are set up to provide training, mentoring, and incubation services, as well as to help students and teachers commercialize their discoveries. Auxiliary institutions such as the University-Industry Liaison Office and the Technology and Innovation Support Center (TISC) supplement these efforts by facilitating partnerships, intellectual property management, and ecosystem coordination. Collectively, these components form a holistic entrepreneurial ecosystem that adheres to international best practices for academic innovation support.

However, UMMTO's experience is not without difficulties. According to Abdelghani and Amara (2024), the university faces chronic challenges such as administrative bureaucracy, inadequate financial and technological resources, and uneven engagement across faculties, with technical and engineering disciplines frequently dominating entrepreneurial efforts. These limitations have an impact on the scalability and durability of entrepreneurial efforts, and they mirror larger structural concerns in Algerian higher education.

This study aims to provide a complete overview of UMMTO's entrepreneurial evolution from 2017 to 2025. It seeks to identify the primary institutional enablers and barriers encountered, evaluate quantitative outcomes such as the number of trained project holders, labeled start-ups, and patent filings, and contextualize these findings within the larger national innovation framework. To do this, the study combines two complimentary theoretical frameworks: the Entrepreneurial Institution Model, which focuses on internal university dynamics such as culture, governance, and capacity-building, and the Triple Helix Model, which highlights the important

role of university-industry-government connections in establishing innovation ecosystems. (Etzkowitz & Leydesdorff, 2025; Guerrero et al., 2016).

By combining these viewpoints, the research contributes to a better understanding of how universities in developing countries can negotiate governmental reforms and institutional hurdles to become productive entrepreneurs. Furthermore, it offers useful insights for policymakers, university administrators, and stakeholders looking to imitate or adapt Algeria's burgeoning model of academic entrepreneurship. Finally, this study contributes to the worldwide dialogue on universities' transformative potential in enabling inclusive and sustainable innovation-driven development.

1. Conceptual Framework

1.1. The Entrepreneurial University Model

The Entrepreneurial University Model has gained popularity in recent years in response to a growing desire for universities to contribute not just to education and research, but also to economic development and societal impact (Verstraete & Fayolle, 2005; Guerrero et al., 2016). According to this model, universities are no longer considered only as knowledge-producing institutions, but rather as engines of innovation that actively participate in the commercialization of research results, start-up promotion, and regional economic stimulation.

This transformation is defined by several essential dimensions. First, entrepreneurial colleges create organizational structures that foster innovation, such as entrepreneurship centers, incubators, technology transfer offices (TTOs), and intellectual property management units. These structures are designed to help students and professors navigate the process of ideation, business development, and commercialization. Second, these universities incorporate entrepreneurship education into academic curricula across disciplines, not just business schools, developing entrepreneurial mindsets and competences in students from other fields (Guerrero & Urbano, 2019). Third, governance models in entrepreneurial colleges are evolving to include incentive systems that promote entrepreneurial activities such as patent registration, start-up creation, and industry partnership, in addition to traditional academic measures like publication and teaching.

Another distinguishing element of the entrepreneurial university is the presence of strategic leadership focused on innovation. Institutional leaders frequently identify entrepreneurship as a primary objective and try to incorporate it into university policy and culture. Organizational flexibility, interdisciplinary collaboration, and openness to external partnerships are also viewed as prerequisites for establishing an entrepreneurial ecosystem within the university context (Guerrero et al., 2016).

This concept is especially significant in emerging markets, where universities are increasingly expected to assist with national economic reform efforts. According to Rosado-Cubero et al. (2024), entrepreneurial colleges encounter challenges such as limited resources, insufficient infrastructure for innovation, and inconsistent policies. As a result, successful implementation necessitates not only internal restructuring but also alignment with larger systemic variables process that involves consideration of external dynamics, as articulated by the Triple Helix Model.

1.2. The Triple Helix Model

Etzkowitz and Leydesdorff (2025) established the Triple Helix Model, which provides a macro-level framework for understanding how innovation originates from the interactions of three institutional actors: universities, industry, and government. Unlike linear theories of innovation, which see universities as separate knowledge producers, the Triple Helix paradigm emphasizes co-evolution, interaction, and feedback loops between the three spheres. Cross-sectoral collaboration produces overlapping roles, shared responsibilities, and hybrid organizations, which are considered as the source of innovation.

In this approach, universities are viewed not only as academic institutions, but also as economic actors who collaborate with business to commercialize research and with the government to develop policy and support frameworks. Industry partners give market knowledge, funding, and growth opportunities, whereas government players supply the regulatory, financial, and legislative infrastructure required to foster innovation. Science parks, public-private incubators, and cooperative research institutes demonstrate the convergence of missions among the three sectors (Schebesch et al., 2024).

The Triple Helix is especially useful for assessing innovation systems in developing and transitional economies, when formal networks between universities, government agencies, and private enterprises are still emerging or fragmented. In such situations, the model emphasizes both the benefits and drawbacks of policy initiatives targeted at increasing innovation capability. For example, state-led initiatives to establish university incubators or promote student entrepreneurship, such as Algeria's Ministerial Instruction No. 1275, may only spark

innovation if they are supported by a favorable legal framework, capable institutions, and active industry participation (Khoualed et al., 2024).

Furthermore, the Triple Helix architecture allows for the establishment of "hybrid organizations," which Etzkowitz (2003) defined as institutions that combine academic, commercial, and policy roles. These include university incubators supported by governmental innovation agencies, technology transfer offices that handle intellectual property for both professors and the institution, and liaison offices that facilitate university-industry contracts. The establishment of these hybrids at Mouloud Mammeri University of Tizi-Ouzou (UMMTO), such as the Development Center for Entrepreneurship (CDE) and the University Incubator, demonstrates the institutionalization of Triple Helix principles.

1.3. Holistic Application in the Case of UMMTO

Using these models in the context of UMMTO provides a twofold analytical perspective. The Entrepreneurial University framework sheds light on the university's internal transformation, including the establishment of innovation-support units, the implementation of training programs, the cultivation of an entrepreneurial culture among students, and initiatives to promote patenting and start-up creation. These changes indicate a strategic reorientation of the university's mission and structure, in line with global trends toward academic entrepreneurship.

At the same time, the Triple Helix framework places these institutional developments in the context of national policy and regional economic activity. UMMTO's ability to implement Decree 1275, collaborate with agencies such as the National Agency for Entrepreneurship Support (ANADE), and match its outputs with local industry needs is the consequence of both internal reform and its integration into a larger innovation system. The quality of interactions between academic, industry, and government actors influences the effectiveness and long-term viability of entrepreneurial outcomes. For example, the success of labeled start-ups is determined by their access to funding (government and private), mentorship (industry), and technical support (university), all of which are rooted in various helixes.

Moreover, this combined paradigm captures the dynamic interaction between policy and practice. While Ministerial Instruction 1275 serves as a regulatory stimulus for university entrepreneurship, its efficacy is influenced by UMMTO's internal capabilities and external relationships. This underlines the notion that effective innovation ecosystems are not established exclusively through top-down mandates, but also through institution-level agency and cross-sectoral collaboration.

Consequently, combining the Entrepreneurial University Model and the Triple Helix Model allows for a more comprehensive picture of how UMMTO is managing its role as a regional innovation actor. It emphasizes the importance of structural restructuring within universities as well as cross-sector collaboration to achieve meaningful and long-term entrepreneurial achievements. As such, this conceptual framework serves as the foundation for assessing the empirical features of UMMTO's innovation journey, which are described in the sections that follow.

2. Literature Review

2.1. The Rise of the Entrepreneurial University Model

In the global knowledge economy, universities' traditional functions as centers of teaching and research have evolved to include entrepreneurship, innovation, and socioeconomic engagement. This shift has given rise to the concept of an entrepreneurial university, which refers to institutions that deliberately incorporate entrepreneurial culture, policies, and structures into their objectives (Etzkowitz & Leydesdorff, 2005). The entrepreneurial university is concerned not only with knowledge creation, but also with practical application through commercialization, spin-offs, and regional development efforts (Guerrero et al., 2016). According to Verstraete and Fayolle (2005), these universities serve as innovation catalysts by using internal resources such as academic expertise, student creativity, and research infrastructure, as well as engaging with external stakeholders.

The emergence of this paradigm is linked to broader factors such as globalization of research, rising need for employable graduates, and pressure on universities to demonstrate effect beyond academic publications. As universities compete for resources and recognition, those that incorporate innovation and entrepreneurship into their frameworks are better positioned to meet market and policy demands (Guerrero & Urbano, 2019). The shift toward entrepreneurial colleges is particularly important in developing nations, as institutions frequently play key roles in pushing socioeconomic transformation.

2.2. University Incubators and Innovation Ecosystems

University-based incubators are critical tools for putting entrepreneurship into action in academic settings. They encourage innovation by providing physical infrastructure, mentorship, technical guidance, and business development resources to students and researchers interested in launching start-ups. Budac et al. (2024) contend that incubators provide "learning-by-doing" environments that supplement academic training and expose entrepreneurs to market realities. Their presence in academic ecosystems helps to close the gap between knowledge development and commercialization.

Recent literature also underlines the need of integrating incubators into larger innovation ecosystems. Rosado-Cubero et al. (2024) depict incubators as "nodes" in multi-actor networks, connecting universities with local enterprises, regional development agencies, and funding organizations. Successful ecosystems rely on more than just an incubator; they also demand long-term collaboration, cross-disciplinary participation, and good leadership. However, incubators in many parts of the Global South continue to encounter significant hurdles. According to Shillie and Wokwen (2024), African university incubators frequently struggle due to infrastructure restrictions, inadequate post-incubation support, and insufficient ties to industry or investors. This underlines the view that incubators must be carefully incorporated into university policies and national innovation agendas in order to achieve long-term success.

2.3. The Entrepreneurial University in Developing Economies

In low- and middle-income countries, the entrepreneurial university model has arisen as both a policy goal and a practical requirement. Economic diversification, youth unemployment, and undeveloped innovation systems have encouraged governments to use colleges as entrepreneurial engines. According to Guerrero and Urbano (2019), universities in these regions suffer unique structural challenges such as bureaucratic lethargy, low funding, and weak links to industry. Nonetheless, case studies from Latin America, Asia, and Africa show that institutional change is feasible with strong leadership, government support, and consistent investment in entrepreneurial education.

According to Gulia et al. (2025), the success of entrepreneurial colleges in developing nations depends on the alignment of institutional interests with national economic objectives. This includes rewriting courses, fostering faculty entrepreneurship, and building a strong incubation ecosystem. However, in many cases, entrepreneurship is restricted to engineering or business schools, limiting the inclusion and reach of new ventures. Furthermore, cultural attitudes about risk-taking and business development can influence how students and teachers engage in entrepreneurship programs. The transition to entrepreneurial colleges necessitates both structural reform and adaptation challenge that is particularly acute in Algeria. Moreover, Prior research highlights that entrepreneurial opportunities can significantly influence strategic growth, particularly when knowledge generation processes are effectively leveraged within ICT firms (Sadaoui et al., 2025). This underscores the importance of aligning university-driven entrepreneurship programs with industry needs to enhance regional economic development.

2.4. Algerian Higher Education and the National Innovation Agenda

Algeria has made concerted efforts to incorporate entrepreneurship into its higher education system, as part of a larger knowledge economy plan. The most significant policy reform in this area is Ministerial Decision No. 1275 (2022), which requires that final-year student projects be eligible for conversion into patents or labeled start-ups. This policy represents the government's intention to connect academic training to economic value creation (Khoualed et al., 2024). While the directive has sparked broad interest among students and universities, its practical application has been unequal.

Several recent research have looked into the impact of this policy. University incubators around Algeria have seen an increase in applications after the implementation of Decree 1275, but many lack the organizational capacity to enable follow-up. Similarly, Saoud et al. (2024) notes that the policy has raised student knowledge of entrepreneurship, but most colleges do not give adequate post-labeling support, such as access to money or business coaching. At the institutional level, there is significant variance in how institutions interpret and apply the decree, leading to variations in performance and reporting.

The decree has also raised discussions regarding the link between academic achievement and entrepreneurial potential. Nadjiba and Khadidja (2024) discovered that certain faculties are more proactive than others in supporting innovation, based on their discipline specialization and leadership culture. Meanwhile, Benali-Reguieg (2025) emphasizes the absence of established criteria for categorizing start-ups and assessing their success. Overall, Decree 1275 provides a promising structure, but it requires additional revisions to be truly successful.

2.5. Organizational Readiness and Cultural Factors

Beyond structural reforms and legislative frameworks, organizational culture and internal motivation play an important role in developing students' and faculty's entrepreneurial behavior. According to Meziane (2023), researchers' propensity to participate in entrepreneurial activities is influenced by institutional signals such as recognition of innovative outputs in career progression, training in intellectual property management, and opportunities to work with industry. When these signals are weak or inconsistent, the institutional culture does not encourage innovation, regardless of the policy context.

Metaiche (2024) offers more insights about students' attitudes regarding entrepreneurship. Her investigation of different Algerian colleges revealed a high level of interest in launching enterprises, but little awareness of how to obtain support institutions such as incubators or entrepreneurship centers. This gap between interest and opportunity reflects deeper concerns with institutional communication and curriculum design. It also emphasizes the significance of integrating entrepreneurial education into all disciplines and academic levels. Guerrero et al. (2016) define "organizational readiness" as the alignment of institutional structures, incentives, and values that promote innovation. In Algeria, institutional preparation varies greatly. Some universities have established specific entrepreneurial support departments and incorporated innovation into their strategic objectives, but others lack fundamental infrastructure and administrative commitment. Understanding this internal diversity is critical for evaluating the feasibility and impact of entrepreneurial policies.

2.6. Institutional Support, Sustainability, and Post-Labeling Challenges

While several Algerian universities have successfully launched student start-ups through labeling programs, there are questions regarding the long-term viability of these businesses. According to the 2025 national study *Start-ups in Algeria: Reality and Challenges*, there are few procedures in place to track start-up growth after labeling. As a result, there is little evidence of survival rates, market success, or job creation among university-based businesses. The absence of time series data hinders evaluation and learning. Similar concerns have arisen in international situations. Rosado-Cubero et al. (2024) underline the importance of post-incubation support, such as access to seed finance, legal advice, and scaling networks. Without these, many start-ups fail to commercialize. In Algeria, incubators frequently focus on the early stages of business formation, with limited space for post-labeling growth. This "early-stage bottleneck," a common problem in poor nations with fragmented innovation ecosystems and limited resources, impedes start-up scaling and sustainability (Guerrero et al., 2016).

To address these concerns, numerous studies have suggested more integrated governance models for academic entrepreneurship. Budac and Ilie (2024) advocate incorporating incubators within university governance systems and connecting them to regional development organizations. This would assure ongoing support and improved alignment with local economic interests. In Algeria, collaborations between universities and organizations such as ANADE and the Ministry of Knowledge Economy could provide the institutional foundation required to support start-up ecosystems.

Similarly, Guerrero et al. (2016) contend that institutional entrepreneurship thrives when universities match internal norms, incentives, and structures with innovative missions, including entrepreneurship into strategic planning and academic development. Furthermore, Etzkowitz and Leydesdorff (2025) emphasize the Triple Helix concept, which supports collaborative networks between universities, industry, and government as the cornerstone for regional innovation ecosystems. This concept has been demonstrated to improve resource sharing, knowledge exchange, and co-creation of economic value. In Algeria, collaborations between universities and bodies such as ANADE and the Ministry of Knowledge Economy could provide the institutional framework required to nurture and expand start-up ecosystems, fostering a favorable climate for post-incubation scaling and commercialization (Rosado-Cubero et al., 2024).

2.7. Critical Perspectives on the Entrepreneurial University

Despite the growing popularity of the entrepreneurial university model, several scholars have raised critical concerns about its implications for higher education. One major line of critique is associated with the concept of academic capitalism, which describes the increasing tendency of universities to adopt market-oriented behaviors such as patenting, commercialization of research, and competition for external funding (Slaughter & Rhoades, 2004). From this perspective, universities are increasingly embedded within economic systems where knowledge is treated as a marketable commodity rather than a purely public good.

These developments are also discussed within the broader debate on the neoliberal transformation of universities, where higher education institutions are encouraged to operate according to principles of efficiency, competitiveness, and performance measurement (Giroux, 2014). While entrepreneurial activities can stimulate

innovation and strengthen university–industry collaboration, critics warn that excessive emphasis on commercialization may create tensions with the traditional academic missions of teaching, independent research, and public service.

Furthermore, scholars highlight the potential conflict between knowledge commercialization and academic autonomy, particularly when research agendas become influenced by market demand or funding opportunities (Mowery et al., 2015). Nevertheless, many researchers argue that entrepreneurial initiatives can coexist with academic values when universities carefully balance economic engagement with their core educational and scientific missions (Clark, 1998; Etzkowitz, 2003).

3. Methodology

To investigate the entrepreneurial transformation of Mouloud Mammeri University of Tizi-Ouzou (UMMTO), this study adopts a quantitative descriptive research design aimed at examining institutional transformation indicators related to the development of the entrepreneurial university model. The analysis relies on secondary institutional data and statistical indicators reflecting changes in entrepreneurial activities, innovation infrastructure, and university–industry collaboration mechanisms.

The research focuses on identifying structural trends and patterns in the evolution of entrepreneurial initiatives within the university context. To achieve this objective, quantitative data were analyzed using descriptive statistical techniques, including growth rate calculations, cumulative indicators, and trend analysis. Such approaches are commonly employed in institutional and policy-oriented research to examine organizational transformation processes.

The methodological approach was informed by both a comprehensive literature review and an empirical examination of institutional data from the Entrepreneurship Center of Mouloud Mammeri University in Tizi-Ouzou. Evidence from institutional reports indicates that the university has made significant progress in supporting project leaders by mobilizing the necessary resources to assist students in transforming innovative ideas into viable entrepreneurial initiatives. This reflects the growing effectiveness of the university's incubation and entrepreneurial support mechanisms.

Quantitative data were collected from official university records covering the period 2017–2025. These included annual reports, internal performance summaries, and project databases managed by the Entrepreneurship Center, the Development Center for Entrepreneurship (CDE), and the University Incubator. The dataset focused on key indicators of entrepreneurial activity, particularly the number of trained project holders per year and the number of graduating projects recognized as start-ups under Ministerial Decision No. 1275.

These variables provided a longitudinal perspective on institutional performance, enabling the identification of trends, turning points, and disciplinary patterns related to entrepreneurship development. Yearly growth rates and cumulative totals were calculated to assess the university's performance over time, while disaggregated data were used to compare results across different academic disciplines.

Although the study relies on descriptive institutional data, triangulation with policy documents and institutional reports enhances the reliability and contextual interpretation of the findings.

4. Results and Discussion

This section discusses and interprets the important findings about UMMTO's entrepreneurial transformation between 2017 and 2025. The findings are organized into four major themes: the institutional ecology, training and education, innovation performance, and policy dynamics. These themes reflect the analytical dimensions derived from the Entrepreneurial University and Triple Helix frameworks (Etzkowitz & Leydesdorff, 2025; Guerrero et al., 2016) and are supported by institutional data, policy documents, and performance indicators collected from university records.

4.1. Institutional Ecosystem: Building the Architecture of Innovation

Over the eight-year study period, Mouloud Mammeri University of Tizi-Ouzou (UMMTO) built a multi-layered business assistance system. This ecosystem is made up of three key structures: the Entrepreneurship Center (which focuses on raising awareness and capacity), the Development Center for Entrepreneurship (CDE), which provides coaching and technical support, and the University Incubator, which facilitates project review, start-up labeling, and patent registration. Complementary units, such as the University-Industry Liaison Office and the Technology and Innovation Support Center (TISC), assist with networking, commercialization, and intellectual property management.

These processes work together to generate what numerous university reports described as a "continuous pipeline" for translating ideas into marketable solutions. This institutional configuration contributes to the

establishment of a structured pathway that supports the transformation of ideas into entrepreneurial projects. Similar institutional arrangements have been identified in the literature as critical components of effective entrepreneurial university ecosystems. Such feedback is consistent with the findings of Clark (1998) and Rosado-Cubero et al. (2024), who contend that high internal coherence and alignment among support systems are required for effective institutional entrepreneurship. These mechanisms operate together to create a continuous entrepreneurial support pathway within the university. Students are progressively guided from training and project development to incubation and startup creation. This structured process strengthens the institutional capacity to transform innovative ideas into entrepreneurial initiatives.

4.2. Entrepreneurial Education and Student Engagement

UMMTO has also achieved great progress in entrepreneurship education, both in size and quality. Quantitatively, the number of trained project holders increased from 69 in 2017 to 186 in 2018, with yearly participation rates stabilizing at around 180 by 2024. This more than 160% growth illustrates that entrepreneurship has evolved into a long-term and institutionalized offering, rather than a one-time activity.

Figure 1 depicts the number of project leaders taught by the UMMTO incubator from 2017 to 2022. The results demonstrate considerable fluctuations over a six-year period. In 2017, the incubator taught 69 project leaders, which climbed dramatically to 186 in 2018, indicating a period of growth and increased interest in entrepreneurship support programs. However, in 2019, there was a significant decrease to 42 trainees, which could indicate either a stabilizing phase or diminished financing and involvement.

In 2020, only 16 project leaders were trained by the UMMTO incubator, marking the most dramatic reduction. This decline is directly related to the COVID-19 epidemic, which affected educational and entrepreneurial operations globally. Restrictions on meetings, institutional closures, and general uncertainty hampered the incubator's capacity to provide training and support sessions. Participation declined dramatically as a result of the cessation of in-person workshops and the general slowdown in academic involvement.

By mid-2021, the incubator had reacted by moving the majority of its programs to digital platforms like Zoom, Google Meet, and Moodle. This changeover allowed for a small rebound, with 36 project leaders training that year. The transition to online formats was largely favorably received because it increased accessibility and reduced logistical obstacles, especially for students from remote places. However, by 2022, the number had decreased to just 10, indicating persisting post-pandemic issues. These most likely included low motivation, financial constraints, and long-term economic impacts that deterred future project initiators. Despite efforts to adjust, the data indicate that the incubator has not yet regained its pre-pandemic speed.

UMMTO's training activities have expanded beyond students to include academics and administrative personnel, introducing them to innovation management and intellectual property procedures. This comprehensive, university-wide strategy exemplifies Fayolle and Torrès (2011) institutional learning model, in which entrepreneurship is integrated into governance, education, and service roles. According to international research, hybrid and experiential learning approaches boost entrepreneurial self-efficacy (Panakaje et al., 2024) and are especially successful in reviving entrepreneurial momentum following disasters. UMMTO's adoption of these measures has been critical to its post-crisis recovery efforts.

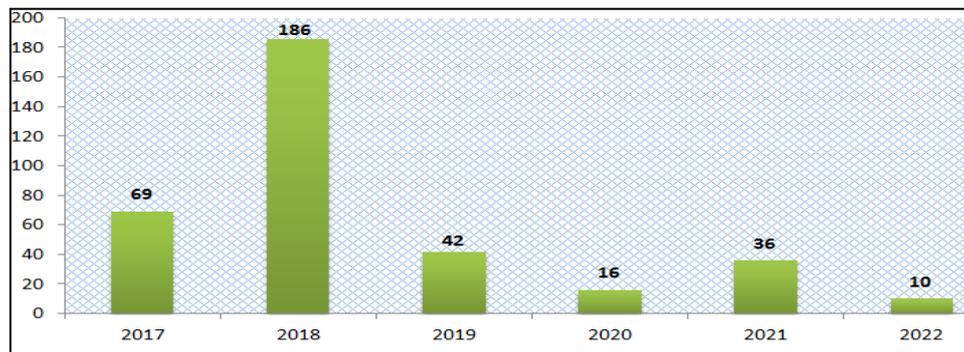
Furthermore, Rosado-Cubero et al. (2024) found that leadership commitment and a clear institutional vision are more important determinants of incubator success than initial financial investment. UMMTO's ecosystem exemplifies the Triple Helix concept, in which universities serve as critical links between government policy, academic research, and industrial demand (Etzkowitz & Leydesdorff, 2025).

Overall, the statistics show a favorable start followed by a pandemic-related fall, emphasizing the necessity of resilience and digital transformation in entrepreneurial support systems. Future measures for maintaining entrepreneurial momentum in the face of external interruptions could include remote training tools, online mentorship, and post-crisis rehabilitation programs.

4.3. Innovation Outputs: Projects, Patents, and Disciplinary Trends

In terms of measurable innovation performance, UMMTO showed both progress and setbacks. Between 2023 and 2024, the total number of innovation projects increased by 9%, indicating continued activity in project development. However, this period also saw a significant drop in start-up labeling (down 57%), as well as patent filings (73%). At first sight, this downturn appears to be a loss of momentum, but institutional reports and policy analysis provide a more nuanced interpretation.

Figure 1: Number of Trained Project Holders (2017–2025)



Source: Director of the UMMTO incubator (2022).

These delays created a backlog in patent processing, causing uncertainty and discouraging submissions. This explanation is corroborated by Abdelghani, and Amara, who documented similar trends across several Algerian universities and attributed them to “transitory institutional instability” rather than to weaknesses in university ecosystems.

Despite these regulatory barriers, UMMTO's portfolio contains some exceptional initiatives that demonstrate both subject diversity and social importance. Avia Detect, for example, use artificial intelligence to monitor chicken health in real time, thereby solving critical food security concerns. Genetoria creates fertility diagnosis kits that combine biological research with user-friendly healthcare solutions. EcoSmart Trash provides digital waste management platforms specifically designed for municipal governments. These examples show that UMMTO's ecosystem not only promotes start-up creation, but also in areas of national and regional strategic relevance (Schebesch et al., 2024).

Engineering and applied sciences remain the dominant disciplines. Between 2017 and 2024, technical faculty members were responsible for more than 51% of labeled projects. However, there are indications of increased participation from the life sciences, law, and humanities. For example, students from non-technical backgrounds created various projects centered on legal technology and environmental ethics. These patterns indicate a gradual expansion of the university's entrepreneurial base and are consistent with international calls for interdisciplinary innovation ecosystems (Guerrero & Urbano, 2019). Nonetheless, institutional reports and performance data indicate the need for additional support mechanisms for students and faculty from underrepresented disciplines. Suggested treatments included developing field-specific entrepreneurship tracks, recruiting cross-disciplinary mentors, and incorporating equity criteria into project selection and funding.

Table 1: List of Incubated Projects by Faculty

Project title	Faculty
-Mobility Networks and Embedded Systems -Location Dependent Service (LDS) -Large-scale Identity Management System Based on Heterogeneous Iris -Recognition (HIR) Using Deep Learning -Design of a Robot for Cleaning Photovoltaic Installations -Avia Detect: Detection and Classification of Farm Poultry Diseases Using Delaunay -Application for Employee Safety in the Workplace -Design of a Connected Electronic Bracelet for Locating and Monitoring Patients with Alzheimer's Disease -An e-commerce and digital marketing website-A digital guide to facilitate accessibility and enrich the user experience in airports. -Smart platform for the promotion and sale of local, sustainable and responsible products	Faculty of Electrical Engineering and Computer Science (FE ECS)
-Development of a Web Application for Real Estate Activity in Algeria -Online Real Estate Agency -Creation of a digital application to showcase and market Algerian bamboo products -Digital platform for legal services	Faculty of Law and Political Science (FLPS)
-Farm Nutri Tech: Use of ICT (Information and Communication Technologies) for Mastering the Nutrition of Dairy Cows -GENETORIA: Exploring Infertility and Developing a Multi-service Platform to Support Couples Seeking Parenthood	Faculty of Biological and Agricultural Sciences (FBAS)

-Study and Development of a Solar Distiller -Manufacturing by extrusion of specific composite filaments for 3D printing	Faculty of Construction Engineering (FCE)
-Development of a Digital Commercial Intermediation and Consulting Platform (INTER COM) -Digital Platform Dedicated to the Artistic Sector -A digital platform to optimize export operations -Online travel insurance website	Faculty of Economics, Business, and Management Sciences (FEBMS)
-A therapeutic digital program designed to support children with phonological developmental dyslexia	Faculty of Humanities and Social Sciences (FHSS)

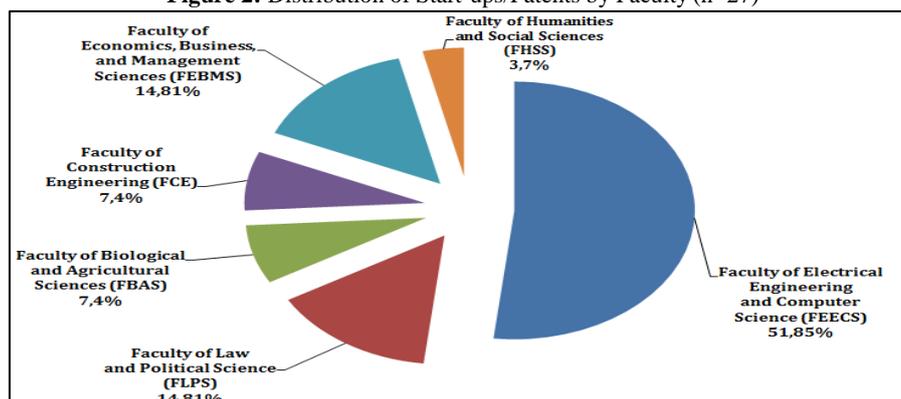
Source: Compiled by the author based on various readings and institutional data.

Table 1 presents a list of innovative projects developed at Mouloud Mammeri University of Tizi-Ouzou (UMMTO), organized by project title and linked faculty. The fostered projects come from a variety of areas, however the Faculty of Electrical Engineering and Computer Science (FGEI) is responsible for more over half of the listed activities. Examples include embedded system initiatives, deep learning-based identity management, robotics for photovoltaic maintenance, and health-focused products such as Alzheimer's patient wearables. This specialization emphasizes the university's strong technology and engineering culture within its innovation ecosystem.

Beyond FGEI, other faculties have made significant contributions. The Faculty of Biological and Agricultural Sciences supports initiatives such as Farm Nutri Tech, which uses information and communication technology to improve dairy cow nutrition, and GENETORIA, which investigates infertility using a multi-service digital platform to assist couples seeking conception. The Faculty of Law and Political Science produced projects such as an online real estate agency and a web application aimed at increasing real estate market activity in Algeria. Meanwhile, the Faculty of Economics, Business, and Management Sciences launched platforms in both commercial consultancy and artistic sectors, indicating the diversification of digital services in the entrepreneurial landscape. Other unique projects include a solar distillation project at the Faculty of Construction Engineering and a disease detection tool for poultry farming techniques.

To summarize, the UMMTO incubator creates a dynamic atmosphere in which young innovators from varied academic backgrounds may turn their ideas into real-world solutions. The importance of the Faculty of Electrical Engineering and Computer Science (FGEI) implies a strong foundation in applied sciences and engineering, although the presence of projects from other faculties reflects a growing interest in entrepreneurship in the social sciences, law, business, and biological sciences. The data also demonstrate the university's ability to promote both high-tech and socially responsible companies, establishing it as a prospective hub for regional development and innovation.

Figure 2: Distribution of Start-ups/Patents by Faculty (n=27)



Source: Compiled by the author based on various readings and institutional data.

4.4 Policy and Triple Helix Dynamics: The Role of Decree 1275

Ministerial Decision No. 1275, which debuts nationally in 2022, requires students to link their graduation projects to either a patent or a labeled start-up. This order was widely regarded at UMMTO as a pivotal point in the integration of academic programs and national innovation strategy. It established a regulatory incentive for

entrepreneurship, prompted institutional reform, and received backing from external groups such as the National Agency for Entrepreneurship Development (ANADE).

However, the decree's implementation exposed significant fundamental problems. Faculty and administrators expressed concerns about the labeling process's lack of procedural clarity, particularly in terms of evaluation standards and long-term monitoring. Students expressed concern about the administrative complexity of adhering to labeling rules while fulfilling their academic duties. As a result, some potential projects withdrew from the labeling process or postponed submission. These challenges are similar to those noted by Khoualed et al. (2024), who discovered that decree-based reforms at Algerian universities are frequently inconsistently enforced and lack enough institutional autonomy. Despite these limitations, UMMTO exhibited adaptive governance, as documented in institutional reports and policy records. The institution established an internal steering committee to oversee Decree 1275 implementation, created standardized project documentation templates, and held frequent collaborative discussions with policy stakeholders. These preemptive actions reduced some of the decree's ambiguities, resulting in more effective implementation. Institutional records indicate that the translation of national policy into regional practice was critical in maintaining credibility and student participation.

When seen through the lens of the Triple Helix concept, UMMTO's reaction illustrates beneficial interaction among university, government, and industry stakeholders. The institution served not just as a knowledge creator, but also as a facilitator of innovative networks. Its collaborations with ANADE, private-sector mentors, and local authorities resulted in a multifaceted support structure for early-stage businesses. Such patterns reflect what Etzkowitz and Zhou (2017) refer to as a "spiral dynamic," in which each helix strengthens and evolves through interaction with the others.

Conclusion

The change of Mouloud Mammeri University of Tizi-Ouzou (UMMTO) from a traditional academic institution to a forward-thinking entrepreneurial university exemplifies how public universities in developing nations can connect with national innovation goals. Over the 2017-2025 period, UMMTO established a structured and multifaceted business environment that included an Entrepreneurship Center, a Development Center for Entrepreneurship (CDE), and a University Incubator. These organizations provided entrepreneurial training, coaching, start-up incubation, and advice on intellectual property protection. This institutional design reflects international best practices and highlights how strategic internal alignment can help universities realize their "third purpose" of economic involvement and innovation (Etzkowitz & Leydesdorff, 2025; Guerrero & Urbano, 2019).

This study confirms that theoretical frameworks such as the Entrepreneurial University model and the Triple Helix model offer robust analytical tools for evaluating university transformation in resource-constrained settings. In UMMTO's case, the internal reorganization was aided by national policy instruments, most notably Ministerial Decision No. 1275, which gave legal incentive for linking graduation projects to start-up creation and patent development (Khoualed et al., 2024). The interplay of top-down policy support and bottom-up institutional innovation has allowed UMMTO to achieve tangible progress in terms of labeled projects, project holder training, and patent filings. However, the university's path has not been without obstacles. Administrative inefficiencies, such as delays in project labeling, inconsistent inter-institutional communication, and ambiguous regulatory procedures, have repeatedly slowed project execution. Limited financial resources have often hampered the expansion of promising ventures.

These findings are consistent with wider critiques in the Algerian innovation ecosystem literature, which identify governance fragmentation and underinvestment as systemic barriers (Abdelghani & Amara, 2024; Saoud, 2024). Furthermore, while the majority of classified initiatives originated in engineering and technology disciplines, there is still a need for stronger cross-disciplinary integration. Non-technical faculties such as humanities, law, and social sciences continue to be underrepresented in start-up production, implying that a more fundamental culture shift is required to entrench entrepreneurship throughout the institution. This disciplinary bias is not limited to UMMTO and has been seen in other Algerian institutions (Metaiche, 2024; Meziane, 2023). Finally, UMMTO's transformation indicates that public universities, especially in poor countries, may serve as incubators of innovation when supported by visionary leadership, strategic planning, and supportive policy settings.

The experience provides useful insights for other institutions in the Global South who want to migrate to more entrepreneurial models. Universities that want to play a significant role in national innovation systems must look beyond individual initiatives and integrate entrepreneurship into their institutional DNA.

This final section provides a detailed examination of the consequences of UMMTO's experience at the policy, managerial, and research levels. From a policy aspect, UMMTO's experience emphasizes the significance of

interministerial collaboration and cohesive governance frameworks. The successful execution of Ministerial Decision No. 1275, which, while pioneering in its desire to integrate academic outcomes with economic creation, requires coordinated efforts from the Ministries of Higher Education and Scientific Research, the Knowledge Economy, and Industry. Discrepancies in implementation timetables, overlapping administrative tasks, and unclear pathways for start-up validation have all led to project deployment delays, mirroring the difficulties raised by Nadjiba and Khadidja (2024) and Benali Reguieg (2025).

To eliminate these structural issues, a national coordination body or interministerial task force might be formed to track progress, award resources, and resolve regulatory obstacles. This would help to avoid duplicate efforts and allow a smoother transition from graduation project to business establishment. Furthermore, separate financing streams for the incubation and post-incubation periods are required. While most institutions, including UMMTO, can manage awareness and training, few have the means to give seed funds, legal help, or follow-up investment opportunities. According to Budac and Ilie (2024), the effectiveness of academic incubators is dependent on both post-graduation support and early training. Additionally, intellectual property laws and patent processing should be expedited. UMMTO's patent activity slowed substantially in 2024 due to regulatory delays in the new digital intellectual property platform. Without rapid, low-cost, and legally binding patent support, student and faculty innovators may abandon formal channels in favor of alternative, informal routes that limit scalability and validity (Sharma & Sejwal, 2025).

At the managerial level, university administrators must view entrepreneurship as a key role that is incorporated into strategy planning, faculty development, and student education. Institutional entrepreneurship thrives when norms and incentives are aligned with innovation objectives (Guerrero et al., 2016). Leadership support has been critical at UMMTO, but achieving scale requires greater integration across all academic disciplines. The next critical stages are to incorporate entrepreneurial courses into curricula and train professors in commercialization and start-up support. Partnerships with local enterprises, such as internships, innovation laboratories, and client engagement, can help start-ups succeed even more (Rosado-Cubero et al., 2024).

UMMTO's case provides various opportunities for future research. First, comparative studies might look at how Algerian universities are implementing Ministerial Decision No. 1275, taking into account characteristics like regional context and leadership style. Second, examining the long-term performance of student start-ups, using measures such as survival rates, job creation, and revenue growth, would provide more insight than labeling and patenting (Gulia et al., 2025). Third, the gender gap in academic entrepreneurship is understudied; understanding the barriers to women's participation could assist shape more inclusive legislation. Finally, the importance of digital tools in supporting start-ups to scale after incubation should be highlighted, especially as Algeria advances in smart technologies and e-governance (Schebesch et al., 2024).

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