ORIGINAL RESEARCH

Structural Requirements of the Third-Generation University: The Case of Medical Sciences Universities in Iran

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Introduction: Given the social, economic, environmental and internal developments of universities, the necessity for medical universities to move to being third-generation universities has been demonstrated. These universities, along with the requirements of entrepreneurship and commercialization of research, are in need of structural requirements. This study was conducted with the aim to identify and introduce the structural requirements of medical sciences universities in Iran in the transition to the third-generation universities.

Materials and Methods: This study was a qualitative approach using a conventional content analysis method. The contributors comprised 16 faculty members working in medical universities in Iran who were purposefully recruited and interviewed face to face in semi-structured interviews between October 2018 and March 2019.

Results: Two wide classifications containing macro-structural requirements (institutional requirements) and micro-structural requirements (organizational requirements) were developed. Institutional requirements included four subcategories including redefining the university as a holding of knowledge business units, redefining academic units as a strategic business unit (SBU) which refer to the mission of the universities and eliminate bureaucracy, independence, and 'Competition in recruitment and contracts' which refer to the administrative requirements of the universities. The organizational requirements included units and offices, centers, and parks that are grouped because of similarities in internal processes.

Conclusion: Medical universities need structural requirements to move to third-generation universities and improve infrastructure. These requirements, which develop in a spiral over time, must be appropriate and tailored to the capacity of each university.

Keywords: third generation university, medical sciences universities, structural requirements, Iran

Introduction

The concept of a third-generation university (3rdGU was proposed by Weissma in 2009 in line with the second academic revolution. Universities, he argues, are changing given the increase of competition for investment, students and academics as government demand for technology-based economic growth, and that economic and social growth and development are tied to the mission of universities.[1] The Second Academic Revolution, which took place in the late twentieth century (70s and 80s), also points out that the development of university–industry relationships was considered to introduce new technologies through the integration of

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industry-required research that led to the emergence of The third mission became universities (economic and social development).[2]

Inevitably, universities will change in content, structure, governance, and strategy to develop relationships with stakeholders and enhance mutual engagement, in which case a model of the university must emerge.[3] Also, developing an organizational mechanism for transferring research from the university as protected intellectual property is a key element of the Etzkowitz model for 3[rd]GU.[4] In addition, the organizational and administrative structure of the university is one of the factors in the creation and development of entrepreneurial universities.[5]

3[rd]GU should be in the form of institutions or organizations that nurture interdisciplinary and internationalization advantage with financial efficiency and infrastructure success.[6] In addition, Skribans et al (2013) believe that designing universities in any country is a fact, but the good situation is that the problem is considered and emphasized by the growing demand for skilled professionals (such as the basic product of traditional universities) and the limited resources of universities such as financial resources, human resources, etc.[7]

On the other hand, the social, economic, environmental revolutions, as well as internal developments of universities in recent decades have been influential in the emergence of 3rd GU. In the process of establishing a 3[rd]GU, it is necessary for universities to transform themselves in structural, functional, managerial and cultural dimensions and expand the infrastructure needed to provide newer functions.[8] Danneels (2007) believes that the appropriate structure for 3rd GU is flexible structure, because flexible structure supports organizational adaptation, innovation and survival.[9] Structural independence provides the benefits of entrepreneurial universities; its greater flexibility increases flow of information.[10]

In Iran, the necessity to move to 3[rd]GU has prompted medical universities to consider the importance of structural requirements alongside entrepreneurship requirements and commercialization of research. Some reasons, which medical universities in Iran need to reconsideration in their general structure and functions, include:

- Their reliance on government budgets and the inability to self-govern
- Lack the ability to implement start-ups to advance the country's economic goals
- To be confined and acting in island

- They do not take advantage of the growth of science production and lack the perspective of exploitation of produced knowledge, and
- They possess an inadequate structure and functions
- The existence of a productivity structure
- Inefficiency of educational functions
- Lack of empowerment of people with current curriculum
- Lack of alumni skills, and
- Lack of making use of worldwide research due to insufficient communication with the outside world[11,12]

Of course, this change in structure and function must be proportionate with the requirements and capacity of universities and with the definition of process and activity. Moreover, the transformation of the country's economic system will not be possible without emphasizing the promotion of the status of medical sciences universities and the entry into the field of 3[rd]GU. Therefore, medical universities are obliged to provide the necessary conditions and prerequisites for the transition to a 3[rd]GU.

On the other hand, there is currently no study in the world that describes the 3[rd]GU system because of its concept of simulation and design. The third-generation university model development is a reality that is essential for all universities around the world, but most existing models face the problem of scarce resources (financial, human resources, etc.) or the inadequate quality and effectiveness of these models. Furthermore, providing the conditions for the development of 3[rd]GU depends on the ability to develop and manage innovative technologies that need to be provided in its infrastructure.[7]

This transformation is necessary for Iranian universities of medical sciences, which are dependent on government funding. And in order to survive, universities of medical sciences need to have structures and processes proportionate to these functions in addition to enhancing their functions; therefore, this study intends to explain the structural requirements of these universities in the transition to 3[rd]GU and answer the following research question of this study: What are the structural requirements of medical universities in transition to 3[rd]GU?

Methods

Giving that the purpose of this study is to explain the structural requirements of the universities of medical sciences in transition to 3rd GU, it is necessary to explore this process using a qualitative methodology, report the details from the informants, and conduct the study in a natural setting. As the

cause-effect relationship is not sought, and we are not seeking lived experience by phenomenology, the method of content analysis is appropriate in which a widely used technique for analyzing is the written, spoken or visual communications in which raw data is divided into categories based on the inferences and then summarized. This study has incorporated a conventional content analysis approach wherein codes and categories are derived from the text data.[13]

This study was conducted with the participation of 16 faculty members (4 females and 12 males) affiliated to medical universities of Iran. The inclusion criteria of the study were determined based on Munhall's criteria (Experiential fit & Good informant)[14] about awareness of 3rd GU, innovation and entrepreneurship, and being owners of a company. They were selected with regard to their experience using purposive sampling method.

During sampling, after contacting the selected participants by phone, the objectives and the subject of the study were clarified to them, and they were asked to contribute in the study, after obtaining verbal informed consent, and promising them that they can leave the study at any time and that all would be gathered unanimously (the names being replaced by special numbers or codes), the interview was conducted in three phases.

We decided to conduct a pilot interview with two of the participants, and after analyzing each interview, the need for new questions or modification and completion of the questions in the first phases, as well as for the next participant was determined for the interviews. The second phase, with a purposive sampling, consisted of fourteen exploratory interviews and after analysis, the researchers concluded that the data were relatively saturated, and in the third phase, to confirm the data, two other participants were interviewed, and by analyzing the new data, the codes and categories gained from previous interviews were approved and it was confirmed that the data were saturated and no new information was obtained. A total of 16 interviews were conducted with 16 interviewees.

Data Collection

The main method of data collection was extensive, semi-structured, and interactive in-depth interviews. All interviews were conducted and recorded by one researcher (first author) and instantly written down on paper. The interviews were run in a quiet environment at a time and place appropriate for the participants, and the mean duration of the interviews was between 50 and 85 min. Each interviewee was interviewed once and a total of 16

interviews were conducted. The interviews continued until data saturation was reached, a point where no new data from transcripts were obtained. The participants' voices were recorded using a voice recorder.

The interview guide based on extensive literature review was used. Firstly, the interview started with a general question asking "In your opinion, what are the structural requirements of medical universities in transition to the third-generation university?" and it was followed by asking probing questions such as "What do you think the results of these requirements will be?", "Why shouldn't it be like this?", "What do you mean by that?" or phrases such as "Please explain in more detail".Graneheim and Lundman's methods were used to analyze the data.[15] Firstly, all interviews were transcribed immediately after each recording and were read several times to make a comprehensive sense of their content; then, according to the aim of the study, the transcriptions, after being reviewed several times, were compressed into the meaning units and initial codes. Then, the codes were reread to be classified into subcategories; finally, the main categories, according to the degree of their semantic similarity, were extracted. Also, attempts were made by the researcher to not be influenced by his presuppositions, as far as possible, in the process of data analysis.

Rigor

To assess data rigor, the authors have used credibility, dependability, conformability, and transferability criterion based on Guba and Lincoln (1985).[16] For this purpose, the following strategies were used: long-term engagement in the research environment, immersion in data, member checking, and peer checking.

Also, there was a constant link between the subject and data. The opinions of the research team regarding the process of interviews and data analysis were considered. The interview transcripts and findings were also shared with some of the participants. Further, processes of the study audit by an external observer, not a member of the research team, who was familiar with the 3rd GU and methodology of qualitative research and had reached a consensus with the results. The transferability was confirmed by sharing the results with two faculty members not included in the study who were in a similar situation as that of the participants of the present study, who confirmed the findings.

Results

From the analysis of participants' narratives, a total of twelve subcategories and two categories "Macro-structural requirements" and "Micro-structural requirements" were attained. Categories and sub-categories are presented in Table 1.

Macro-Structural Requirements

Participants declared redefining the university as a holding of knowledge business units, redefining academic units as strategic business unit (SBU), eliminating bureaucracy, independence in attraction, and competition in recruitment in the transition of medical science universities to third-generation universities as macro-structural requirements.

Redefining the University as a Holding of Knowledge Business Units

According to the participants, if the medical universities are to become a third-generation university they need to be seen as a holding company and a holding of knowledge business units.

> To have a third generation university, we need to define the university as a holding company and redefine all of its

Table 1 Categories and Sub-Categories Obtained from the Analysis

Sub-Categories	Categories
Redefining the university as a holding of knowledge business units Redefine academic units as strategic business unit (SBU) Eliminate bureaucracy Independence and Competition in recruitment	Macro-structural requirements
Office of Industrial Relations, Office of International Relations Entrepreneurship Schools, Entrepreneurial Education Centers and Entrepreneurship Offices Intellectual Property Unit, Patent Offices, Law and Contract Tracking Office Technology Dept. (Technology Management Unit, Technology Units and Technology and Entrepreneurship Club) Venture Capital Funds Knowledge Management and Translational Unit, Technology Observatory and Horizon Scanning Centers Innovation centers, Incubators, Accelerators and Science and Technology Park R&D units and establishment of knowledge-based companies	Micro-structural requirements

functions in this context. We need to redefine groups and departments according to the business economy. At this university, each unit is a business unit, a unit which has input, output and processes and its output is the financial profit that becomes autonomy. (P10)

Redefine Academic Units as Strategic Business Unit (SBU)

Also, universities of medical sciences redefine academic units as strategic business units. In this case, each department, such as spin-offs outside of the university, is seen as a knowledge-based company and contracted with the university.

> In order to have a third-generation university, we need to redefine the departments and educational groups with regard to the business economy and they should be business units in their mission. (P2)

Eliminate Bureaucracy

In addition, medical universities in Iran need to minimize bureaucracy in order to achieve their missions, because bureaucracy reduces creativity and innovation as well as mitigating incentives for university staff.

> Now, our faculty members want to become involved financially with companies outside the universities, they have to go through a lot of filters to invest their money. Therefore, they try to communicate with different companies, but their connection is not visible, because the university has made the job hard. The university has increased the bureaucracy which prevents such action being possible. (p4)

> We have so much bureaucracy inside the systems that accepting the innovations and mental creations within them is meaningless. (p15)

Independence in Attraction

Participants pointed out that universities should be independent in attracting and creating competition in the recruitment of a student, employee and faculty with the indicators of the third-generation university.

> Some people who are in the first-level of university that do not have the necessary conditions to be a student. I believe universities should be independent in attracting students. I have to attract people that fit into the third generation. There should be some indicators if we are to make a choice,For example, they have to be competitive, which is one of the 3GU indicators. Competitive action in recruiting an employee, in attracting students, and in

attracting a faculty. And this does not just apply to a certain language, country or border it applies to everyone and everywhere. (p7)

Micro-Structural Requirements

Participants acknowledged that research & development (R&D) units, innovation centers in the transition of medical science universities to third-generation universities as micro-structural requirements.

R&D Units and Establishment of Knowledge-Based Companies

Medical science universities that are based on service and apply knowledge but do not valorize it. Therefore, we need R
& D units at the university for valorization of knowledge.

> I think we need to create a research and development unit that is rather empty in the medical sciences universities compared to in the Ministry of Science, in order to use the knowledge generated at universities to be valuable and useful. (p3)

> R & D are dependent on companies. One of the structures we need to build is the establishment of knowledge-based companies in colleges. You know, the requirement for being knowledge- based is that R
> & D is on the side of the company, and it builds the company knowledge- based. (p6)

Innovation Centers, Incubators, Accelerators and Science and Technology Park

One of the centers to be established at medical science universities is innovation centers, incubators and accelerators. The prototypes derived from the ideas in the incubators to become start-ups and then enter the innovation centers for stocktaking and marketing analysis.

> At first, the idea turns into a prototype, but this prototype must go to the incubator to become a startup company. Then, from the startup company proceed to an innovation center, to take stock for work with big companies, and its marketing will be done, and will be a large company. (p7)

> Innovation Center Where you build your company, you create an accelerator, it's the center for entrepreneurship training at the university. That is one of the structures that should be created. It has a centrality and provides service to all colleges. (p13)

> We now want the incubator at our universities, also we need the science and technology park, which itself is

a combination of incubator!!!!!!!. Like the University of Cambridge, all businesses, companies that are contracting with the university, go there. (p6)

Knowledge Management and Translational Unit, Technology Observatory and Horizon Scanning Centers

The participants emphasized that the establishment of knowledge management and translational unit is a requirement of the third-generation university, which, through the creation of the horizon scanning centers and the technology observatory, would result in appraise and synthesis of knowledge and the transformation of raw knowledge into the knowledge product.

> Unfortunately, we do not have the knowledge translation process in measuring knowledge value. That is, the faculty generates knowledge that is not the ability to translate into the problem of society. (p4)

> Dynamic interaction is the essential necessity of interaction with the community, which can connect the inside to the outside, monitor future developments, horizontally scang, and develop their programs based on this horizon scanning. (p10)

Venture Capital Funds

Some contributors argued that the existence of a venture capital fund near universities means attracting funding or investment in start-ups and start-ups which are at high risk and mainly benefit from the high technology.

> Seed funds for universities should seem to be available for funding, followed by VC = venture capital funds.our third-generation universities should have their own specific venture capitals alongside these university centers, and feed the system's financial resources. (p11)

Technology Dept. (Technology Management Unit, Technology Units and Technology and Entrepreneurship Club)

To offers of contributors, it is possible to separate the Vice-Chancellor of Technology from Vice-Chancellor of Research and Technology at Third-Generation Universities. In this department, the units of technology, technology management and technology and entrepreneurship clubs and other units will play a role.

> In my opinion, the units should be created inside the university and at the university, not next to the university. The technology unit, in my opinion, is a collection of

research and technology deputy. Perhaps one day, the deputy director of technological affairs will be separated from the research deputy. Technology has its own complex set of strategies that are neither defined in education nor research. (p9)

We have a lot of upstream documents nowadays that are legalizing technology. The ten regions that are defined in the country, many of them on their own, the formation of technology administrations, is being emphasized very seriously. (p11)

I think the university should have some special support, create a number of entrepreneurship offices in colleges. I think that we will create a technology and entrepreneurship club in all colleges. Even let's face it all, not just to have a room under the ground, and should be in front of everyone. Students constantly see it, its walls are glass. Keep the entrepreneurial slogans open to those who are eager to open the glass. See that the students are ideas. (p14)

Intellectual Property Unit, Patent Offices, Law and Contract Tracking Office

Participants believe that one of the areas that medical universities need to have on the path to a third-generation university is the Intellectual Property Unit, Patent Office, and the Law and contracts Office.

Our inputs are in universities, designs and inventions. So our intellectual property law must be the same, our patents must be in place, patent offices should be in the universities. (p15)

Failure to write contracts and unawareness of legal issues is the biggest blow to the startup companies that are formed by students and professors with large corporations, which means they are not able to write well how to participate. Well, you know, no one has compassionate consulted them. (p1)

Entrepreneurship Schools, Entrepreneurial Education Centers and Entrepreneurship Offices

Participants pointed out that the creation of the Faculty of Entrepreneurship is contributing to the development of creativity, innovation and creative thinking in students.

In my opinion, developmental thinking, creative thinking, and thoughtfulness must penetrate our universities. So how can students now get familiar with this line of thought at universities? It seems like adding some preconditions to their lessons, for example, lessons such as Entrepreneurship, creativity, business education can help them, as well as laying entrepreneurship colleges alongside universities. (p2)

I think the university should have some special support, create a number of entrepreneurship offices in colleges. (p5)

Office of Industrial Relations and Office of International Relations

Participants said that in order to achieve economic prosperity and development, attract and create capital; we need the cooperation and communication of the medical science universities in industry both in the domestic and international sectors.

We need to build trust and create localization in order to be able to do benchmarking. We must attract propagators from different countries in this field, so we need the international communication of the universities, of which international relations office of universities is helpful in this area. Also, the industry relations office can enter this environment and become the core of the story. (p8)

Medical science universities need an office for industrial relations, with its principle definition and by defining the process that must take place within it. It's not exactly our version that we just create office of industrial relations, but nothing happens within it. (p12)

Discussion

The new generation of universities confronts them with fundamental changes in various systems, including the structural system.[7] The purpose of this study is to determine the structural requirements of medical universities in the transition to a third-generation university. The findings showed that these requirements include macro and micro structural requirements.

Macro-structural requirements, or institutional requirements, in this study imply the requirements and processes involved in the macro-structure of the university refer to the redefinition of academic units to the business unit and even the university itself as a holding company and, is interpreted into mission requirements. According to the findings, medical universities need to be seen as a holding company to become a 3rd GU.

Accordingly, some universities around the world, such as the University of Malta, are pioneering the establishment of the University of Malta Holding Companies (MUHC) and the University of Abu Dhabi with the establishment of the Abu Dhabi University Holding Company (ADUHC), particularly in higher education and treatment sectors.[17,18]

Researchers in this study believe that if the university is converted into a holding company, each of the

departments, like spin-offs outside the university, will be seen as a knowledge-based company and contracted with the university. Therefore, the mission of the universities needs to be reformed.

These universities also need a number of administrative requirements, including independence in recruiting students and faculty, competing in recruiting students and staff, transparency and competing for contracts. Weisma (2009) also argues in his book, competition for better academics, better students, and better research contracts as essential features of 3rdGU.[19]

In addition, medical universities in the transition to a 3[rd]GU need to minimize bureaucracy in order to achieve their goals, because bureaucracy reduces creativity and innovation and reduces motivation of university staff. The findings of Molavi et al (2017), which showed that reducing bureaucracy would change positive attitudes and build trust and motivation in individuals, are consistent with the findings of this study.[20] Therefore, macro-structural requirements do not need to create a unit or office, but need to change in the current process.

But Iranian universities of medical sciences in the transition to a 3rdGU with micro-structural requirements can provide the platforms needed to move universities. These requirements include the units and processes that universities initiate or create, and define the processes that must take place within each unit, creating the context for their movement. Of course, micro-structural requirements mean more construction and physical space, and we can divide it into units, offices, centers, and parks.

Researchers in this study believe that in order to have a3[rd]GU, in the structural sector we need to establish units and offices to carry out activities for the third purpose (exploitation of know how).

At present, there is an office relation with industry at the university, but it does not have the necessary efficiency and effectiveness, so we need to redefine the process within it. Likewise, setting up an accelerator unit at universities to validate successful ideas, creating venture capital funds for financing, establishing R&D units, establishing a commercialization unit to meet the goals of a3[rd]GU, and establishing a technology management unit at universities, are helpful to transition to a3[rd]GU. The development of technology transfer offices and entrepreneurship offices in universities was among the factors that Gibb (2012) points out in his model for university entrepreneurship.[21] Radojevich Kelly et al (2012) also noted in their study that accelerating firms increase graduates' success in acquiring capital by launching a business, albeit using entrepreneurial mentorship and venture capital enhances overall success in this way.[22]

Centers and parks are other structural requirements that scholars agree are necessary to establish at a3[rd]GU . Because, innovation centers and science and technology parks in universities are necessary to create different knowledge-based companies. The findings of Shahverdiani's study (2010) also suggested that the development of science and technology parks, incubators and innovation centers in universities would lay the grounds for development. Therefore, it is necessary to prioritize the creation of these centers and parks in the development planning of universities.[23] In addition, the researchers believe that along this path, the establishment of an entrepreneurship club in each college can also influence the mindset of university students and staff. Of course, these units and centers are not created in all universities but in accordance with the capacity of each university.

Conclusion

Undoubtedly, for the sake of their survival and independence, Iran's medical universities must move to a third-generation university, which requires changes in the structural levels of universities. In this study, the structural requirements of universities were identified from the perspective of key informants and divided into two categories: micro and macro structural requirements. Micro-structural (organizational) requirements refer to the establishment of units and offices, parks and related centers in universities, and macro-structural (institutional) requirements refer to the university's mission and administrative requirements. Of course, universities cannot select all the structures and perform the corresponding functions, and not all structures are suitable for universities. Therefore, each university can choose appropriate and proportionate structures depending on its capacity and perform relevant activities in order to move towards a3[rd]GU .

Ethical Approval

In order to comply with ethical considerations, we obtained the approval from the Ethics Committee of IUMS (Code no. IR.IUMS.FMD. REC1396.9221486203). Also, while providing information to the participants about the research objectives and obtaining permission for recording of the interviews, they were assured that their information would remain confidential. They were also informed that they could leave the study at any time, but none of them left the study.

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Author Contributions

All authors contributed to data analysis, drafting and revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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