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# A Proposed Model for Integration and Cooperation between University, Industry, and Government in Arab countries: Innovation Triple Helix Model

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**Abstract:** This research develops a proposed model for integration and cooperation between university, industry, and government in Arab countries using the innovation Triple Helix Model. The mixed-method approach with its quantitative and qualitative aspects is used to achieve the research objectives. The research sample consists of a sample of 51 experts from the university, government, and industry sector in the first round, and 30 experts in the second round. Among the results is that the research develops a proposed model for integration of the roles and aspects of cooperation between the university, industry, and government in Arab countries using the triple helix model of innovation consisting of (7) domains that include (183) roles for actors. The paper recommends that the Triple Helix Implementation Project shall be considered an Arab and national project, alongside the need for the League of Arab States to adopt an Arab innovation system to manage national innovation systems. The research also recommends spreading the culture of innovation at the national and Arab levels and accelerating the formation of policies, plans and strategies and issuing legislation related to the use of the triple helix.

**Keywords:** Arab Countries, Innovation, Triple helix, University.

## 1 Introduction

On the brink of the third millennium, Arab societies have faced a wave of comprehensive changes, developments and transformations due to the emergence of globalization, the technological and information revolution, the communications revolution and competitive pressures, development and innovation in the fields of production, economic changes and the shift towards a knowledge economy. Knowledge-based economies are the strongest and most dominant in the global economy today, as innovation is now a standard that determines the degree of progress of societies and one of the important factors for achieving sustainable development in all sectors. Recently, countries have witnessed a shift from sources of innovation confined to a single institutional domain, whether new product development in industry, policy making in government, or knowledge creation and dissemination in university, to the interaction between these institutional domains. This transformation is not only limited to

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different mechanisms for restructuring the sources and path of innovation in the field of innovation, but also rethinking the main models for conceptualizing innovation (Ranga & Etzkowitz, 2013).

University, industry and government represent three different contexts destined to reach an understanding. The need to clarify the relationship between these three different contexts is very important, as this has led academics to search for models that help facilitate this mutual relationship and design policies related to research, development, and innovation (Aghion et al., 2008; Fitriati et al., 2012). A helical-shaped model similar to the double helix of DNA is first presented by Leydesdorff and Etzkowitz at an academic conference in Amsterdam in 1996. This model allows combinatorial innovations to occur between the three main interconnected actors "university, industry, and government" (Gachie, 2020). This model has evolved from a statistic configuration model in which government is the dominant institutional sphere.

University and industry are parts of the state and have evolved into a laissez-faire configuration model in which industry, university, and government are separate and independent from each other. These actors interact with each other only modestly through strong boundaries (Cai, 2015; Etzkowitz, 2003). This model focuses on the driving force of industry to stimulate the establishment of a triangular relationship, with government and universities acting as secondary institutions for innovation through the current third model "a balanced configuration model" in which university, government and industry intersect and cooperate with each other (Etzkowitz, 2011; Larsen et al., 2018, Morrar et al., 2018; Morrar et al., 2017). Thus, shifting from strong boundaries between separate institutional domains to an overlapping, more flexible system with each assuming the role of the other is a significant step and process (Cai, 2015; Thornton et al, 2012; Ranga & Etzkowitz, 2013).

Although the state controlled both the university and industry, there were no cooperative links between the university and industry at the same time, as the matter developed through the freedom of both the university and industry from government control. However, each of the three helixes works in isolation from the others. Later on, there became triple links between the university, government, and industry, in addition to bilateral links between each of the two helixs, thus addressing the imbalance in the performance of these fields in their traditional roles through the contribution of other fields in performing these roles, which leads to increasing the efficiency of the entire innovation system. Thus, this model brings together the three main actors "university, government, and industry" in promoting innovation instead of one or two actors as in the previous two models (Gachie, 2020).

According to Dzisah and Etzkowitz (2009), the dynamics of the triple helix is based on the following basic triple elements: the prominent role of universities in innovation on par with companies and government in a knowledge-based society, the collaborative relationship between the three basic institutional areas, and the helixes taking on the roles of others. The triple helix is an effective system in understanding innovation dynamics at the regional, national or international level because it provides a good framework for understanding the central inquiries in innovation processes, including identifying who the main actors are, what are the mechanisms of interaction between these actors, and what are the enabling conditions for the interactions (Cai & Amaral , 2021).

In terms of actors, the Triple Helix model focuses on university, industry, and government. However, it does not exclude other actors that are considered to be secondary players such as legal firms, intermediaries, and nongovernmental agencies (Cai & Etzkowitz, 2020). In each of the three main actor areas, a wide range of actors are also present. Among these actors are that a distinction is made between (a) individual innovators and institutions (b) R&D innovators and non-R&D innovators; and (c) "mono-domain" and "multi-domain" (hybrid) organizations (Ranga & Etzkowitz, 2013). Concerning the interaction mechanism and enabling conditions, the triple helix model is an interactive model consisting of overlapping institutional fields.

The spheres of university, government and industry actively interact with each other by taking on the role of the other and performing new ones while maintaining their traditional function, as organizations taking on non-traditional roles are seen as a major potential source of innovation in innovation (Yoon, 2015; Etzkowitz, 2008). The Triple Helix model emphasizes that the three sectors should mutually cooperate and that each sector should play some additional roles that the other two sectors already play (Etzkowitz & Leydesdorff, 2001). According to this model, the university, government, and industry work together and interact with each other, but each maintains its main role and distinct identity (Larsen et al., 2018). The model is formed through the fulfillment of the needs of the three helixes and the internal transformation phase, where each institutional field in addition to performing its traditional roles performs the roles of others.

In the same context, the next stage is increasing tripartite interactions between the three institutional fields and increasing interdependence between them and the emergence of intermediate or hybrid organizations that link these fields together and then institutionalization (Etzkowitz, 2003; Etzkowitz, 2011; Cai, 2015). As helix models emerge, a specific role for each field in supporting economic growth through innovation must be formalized (Cavallini et al., 2016). Also, the ideal triple helix model can only be expected to work efficiently through the

availability of sufficient and necessary enabling conditions such as the ability to create a knowledge base that has marketing potential (Ranga & Etzkowitz, 2013).

The ideal triple helix model cannot be expected to work efficiently except through the availability of sufficient and necessary enabling conditions, such as the ability to create a knowledge base that has marketing potential (Ranga & Etzkowitz, 2013). Other conditions are that the civil society shall be a launching platform for the three helix interactions (Etzkowitz, 2014; Cai & Lattu, 2022), the convening of helix representatives to overcome innovation gaps (Etzkowitz, 1993), and the availability of the seven logics identified by (Cai, 2015) as intangible conditions for the formation of an ideal triple helix.

The concept of the triple helix is based on the idea that innovation is the result of an interactive process involving different areas of actors where each contributes according to its institutional function, and therefore, this model is ideal for promoting innovation (Cavallini et al., 2016). Although innovation may arise in any of the three sectors, the most effective influence is to create a partnership between the three sectors in the innovation process, as the most appropriate environments for innovation are created at the intersections between the three institutional areas (Cai, 2015; Thornton et al, 2012; Ranga & Etzkowitz, 2013). The modern vision includes not only the natural dynamics of innovation but also the creative renewal that arises within each of the three institutional domains and at their intersections to achieve innovation.

Multi-field (hybrid) institutions operate at the intersection of the institutional fields of university, industry, and government, combine elements of each field in their institutional design, and represent the composition of the balanced model of the triple helix. These organizations are characterized by more permeable institutional boundaries and less centralized decision-making in order to increase flexibility and respond to changing market demands (Ranga & Etzkowitz, 2013). The Triple Helix System of Innovation is a new type of innovation that does not follow traditional paths and represents a radical departure from the traditional transfer of technology and knowledge. What distinguishes this system from other forms of innovation system is the evolutionary process underlying the relationship between the three institutional actors, capable of creating conditions for generating, exchanging and disseminating appropriate knowledge that is conducive to rapid learning and innovation and addressing emerging issues in the development of knowledge-based economies (Saad, 2004; Saad & Zawdie, 2005).

It is a developed model that provides an alternative perspective on the dynamics of innovation, showing a triple helix political network in which the three main actors - industry, university and government - interact in an evolutionary manner that allows for new sophisticated combinations (Leydesdorff & Porto-Gomez, 2019) because it is based on three actors that are intertwined in generating an innovation system (Etzkowitz, 1993; Etzkowitz &Leydesdorff, 1995). Triple helix relationships between university, government, and industry are indispensable conditions for promoting innovation (Etzkowitz & Leydesdorff, 2000).

The benefits of implementing the triple helix are numerous for all three key players, as it is beneficial for industry, which obtains financial support for its developments from the government and access to cutting-edge knowledge and skills from the university knowledge base (Fain et al., 2010). It is beneficial to the government because it enables it to support improvements and economic growth and advance its competitiveness in a global context (Ranga & Etzkowitz, 2013). It is also beneficial for the university because it increases its influence on policy through partnerships and builds its reputation within the economy by applying the knowledge produced within its programs and providing knowledge and technological support to the industrial partner (Etzkowitz, 2003).

Gachie (2020) also show a number of benefits from implementing the triple helix, including networking and access of universities to laboratories, equipment, and industry partners, translating scientific publications into commercial products and patents, and employing scientific research to develop new ways to deal with the country's challenges. Other benefits include developing a sustainable policy to deal with the issues of the three parties for sustainable national development, creating startups based on commercializing research, and providing a platform for exchanging mutually beneficial experiences to ensure a systemic paradigm shift for sustainable development.

The triple helix is an indispensable element of national and regional development in the era of knowledge economy (Etzkowitz, 2008) and a key to innovation and social and economic development (Ranga & Etzkowitz, 2013). It is also an internationally recognized model for understanding entrepreneurship and the changing dynamics of universities, innovation, and social and economic development, and an important driver of innovation and entrepreneurship (Kim & Yang, 2012, 154). The Triple Helix is an analytical framework for exploring the complex dynamics of the knowledge society and informing policy makers at national, regional and international levels in designing new innovation and development strategies (Etzkowitz, 2003). It is also a guideline for resolving analytical weaknesses in country-level innovation system approaches (Leydesdorff & Zawdie, 2010).

Accordingly, this has gained a great reputation as an integrated approach to improving the wealth of developing regions alike, and helping universities, governments and industries to play their assigned role in the regional and national development agenda (Saad, Zawedi & Malairaja, 2008). Also, the Triple Helix, which Itzkowitz called

"innovation in innovation," is a key concept guiding national and regional innovation policies around the world (Cai, 2015) and a policy tool to promote innovation (Brem & Radziwon, 2017; Gachie, 2020). Creating and strengthening linkages between various key actors in promoting innovation is extremely important for a prosperous economy (Bhutto & Lohana, 2018; OECD, 2018).

Strengthening these links increases the role of the university, government, and industry in generating new institutional forms in the production, transfer, and application of knowledge (Champenois & Etzkowitz, 2018). University, industry and government interact in an evolutionary way, allowing for innovative new recombination (Leydesdorff & Porto-Gomez, 2019). The model and its main innovation theory recognize the importance of the three components "universities, industry, and government" and their interaction in fueling innovation and promoting entrepreneurship (Afzal et al., 2018). The triple helix model in the government sphere emphasizes the supportive role of policymakers in promoting and facilitating innovation and entrepreneurship (Hertog, 2000) by setting regulations and rules supporting the launch and expansion of new projects, developing or adopting new innovations, and providing financial incentives supporting the development of innovation (Solesvik, 2017).

Companies and institutions in industry also act as drivers and catalysts in activating and mobilizing innovation (Lee & Miozzo, 2019), as commercial organizations obtain the required capital and approval from companies that support the launch of new research projects. Business companies also sponsor the launch of startups through financial, professional, or commercial support, or a combination of them (Sarpong et al., 2017), while the university represents the developmental role played by academic institutions in developing innovation (Samo & Huda, 2017). It represents a platform for discussing and achieving the goals and needs of government and industry (Nonaka & Toyama, 2003), helping actors and stakeholders discuss pressing issues and their proposed solutions in an environment that facilitates access to comprehensive knowledge (Teets et al., 2017), the university and other academic settings serve as a launching pad for innovation and entrepreneurship (Hellmann & Puri, 2002). Given the introduction about innovation Triple Helix Model, the literature review related to the issues previously raised is provided in the next section.

## 2 Literature Review

Pieces of research have recently documented the innovation triple helix model in various aspects and domains. Gachie (2020) explores and explains the nature of the presence or absence of collaboration between higher education institutions, industry and government in stimulating innovation within a broader understanding of the triple helix model within the national innovation system. A mixed-method approach is used to achieve the research objectives. The research sample consists of 12 heads of a research center in South Africa to explore the current state of the triple helix model and its potential weaknesses and propose corrective actions to legitimize a new framework in a real-world setting. It is concluded that the role of government within the model should be defined, cooperation between higher education institutions and the private sector should be strengthened through the application of the proposed new framework, improving the commercialization of research should be at the top of the Triple Helix policy agenda, and there shall be a coherent realignment of the model strategy to meet the changing needs and patterns of actors in a network where this can only be achieved between knowledgeable network actors.

Moreover, Mascarenhas et al. (2020) acquire new perspective on partnerships in the triple helix model, including the role of governments. A descriptive approach is used to achieve the research objectives. Using interviews with representatives of universities, companies and governments in two countries "Portugal and Spain", the research focuses on how innovation partnerships are formed and what obstacles can arise to cooperation. The findings show that governments can play not only the role of funder and legislator, but also the direct participant in innovation by entering into partnerships with other actors in the Triple Helix. It is also found that networks often operate with public funds regardless of the partners and needs involved.

Also, Souleh (2020) reveals the links between university and perceived industry within the framework of the triple helix model at the University of Biskra in Algeria. A descriptive approach is used to achieve the research objectives. A survey analysis is conducted from the point of view of a sample of 138 individuals from all university departments. It is found that the majority of the sample confirms no formal links with industry, but that the research population wants to create new links. In light of this, a set of recommendations is provided for academics and practitioners to activate and increase these links.

Besides, Yoda and Kuwashima (2020) investigate historical changes in university-industry-government collaboration in Japan using the triple helix framework. Japan is used as a case study to explore how regulation changes affect university-industry-government collaboration. The results show that collaborations have led to the development of university-industry-government relationships and the scope of collaboration is changing in response to reforms in regulations and laws.

On the other hand, Pique et al. (2020) analyze how leading Silicon Valley universities UC Berkeley, Stanford, and UCSF have evolved and adapted to new requirements, thus shaping the evolution of Silicon Valley. Quantitative and

qualitative data and changes occurring between 2007 and 2018 are used to achieve the research objectives. The findings show that a growing interest in entrepreneurship education and intense activity of technology transfer offices, increased interactions between universities and investors "business angels, venture capital funds, and corporate investors", and improved infrastructure specific for incubation and acceleration of business ideas.

Furthermore, Olvera et al. (2020) focus on UBC's key performance indicators, business needs and objectives of companies co-located in university science parks in Spain and Mexico. To identify university KPIs used by co-located companies and explore university KPIs and critical success factors for service providers, data are collected through online questionnaires. Online questionnaires are administered to companies in Spain and Mexico, with 14 semi-structured interviews conducted with service provider managers to explore UBC key performance indicators and success factors for service providers in both countries. Among the results developing two frameworks that include the university's key performance indicators, taking university and corporate perspectives into account: long-term goals, strategies and key performance indicators, in addition to key performance indicators for progress.

Additionally, Ahmed (2021) develops a proposed strategy based on the triple helix for managing innovation in Egyptian universities in light of Vision 2030. A descriptive approach is used to achieve the research objectives. A questionnaire is applied to (100) individuals working in innovation support, technology transfer and marketing offices in Egyptian universities. The results develop a strategy for managing innovation in Egyptian universities according to the triple helix model in order to contribute effectively to achieving Egypt's Vision 2030.

What is more, Prasetio et al. (2021) study the role of the triple helix in knowledge transfer and innovation systems. A descriptive approach is used to achieve the research objectives. The questionnaire is applied to a sample of 360 people selected through an interception and online survey approach. The results show that the triple helix consists of 3 variables directly related to knowledge transfer, as knowledge transfer is directly related to innovation systems. The results show that innovation systems can be formed early, starting with the university environment and good government policies. It is also concluded that dealing with the triple helix requires synergy and a special strategy to leverage knowledge transfer in order to create an innovation system.

Also, Tambos et al. (2021) analyze the perception of university actors at the municipal public university for the inter-institutional partnership. A qualitative approach is first adopted by mapping inter-institutional partnership networks through business-government-university agreements, alongside using a quantitative approach based on Rodrigues's research. The results show that the role of the university from the point of view of university actors is to provide teaching, research and guidance to produce and disseminate knowledge. There is also a lack of clarity among participants about whether the relationship between the university and the external environment may pose risks to the university.

Besides, Etzkowitz and Zhou (2021) deepen knowledge about technology transfer and academic entrepreneurship at Stanford University. The research appropriates a comparative case study approach through interviews, archival research and participant observation, conducted over the past 35 years. The results find that the self-regulatory ideology of entrepreneurship derived from serial entrepreneurs' successes is a cause of re-improvement. The results also show that faculty and students have harnessed the potential at Stanford with bottom-up initiatives, create support structures to bridge entrepreneurship gaps, and integrate research, teaching, and entrepreneurship. It is also found that the embodiment of the relationship between Stanford and Silicon Valley "university and region" has also brought about a broader academic transformation in the field of entrepreneurship, but different levels of external and internal support are needed for different types of regions and academics at different levels of technology transfer interests and capabilities.

Moreover, Khashaba and Khalil (2021) develop a proposed scenario for applying the triple helix model in developing countries as an entry point for building a knowledge economy by identifying the application of the triple helix model in the Chinese government's leadership style for the late situation. A descriptive approach is used to achieve the research objectives. It is concluded that the inability of developing countries to enter the knowledge economy is due to excessive focus on the first type of theoretical knowledge production, "research and theoretical teaching in the context of specialization." The research recommends following the Chinese government's leadership pattern for the late situation in applying the triple helix model so that it can shift towards a knowledge economy and establishing a center for studies of applying the triple helix model in Egypt to develop emerging companies, applied professional universities, and applied pioneering universities to enter and build the knowledge economy.

Likewise, Salomaa et al. (2021) explore how triple helix mechanisms can stimulate regional innovation systems in places that have not traditionally had a long history of collaboration. To achieve this aim, experiences from five regions with relatively sparse triple helix environments are studied to provide evidence of the ways in which universities have sought to play the role of honest broker to help address the difficulty that arises between partners with very different interests. 194 semi-structured interviews are conducted with academics, local authorities and relevant stakeholders. The research identifies several processes that enable universities to play this role, contributing to the densification of dispersed innovation environments,

increasing clustering and diversity while helping to address the tensions and problems that densification brings.

Besides, Maziri et al. (2021) examine the impact of university-industry-government relationship as a mechanism to improve the performance of SMEs. The quantitative research method is used to achieve the research objectives. A questionnaire is applied to a sample of 250 SME managers in the greater Johannesburg area in South Africa. The results find that SMEs' cooperation with universities, industry, and government agents has a positive and significant impact on product innovation. It is also found that there is a strong positive relationship between product innovation and business performance, as the association between the triple helix agents and business performance is significantly modified by product innovation.

Moreover, Quartey and Oguntoye (2021) reveal how the triple helix contributes to understanding and promoting industrial sustainability in Africa. A systematic review approach is used to achieve the research objectives. Thematic analysis of the triple helix literature reveals that despite current limitations, stakeholders can find common ground to leverage opportunities to improve innovation and knowledge-based manufacturing to achieve industrial sustainability. The thematic analysis also shows that maximizing enablers and minimizing barriers to the interconnections and interrelationships between universities, industries, governments and their intermediaries represents a useful starting point towards understanding and promoting industrial sustainability in Africa. The research recommends a conceptual model and research propositions to guide future research that seeks to clarify how key stakeholders within the triple helix framework can effectively contribute to social, economic and environmental well-being through industrial sustainability.

Also, Ben Chaouat and Kadri (2021) identify the efforts of the higher education sector in Algeria to move towards an entrepreneurial university. A descriptive approach is used to achieve the research objectives by presenting the three European education models: the Humboldtian, Anglo-Saxon, and Anglo-American model, the transition from Mode 1 to Mode 2 and Mode 3 in knowledge production, the trend towards an entrepreneurial university while clarifying the triple helix model, and presenting Algeria's efforts in this regard. The findings show that the higher education sector in Algeria tries to adapt to environmental transformations by creating a relationship with government agencies and industry to support graduates, instill the spirit of creativity and innovation, and push them to participate in social and economic development through university facilities within the framework of a cooperative relationship with government and industry.

On the other hand, Castro et al. (2022) analyze professors' perceptions of the possibilities and difficulties of university-market-government integration in the local context of Montes Claros-MG, Brazil. Mixed methods are used by collecting qualitative data through semi-structured interviews and collecting quantitative data using survey questionnaires. The study identifies four practical issues as important factors affecting the integration capacity between agents, namely the lack of institutional support to ensure legal stability, the need for external agents to pay attention to the activities carried out at the university, professors' motivations, and the importance of having an administrative technical structure capable of providing support.

Besides, Nikolaou (2022) develops an evaluation of higher logistics education in the Sultanate of Oman to identify evidence of innovation elements in implementing the sustainable development ecosystem in a higher education environment using the triple helix of innovation competencies. A qualitative inductive reasoning approach is used to follow up on data collection from stakeholders with the use of semi-structured interview and document analysis. It is found that there are varying levels of awareness among faculty members in the field of logistics. The findings that minimal incentives, lack of grants, and poor industry collaboration in providing internships limit students' industry experience. The results also find that international cooperation, internationalization, and freedom in substantive discussions are limited.

Moreover, Al-Hakim et al. (2022) develop a triple helix digital platform model in a product innovation ecosystem. Soft Systems Methodology (SSM) is selected to make proposed scientific contributions to knowledge management in the triple helix digital platform model, especially knowledge sharing in product innovation. Data are collected through literature review and interviews with one researcher and two SME owners. It is found that a conceptual model and prototype are needed for designing a digital platform with a strong foundation for innovating knowledge sharing products in the digital platform ecosystem.

Further, Yang (2022) develops a triple helix model of doctoral education based on existing literature with a case study of a doctoral training center sponsored by the Engineering and Physical Sciences Research Council in the United Kingdom. The research appropriates document studies and observation as tools to study the roles of university, industry, and government and their interactions in doctoral education. The results find that universities provide specialist, interdisciplinary and professional training for doctoral students, industry offers opportunities for research, training, research grants and placements, and governments stimulate cooperation between universities and industry through support policies and grants, as universities, industry and governments benefit from these

interactions. The research recommends the need to develop curricula, supervision and match research projects from industry with the research interests of doctoral students and research findings located in the boundary spaces of the triple helix model of doctoral education to develop the industrial doctorates.

What is more, Murillo-Luna & Hernandez-Trasobares (2023) examine the potential synergistic effect of collaboration between firms and key agents of the triple helix "university, industry, and government" on corporate eco-innovation. A broad sample of Spanish companies from different sectors "38,269 observations" is analyzed over a 9-year period. The results show a synergistic effect of collaboration on eco-innovation, as collaboration between firms and key agents of the Triple Helix approach, individually or jointly, increases the likelihood of firms' eco-innovation. The results also indicate that the greater the number of agents, the greater the possibilities for environmental innovation for companies, as the effect of cooperation on environmental innovation for companies depends on the type of agents.

Additionally, Wang (2023) calculates the peer coordination score of the triple helix in China from 2010 to 2020 by constructing a triple helix evaluation index system covering 3 first-order indicators and 32 second-order indicators, analyzing the temporal change trend and spatial regional differences, and discussing the overall influencing factors. The results find that the coordinated development of government guidance, industrial innovation and scientific research subsystems is low, as the peer coordination of the triple helix has been improved but is still in a state of moderate imbalance. The findings also show that the level of formation, market demand, economic development, openness to the outside world, and the level of urbanization are the main factors affecting peer coordination of the triple helix of the unit "university - industry – government", but these factors have heterogeneous effects on different regions.

Similarly, Noya et al. (2023) reveal the relationship between the triple helix innovation ecosystem and SME performance and the role of the SME community as a mediator between them. The quantitative approach is used by administering an online questionnaire to a sample of 386 SME managers and SME community members in Malang District, East Java, Indonesia. The results find that the triple helix ecosystem is collaboration between government, large companies, and universities, and that triple helix ecosystem innovation is positively and significantly related to SME performance. The findings also show the SME community partly mediates the relationship between them and the SME community plays a strategic role in the triple helix agents' intervention process to improve SME performance.

In the same context, Moreira and Macke (2023) provide a framework to guide the smart city through the triple helix of innovation. A semi-structured questionnaire is applied with 12 interviewees in four project initiatives using ICT in Porto Alegre and Caxias do Sul RS. The research finds that city government lacks defining visions for the city, solving real problems, and developing public policy to include these visions. It is also found that smart city companies emphasize leveraging knowledge for the smart economy, business environment and supporting institutions, and high-tech industry. Universities also have contributed to smart city projects by making cities clean and green through skilled human resources.

Moreover, Flechas et al. (2023) analyze the influence between actor characteristics on startup ecosystem quality from a global perspective. To achieve this objective, cross-sectional data for 35 countries between 2017 and 2018 are studied. It is also found that each element of the triple helix alone does not positively impact the quality of the startup ecosystem. Also, analyzing the actors jointly by constructing a second-order latent variable, i.e. the triple helix shows that constructing the triple helix has a positive impact on the quality of the startup ecosystem.

Also, Liche and Střelcová (2023) reveal the gap in how Addis Ababa University of Science and Technology and Adama University of Science and Technology evaluate the technology development process and how can the current approach to catalyze triple helix reactions is improved? To achieve this objective, insights from Organizational Control Theory (OCT) and the Context, Input, Process, Product (CIPP) evaluation model of the Triple Helix framework are integrated into the qualitative case study design. The research finds that the current approach combines outcomes-based and behavioral assessment, which limits engagement with industry. The research recommends the necessity of adopting a more comprehensive evaluation system based on common goals, involving industry as external stakeholders, and relying on people, as a path to the triple helix.

In addition, Ferdinands et al. (2023) understand the innovation environment in a developing country "Sri Lanka" through the triple helix model and reveal the interrelationships that exist between the three helices of academia, industry and government and their impact on the most important stage in the innovation process through marketing patent and ensuring the differential impact is determined by patent ownership. A survey method is used to collect the opinions of 220 registered patent holders in Sri Lanka classified according to organizational and individual ownership. The results show a weak correlation between academia support, industry support, and the commercial success of patents. However, government support for the helix is not important in the commercial stage, and there are two different support standards in each helix for the two ownership groups. With this review in mind, there is a dire need to conduct studies to propose a model for integration and cooperation between university, industry, and government in Arab countries using innovation triple helix model.

## 3 Research Problem

Innovation is the key to growth and economic progress of countries in a knowledge-based economy (Han, 2017). Developed countries have recognized the important role that innovation plays in adding value to the country's products and processors, investing heavily in research and development to build an innovative ecosystem that supports the country's industries (The Global Economy, 2022). Concerning the Arab countries, Issa and Al-Mahjoubi (2020) demonstrate that the Global Innovation Index for 2019 indicated large gaps between Arab countries in addition to the gap between them and developed countries in this field. For example, there is a clear decline in the index of companies' spending on research and development, as statistics indicate that 89% of spending on research in Arab countries comes from government sources.

Integration between national innovation systems must be encouraged to form an integrated Arab system for innovation, higher research on innovation, and coordination and cooperation between university education institutions and companies in the field of research and development. Arqoub et al. (2021) indicate that the level of comprehensive innovation in Arab economies is relatively weak and needs to be improved and developed due to the weak efficiency of their innovation systems. Also, it represents an important challenge for all Arab countries to ensure their scientific, cognitive and technological independence to enhance their chances of getting rid of economic dependency on the leading countries.

In the same course, Annan (2018) points out the weakness of innovation in Arab countries as a result of the weakness of the necessary infrastructure for communications and information technology, and the shortage of the connection between research and development institutions and the outputs of higher education and what is required by the production sectors, especially the knowledge sectors. Other problems are that higher education suffers from the weakness of keeping its approved policies in line with the human capital requirements necessary to establish a base for knowledge industries that are comparable to developed countries, the absence of a culture of knowledge production and localization in Arab countries, and reliance on purchasing production capabilities from developed countries. Therefore, Arab countries must build a national innovation system and strengthen the relationship between companies, research centers and universities that cooperate with each other to benefit from and attain scientific knowledge adapted according to local needs based on knowledge-intensive industries.

As noted by Abdel-Lawi et al. (2020), weak Arab innovation systems are due to many obstacles, including low spending on research and development, weak institutional support, and the political and social context that conflicts with the development and promotion of science in Arab countries. Therefore, it is recommended that building a competitive advantage through innovation and productivity requires reducing economic policies by Arab countries based on comparative advantage based on natural resources and factor intensity, and make long-term investments in education. Other recommendations include amending educational policies so that the education system becomes more oriented towards developing research and development and making scientific research outputs serve the economic and social environment, developing the capabilities to innovate and deal with innovative outputs, and modernizing the information infrastructure with an economic environment conducive to market transactions.

Also, Romali et al. (2018) also point out that there is a clear deficiency in the reality of government innovation in Arab countries. However, AbdelRahman and Arqoub (2019) show a weak level of innovation in Arab business organizations, lack of reliance on effective innovation management systems, a weak level of economic performance for Arab business requirements, the absence of a strategy for activating the role of business organizations in achieving economic development, and weak interest in the research and development process in these organizations. Therefore, the study recommends adopting and approving effective innovation management systems in Arab business organizations.

It is also noted that the delay of Arab universities in international rankings is due to a number of reasons, including weak spending on scientific research, the loss of scientific talents abroad "brain drain", the absence of the role of the private sector in supporting scientific research, and the absence of national policies, strategies and plans for scientific research, which led to the weak contribution of higher education and scientific research systems to accelerating the wheel of development (Al-Sharif, 2020). Other reasons comprise the lack of an explicit text indicating sustainability outcomes within the standards for funding scientific research in Arab universities (Suleiman, 2022), the low number of qualified researchers, investment problems and the convictions of donors and the private sector, the shortage of faculty members' research published internationally, the weak independence of universities in education and scientific research, the decline in the level of curricula and study programs and their obsolescence, problems with intellectual property rights, the absence of a spirit of competition and creativity, and weak interest in scientific and technological studies (Fares, 2020).

Many development policies for Arab university education institutions, therefore, focus on transforming them into platforms for innovation and entrepreneurship that combine the implementation, innovation, and production of knowledge-based academic programs with being institutions that support the state's directions. They also center on economic and community development and integration with community institutions - especially those

concerned with development in the government and private sectors - to meet the requirements of economic growth and localization of work. Many policies also depend on redesigning universities and their programs so that they link intellectual assets and the labor market through managing innovation and entrepreneurship, maximizing the role of scientific research, and creating new industries that achieve global competitive sustainability (Mutawa et al., 2017).

A recent study by Al-Jawarin's (2017) recommends the need for Arab countries to allocate a budget for scientific research and encourage scientific research institutions to direct their research to solve the technological problems facing industrial institutions, establish scientific research centers with international specifications and provide them with appropriate financial support in order to be beneficial to scientific development and encourage innovation, and create effective communication channels between scientific research institutions and productive sectors. Annan (2018) indicates that in order for Arab countries to face the challenges of global changes, they must diversify their economies and develop the industrial base through knowledge-based industries. Arab countries must also build national innovation systems, strengthen the relationship between companies, research centers and universities to benefit from and gain practical knowledge, adapt it according to local needs, and enhance investment in human capital by developing its innovative skills and activating its role in the national economic system.

Moreover, Al-Dahdouh (2021) also recommends the necessity of making appropriate changes to the scientific research system in universities through strategic planning in line with the rapid transformations in the internal and external environments with the highest standards of excellence, competition, and quality through the universities' agreement with all sectors on a common work vision that establishes steadfastness, challenge, and survival. Other steps include modernizing the structure of scientific research in an integrated manner and localizing electronic technology, establishing and equipping laboratories, developing creative capital through discovering, nurturing and empowering creative people, enhancing local and international cooperation and partnership, and focusing on the intellectual, creative and skill aspects of educational curricula.

Altogether, creating and maintaining a knowledge-based economy is an extremely difficult task, and this requires, first and foremost, building a real innovation ecosystem (Nikolaou, 2022). On the other hand, a useful framework for evaluating the ongoing interactions between these three players stems from the triple helix model of innovation (Figueiredo et al., 2023). The concept and benefits of the Triple Helix are generally discussed within innovation frameworks (Champenois & Etzkowitz, 2018). The triple helix theory provides an analytical framework and method for studying the relationship between innovation actors at the system level (Strand et al., 2017). It focuses on three powerful social systems in socio-economic development: university, industry and government, which make innovation, entrepreneurship and economic growth possible in a knowledge-based society (Cai & Lattu, 2022).

The triple helix theory is the first innovative approach through the role that universities play on an equal footing with industry and governments in encouraging innovation. Governments that do not rely on excessive governance focus on creating effective and dynamic mutual relationships between the actors in the helix. It encourages the creation of strategic alliances between companies and universities through targeted policies. Applying this concept helps them overcome obstacles in their relationships, promoting innovation and collaboration on important technologies and products in the future (Etzkowitz, 1995). It is supportive of the development of a sustainable innovation system, especially since knowledge management involves complex problems that cannot be solved with a single variable (Luengo-Valderrey et al., 2019; Villarreal & Calvo, 2015).

Sustainable innovation projects can use the triple helix model to accelerate and implement these innovations (Prasetio et al., 2021). It provides an appropriate framework that views these actors as more about how to increase knowledge or how to shape a sustainable innovation system (Newel et al., 2017). It plays an important role in developing innovation policies that focus on developing knowledge transfer, as coordinated work between government, universities and industry helps in developing types of innovation policies that integrate the views and interests of different parties (Prasetio et al., 2021).

Likewise, this model reflects the shift from the industrial society in which bilateral relations between industry and government prevail to the knowledge society characterized by the tripartite relationship between the university, industry and the government. The hybridization between elements of university, industry, and government institutions creates new institutional and social forms of knowledge production, transfer, and application that provide innovation and economic development in the knowledge society (Ranga & Etzkowitz, 2013; Etzkowitz, 2008). Therefore, it is neither wrong nor exaggerated to say that actors in the triple helix model play a crucial role in creating an entrepreneurial community (Fidanoski et al., 2022).

The triple helix has therefore emerged as an important concept in the literature, being widely promoted as a mechanism used by countries to build and sustain innovative economies and thus generate greater economic benefits (Bartoloni et al., 2022; Sa´ et al., 2019; Zhang et al. al., 2019). The triple helix of interactions between universities, industry, and government has become widespread in studies of innovation and entrepreneurship in knowledge-based society (Cai & Etzkowitz, 2020). The Triple Helix approach aims to help researchers understand

the connections between universities and their surrounding areas because it brings together the idea between government and private actors through mutual collaboration on resources, needs, and mixed solutions (Brem & Radziwon, 2017).

Therefore, the triple helix model has been commonly used in the field of innovation, entrepreneurship, and higher education research as a framework for understanding the interactions between key actors in different innovation systems because the triple helix relationships between academic, industry, and government relationships are indispensable conditions for promoting innovation and growth (Malik & Wickramasinghe, 2015). Feola et al. (2017) point out that according to the literature, there is now a clear justification for resorting to the triple helix model to describe the relationships between academia, industry and government, as regional development theories emphasize that the strongest links are between universities, business and government, in addition to specific local activities such as capital growth, local technology transfer and networking that together lead to better overall outcomes.

The Triple Helix is one of the systems that have the right mechanisms that can stimulate regional innovation systems in places that have not traditionally had a long history of cooperation (Salomaa et al., 2021). It also allows many countries to improve and accelerate their innovation processes to increase their competitiveness, face ongoing global economic changes, and develop countries that are undergoing a transition towards innovation-based economies, as it represents a tool to accelerate this transformation (Afzal et al., 2017). The triple helix model also gives a deeper understanding of the relationships between university, industry and government in shaping the national innovation system (Etzkowitz & Leydesdorff, 2000), thus emphasizing the necessity of interaction between universities, industry and government for these fruitful patterns of flows between actors.

These three types of flows require specific policies and resources to ensure the effective functioning of a strong national innovation system. Therefore, the triple helix phenomenon has been recognized at the level of developed and developing countries (Maziriri et al., 2021). The triple helix has been used in developing countries to encourage economic and social development based on knowledge creation (Saad & Zawdie, 2011). The development of the Triple Helix model requires prior structuring and coordination (Cai & Etzkowitz, 2020), but the interaction between actors in the Triple Helix is difficult to manage because it requires the activities of multiple and disparate sectors within complex subsystems (Jovanović et al., 2020).

Still, there is a question about how to better manage Triple Helix interactions in order to improve the effectiveness and efficiency of the innovation ecosystem, which requires evaluating the performance of Triple Helix actors (Dankbaar, 2019). As confirmed by Vivar-Simon et al. (2022), cooperation between universities, companies and government is still low, and therefore, it is necessary to develop research projects and tools to enhance this cooperation. Against this, the research problem is reflected in answering the following questions.

- What are the elements of the proposed model for aspects of integration and cooperation between university, industry and government in Arab countries using the innovation triple helix model from the perspective of experts?
- What are the guarantees of the success of the proposed model for aspects of integration and cooperation between university, industry and government in Arab countries using the innovation triple helix model from the perspective of experts?
- What are the obstacles to the success of the proposed model for aspects of integration and cooperation between university, industry and government in Arab countries using the innovation triple helix model and methods to overcome them from the perspective of experts?

## 4 Research Significance

This research significance is reflected in the fact that this research coincides with the trends of Arab countries, their sustainable development visions, and their plans to shift towards a knowledge-based economy. It is also lies in enriching Arab libraries with scientific information about the triple helix model, the requirements for achieving it, and the roles of the three main actors “university, industry, and government” involved in it. This paper can contribute to increasing the awareness of policy makers, decision makers, and officials about the significance of adopting the triple helix model in developing the innovation system in Arab countries.

Hopefully, the research results and the proposed model can contribute to assisting decision makers and decision-makers in Arab countries in developing plans and strategies to build an Arab and national innovation system in which the integration of roles and aspects of cooperation between the university, industry and government in developing innovation according to an Arab and national agenda is maximized, taking into account the guarantees and requirements for its implementation and acceleration in addressing and confronting the obstacles and challenges facing it.

Also, this study helps officials in Arab countries develop the national economy in their countries, transform industry

into innovative industries, and transform universities into entrepreneurship universities under the umbrella of the government that integrates the roles of each of them. It is hoped that this study will be a starting point to open new horizons for researchers in conducting other studies in which other variables are added and linked to the triple helix model. The current study may also address many of the problems facing the industry, government, and university sectors, and thus the Arab economy in general. It is hoped that this study can employ study tools to diagnose the reality of the industry, government and university sectors in light of this trend and develop the necessary plans and strategies for implementing the triple helix in Arab countries in light of the integration between their roles.

## 5 Research Terms and Definitions

In this paper, the terms "Triple Helix" is mentioned, and its procedural definition is as follows:

The triple helix is defined as an analytical construct that synthesizes the key features of university–industry–government (Triple Helix) interactions into an innovation system' format, which is defined according to systems theory as a set of components, relationships and functions (Ranga & Etzkowitz, 2013). It is a model that shows the dynamic interaction between the university, government and industry, where the government sets policies and industry and the university interact continuously. It is also considered one of the most important models that describe the processes of transferring knowledge and the interactions that take place during its transfer (Ibrahim, 2015).

On the other hand, Yoon (2015) defines the Triple Helix model as an interactive model consisting of overlapping institutional fields, where the institutional fields of university, government, and industry actively interact with each other by performing their traditional functions and taking on the role of the other. The university assumes innovation and entrepreneurship functions, in addition to its traditional role as a provider of human resources and basic research, while industry provides its own training and research at senior levels. However, the government helps in changing the regulatory environment and direct or indirect financial assistance, such as providing investment capital to help start new projects.

Procedurally, the triple helix model of innovation can be defined in this research as an innovation-focused model. The triple helix model of innovation consists of a set of components that define the roles of each main actor, i.e. university - government – industry unilaterally and the roles of each actor with the other two actors in bilateral and tripartite interactive and cooperative relationships in order to perform a set of functions "government - industry, government – university, and university-industry-university-industry-government representatives" to promote national innovation. It is measured procedurally by the proposed degree of these desired roles through the answers of experts from university faculty members and experts from the governmental and industrial sectors to the questionnaire items related to the roles and cooperation of actors in the triple helix model, i.e. individual - bilateral – triadic".

Moreover, the questionnaire consists of the following seven domains: roles of the government, roles of the university, roles of industry, roles and aspects of cooperation between the government and industry, roles and aspects of cooperation between the government and the university, roles and aspects of cooperation between the university and industry, and roles and aspects of cooperation between university representatives, industry and the government.

## 6 Research Limitations

The findings of this research can be generalized in light of the following limitations:

1. Objective Limitations: This research is limited to developing a proposed model for integration and cooperation between university, industry, and government in Arab countries using the innovation Triple Helix Model
2. Human Limitations: This research is limited to a sample of experts from faculty members in universities, industry, and government in Arab countries
3. Spatial Limitations: This research is conducted in in Arab countries
4. Temporal Limitations: This research is conducted in the first semester of the academic year 2023/2024.

## 7 Method

**Research Approach**

A mixed-method approach with its quantitative and qualitative aspects is used to achieve the research objectives. Its tools are a questionnaire and semi-structured interviews with some experts in universities, industry, and government in the Arab countries who have experience in projects related to the use of the triple helix to identify the dimensions and elements of the proposed model, and the aspects of integration and cooperation between the university, industry, and government in the Arab countries in light of the triple helix model of innovation.

**Research Population & Sample**

The research sample consists of 51 experts, i.e. 21 experts from faculty members in Arab universities, 15 experts from industry, and 15 experts from government departments. After adding the experts' suggestions to the open question in the initial form of the questionnaire, the final form of the questionnaire is reviewed by the same previous experts, but only 30 of them answered the questionnaire, 13 experts from university faculty members, 8 experts from industry, and 9 experts from government departments. These experts

are selected to conduct a semi-structured interview after completing the proposed model to establish the necessary guarantees for the success of the model, its obstacles, and methods to overcome them. All experts are selected to cover the majority of the Arab university, industrial and governmental sectors and have experience in innovation institutions, hybrid institutions and projects related to the triple helix.

**Research Instrument**

A closed-open 135-item questionnaire covering 7 domains is developed to identify the roles and aspects of cooperation expected from the main actors in the triple helix, and the joint or individual roles and aspects of cooperation in bilateral and trilateral interactions, along with an open question at the end of each domain that reads "Do you have other suggestions that can be added?" so that the experts can add their suggestions. The said questionnaire is developed using the following theoretical literature and previous studies (see for example, Ibrahim, 2015; Hajhamad, 2017; Gachie, 2020; Souleh, 2020; Ahmed, 2021; Khashaba & Khalil, 2021, Wang, 2022).

The questionnaire is then presented to the competent validators, where a five-point Likert scale is adopted, as five levels are specified for the questionnaire to clarify the degree of agreement: (5) very high, (4) high, (3) medium, (2) disagree, (1) totally disagree. A semi-structured interview is also conducted with a number of experts after they complete validating the final form. It is presented to them 10-15 days before the interview to establish the necessary guarantees for the success of the model, the obstacles to implementing this model and methods to overcome them.

**Research Instrument Validity**

**Face Validity**

Face validity is used to check the research instrument validity by reviewing the questionnaire in its initial forms from (17) experienced and specialized faculty members in universities and officials in industry and government in the Arab countries. The comments, modifications, and recommendations proposed by the validators are taken into account, as the items have obtained an approval rating of (80%) or more. The necessary action is taken with the items suggested to be deleted, modified, or reformulated, and thus the questionnaire in its final form consists of (135). This method is suitable for checking the face validity of the questionnaire, that is, its items can measure what they are set to measure.

**Internal Consistency Validity**

By applying the questionnaire to a survey sample of (21) faculty members in universities and officials in industry and government in the Arab countries., the correlation coefficient is calculated between the degree of each item with the total degree of the related domain as shown in Table (1).

**Table 1:** Correlation Coefficients between the Degree of the Item and the Total Score of the Related Domain.

| **University-Industry-Government** | | | | **University – Industry** | | **Government – Industry** | | **Government - University** | | **Industry** | | **University** | | **Government** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** | ***Correlation*** | **Coefficients** |
| 0.65 | 33 | 0.75 | 1 | 0.75 | 1 | 0.71 | 1 | 0.65 | 1 | 0.70 | 1 | 0.68 | 1 | 0.71 | 1 |
| 0.68 | 34 | 0.73 | 2 | 0.69 | 2 | 0.75 | 2 | 0.67 | 2 | 0.73 | 2 | 0.75 | 2 | 0.65 | 2 |
| 0.71 | 35 | 0.65 | 3 | 0.76 | 3 | 0.69 | 3 | 0.71 | 3 | 0.69 | 3 | 0.68 | 3 | 0.73 | 3 |
| 0.67 | 36 | 0.71 | 4 | 0.68 | 4 | 0.73 | 4 | 0.66 | 4 | 0.67 | 4 | 0.65 | 4 | 0.68 | 4 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.76 | 37 | 0.65 | 5 | 0.66 | 5 | 0.65 | 5 | 0.68 | 5 | 0.65 | 5 | 0.71 | 5 | 0.71 | 5 |
| 0.73 | 38 | 0.72 | 6 | 0.71 | 6 | 0.68 | 6 | 0.65 | 6 | 0.71 | 6 | 0.73 | 6 | 0.69 | 6 |
| 0.75 | 39 | 0.75 | 7 | 0.75 | 7 | 0.75 | 7 | 0.72 | 7 | 0.72 | 7 | 0.71 | 7 | 0.68 | 7 |
| 0.67 | 40 | 0.69 | 8 | 0.73 | 8 | 0.69 | 8 | 0.70 | 8 | 0.69 | 8 | 0.75 | 8 | 0.72 | 8 |
| 0.71 | 41 | 0.68 | 9 | 0.71 | 9 | 0.66 | 9 | 0.66 | 9 | 0.68 | 9 | 0.67 | 9 | 0.65 | 9 |
| 0.69 | 42 | 0.73 | 10 | 0.65 | 10 | 0.68 | 10 | 0.69 | 10 | 0.79 | 10 | 0.71 | 10 | 0.68 | 10 |
| 0.68 | 43 | 0.68 | 11 | 0.73 | 11 | 0.67 | 11 | 0.63 | 11 | 0.72 | 11 | 0.69 | 11 | 0.69 | 11 |
| 0.85 | 44 | 0.69 | 12 | 0.69 | 12 | 0.71 | 12 | 0.65 | 12 | 0.72 | 12 | 0.68 | 12 | 0.71 | 12 |
| 0.65 | 45 | 0.74 | 13 | 0.74 | 13 | 0.69 | 13 | 0.74 | 13 | 0.65 | 13 | 0.85 | 13 | 0.65 | 13 |
| 0.71 | 46 | 0.71 | 14 | 0.71 | 14 | | | 0.71 | 14 | 0.68 | 14 | 0.65 | 14 | 0.68 | 14 |
| 0.69 | 47 | 0.71 | 15 | 0.71 | 15 | | | 0.71 | 15 | | | 0.71 | 15 | 0.66 | 15 |
| 0.75 | 48 | 0.69 | 16 | 0.71 | 16 | | | 0.65 | 16 | | | 0.69 | 16 | 0.75 | 16 |
| 0.68 | 49 | 0.65 | 17 | 0.71 | 17 | | | 0.73 | 17 | | | 0.75 | 17 | 0.69 | 17 |
| 0.65 | 50 | 0.71 | 18 | 0.71 | 18 | | | 0.69 | 18 | | | 0.68 | 18 | 0.70 | 18 |
| 0.73 | 51 | 0.73 | 19 | 0.71 | 19 | | | 0.68 | 19 | | | 0.65 | 19 | 0.68 | 19 |
| | | 0.75 | 20 | 0.71 | 20 | | | 0.73 | 20 | | | 0.73 | 20 | 0.66 | 20 |
| | | 0.66 | 21 | 0.74 | 21 | | | 0.68 | 21 | | | 0.70 | 21 | 0.66 | 21 |
| | | 0.69 | 22 | 0.71 | 22 | | | 0.69 | 22 | | | 0.75 | 22 | 0.75 | 22 |
| | | 0.66 | 23 | 0.71 | 23 | | | 0.74 | 23 | | | 0.69 | 23 | | |
| | | 0.75 | 24 | 0.69 | 24 | | | 0.69 | 24 | | | 0.65 | 24 | | |
| | | 0.69 | 25 | 0.65 | 25 | | | | | | | 0.70 | 25 | | |
| | | 0.70 | 26 | 0.71 | 26 | | | | | | | 0.71 | 26 | | |
| | | 0.68 | 27 | 0.73 | 27 | | | | | | | 0.65 | 27 | | |
| | | 0.66 | 28 | | | | | | | | | 0.73 | 28 | | |
| | | 0.65 | 29 | | | | | | | | | 0.68 | 29 | | |
| | | 0.69 | 30 | | | | | | | | | 0.71 | 30 | | |
| | | 0.71 | 31 | | | | | | | | | 0.69 | 31 | | |
| | | 0.75 | 32 | | | | | | | | | 0.68 | 32 | | |

reformulated, and thus the questionnaire in its final form consists of (135). This method is suitable for checking the face validity of the questionnaire, that is, its items can measure what they are set to measure.

**Internal Consistency Reliability**

The research instrument reliability is checked by calculating the reliability coefficient by applying Cronbach's Alpha formula on all domains. The Cronbach's Alpha formula measures the extent of consistency in the respondents' answers to all the items in the questionnaire as shown in Table (2).

**Table 2:** The Reliability Coefficients of the Roles' and the Interactions' Questionnaire Suggested between the Main Actors in the Triple Helix in the Arab Countries

| Domain | Internal Consistency |
|---|---|
| **Government Roles** | **0.84** |
| **University Roles** | **0.87** |
| **Industry Roles** | **0.83** |
| **Cooperation between the Government and the University** | **0.85** |
| **Cooperation between Government and Industry** | **0.85** |
| **Cooperation between University and Industry** | **0.86** |
| **Cooperation between Representatives of Government-Led Actors** | **0.82** |
| **Overall** | |

As shown in Table (2), the reliability coefficients of the psychological capital instrument in Arab universities have ranged between (0.82) and (0.87), where the highest reliability coefficient is the university roles, while the lowest is cooperation between representatives of government-led actors.

**Statistical Processing**

The following statistical methods are used to answer the research questions and process the data statistically.

1. Means, standard deviations, ranks, and degrees are used to answer the first research question.
2. Cronbach's Alpha coefficient is used to find the internal consistency coefficient of the research instrument.

The degree of availability of the requirements is also determined by applying the following equation:

And by adding (1.2.33) to the Minimum Value of the alternative (the minimum); the criterion for expressing those levels is: the Mean ranging between (1-2.33) indicates a Low Degree, the Mean ranging between (2.34-3.67) indicates a Medium Degree, and the Mean ranging between (3.68-5) indicates a High Degree.

## 8 Results and Discussion

**First: Results related to the First Research Question**

**What are the elements of the proposed model for aspects of integration and cooperation between university, industry and government in Arab countries using the innovation triple helix model from the perspective of experts?**

To answer this question, the means and standard deviations of responses of faculty members to the roles' and the interactions' questionnaire suggested between the main actors in the Triple Helix in the Arab Countries are calculated. Table (3) illustrates those results.

**Table 3 :**Means, Standard Deviations, degrees, and Rank of the Required Degree of Roles and Interactions Questionnaire Suggested between the Main Actors in the Triple Helix in the Arab Countries.

| No. | Domain | Mean | Standard Deviation | Degree | Rank |
|---|---|---|---|---|---|
| **1** | **Government Roles** | **4.92** | **0.87** | High | **1** |
| **2** | **University Roles** | **4.87** | **0.81** | High | **3** |
| **3** | **Industry Roles** | **4.77** | **0.86** | High | **7** |
| **4** | **Cooperation between the Government and the University** | **4.80** | **0.90** | High | **6** |
| **5** | **Cooperation between Government and Industry** | **4.82** | **0.85** | High | **5** |
| **6** | **Cooperation between University and Industry** | **4.86** | **0.84** | High | **4** |
| **7** | **Cooperation between Representatives of Government-Led Actors** | **4.88** | **0.83** | High | **2** |

As shown in Table (3), the means of the study sample's approval on the proposed roles and interactions between the main actors in the triple helix in the Arab countries have ranged between (4.77) and (4.92) with a high degree**.** The highest domains in terms of means are government roles with a mean of (4.92), and the lowest domains are industry roles with a mean of (4.77). This confirms the sample's awareness of the importance of the proposed roles in activating the use of the triple helix model in Arab countries as a model that facilitates the mutual relationship between actors to facilitate the innovation process. The government's roles are in first place due to the centralization of the Arab countries and the state's dominance over policies related to universities and industry, and therefore its role is at the forefront in implementing this model.

Moreover, the university is the core of the triple helix process and the source of innovation and entrepreneurship. The relationship between the university and industry is extremely important and suffers greatly in Arab countries due to weak interests, loss of trust, and differences in interests. The relationship between the government and the university is ranked in the penultimate place, given that the government originally supervises universities through the ministries of higher education, while industry is ranked in the last place, given that its success in achieving innovation

Additionally, the questionnaire includes an open question for experts to provide their additions to each of the seven domains of the questionnaire. Some experts have added a number of additional roles in each domain: (8) roles in the first domain "government roles", (7) roles in the second domain "university roles", (3) in the third domain "industry roles", (7) ) roles in the fourth domain "cooperation between the government and the university", (3) roles in the fifth domain "cooperation between the government and industry", (7) roles in the sixth axis "cooperation between the university and industry", and (13) roles in the seventh domain "cooperation between representatives of government-led actors".

To ensure the consensus of experts on all proposals added individually or by a small sample of experts in answering the open question in the questionnaire, these proposals were added to the first form of the questionnaire, so that the questionnaire has (183) items distributed over (7) domains. The questionnaire is sent again to the experts, but only (30) experts responded, who are selected to conduct the semi-structured interview to establish guarantees of the success of the proposed model, its obstacles, and methods to overcome them. Tables (4-10) illustrate the experts' responses to the questionnaire after adding the suggestions

1. **Government Roles Domain**

**Table 4:** Means, Standard Deviations, degrees, and Rank of the Required Degree of Government Roles to Implement the Triple Helix in the Arab Countries.

| Text of the Item | AM | SD | Degree | Rank |
|---|---|---|---|---|
| Establishing and activating a national innovation system based on innovation. | **4.97** | **0.77** | **High** | **1** |
| Issuing the necessary laws and legislation to protect intellectual property, patents, copyrights, production, manufacturing, marketing and distribution of innovations. | **4.97** | **0.82** | **High** | **2** |
| Expanding the establishment of national and regional innovation centers and networks, i.e. scientific clusters, science parks and gardens, technology transfer offices, open innovation platforms, technology networks, networks of centers of excellence, business incubators and accelerators, alliances for innovation, and venture capital companies. | **4.97** | **0.85** | **High** | **2** |
| Providing logistical support and infrastructure for the Triple Helix application. | **4.96** | **0.84** | **High** | **4** |
| Launching a market-oriented economy approach. | **4.95** | **0.79** | **High** | **5** |
| Issuing legislation that creates a competitive environment in the market and prevents monopoly. | **4.94** | **0.83** | **High** | **6** |
| Providing national policies and legislation that support partnerships between the parties of the triple helix. | **4.94** | **0.85** | **High** | **6** |
| Launching and developing national strategic policies and plans for research, development and innovation. | **4.93** | **0.81** | **High** | **8** |
| Launching the National Innovation Forum according to an agenda consistent with the country's future plans. | **4.92** | **0.85** | **High** | **9** |
| Allocating flexible funding and incentives for major national and regional research and development projects. | **4.91** | **0.79** | **High** | **10** |
| Strengthening the role of national and regional innovation ecosystems. | **4.90** | **0.76** | **High** | **11** |
| Creating an environment and culture that supports entrepreneurship and innovation at the national level. | **4.88** | **0.78** | **High** | **12** |
| Issuing legislation regulating the movement of trade between the university and industry. | **4.87** | **0.79** | **High** | **13** |
| Issuing the necessary legislation to protect the environment. | **4.86** | **0.78** | **High** | **14** |
| Supporting fellowships and research grants. | **4.85** | **0.85** | **High** | **15** |
| Establish government-based intermediary organizations to support the implementation of the triple helix such as development agencies, funding agencies, research and technology organizations. | **4.83** | **0.81** | **High** | **16** |

| | | | | |
|---|---|---|---|---|
| Supporting the development of infrastructure for the commercial process of patents and facilitating their access to markets. | **4.82** | **0.86** | **High** | **17** |
| Ensuring that macro policies enhance the commercial potential of patents. | **4.80** | **0.78** | **High** | **18** |
| Coordinating and integrating the various efforts and strategies of different ministries through a network that supervises linking them and coordinating their efforts with other parties in the fields of research, business, and financing for the public and private sectors in the country. | **4.79** | **0.76** | **High** | **19** |
| Formulating an inter-ministerial innovation coordination unit to provide a clear innovation roadmap within each unit of the ministry and be responsible for monitoring and evaluating the government's efforts in innovation. | **4.78** | **0.88** | **High** | **20** |
| Designing a mechanism to coordinate the efforts of relevant ministries to achieve and monitor the achievement of knowledge, innovation and scientific research, a pillar of the sustainable development strategy. | **4.77** | **0.80** | **High** | **21** |
| Developing policies and programs on developing human resources for research and development at the national level. | **4.69** | **0.85** | **High** | **22** |
| Total roles of government | **4.88** | **0.82** | **High** | |

As shown in Table (4), the means of experts' approval on the government's roles "internal transformation" in the triple helix model have individually ranged between (4.69) and (4.97), with a high degree for all items, and an overall mean of (4.88), with a high degree. The highest item is the establishment of a national system for innovation because it is the incubator that will bring together the three parties and integrate them, while the lowest one is the development of policies and programs on developing human resources for research and development at the national level. This may be because the government alone may adopt these policies and needs other specialized bodies to help it in this regard, such as universities. However, in light of this centralization and government control over policies related to universities and industry, researchers consider this element no less important than the rest of the previous elements.

**2.University Roles Domain**

**Table 5 :** Means, Standard Deviations, degrees, and Rank of the Required Degree of University Roles to Implement the Triple Helix in the Arab Countries.

| **Text of the Item** | **AM** | **SD** | **Degree** | **Rank** |
|---|---|---|---|---|
| Preparing the appropriate academic structure for the university's commercial activity such as technology transfer offices. | **4.97** | **0.81** | **High** | **1** |
| Representing representatives from industry on university governing boards. | **4.97** | **0.84** | **High** | **1** |
| Helping researchers obtain the necessary funds to finance applied research and innovations. | **4.96** | **0.82** | **High** | **3** |
| Providing seed funding to conduct and commercialize market-oriented research and innovations. | **4.96** | **0.85** | **High** | **3** |
| Creating new companies based on researchers' research and innovations. | **4.95** | **0.82** | **High** | **5** |

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|---|---|---|---|---|
| Licensing patents based on technology. | **4.94** | **0.86** | **High** | **6** |
| Providing the offices, structures and competencies necessary to provide consulting services. | **4.93** | **0.79** | **High** | **7** |
| Providing evidence of conducting, supervising, and ethics scientific research. | **4.91** | **0.78** | **High** | **8** |
| Providing technology transfer and marketing through university-run institutions. | **4.90** | **0.82** | **High** | **9** |
| Linking university education curricula to technology and the requirements of the real business world. | **4.89** | **0.85** | **High** | **10** |
| Promoting investment in communication institutions and networks between the university and its social and economic environment. | **4.88** | **0.81** | **High** | **11** |
| Launching entrepreneurship and innovation programs and activities at all levels of education, research and community service. | **4.88** | **0.85** | **High** | **12** |
| Applying academic standards issued by the competent authority for quality assurance and accreditation. | **4.87** | **0.78** | **High** | **13** |
| Producing, disseminating and applying knowledge to create added value. | **4.87** | **0.83** | **High** | **14** |
| Providing high-quality human resources for research and development. | **4.86** | **0.79** | **High** | **15** |
| Focusing research activities on creating new technologies. | **4.85** | **0.85** | **High** | **16** |
| Providing legal entities and procedures for contracts related to research projects, training, patents and the use of shared resources. | **4.84** | **0.81** | **High** | **17** |
| Providing units of a special nature to provide funded services to industry and government. | **4.84** | **0.82** | **High** | **18** |
| Activating a strong and effective system of rewards and incentives for business and entrepreneurial activities at the university. | **4.83** | **0.75** | **High** | **19** |
| Spreading the culture of entrepreneurship and innovation at all university levels. | **4.83** | **0.80** | **High** | **20** |
| Integrating research-based education, market-based education and lifelong education programs. | **4.82** | **0.88** | **High** | **21** |
| Preparing regulations to regulate the relationship between the university and industry, and cooperation mechanisms between them. | **4.81** | **0.78** | **High** | **22** |

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|---|---|---|---|---|
| Training and dissemination of a culture of investment and marketing of scientific research results, transfer and licensing of technology, and negotiation with company owners and the industrial sector between faculty members and students. | **4.80** | **0.85** | **High** | **23** |
| Directing all university employees to benefit from the programs of national and international innovation centers. | **4.79** | **0.79** | **High** | **24** |
| Educating university employees about bodies interested in and funding research projects and creative ideas. | **4.78** | **0.81** | **High** | **25** |
| Developing plans to market the consulting services provided by universities to the industry sector. | **4.78** | **0.83** | **High** | **26** |
| Employing artificial intelligence technologies in all university activities and tasks. | **4.77** | **0.84** | **High** | **27** |
| Developing faculty members professionally includes all competencies related to applying the Triple Helix such as research competencies, use of teaching methods based on problem solving and research. | **4.76** | **0.81** | **High** | **28** |
| Developing incentive plans that focus on innovation and entrepreneurship. | **4.74** | **0.76** | **High** | **29** |
| Focusing on the activities of the third mission of universities, "Entrepreneurship University". | **4.73** | **0.84** | **High** | **30** |
| Participate in research, development and innovation networks and platforms, and launch their own platforms and networks. | **4.72** | **0.85** | **High** | **31** |
| Develop plans to introduce investors, businessmen and industry to scientific research, innovations and technology produced by universities. | **4.71** | **0.79** | **High** | **32** |
| Total university roles | **4.85** | **0.81** | **High** | |

As shown in Table (5), the means for experts' approval on the university roles "internal transformation" in the triple helix model have individually ranged between (4.71) and (4.97), with a high degree for all items, and an overall mean (4.85), with a high degree. This confirms the importance of these roles from the point of view of experts, as preparing the appropriate academic structure for the university's commercial activity is ranked in the first place, as it is an extremely important element for the university to take on the roles of industry in the event of industry delay and helps them to be universities of entrepreneurship and knowledge transfer.

However, developing plans to introduce investors, businessmen and industry to scientific research, innovations and technology produced by universities is ranked in the last with a high degree. This may be due to the belief of some experts that this element can be achieved implicitly in some of the previous elements. Yet, from the researchers' point of view, it will only be achieved by drawing up plans for this purpose.

**3 Industry Roles Domain**

**Table 6 :**Means, Standard Deviations, degrees, and Rank of the Required Degree of Industry Roles to Implement the Triple Helix in the Arab Countries.

| Text of the Item | AM | SD | Degree | Rank |
|---|---|---|---|---|
| Expanding the establishment and activation of science and technology parks, business incubators and other innovation centers. | **4.88** | **0.79** | **High** | **1** |
| Providing summer training programs to enhance innovation skills related to the labor market and new industries. | **4.87** | **0.77** | **High** | **2** |
| Establishing the necessary programs and mechanisms to improve production and innovation processes. | **4.85** | **0.83** | **High** | **3** |
| Expanding the establishment and financing of emerging industrial companies based on innovation. | **4.83** | **0.86** | **High** | **4** |
| Applying scientific and technological knowledge to create material value. | **4.82** | **0.82** | **High** | **5** |
| Producing and marketing new and innovative services and products. | **4.81** | **0.85** | **High** | **6** |
| Engaging in experimental development of services and products. | **4.80** | **0.77** | **High** | **7** |
| Providing research chair programs to develop scientific research in industry fields. | **4.78** | **0.80** | **High** | **8** |
| Providing a database on industry activities and related matters. | **4.77** | **0.86** | **High** | **9** |
| Increasing entrepreneurship capacity in the industry. | **4.75** | **0.77** | **High** | **10** |
| Providing access to investment capital and seed capital. | **4.73** | **0.78** | **High** | **11** |
| Allocating funds to support research and development. | **4.72** | **0.81** | **High** | **12** |
| Focusing on innovation and patents to give more business opportunities. | **4.71** | **0.85** | **High** | **13** |
| Defining the roles of market-based intermediary agencies in the triple helix such as lead companies , consultants, industrial and trade professional associations , and advisory capitalists | **4.70** | **0.79** | **High** | **14** |
| Total industry roles | **4.79** | **0.83** | **High** | |

As shown in Table (6), the means for experts' approval on the university roles "internal transformation" in the triple helix model have individually ranged between (4.70) and (4.88), with a high degree for all items, and an overall mean (4.79), with a high degree. This confirms the importance of these roles from the point of view of experts, as expanding the establishment and activation of science and technology parks, business incubators and other innovation centers is ranked first, as it is an extremely important element because they represent hybrid institutions in which the parties of the triple helix share to generate innovation and entrepreneurship. Defining the roles of market-based intermediary agencies in the triple helix such as leading companies, consultants, industrial and trade professional associations, and advisory capitalists is ranked last with a high degree as well. This may also confirm the importance of this element, but due to the centralization of the Arab countries, the government also intervenes in these institutions. However, in light of the desired trend under the triple helix, the role of industry in achieving this element must increase.

### 4. Cooperation between the Government and the University

**Table 7:** Means, Standard Deviations, degrees, and Rank of the Required Roles and the Cooperation Aspects between Government and University to Implement the Triple Helix in the Arab Countries.

| Text of the Item | AM | SD | Degree | Rank |
|---|---|---|---|---|
| Holding joint meetings to discuss university and government issues to make the necessary improvements. | **4.93** | **0.81** | **High** | **1** |
| Participating to establish and finance innovation centers and intermediary organizations at universities to enhance cooperation with industry and government "university business incubators, entrepreneurship clubs, business accelerators, science and technology park, collaborative research centers, industrial liaison offices, technology transfer and licensing offices). | **4.92** | **0.78** | **High** | **2** |
| Providing advanced infrastructure that supports research, development, entrepreneurship and innovation. | **4.91** | **0.86** | **High** | **3** |
| Providing rare facilities for research and development in universities. | **4.90** | **0.80** | **High** | **4** |
| Issuing the necessary legislation to transform leading universities into research and entrepreneurship universities and activating them. | **4.90** | **0.85** | **High** | **5** |
| Issuing laws and legislation guaranteeing the governance and independence of universities. | **4.89** | **0.81** | **High** | **6** |
| Establishing government funding programs to finance research, development and innovation project initiatives and enhancing research capabilities in universities. | **4.88** | **0.83** | **High** | **7** |
| Establishing government policies that encourage competition between universities in innovation. | **4.86** | **0.77** | **High** | **8** |

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|---|---|---|---|---|
| Establishing technological networks and platforms that link universities and various relevant parties locally, nationally and internationally. | **4.86** | **0.83** | **High** | **9** |
| Directing universities towards benefiting from research programs funded by international bodies and organizations. | **4.85** | **0.79** | **High** | **10** |
| Cooperating in developing the global vision for regional innovation systems. | **4.84** | **0.80** | **High** | **11** |
| Participating to organizing the regional and national innovation ecosystem. | **4.84** | **0.81** | **High** | **12** |
| Participating in projects that enhance the portfolio of government venture capital funds associated with a specific region. | **4.83** | **0.83** | **High** | **13** |
| Activating partnership between the university and the government in solving administrative, social and economic problems in the country. | **4.81** | **0.85** | **High** | **14** |
| Providing distinguished technological infrastructure for universities. | **4.80** | **0.79** | **High** | **15** |
| Partnership between the government and the university in student and graduate employment programs. | **4.80** | **0.83** | **High** | **16** |
| Providing legislation to ensure that the university can move freely in contracting companies with industry and marketing its research production. | **4.79** | **0.84** | **High** | **17** |
| Partnership between the university and the government in developing research centers and related government entities. | **4.78** | **0.86** | **High** | **18** |
| Amending university regulations and systems to allow universities, academics and research staff to create, manage and contribute to startup companies. | **4.77** | **0.85** | **High** | **19** |
| Providing government awards to support innovative researchers at universities. | **4.76** | **0.81** | **High** | **20** |
| Supporting various marketing efforts by funding university-owned startups. | **4.76** | **0.85** | **High** | **21** |
| Identifying suitable higher education institutions and facilitate their development into “research-led” institutions or entrepreneurial universities. | **4.75** | **0.78** | **High** | **22** |
| Improving the dissemination of university research through government support for early innovations. | **4.73** | **0.77** | **High** | **23** |
| Supporting universities to transfer and commercialize technology. | **4.72** | **0.83** | **High** | **24** |
| Total roles and aspects of cooperation between the government and the university | **4.82** | **0.86** | **High** | |

As shown in Table (7), the means for experts' approval of the required roles and the cooperation aspects between government and university to implement the triple helix in the Arab countries have individually ranged between (4.72) and (4.93), with a high degree for all items, and an overall mean (4.79), with a high degree. This confirms the importance of these roles from the point of view of experts, as holding joint meetings to discuss university and government issues to make the necessary improvements is ranked first which asserts the importance of this element because it is the basis for integration between the roles, as identifying priorities, problems, and challenges is the first step to meeting the needs of the actors. Also, supporting universities to transfer and market technology is ranked last with a high degree as well, as some experts may have thought that establishing simple innovation centers and centers might serve this purpose. However, researchers see the significance - as experts do - of this element to achieve continuous material, moral and logistical support for this aspect in light of the government's control over university policies.

### 5. Cooperation between Government and Industry

**Table 8:** Means, Standard Deviations, degrees, and Rank of the Required Roles and the Cooperation Aspects between Government and Industry to Implement the Triple Helix in the Arab Countries

| Text of the Item | AM | SD | Degree | Rank |
|---|---|---|---|---|
| Providing grants and tax exemptions to encourage emerging, small and medium-sized companies to help invest in education, scientific research, innovation and increase the ability to compete in the market. | **4.93** | **0.83** | **High** | **1** |
| Cooperating in developing and activating employment programs in the industrial sector. | **4.92** | **0.83** | **High** | **2** |
| Facilitating procedures for establishing and forming small and medium-sized companies and removing bureaucracy. | **4.91** | **0.83** | **High** | **3** |
| Providing social welfare programs and projects for workers in the industrial sector. | **4.90** | **0.83** | **High** | **4** |
| Launching joint training and development programs for workers in the industrial sector. | **4.88** | **0.83** | **High** | **5** |
| Cooperating to implement economic projects that serve local sectors. | **4.87** | **0.83** | **High** | **6** |
| Providing financial support, incentives and rewards from the government to develop knowledge and industrial innovations. | **4.86** | **0.83** | **High** | **7** |
| Facilitating procedures for exporting new facilities and products. | **4.84** | **0.83** | **High** | **8** |
| Facilitating the opening of new markets internally and externally. | **4.83** | **0.83** | **High** | **9** |
| Supporting for companies in accessing knowledge. | **4.79** | **0.83** | **High** | **10** |
| Assisting companies in obtaining public utility infrastructure from government agents. | **4.76** | **0.83** | **High** | **11** |
| Industry focus on the needs of both the national economy and global competitiveness. | **4.71** | **0.83** | **High** | **12** |
| Providing all information to companies about services or information available from government agents. | **4.70** | **0.83** | **High** | **13** |
| Total roles and aspects of cooperation between government and industry | **4.84** | **0.86** | **High** | |

As shown in Table (8), the means for experts' approval of the required roles and the cooperation aspects between government and industry to implement the triple helix in the Arab countries have individually ranged between (4.70) and (4.93), with a high degree for all items, and an overall mean (4.84), with a high degree. This confirms the importance of these roles from the point of view of experts, as the emphasis on providing grants and tax exemptions to industry is ranked first which is extremely important to encourage industry to partner, change its views and desire to import and gain quickly, as the industry has a very important role in the model as an input and target. Also, providing all information to companies about services or information available from government agents is ranked in the last place with a high degree, which is also an important element because they represent the government-based mediators of the triple helix and have an active role in making this model successful.

### 6. Cooperation between University and Industry

**Table 9:**Means, Standard Deviations, degrees, and Rank of the Required Roles and the Cooperation Aspects between University and Industry to Implement the Triple Helix in the Arab Countries.

| Text of the Item | AM | SD | Degree | Rank |
|---|---|---|---|---|
| Focusing on research activities as required by the market research. | **4.97** | **0.81** | **High** | **1** |
| Making partnership on knowledge/technology transfer and commercialization such as consulting and training and commercial exploitation of intellectual property resulting from academic research. | **4.97** | **0.85** | **High** | **1** |
| Urging university-led cooperation on developing innovation in industry and solving its problems. | **4.96** | **0.77** | **High** | **3** |
| Organizing employment fairs with the participation of business representatives, such as the "Employment Forum". | **4.95** | **0.77** | **High** | **4** |
| Launching participatory programs and projects to incubate and develop industrial innovations. | **4.95** | **0.83** | **High** | **5** |
| Making industry's contribution to providing sufficient funding to develop the university's research, development and innovation programs, institutions and activities such as fellowship programs and research grants, establishing and financing business incubators, science and technology parks and other innovation centers, donating industrial laboratory equipment, and establishing/strengthening infrastructure, laboratories and specialized laboratories. | **4.95** | **0.85** | **High** | **6** |
| Helping industry participation in activating teaching, learning, scientific research, and entrepreneurship and innovation programs at the university. | **4.94** | **0.83** | **High** | **7** |
| Facilitating joint applied research to develop/produce new technology that serves the industrial sector. | **4.93** | **0.79** | **High** | **8** |
| Sharing infrastructure between the university and industry in terms of laboratory facilities, equipment, tools and consultations in research and development to access the latest facilities. | **4.91** | **0.77** | **High** | **9** |
| Holding joint conferences, seminars and workshops to develop the university and industry. | **4.90** | **0.82** | **High** | **10** |

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|---|---|---|---|---|
| Forming joint committees/units to hold meetings and sessions on providing consultations, research, patents, projects, research, and transferring joint contractual knowledge in innovation and entrepreneurship to formalize and organize procedures and facilitate procedures. | **4.86** | **0.86** | **High** | **11** |
| Helping industry in developing and presenting curricula in accordance with industry and labor market requirements. | **4.84** | **0.80** | **High** | **12** |
| Creating an entrepreneurship ecosystem around universities in which a dynamic diversity of companies is located. | **4.83** | **0.85** | **High** | **13** |
| Providing joint training and employment programs and networks to train and employ faculty members, researchers and industrialists in industry on a part- or full-time basis and vice versa. | **4.82** | **0.83** | **High** | **14** |
| Helping university industry enable problem-based and work-based learning. | **4.81** | **0.81** | **High** | **15** |
| Registering patents arising from industry-funded research and transferring them to commercial partners for transformation into tangible innovative products and treatments. | **4.80** | **0.77** | **High** | **16** |
| Transferring technology from university to industry through spin-offs, start-ups, licensing and academic entrepreneurship. | **4.80** | **0.79** | **High** | **17** |
| Providing part-time or online master's degree and doctoral programs targeting workers in business institutions. | **4.79** | **0.81** | **High** | **18** |
| Seeking the assistance of prominent industry figures in the university's educational and research activities. | **4.79** | **0.82** | **High** | **19** |
| Opening their facilities to researchers and faculty members, study their problems, develop solutions for them, and learn about developments. | **4.79** | **0.83** | **High** | **20** |
| Holding workshops that bring together members representing universities and production institutions to study common issues and support partnership between them. | **4.79** | **0.85** | **High** | **21** |
| Receiving experts from industrial institutions to give lectures at universities on practical aspects or to educate students about what the labor market requires. | **4.79** | **0.86** | **High** | **21** |
| Establishing research centers that work directly with organizations and industry to address the challenges of business enterprises. | **4.78** | **0.81** | **High** | **23** |
| Providing lifelong learning programs for industry professionals. | **4.77** | **0.84** | **High** | **24** |
| Facilitating mutually beneficial educational programs and courses related to the world of business, placements and careers for students. | **4.76** | **0.80** | **High** | **25** |
| Establishing and employing advisory offices or contact center links and helplines to facilitate research activities. | **4.75** | **0.77** | **High** | **26** |
| Using industry figures as external auditors to evaluate innovative activities at universities related to industry. | **4.74** | **0.82** | **High** | **27** |
| Total roles and aspects of cooperation between the university and industry | **4.85** | **0.84** | **High** | |

As shown in Table (9), the means for experts' approval of the required roles and the cooperation aspects between university and industry to implement the triple helix in the Arab countries have individually ranged between (4.74) and (4.97), with a high degree for all items, and an overall mean (4.85), with a high degree. This confirms the importance of these roles from the point of view of experts, as focusing university research activities on market research is ranked first which is an extremely important element so that industry and the economy can benefit from this knowledge, apply it, and transform it into innovations. However, using industrialists as an external reviewer to evaluate the innovative activities of industry-related universities is ranked in the last place, with a high degree as well, since the element of experience possessed by industrialists is extremely important for evaluating the innovative activities of universities and maximizing the universities' benefit from linking theory and practice.

### 7 Cooperation between Representatives of Government-Led Actors

**Table 10:** Means, Standard Deviations, degrees, and Rank of the Required Roles and the Cooperation Aspects between Representatives of Government-Led Actors to Implement the Triple Helix in the Arab Countries.

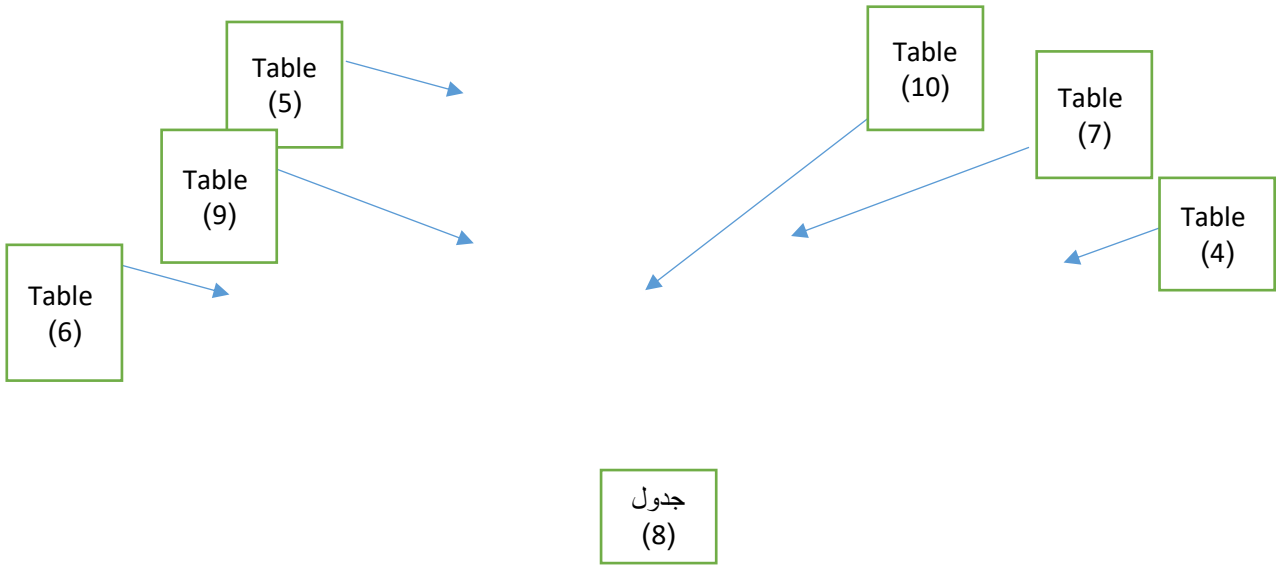
| Text of the Item | AM | SD | Degree | Rank |
|---|---|---|---|---|
| Launching major national programs and projects on which the triple helix projects are based. | **4.97** | **0.77** | **High** | **1** |
| Providing the necessary funding and arrangements to establish research, applied or specialized universities according to the needs of companies. | **4.96** | **0.85** | **High** | **2** |
| Conducting research, publications, patents and joint projects. | **4.95** | **0.81** | **High** | **3** |
| Developing an integrated approach to conducting and marketing applied research. | **4.95** | **0.82** | **High** | **4** |
| Partnership in technology support programs in cooperation between the three main actors. | **4.94** | **0.77** | **High** | **5** |
| Tasking universities in partnership with industry and government with conducting research broad enough for commercialization. | **4.94** | **0.80** | **High** | **6** |
| Building and enhancing the research capabilities of participants within the triple helix model. | **4.94** | **0.82** | **High** | **7** |
| Formulating, developing and implementing partnership policies in accordance with the requirements of the triple helix. | **4.93** | **0.77** | **High** | **8** |
| Increasing fund by industry and government for hybrid projects and institutions. | **4.93** | **0.85** | **High** | **9** |
| Developing and establishing activities that represent the priorities of all actors. | **4.93** | **0.87** | **High** | **10** |
| Concluding contracts and research agreements between participating parties and activating them. | **4.93** | **0.88** | **High** | **11** |
| Financing and managing pioneering projects, research activities, marketing, and incubating innovations. | **4.92** | **0.77** | **High** | **12** |
| Supporting and conducting applied research that serves industry and government. | **4.92** | **0.82** | **High** | **13** |

| | | | | |
|---|---|---|---|---|
| Supporting various marketing efforts by financing startups. | **4.91** | **0.79** | **High** | **14** |
| Establishing and activating hybrid institutions and projects that integrate the three parties such as science and technology parks. | **4.91** | **0.80** | **High** | **15** |
| Providing different forms of commitments to the parties involved, such as the government acting as chair of the team. | **4.91** | **0.83** | **High** | **16** |
| Directing universities to focus on innovative, market-oriented research. | **4.91** | **0.85** | **High** | **17** |
| Mapping R&D actors, analyzing their evolution over time and future trends, understanding and defining their priorities and designing their agendas. | **4.91** | **0.87** | **High** | **18** |
| Improving the dissemination of university research by supporting early innovations from government and industry. | **4.90** | **0.77** | **High** | **19** |
| Increase the capabilities of human resources involved in the triple helix model. | **4.90** | **0.81** | **High** | **20** |
| Identifying and alerting international trends in developing and implementing partnership policies. | **4.90** | **0.84** | **High** | **21** |
| Providing consultations and implementing programs, each with regard to its relevant actors. | **4.89** | **0.83** | **High** | **22** |
| Providing the necessary funding to activate all relevant innovation centers and communities. | **4.88** | **0.82** | **High** | **23** |
| Providing regional and national coordination and support networks. | **4.88** | **0.83** | **High** | **24** |
| Financing and supporting capacity building for technology transfer. | **4.88** | **0.85** | **High** | **25** |
| Establishing and supporting the National Innovation Forum. | **4.87** | **0.79** | **High** | **26** |
| Encouraging policy formulation and the role of development leadership in managing hybrid institutions. | **4.87** | **0.84** | **High** | **27** |
| Launching and supporting knowledge exchange programs between participating parties. | **4.86** | **0.86** | **High** | **28** |
| Establishing technology-based hybrid companies to support entrepreneurship, apply scientific research, and provide alternative financing sources. | **4.85** | **0.81** | **High** | **29** |
| Establishing joint-stock companies to market the outputs of scientific research, innovations and technology, and marketing patents in universities, and involving | **4.85** | **0.84** | **High** | **30** |

| | | | | |
|---|---|---|---|---|
| Designing reward schemes that encourage academics to work with companies to develop demand-driven innovation. | **4.84** | **0.81** | **High** | **31** |
| Establishing globally applicable regulatory frameworks upon which government-led partnership projects between universities and the industrial sector are built. | **4.84** | **0.83** | **High** | **32** |
| Providing full support for the implementation of distinguished innovations that serve the industry. | **4.84** | **0.84** | **High** | **33** |
| Identifying national priorities and challenges and putting them into well-defined problems that need to be solved. | **4.84** | **0.86** | **High** | **34** |
| Creating a "knowledge bridge" by establishing TH innovation journals and the website of universities and institutions that exchange knowledge and information in the field of high technology and new research development. | **4.83** | **0.77** | **High** | **35** |
| Accelerating the pace of innovative small and medium enterprises. | **4.82** | **0.81** | **High** | **36** |
| Holding conferences, workshops, training, and providing consultations to enhance the capabilities of actors in the triple helix. | **4.81** | **0.80** | **High** | **37** |
| Creating networks and alliances between participating parties. | **4.81** | **0.82** | **High** | **38** |
| Forming regional and national groups for excellence and creating a competitive environment for entrepreneurship to integrate cooperation between university, industry and government. | **4.81** | **0.83** | **High** | **39** |
| Defining the roles of the three actors in the model, and developing policies to eliminate duplication of roles, with equality between the components of the model to facilitate the circulation of innovation. | **4.81** | **0.85** | **High** | **40** |
| Establishing monitoring and evaluation policies, objectives, strategy and leadership by the government, providing criteria and indicators for the success factors of effective cooperation, and evaluating the performance of the triple helix through mixed indicators. | **4.80** | **0.80** | **High** | **41** |
| Institutionalizing the triple helix by providing a competitive and democratic environment for policy making. | **4.80** | **0.85** | **High** | **42** |
| Support partners' research capabilities, i.e. research infrastructure, human capital, ICT, etc. in scientific fields that promote development and new businesses. | **4.79** | **0.77** | **High** | **43** |
| Facilitating interactions between the three main sectors by strengthening the role of civil society. | **4.78** | **0.78** | **High** | **44** |
| Facilitating the internal transformation process for the three main parties through market orientation and operations management. | **4.77** | **0.80** | **High** | **45** |

| | | | | |
|---|---|---|---|---|
| Providing networking in formal and informal structures at national, regional and international levels for triple helix interactions. | **4.76** | **0.81** | **High** | **46** |
| Holding national and Arab competitions on research, development and innovation. | **4.76** | **0.83** | **High** | **47** |
| Providing innovation space by integrating new concepts of organizational performance for better ways to innovate and enhance it. | **4.76** | **0.85** | **High** | **48** |
| Motivating representatives of the triple helix to participate in new joint projects, defining common visions and goals. | **4.74** | **0.79** | **High** | **49** |
| Activating the role of intermediary organizations, whether university-based, government-based, or market-based. | **4.72** | **0.81** | **High** | **50** |
| Providing workshops for future development activities. | **4.71** | **0.80** | **High** | **51** |
| Total roles and cooperation between representatives of government-led actors | **4.86** | **0.86** | **High** | |

As shown in Table (10), the means for experts' approval of the required roles and the cooperation aspects between representatives of government-led actors to implement the triple helix in the Arab countries have individually ranged between (4.71) and (4.97), with a high degree for all items, and an overall mean (4.86), with a high degree. It is thus ranked in the second place after the government. This confirms the importance of these roles from the point of view of experts, as launching major national programs and projects based on the triple helix projects is an extremely important element, considering that the government in the Arab countries is the axis of linking industry and government. Therefore, a comprehensive project must be launched around which these parties and others can rally to develop innovation. However, providing workshops for future development activities is ranked in the last place, with a high degree as well, as this is an important element in view of the many rapid and frequent changes and challenges facing the Arab countries, requiring the continuity of holding these workshops in order to modify future trends in a way that suits these challenges. Given the previous analysis, the proposed model for integrating roles and aspects of cooperation between the three main actors "university - industry - government" in implementing the triple solution in Arab countries can be as shown in Figure 1.




جدول (8)

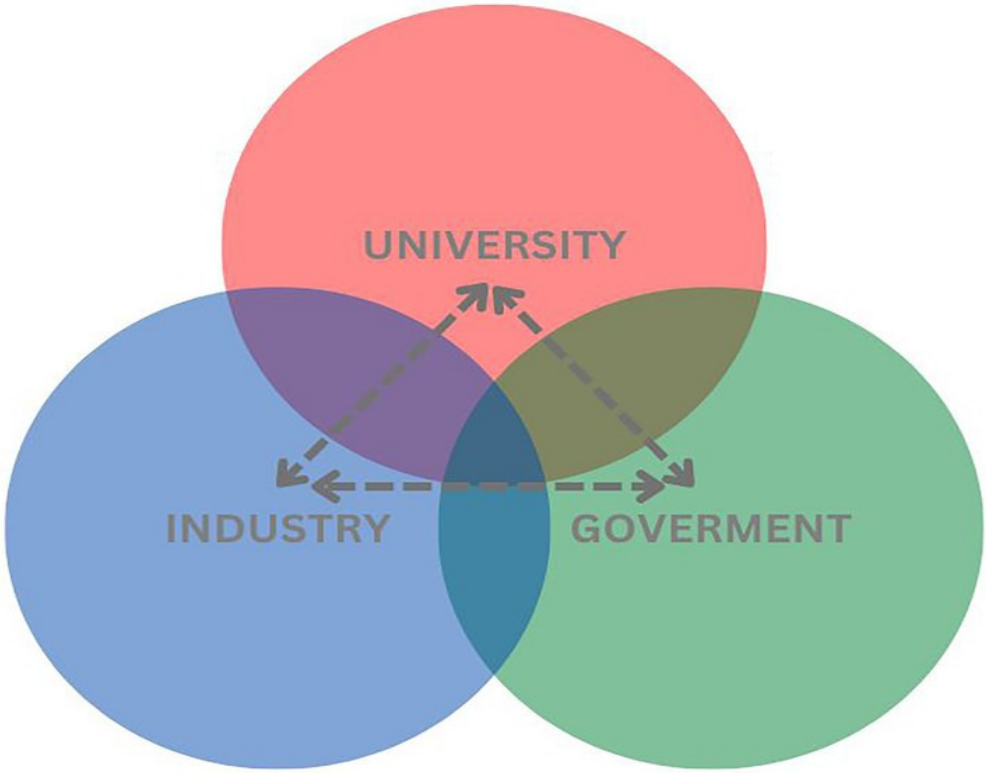



**Fig.1:** A Model of the Roles and Aspects of Cooperation between the Main Actors "University - Industry – Government" in the Triple Helix Model.

As illustrated in Figure (1), it is clear that achieving the triple helix model requires individual roles for the three actors "university - industry – government", roles in relation to bilateral relations, and roles in relation to the representatives of the actors in the tripartite interactions led by the government. These roles are specified in the previous tables, and must be taken into account for the successful adoption of this model in Arab countries.

**Second: Results related to the Second Research Question**

**What are the guarantees of the success of the proposed model for aspects of integration and cooperation between university, industry and government in Arab countries using the innovation triple helix model from the perspective of experts?**

To answer this question, a semi-structured interview is conducted with (30) experts from universities, industry, and government departments in Arab countries who answered the questionnaire in the second round after adding suggestions from the experts in the first phase of applying the questionnaire, as the period between the two applications range between 10-15 days. A number of previous literature and studies are also reviewed such as (Ibrahim, 2015; Hajhamad, 2017; Souleh, 2020; Ahmed, 2021; Gachie, 2020; Wang, 2022). Given this, the guarantees for the success of the proposed model are reflected in making the nature of the relationship exemplary collaborative partnerships on an equal footing to drive innovation at the local, regional and national levels, appointing an innovation representative with a vision for knowledge-based development to lead the three institutional areas, providing offices for coordination between universities, the industrial sector, and the government, providing brainstorming, analyzing problems, and formulating plans, and having special interest groups of researchers, practitioners and policy makers in the Triple Helix to develop and present research, projects, publications and research, achieve excellence and proactivity, disseminate outputs and provide policy advice in specific sub-areas of the Triple Helix model and theory.

Other guarantees lie in ensuring clarity of the roles of all actors in the proposed model, whether at the individual, bilateral or tripartite level, establishing specific and clear protocols to enhance the model, develop a strategic plan to address the specific needs of industry, government and higher education institutions, identifying the needs and priorities of the country, and thus the industry and the university to activate and arrange specific directions in the model, providing the necessary policies and procedures for

all stakeholders to participate in the model, ensuring non-repetition of activities through synergy between actors, establishing standards of practice for each Arab country to meet the needs of each actor in the triple helix, and following a collaborative leadership style and democratic methods in model management and decision-making to bring together different viewpoints and develop a common vision.

Of the key guarantees are ensuring that the criteria and indicators for evaluating the model's performance should cover cooperation at the institutional, project, individual researcher, operational, financial, and relational levels to reach a knowledge-based economy, making cooperation and conflict control to transform tension and conflict of interests into convergence and convergence in the interests of the participating parties, crossing the organizational and technical boundaries between the components of the triple helix to facilitate the exchange of knowledge, ensuring availability of competent human resources in the field of technology generation and dissemination, having a large absorptive capacity for companies and a large demand for knowledge and technology from the industrial sector and innovative individuals, strengthening the infrastructure of all participating parties and hybrid institutions, applying knowledge management processes in order to increase the knowledge production necessary to enhance innovation, making availability of feedback loops in the development of the triple helix, and ensuring accuracy and clarity of policies, programs, interventions and resources allocated precisely to facilitate the relationship between the parties concerned, and provide comprehensive support to each actor.

In the same context, there are many important guarantees such as apply evidence-based practices to ensure the sustainability and development of the model, adopting a long-term vision for institutional change for actors in light of the triple helix, providing a social belief among actors that knowledge production and technological progress are the key to successful growth and economic competition, developing and implementing principles for effective implementation of partnerships and programs in accordance with influences on international/local guidelines in this regard, developing skills and competencies for those in charge, participants in the model, and service providers in the model through various training, making continuous education of network actors, recognizing the central role of the private sector in commercializing research and addressing complex societal problems, and recognizing the economic, social and environmental reality of the Arab countries, and structuring the challenges of sustainable development through strict controls, policies, strategies and interventions in accordance with this model.

**Third: Results related to the Third Research Question**

**What are the obstacles to the success of the proposed model for aspects of integration and cooperation between university, industry and government in Arab countries using the innovation triple helix model and methods to overcome them from the perspective of experts?**

To answer this question, the experts are asked in a semi-structured interview about this aspect to present a number of obstacles and methods to overcome each obstacle. Several previous literature and studies are also reviewed, such as (Malik & Wickramasinghe, 2015; Elhadidi & Kirby, 2017; Ahmed, 2021; Chryssou, 2020; Tiras, 2020; Castro et al., 2022; Gachie, 2020; Wang, 2022). In light of this, the obstacles to the success of the proposed model and methods to overcome them are reflected in the fact that the majority of universities in Arab countries fall under the ivory tower model, which requires the state to accelerate the transformation of universities into research universities and entrepreneurship universities, start with leading universities, and increase competition between universities to achieve this transformation, while setting rewarding rewards for these universities that were able to transform. Other obstacles include weak independence of universities, which requires speeding up the adoption of legal and administrative measures to ensure the independence of universities, restructuring and governing them, and increasing the powers delegated to their management and raising awareness about this and loss of common culture among the actors in the triple helix model due to conflicts of interest, cultural differences, and the nature of the work.

There are also many problems such as the focus of industries and companies on quick gains, which requires making industrialists aware of the importance of innovation and its ability to achieve big gains, strengthening their national role in developing the economy, considering the private sector as the pillar of innovation, and providing incentives that encourage them to participate, the lack of experience in developing and marketing new products requiring holding seminars and workshops to prepare specialists in this field as a nucleus for disseminating this thought to all actors, and making research marketing at the top of the model, the weak infrastructure and facilities at universities that requires searching for alternative funding sources, government and industry support, and sharing tools and facilities between industry and the university in accordance with specific protocols and legislation, the fear of a lack of rewards for academics to work in triple helix partnerships necessitating providing rewarding material and moral rewards to researchers and faculty members to increase their interest in communicating with the industry sector and participating effectively in the model, and providing special privileges to participants within their universities or in their academic promotions, and working in the triple helix system does not support academic promotions for faculty members which necessitates amending the regulations for faculty promotions, including this aspect within the conditions for promotions, and setting high points for it.

Of the key problems are working in the triple helix system does not support academic promotions for faculty members which requires amending the regulations for faculty promotions, including this aspect within the conditions for promotions, and setting high points for it, the lack of allocated funding and technological resources necessary to strengthen the partnership that requires considering the project as a national program, mobilizing all forces, institutions and civil society, collecting donations and subscribing to groups of people to complete this project and providing the necessary funding and technological resources for it according to a clear strategic plan, the presence of forces opposing change and development among the components of the triple helix, necessitating continuous cultural awareness from various actors according to specific programs for this purpose, and informing them of the importance of applying the triple helix to institutions and the nation as a whole, and the administrative routine and excessive bureaucracy in obtaining approvals which requires speedy access to electronic transactions and management to break administrative routine and bureaucracy, and amend regulations and laws that ensure facilitation and speed of procedures.

Among the important problems are the absence of guidelines, protocols, and the structure supporting the continuity of the partnership requiring developing and implementing principles for the effective implementation of partnerships and programs, taking into account international and local guidelines, following democratic methods in developing and adopting these guidelines, and developing protocols to meet the needs of actors, and protocols that ensure effective performance in the model, the absence of research-based evidence programs for the effective implementation of future goals that requires the entities responsible for managing the model to develop research-based evidence after studying the future goals, and raising awareness of their components and ways to achieve what is stated in them, the lack of central strategic leadership which requires that the model be led by the government, appointing an innovation representative, a coordination unit, and special interest groups for each sub-helix, developing the necessary strategic plans, equipping leaders with all relevant concepts, and appointing multidisciplinary teams, and the shortage of financing mechanisms necessary for the establishment of startup companies that requires activating the role of the private sector and its participation in this matter, and improving its tax privileges in exchange for providing corporate grants, scholarships, financial grants, and the establishment of startup companies spread in universities, with an increase in the state's interest in accelerating small and medium enterprises based on innovation.

Other key points about the using the innovation triple helix model and methods to overcome them are the lack of information and strategies on how to enhance the model due to the lack of initiatives, the lack of competencies in some sectors, and the absence of the necessary funding which require holding competitions and forming committees to put forward new initiatives, continuous education to raise competencies, and allocating a budget within the model for this matter, the weak competitiveness due to the social and economic issues facing Arab countries which requires developing political measures and interventions to enhance resilience, address sustainable development issues, mitigate the challenges facing the model, and consider the model the way to solve these complex problems, with a model and flexible strategic plan to meet ongoing needs, the lack of national innovation centers in Arab countries which requires Arab countries to consider the matter a national duty, and to accelerate the establishment of these centers according to a short time plan, provided that they are in accordance with international standards in terms of location, space, and equipment, the lack of commitment to partnerships such as spreading awareness of the importance of communication, partnership, and a culture of cooperation, and the necessity of developing an effective accounting system, and the weak ability to formulate an action plan among actors leads to isolation, inefficiency, and duplication of tasks which requires appointing specialists, setting selection criteria, offering training courses, and forming committees specialized in planning.

## 9 Recommendations

Given the previous results and discussion, the current piece of research considering the triple helix application project as an Arab and national project, adopting an Arab innovation system under which national innovation systems operate, spreading the culture of innovation at the national and Arab levels, accelerating the formation of policies, plans and strategies and issuing legislation related to the implementation of the triple helix, establishing regional, national and Arab research and innovation centers and intermediate and hybrid institutions to achieve the changing needs and patterns of entities in the network, and accelerating the internal transformation of actors in the triple helix model.

Other key recommendations are the needs to address the obstacles of the model and developing it, and developing the necessary strategies and mechanisms for this, accelerate the preparation of the infrastructure and technology necessary to implement the triple helix, issue laws related to the requirements for activating the triple helix, such as those related to patents, intellectual property protection, and others, review the roles of the actors in the model according to the reality and needs of each Arab country, and address the challenges and obstacles facing each of them, and conduct more research on the triple helix from diverse and complementary points of view.

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