




## Towards the third generation universities: The core innovative function approach

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### Abstract

**Background:** Undoubtedly, economic and social value added depends on the functions of universities. Moving toward third-generation universities (3rd GU) is an inevitable process. These universities need different functions than traditional ones; therefore, identifying and determining their functions is essential. The purpose of this study is to collect, match and explore the functions of universities in the transition to 3rd GU and ultimately offer a functional model of the 3rd GU for the use of professors, academics and policymakers in order to evaluate and promote universities.

**Methods:** A critical review method was adapted. Literature was included based on their relevant empirical data to research objectives and referral rates, and texts with more conceptual richness entered the study without time limitations.

**Results:** A total of 20 texts were included in the final analysis. While presenting the basic model, extracts the overarching concepts associated with the success of 3rd GU. These key concepts include the 7 core functions of innovative and entrepreneurial activities, supportive activities (financial and non-financial), entrepreneurial education (curriculum and academic workforce empowerment), creation and provide applied knowledge, boundary-spanning function or communications and interactions with other elements of the national innovation system (state and industry), develop innovative and entrepreneurial culture and institutional governance and leadership in the direction of economic growth and development.

**Conclusion:** Using new functions at universities would be a move toward 3rd GU, economic growth and development in the country. So, these functions are a practically useful guide to policymakers to estimate the rate of success in each university and deliver the necessary suggestions to provide the mechanisms for the establishment of a successful university.

**Keywords:** Innovation Function, Transition, Third Generation University

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### Introduction

Universities are changing, and the transition phase in a fundamental way. First-generation universities (medieval), tended to education. The transition to second-generation universities (the first transfer) is rooted in the social transi-

tion between the Renaissance and the Enlightenment. The purpose of these universities is to create knowledge and research. Although second-generation universities have their own quality and attraction, the constant struggle to

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#### ↑What is “already known” in this topic:

The current functions of universities (education and research) do not have much impact on the country's economic growth and development. Therefore, we need to redefine the functions for the economic and social value added in order to upgrade the universities. In this case, universities will move toward third-generation universities.

#### →What this article adds:

This paper, for the first time, identifies the innovative functions of third-generation universities and provides guidance for the leadership and governance of universities in evaluating and promoting universities in order to achieve economic and social added value.

get enough budgets and the limited role of universities in scientific research and education has led to the rethinking of the emergence of thinking such as the specialization of universities and the emergence of 3<sup>rd</sup> GU in the late nineteenth century. It means that universities should become centers for producing basic knowledge, and companies and institutions need to translate knowledge into practical solutions for the application of applied knowledge (1).

The concept of the 3<sup>rd</sup> Generation University was introduced through Weissama in 2009 in link with the second scientific revolution. He believes that universities, given the increasing struggle for absorption investment, students and academics are changing as government demands for technology-led economic growth and economic and social development is now tied to the mission of universities (2).

In the second transition period from modern to post-modern in the late twentieth century and the emergence of 3<sup>rd</sup> GU, universities are experiencing commercialization models and can be considered as tools for economic growth. Their goal is to generate knowledge and conduct research, and exploit applied knowledge. Their role is to create wealth, operate in a modern and interdisciplinary way, and educate professionals, scientists and entrepreneurs and have a global trend (1).

In the new approach to the role of universities, the 3<sup>rd</sup> GU is defined as a center for the production, transfer, and implementation of innovation by maintaining the function of traditional universities. In fact, the approach of these universities is not only based on the organization of research but also on progress and development (3).

Therefore, given the fact that the emergence of the 3<sup>rd</sup> GU is inevitable and these universities need different functions than the traditional universities, and on the other

hand, the relevant literature and articles are less, providing the functions of the 3<sup>rd</sup> GU seems a necessity. Finally, this study aims to provide a model of core innovation functions of the 3<sup>rd</sup> GU for the use of professors, academics and policy-makers in order to evaluate and promote universities. Obviously, applying these functions to universities will lead them to their new mission (economic and social development).

### Methods

This paper undertakes the literature through a critical review. This was chosen because the dominant form of articles related to 3<sup>rd</sup> GU was mainly about the views, models, and patterns, and not intended to measure effectiveness; we also sought to identify the most meaningful concepts in the field of 3<sup>rd</sup> GU and present the model. A critical review approach is the widespread identification of texts, the critical evaluation of their quality, along with the degree of innovative analysis and synthesis, and, ultimately, elaborates and abstracts of a model or hypothesis (4).

### Search Strategy and Selection Criteria

The search for literature included data that was prioritized based on their relevant empirical data to research objectives and referral rates, and texts with more conceptual richness, entered the study and were purposefully and comprehensively reviewed and extracted in a multi-stage process between English documents and articles without time limitations and by using relevant keywords in the PubMed, Embase, Google Scholar, Google, ERIC, Scopus, Elsevier, Web of Science, OVID, EBSCO, and Science Direct databases. These databases were chosen for their comprehensiveness and relevance to the review ob-

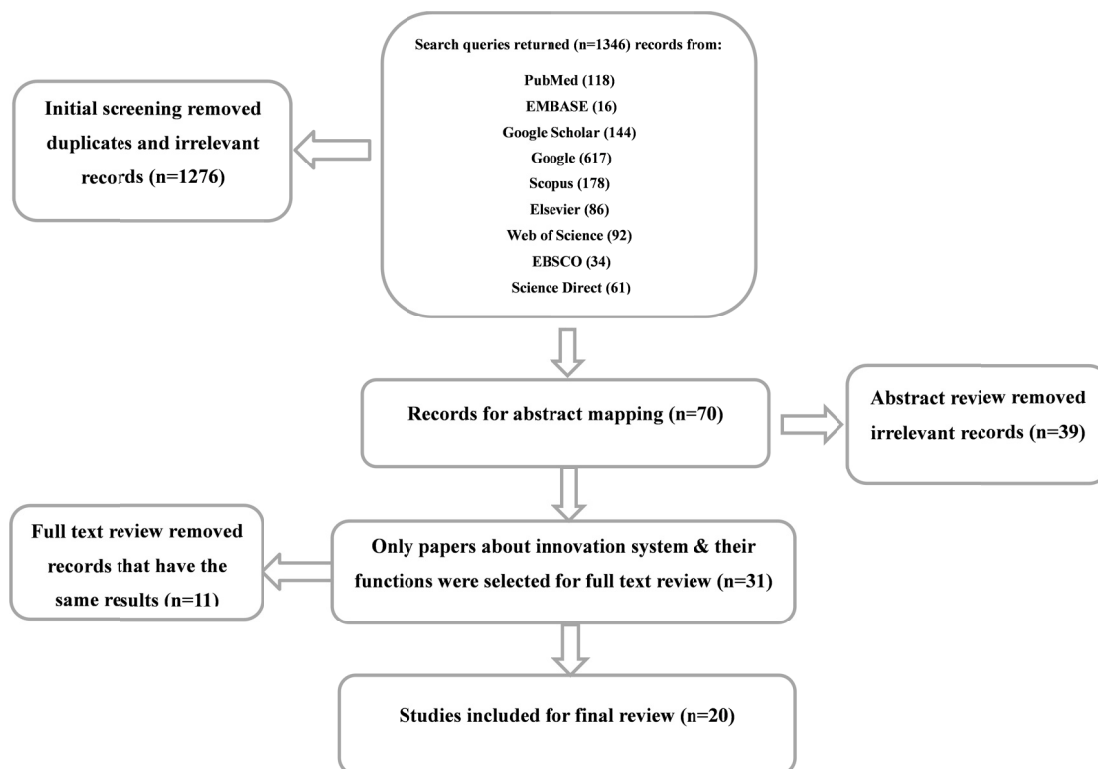


Fig. 1. Flowchart of Inquiry Results

jective. The texts that were not written in English and were not related to the functions of 3<sup>rd</sup> GU were excluded.

The search keywords included the "3<sup>rd</sup> Generation University, Functions of University, Entrepreneurial University, Medical Science Universities, Entrepreneurial Ecosystem, the Higher Education, Institutional Economics." Also, with regard to the scope of research, the following concepts are searched by OR and AND in combination with the main concepts.

"Knowledge development, Knowledge transfer, Knowledge translation, Transition, Technology transfer, Strategy"

In order to extract the final articles and based on the relationship between data and research objectives, the citation rate, and conceptual participation of the article in the synthesis and abstraction of the model, each article was examined individually by each member of the research team. Then, each of these articles was examined among the members of the research team with the same criteria.

Finally, the articles and texts that provided the definition or interpretation of the concepts, components, and functions of 3<sup>rd</sup> GU or provided evidence in connection with them, were chosen for studying the full text and the basis for the study (Fig. 1).

### Analysis

First, each of the texts was critically studied and the key concepts related to the functions of the 3<sup>rd</sup> GU were extracted from each of the texts. Then, in order to reach a consensus, the concepts extracted by the members of the research team were examined. After finalizing the key concepts, the initial draft of the overarching concepts table was obtained, which after the process of iteration between the research team, the final concepts were classified. So, the overarching concepts and synthesizing in 10 categories based on the amount of conceptual contribution. Finally, the findings in these categories were abstracted our innovation functions model of 3<sup>rd</sup> GU according to original maturity.

### Results

The result of the review and critique of related literature explored the core innovation functions of 3<sup>rd</sup> GU. A summary of overarching concepts of functions of 3<sup>rd</sup> GU is presented in Table 1.

#### Innovation activities

Science, technology, and innovation reinforce competitiveness, productivity and job creation and act as key mechanisms for sustained growth in a knowledge-based economy. Knowledge valorization, knowledge transfer from research and development organizations (R & D) to other sectors that awaits socioeconomic values is mainly due to the fact that the industrial economy needs to change the own development paradigm from exploiting resource-oriented to knowledge and innovation-oriented. There are three major interpretations of the concept of conversion of knowledge created to value by research and development: (i) knowledge valorization, (ii) knowledge com-

mercialization, and (iii) knowledge investment (5).

#### Entrepreneurial activities

Entrepreneurship activity is important as one of the major goals of universities, and it is a new business accelerators a catalyst for widespread expansion and economic growth, it is a new business accelerator. According to Gianodis et al. 2016, the formation of start-ups is also one of the entrepreneurial activities of universities (6).

Compared to traditional academic environments, shifting to entrepreneurship needs the change of missions and functions within universities with their teaching and research as well as the development of entrepreneurial activities (7). Entrepreneurship is an important part of university strategy. To improve an entrepreneurial organization with an innovative culture, entrepreneurial activities should be developed in a strategy (8).

#### Supportive activities

The university's supporting activities refer to the two areas of financial support and non-financial support activities:

##### (A) non-financial support activities

The university's support for technology transfer and start-ups is one of the formal facilitating in the development and advancement of entrepreneurial universities. In a knowledge-based economy, universities are typically trying to support technology transfer and promote start-ups (9). Examples of this support are small business centers, research facilities, research teams or quasi-companies, communications agencies, technology transfer offices and incubators (10). Audretsch (2014) continues that the role of universities is beyond the production of technology transfer (patents, spin-offs and startups) (11), thus provides a special leadership to create thinking, activity, institutions and entrepreneurial capital (12).

The university should support the pre-launch phase of the start-up to commercial growth phase, including development and network coaching. Furthermore, universities need to connect their investors and their companies to the wider entrepreneurship ecosystem (8). Universities have built internal mechanisms to support academic entrepreneurship, namely the exploitation of the university's IP (13), the creation of spin-off and academic advisory activities, and, at university level, patent policies, spin-offs and advice is intended to control the business activities of academics (14).

##### (B) financial support activities

The venture capital and research grants are examples of university financial support activities. The university has a sustainable financial strategy to support entrepreneurship development, which includes funding or sufficient support for entrepreneurship activities as part of the (long-term) university's funding. Universities must invest in their entrepreneurial activities through their financial strategy. The university facilitates access to private financing for potential entrepreneurs (8). Venture capital has been created to provide the initial stages of commercialization of academic research (15, 16).

### 3rd GU Core Innovative Function

Table 1. Overarching Concepts of Functions of 3<sup>rd</sup> GU

Overarching concepts	Kirby et al (2011)	OECD (2012)	Guerrero & Urbano (2012)	Paul Coyle et al. (2013)	Etzkowitz (2013)	Savetpanuvong & Pankasem (2014)	Baldini et al. (2015)	Guerrero et al. (2016)	Gianiodis et al (2016)	Harrington & Walsh (2017)
Innovative activities	Develop innovative activities		Commercializing innovation from university research	Technological innovation and 'engines of growth'  Innovation in research approaches, achieving impact, and finding a resource	play a strategic role in encouraging innovation  Diffusing innovation	Transform from bureaucracy and corporatism into multidisciplinary  Transform its innovation originator role to innovation diffusion role convert its innovation creator role to innovation diffusion role	support and diffuse technology commercialization activities in academic institutions	Development and strengthening of national innovation ecosystems  Stimulate innovation by entrepreneurial firms as drivers of innovation	Service innovation and engagement with organizational learning processes	Enhancing activities in a regional innovation system  Development of innovation in students
	Development of entrepreneurial Activities  Commercialization of their research Entrepreneurship role models Contribution to regional development (jobs created, funding) Minimal regulation for new venture creation to encourage collective entrepreneurial action at all levels. Creation and a spin-off of new businesses	Entrepreneurial activities should be established in the strategy	Employment creation  Entrepreneurial universities play an important role as both knowledge-producer and a disseminating institution Encouraging the formation of high-technology firms  Minimal regulations for new venture creation	universities for employability and/or employment, universities for useful knowledge, universities for enterprise, universities for social enterprise, and the 'business engaged' university.  Joint ventures with business associations and local authorities in enterprise development	technology transfer, firm formation and regional development  commercializing the intellectual property  to organize a new enterprise  Knowledge-based regional development strategy.	Research and technology commercialization  produces entrepreneurs or new ventures to the market and society  foster technology entrepreneurs with innovation and societal responsibility  foster the creation of new ventures	Successful commercialization of university research results  Involvement in academic entrepreneurship has different forms of pay-offs for universities  Development of academic start-ups The creation of academic spin-offs	Development and strengthening of entrepreneurial ecosystems  Growth through innovation and venturing activities Creation of spin-offs	commercialization of new technologies and business communities  Entrepreneurial activity  The formation of startups	

Table 1. Ctd

Supportive Activities	Financial	Seed funding	Generate revenues for the institution from spin-off activities; Diversify funding sources and reduce their dependency on <b>state/public funding</b>	Availability of venture capital <b>A diversified funding base</b>	Broadening revenue flows	The venture-capital model invented to fund the early stages of university research commercialization	Financing or adequate support of entrepreneurial activities	creating new mechanisms for funding research activities	access to private/public sources of funding
		to support technology transfer and promote start-ups and business start-ups; An effective policy concerning intellectual-property to promote technology transfer	Commercialize research results through technology transfers and business start-ups; Support business start-ups; provides access to business incubation facilities	business incubators technology transfer offices Support for technology transfer Support for start-ups Science park Encouragement and support Policies and technology	business and the commercialization of university intellectual property technology transfer offices, incubators and science parks Incubator and technology park activity; provide a platform for wider exploration of the university's entrepreneurial potential	incubators as 'third mission' rather than educational function Administrative mechanisms such as licensing offices and incubator facilities intellectual-property management	Provides support for individuals and groups to move from entrepreneurial ideas to action should make mentoring services available to both student and graduate entrepreneurs Development of consultancy policies Consultancy activities of academics	Development of university patents Licensing Creation of Technology Transfer Offices (TTOs), The exploitation of university-owned IP,	technology transfers, science parks, incubators Development of spin-off firms, patents, licenses entrepreneurial activity as a significant source for stakeholder support

### 3rd GU Core Innovative Function

Table1. Ctd

Creation & Provision Of Knowledge	Knowledge transfer (patents, licenses, contracts)	Mechanisms in place for exploiting internal knowledge	Capitalization of knowledge	Creating useful knowledge	An institution in which knowledge is also created and put to use.	Knowledge management	Creation of academic knowledge	Provider of knowledge (technology)	Knowledge and technology integration are essential for the commercialization of university IP	Knowledge-based industries
	Development of knowledge-based economies because they generate, apply, and disseminate knowledge	To collaboration and knowledge exchange with industry, society, and the public sector.  Support knowledge exchange mechanisms and collaboration with the external environment	Knowledge transfer (patents, licenses, spin-offs)  Exploitation of knowledge	Strengthening of the university's capacity for knowledge exchange  Research, knowledge transfer, and exchange  Improving knowledge exchange processes	Dissemination of available methodologies that retrieve lost knowledge	Sharing knowledge over the network  Exchange knowledge anytime anyplace on any device  Product multidisciplinary knowledge	Entrepreneurial knowledge exchange activities within the higher education sector	Generation of knowledge (a traditional function) Knowledge transfer to the business (a new function)  Intersection of education, research, and transfer of knowledge		Knowledge transfer to industry  Contributing to knowledge generation
Facilitate And Consolidate Communications / Interactions With Other Elements Of The National Innovation System	Interaction of university, industry, and government	Support and drive regional, social and community development	Involved in partnerships, networks and other relationships with public and private organizations	The creation of active partnerships with other universities, national and international, with local government and development agencies, with NGOs	Interactions with venture capitalists and business	The interaction of the university with the environment, the "structural coupling" between university and region	Industry-university collaborations	Building/supporting inter-relationships/linkages among entrepreneurs, venture capitalists, business incubators, and other actors	Interactions among individuals/ organizations/ organizations/contexts	University-industry relations
	Links with industry  Knowledge exchange (generate added value)  Provides opportunities for staff and students to take part in entrepreneurial  To support staff and student mobility between academia and the external environment.	Committed to collaboration and knowledge exchange with industry, society and the public sector (support mechanisms for coordinating these relationships)  Has strong links with incubators, science parks and other external initiatives, creating opportunities for dynamic	An umbrella for interaction, collaboration, co-operation and among the core elements of a national innovation system  Strong collaborative agreements between university and industry	Active involvement with alumni groups  Establishing close links with the businesses and communities	Academic advances infuse new technologies into existing industries  An entrepreneurial university interacting with industry and government	Interacts closely with industry and government  The Triple Helix model is the framework where university, industry and government interacting dynamically to create innovation for a knowledge-based society.  Explore opportunity via government and industrial connection.	Interaction with the industrial world	Industry-university relations focusing on the commercialization		Research centers can also play a role in connecting with industry and developing depth in these interactions  Faculty should be given the freedom to pursue links with industry

Table1. Ctd

Entrepreneurial Education	Curriculum	Curricular reform	Research results are integrated into entrepreneurship education and training (curriculum up-to-date)	Entrepreneurship courses for students and academics	'Employability' is being embedded contextually in the curriculum	Established training programs in entrepreneurship designed to create firms	Recognize business opportunities and transform the ideas to products through action-oriented and research integrated curriculum	Willingness to change and multidisciplinary training	The relevance of entrepreneurial education, opportunity recognitions and intention,	Validates entrepreneurship learning outcomes	Entrepreneurship Education at Universities
		Entrepreneurship courses for students and academics	Promoting diversity and innovation in teaching and learning. Entrepreneurial behavior is encouraged and supported throughout teaching and in extracurricular activities	Entrepreneurial teaching methodologies	Wider opportunities for student experiential	To encourage student entrepreneurs					Support entrepreneurship and entrepreneurship education.
Entrepreneurial Education	Academic Workforce powerment	Ways of teaching Producing graduates who are not only job seekers but also job creators			Enterprise and entrepreneurship pedagogy and knowledge organization across the university						Entrepreneurship teaching methodologies, through both curricular and extra-curricular activities to engage in entrepreneurial and creative activities
		The development and implementation of entrepreneurial courses for students,									
Entrepreneurial Education	Academic Workforce powerment	Recruit graduate students internationally	Stimulates and supports the development of entrepreneurial mindsets and skills.	To develop both creative and critical thinking	learning experiences alongside entrepreneurial and enterprise skills	Encourage their staffs to the formation of a firm.	All staffs to be entrepreneurial and build teacher as a business mentor or industry consultants	Entrepreneurship education	Strong contributions proving talent human capital (entrepreneurs, employees)	Invests in staff development	Successfully producing graduates with entrepreneurial mindsets
		Greater faculty responsibility for accessing external sources of funding	Generating entrepreneurial competencies and skills; Provides opportunities to experience entrepreneurship.	Provides a workforce and value added with the creation or transformation of knowledge	Formal teaching and learning strategies; staff development programs; and student-led initiatives				Talented human capital and a qualified workforce		

Table1. Ctd

Development Of Entrepreneurial Culture	Development and understanding an entrepreneurial culture	Building an entrepreneurial culture within the staff body	Promote an entrepreneurial culture	Development of the 'enterprising person and entrepreneurial mindset'	Creating an entrepreneurial culture	Promotion of entrepreneurial culture	Increasing the opportunities to attract smart people interested in the commercialization of their research results	Supporting the entrepreneurial culture (values and attitudes toward educational programs)	Development of an entrepreneurial culture	
	Favorable staff and student attitudes toward entrepreneurship Adequate cultural values	Raises awareness of the value/importance of developing entrepreneurial abilities amongst staff and students.	Favorable student & staff attitudes towards entrepreneurship	A Strategy for Business Engagement – developing an Entrepreneurial Culture fostering a more entrepreneurial mindset in the organizations	Importance of entrepreneurial culture and behavior will eventually change the core structures of the university	Actively encourages individuals to become entrepreneurial		The entrepreneurial culture at institutions was more holistically	Favorable attitude by staff toward entrepreneurship was identified as the most important facilitator	
	Favorable attitudes of students and faculty toward entrepreneurship	Build and foster an entrepreneurial culture	The entrepreneurial attitudes of academics, managers, researchers, staff and students						Developing an entrepreneurial mindset	
Governance And Academic Leadership In The Direction Of Economic Growth And Development	Have a new managerial ethos in governance, leadership, and planning	Generating entrepreneurial motivation, cognition, and attitudes;	Management, governance and leadership	Governance, strategy, organization design and leadership at all levels	Assesses the level of engagement in entrepreneurial teaching and learning across the institution	Management with entrepreneurial style to cultivate leadership, initiative, dynamic founding team (Resource-based View)	Be responsive to the interests of a variety of external stakeholders	Contribute and provide leadership for creating entrepreneurial thinking, actions, institutions and entrepreneurial capital	Provide effective incentive systems for scientists	Involve management in rewarding entrepreneurial activity and encouraging staff
	University leaders should be skilled at identifying business opportunities that arise from the dynamic interaction of the organization and its stakeholders	Gives status and recognition to other stakeholders	Entrepreneurial organizational and governance structure,	The entrepreneurial leader is a role model for enterprising behavior	assesses the impact of entrepreneurship teaching and learning	Collaborative leadership	Clear rules on intellectual property ownership	Adopts an entrepreneurial management style		Entrepreneurial organization and entrepreneurial leadership
	Appropriate reward system	Understand the value of multiple stakeholder engagement to support entrepreneurship	Appropriate reward systems Entrepreneurship role models	Style of this transformational leadership model				To manage the innovation/entrepreneurship functions		Entrepreneurship role models, and reward system



Table1. Ctd

Revise And Manage Multiple Missions Of University In Direction Of Economic Growth And Prosperity	Their traditional missions of teaching and research, add the generation of social and economic value to society	Commitment to creating economic and social value and impact  Improving the economic welfare	Focused on fulfilling teaching, research and entrepreneurial activities simultaneously  The new university missions are focused on their contribution to social development and economic growth Generate jobseekers Publishing papers with practical implications Knowledge transfer (patents, licenses, spin-offs)	Contribution to national, regional and local economic and social development  Social and economic utility  The emphasis is upon 'economic value'  Contributing to local and regional economic and social development	Involves extension from ideas to practical activity, capitalizing knowledge, organizing new entities and managing risks  University's role in economic and social development, based upon innovation  Regional economic development	Universities have a strategic role to play in regional, national, and economic development.  Providing economic autonomy	Contributing to the technological and economic development  Contribution to develop and sustaining economic growth	The core entrepreneurial university missions (teaching, research, and socio-economic contribution)  Facilitating economic growth To stimulate regional economic development	Entrepreneurial activity as an important component of a university's mission  Advance regional economic development  Economic growth and wealth creation  Increase economic development	The mission of universities has evolved from engaging in traditionally focused activities such as teaching and research to a broader remit that includes commercialization and economic development.  "Third mission" university
	Efforts to recruit graduate students internationally	Internationalization  Attracts international and entrepreneurial staff (including teaching, research and PhDs)  Demonstrates internationalization in its approach to teaching	Increasingly collaborating, networking and partnering with multiple industries, universities  As a driving force for competitiveness in global markets	Internationalization processes;  International alumni engagement  Creating an international presence  University's international reputation is a vital stimulus  Increasing global competition	Retain competitive advantage accrued and develop new sources of competitive advantage within the service sector	The elimination of barriers to international collaborative research created by different national laws regarding the ownership and exploitation of IPRs  Defending universities' competitive position	The role of internationalization has been misunderstood in the academic debate of emerging universities models  To innovation, competitiveness	Internationalization	Efforts to recruit graduate students internationally  Competitiveness	

### **Entrepreneurial education**

In general, universities are expanding, developing and training their entrepreneurship to the Institute, including all employees and students, which shows the university require having an organizational structure to support entrepreneurship development as well as provide the appropriate tools for providing teaching and training opportunities from indoors and outdoors environments.

Entrepreneurial education is divided into two parts: the curriculum and the academic workforce empowerment:

#### **A) Curriculum**

The development and implementation of entrepreneurship courses for students, as one of the important factors helps in the further integration of the university into an entrepreneurial university (17). Therefore, reform of curriculum and efforts to attract international postgraduate students are a common answer to the call for increased entrepreneurship in universities (18).

Entrepreneurship courses for students and academics are effective and facilitating formal factors and entrepreneurial teaching methods are effective informal factors in the proposed conceptual framework of entrepreneurial universities. Also, the number of courses, programs, and entrepreneurial activities, the proposed period in entrepreneurship and the research methodology are the criteria for assessing the educational objectives of university entrepreneurship (19).

The goals of an entrepreneurial university are focused on the production of graduates who are not only job seeker but also job creator (20). Universities, in order to become entrepreneur, must apply the resources and capabilities to enable their students, faculty and staff in initiatives, business opportunities, and ideas transformation into products, through action-based curriculum and integrated with research (21).

#### **B) Empowering the academic workforce**

Creating skills and entrepreneurial abilities in faculty members and academics is one of the performance indicators in university entrepreneurship. The university is also investing in employee development to support entrepreneurship. Employees are a key source of strategy, entrepreneurship education, support for business start-ups and all entrepreneurial activities that the university wants to develop (8).

Although the formation of companies by the university is not a new phenomenon, universities have recently accepted to encourage their employees to do so. In addition, faculty members maintain their position who are involved in the formation of companies. Some universities are concerned that entrepreneurial interests may alienate faculty members from their traditional educational activities, and some academics avoid attending in universities that are under the control of companies that share research projects on campus. Companies that have been formed by academics have their impact on the university. In this case, universities will engage in commercialization of research (15).

### **Creation and presentation of applied knowledge**

According to Kirby et al. (2011), one of the criteria for assessing the success of entrepreneurial universities is the transfer of knowledge (through patents, licenses, and contracts), which is the consequence of these universities in the research sector (19). Universities play an important role in the development of knowledge-based economies for the creation, application and dissemination of knowledge (22).

Universities must have mechanisms for exploiting knowledge and internal resources, and they have a great deal to exchange knowledge, through collaboration and participation. Knowledge exchange should be part of institutional politics. Therefore, the university should support the mechanisms of knowledge exchange and cooperation with the external environment. The university also conducts regular monitoring and evaluation of academic knowledge exchange activities (8).

One way that universities can add value in access to key strategic goals of a university is to improve knowledge exchange processes (23).

#### **Facilitate and consolidate communications and interactions with other elements of the national innovation system**

The University is committed to collaborating and sharing knowledge with industry, society and the public sector, and has strong connection with incubators and science parks in order to create opportunities for the dynamic exchange of knowledge. Universities can generate value added from their relationships with their outside environment. Hence, university communication with the industry is one of the official facilitators in the university entrepreneurship (19).

Building a close relationship with business and communities is a strategy for the development of entrepreneurial universities. Many successful international businesses have excellent communication links. Establishing strong relationships with business and industry is essential to ensure that education and research are directly related to society and the environment (23).

Triple Helix is a framework that interacts with college, industry and government to interact with each other in order to innovate in a knowledge-based society. The university discovers opportunities through government and industry communications, and it is provided by faculty, staff and students (21).

In the entrepreneurship ecosystem, universities have strong partnerships to create or support relationships and communications between entrepreneurs, risky investors, business incubators, and other actors (24).

#### **Development of entrepreneurship culture**

Promotion of entrepreneurship culture is one of the mechanisms that can help entrepreneurship in universities and is one of the criteria for the success of entrepreneurial universities. At the heart of every culture of entrepreneurship, entrepreneurial universities have the ability to innovate, recognize and create opportunities, teamwork, risk

acceptance, and response to challenges. Understanding the culture of entrepreneurship by students leads to their favorable attitude toward entrepreneurship in the university (19).

Creating a culture of entrepreneurship in the staffing group is essential to increase and improve the quality of entrepreneurial activities of the university. The encouragement and appreciation of entrepreneurial behavior in all employees reinforces the commitment to development as an entrepreneurial university. Universities must also encourage employees and students to develop entrepreneurial mindsets, behaviors and skills through a range of mechanisms that can be devoted to the individual. Universities can create and reinforce a culture of entrepreneurship by hiring employees with strong entrepreneurial backgrounds. Therefore, the institution should use entrepreneurial attitudes and experience as a measure of employment (8).

The development of entrepreneurial culture is a business strategy, and strong leadership and good governance for the development of an entrepreneurial culture are vital and necessary (23). Hence, an entrepreneurial university must inject an entrepreneurial mentality into any graduate, and this is not possible without the content of entrepreneurship in the academic curriculum (25).

#### ***Governance and academic leadership in the direction of economic growth and development***

Entrepreneurial universities have a new management ethics in governance, leadership and planning. In addition, university leaders need to be expert in identifying business opportunities that create from the dynamic engagement of organizations and their stakeholders (26).

Also, leadership and governance are as one of the dimensions of the Entrepreneurship Guidance Framework in Europe, stating that strong leadership and good governance are crucial to developing an entrepreneurial culture within an institution. In fact, entrepreneurship should be an important part of the strategy of universities (8). One of the main factors of entrepreneurial universities is the entrepreneurial attitude of academics, managers, researchers, employees and students. This means that a sufficient mix of leadership and university governance and a positive attitude toward entrepreneurship in the university community are causing significant changes in the university. As a result, an entrepreneurial university requires managers with leadership attributes in full time professional positions to carry out their mission (27).

But, implementation of entrepreneurial processes in universities is condition for entrepreneurship and one of which is an entrepreneurship management style for leadership development. The collaborative leadership is one of the leadership styles that is most effective at entrepreneurial universities (21).

One of the university's subordinate roles in governance and leadership is identifying and focusing on the competitive advantage of economic growth and development. Increasing university reputation, competition, and differentiation has been introduced as one of the activities that contribute to the potential of entrepreneurship to achieve key

university goals (23). Internationalization is another subordinate role for universities in the functioning of governance and leadership, so having an international perspective at all levels (19), is one of the characteristics of these universities. Also, establishing an international university presence can help in reviewing the potential of entrepreneurship in achieving key university strategic goals of value added (23).

Reviewing and managing the multiple missions of the university to boost economic growth is a necessary requirement for 3<sup>rd</sup> GU. In such organizations, in addition to traditional teaching and research missions, social and economic values are added to society (7).

The mission of universities has evolved from participating in more focused activities, such as teaching and research to a broader stage, including commercialization and economic development. In addition, universities have a strategic role in regional, national and economic development. In this context, the Triple Helix model plays a role (28).

#### **Discussion**

All authors who have yet discussed the necessity of conversion for universities to third-generation universities, introduced 3<sup>rd</sup> GU as entrepreneurship universities, and presented the corresponding functions for these universities. But our findings in this study, while criticizing this approach as an incomplete one in existing literature, introduced 3<sup>rd</sup> GU as entrepreneurial and innovative universities (as Kyro and Matila mentioned) (2) and, while extracting, elaborating and synthesizing the functions of the 3<sup>rd</sup> GU in this format, Finally, a comprehensive and applied model for 3<sup>rd</sup> GU was abstracted and resulted.

This model improves the weakness of the lack of a functional model in the texts by providing an useful guide for moving universities toward the 3<sup>rd</sup> GU.

Based on the findings of this study, researchers categorize the functions of universities and provide it in the following model (Fig. 2):

##### ***1. Innovative and entrepreneurial activities***

Innovative and entrepreneurial activities are the foundation of all other functions. Each research starts with a basic research based on the community's needs and must pass through the translational research field before use. The work of translational research is an intervention proposal and requires a deep understanding of basic research and existing problems. In the discussion of third-generation universities, translational research seems to be very important because it is innovation proposal before the impact of innovation is evaluated.

When it comes to its impact, we need to look at how to present it in the form of goods or services, which is done in the research and development unit. Valorization is an event or action that occurs in this unit. In the next step, the production and marketing of a product or service is considered. These sequences of activities guided us to innovative and entrepreneurial activities (first core functions of 3<sup>rd</sup> GU).

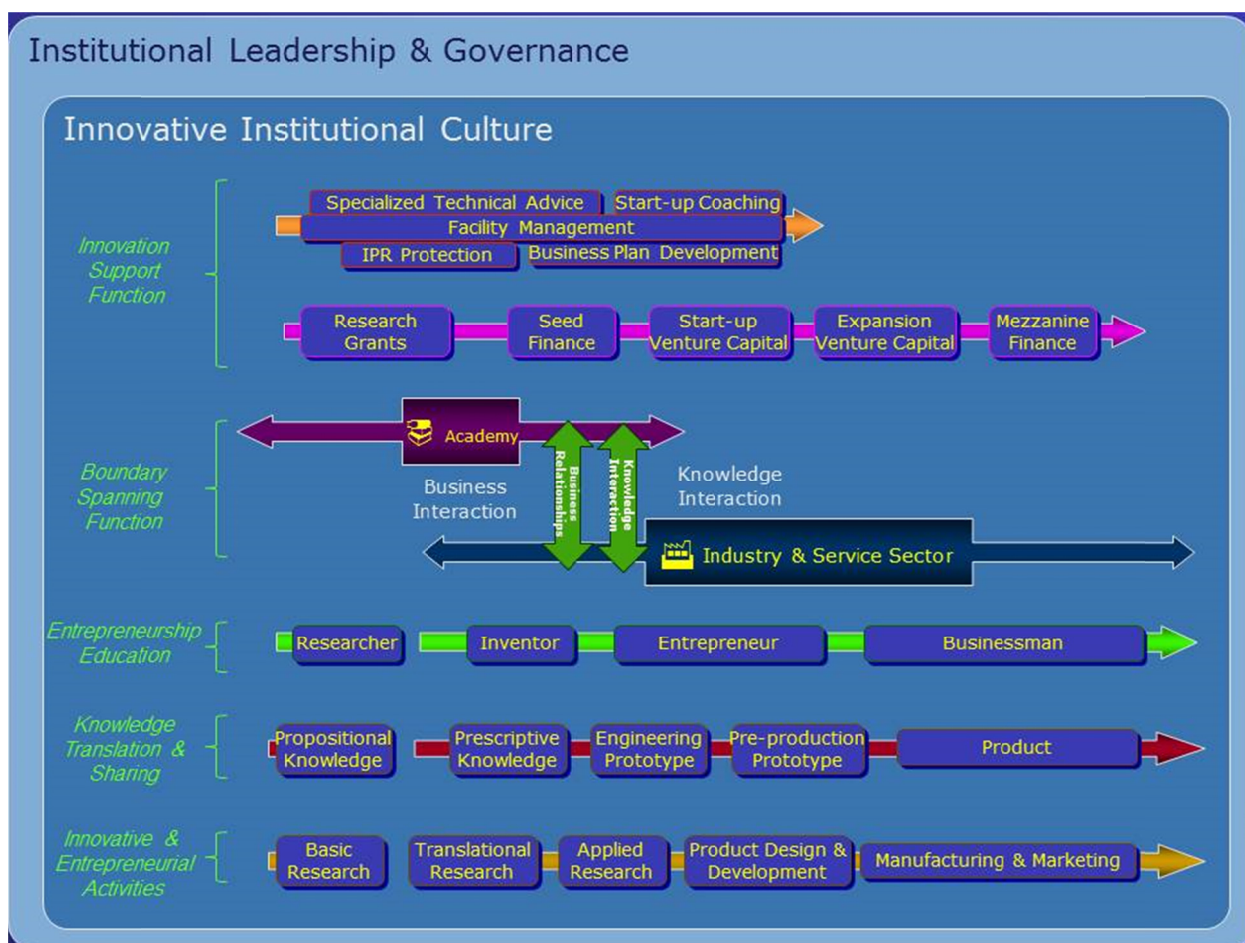


Fig. 2. Core Innovation Functions Model of 3<sup>rd</sup> GU

## 2. Sharing and translating knowledge

In this section, we translate and share the knowledge produced (propositional and prescriptive knowledge). Then, knowledge transformed to engineering prototype and, pre-production prototype and finally product. In other words, the 3<sup>rd</sup> GU is a university that runs the path of management and knowledge sharing from academia to business. Here is the creation of knowledge related to innovation and entrepreneurial activities and the provision of knowledge related to the exchange, transfer, diffusion and management of knowledge (29). These conversations led to sharing and translating knowledge activities (second core functions of 3<sup>rd</sup> GU).

## 3. Entrepreneurial education

Entrepreneurial education is also related to the curriculum and entrepreneurship education, as well as the empowerment of staff and faculty members. At 3<sup>rd</sup> GU, we expect that the faculty member is not just an educator, but also a researcher, inventor, entrepreneur, and businessman, and their empowerment programs should be provided (30). These arguments directed us to entrepreneurial education (third core functions of 3<sup>rd</sup> GU).

## 4. Boundary Spanning Function

The 3<sup>rd</sup> GU must go beyond boundaries and interact with the industry and government sectors in accordance with the Triple Helix model (31). These interactions can be discussed both in knowledge and in business background:

Levels of knowledge interactions include strategy and planning, information transfer, transfer of skills between sectors through individuals, increase skills, increase exploiting commercial knowledge, and level of access to facilities and capabilities.

Levels of business interactions, including: collaboration and Business partnerships, contracts and consultations, business partnerships, business competition, business associations, business networks, graduate associations, university-industry affiliate organizations, business growth centers and science and technology parks (32).

These activities conducted us to boundary spanning function (fourth core functions of 3<sup>rd</sup> GU).

## 5. Support activities (financial and non-financial)

The University's financial support activities include research grants, start-up venture capital, expansion venture capital, Seed Finance and Mezzanine Finance.,

The University's non-financial supports include special-

ized technical advice, start-up coaching, facility management and intellectual property protection and business plan development. These setting of activities guide us to Support activities (financial and non-financial) (fifth core functions of 3<sup>rd</sup> GU).

#### 6. Develop innovative and entrepreneurial culture

The development of the innovative institution culture is accompanied by activities such as changing the mentality and the perspective of the academic workforce by providing entrepreneurship courses, which is a clear reflection of entrepreneurship in the organization's symbols and slogans. Also, rewarding to entrepreneurial activities and promoting entrepreneurial activities in social & cultural events are the functions of the 3<sup>rd</sup> GU in develop innovative and entrepreneurial culture.

#### 7. Institutional governance and leadership in the direction of economic growth and development

Leaders in these universities, in order to support entrepreneurial and innovative activities, balance management behavior practices with transformative leadership styles (33). All functions take place in the context of institutional culture and institutional leadership style, and this style of leadership is that makes the institution's culture. All these functions together move the university towards economic and social value added (7).

#### Conclusion

Universities are required to survive and stay in the cycle of the innovation system and the Triple Helix model to promote their functions. Moving toward 3<sup>rd</sup> GU, that is both innovative and entrepreneurial, can contribute to these changes. Therefore, awareness of the functions of these types of universities is needed both for their survival and for the development of the economies of the states. In this study, various functions of the 3<sup>rd</sup> GU were identified and determined, which included 7 main functions of innovative and entrepreneurial activities, supportive activities (financial and non-financial), entrepreneurial education (curriculum and academic workforce empowerment), creation and the provision of applied knowledge, Boundary Spanning Function or communications and interactions with other elements of the national innovation system (state and industry), the development of innovative and entrepreneurial culture and institutional governance and leadership in the direction of economic growth and development.

The proposed model in this study can be the basis for the planning, implementation and evaluation processes of universities in updating their functions in the transition to 3<sup>rd</sup> GU. Obviously future studies can use these functions and design tools and relevant questionnaires to determine the rate of success in each university and provide the necessary suggestions to provide the mechanism for the establishment of a successful university.

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#### Conflict of Interests

The authors declare that they have no competing interests.

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