
Commercialization of University Research and Innovations in Iran: Obstacles and Solutions

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Commercialization of the university researches and innovations becomes more and more important in this era of volatile changes. Every day we could feel the challenges associated with this process in any knowledge based institute, such as universities, research centers, R&D centers, etc. Commercialization challenges are an integral part of these entities, and their managers are looking for some ways to handle them. In the present study, we used the Delphi method to find the main challenges and main solutions for commercialization of the university researches and innovations in Iran. After reviewing the literature, the challenges are considered and then the solutions are proposed. Finally, the paper concludes with a discussion of the research findings.

Keywords: *Commercialization, Obstacles, Solutions, Research, Innovation*

Introduction

Commercialization of university researches and innovations is an integral part of a knowledge based institution. This process has its own risks and uncertainties, and CEOs are always interested in development of new innovations to compete with their competitors (Li et al., 2005; Lumpkin and Dess, 1996). Moreover, commercialization of university researches and innovations depends on direct investment of the companies (Hitt et al., 1996; Zahra and Nielsen, 2002).

Although governments attempt to eliminate the obstacles to commercialization of innovations, through Incubators, Science Parks, etc., still there are a variety of obstacles before the commercialization process. Incubators are joint offices which help newly established firms and start-ups to handle their problems (Hackett and Dilts, 2008). Also, Science Parks and University Research Parks lay the grounds for development of those firms and facilitate the commercialization of their researches and achievements (Lofsten and Lindelof, 2005; Link and Scott, 2007; Sooreh et al., 2011).

The present study concentrates on the main obstacles to the commercialization of researches and innovations in Iran, and tries to answer to these two main questions? First, *“what are the main obstacles to commercialization of university researches and innovations in Iran?”* And second, *“what are the main solutions to eliminate the main obstacles to commercialization of university researches and Innovations in Iran?”* To answer these two main questions, we firstly reviewed the paper and then the Delphi method is used to collect expert views in this respect. Finally, the paper concludes with the main research achievements.

Literature Review

Today, universities act as important agents of knowledge-based economies and the innovation cycle (Etzkowitz, 2003), agents that are considered as the driving engine of human knowledge and which aim at the development of societies. This is more evident in entrepreneurial societies in which in view of Audretsch (2007) the knowledge-based entrepreneurship is considered as the driving force behind economic development, employment, competitiveness in global markets, etc. In this regard, the entrepreneurial

university plays an important role as both a manufacturer and a disseminating institution (Guerrero et al, 2010). Private and public sectors seek the produced knowledge in universities in order to address their problems and difficulties. Clearly, this is the result of the second revolution in the missions of universities and involves commercial engagement and goes beyond the educational and research purposes of these entities (Salamzadeh et al., 2011).

Notwithstanding that universities and members of faculties do not traditionally view research as capacities for exploiting market opportunities, they have come to the realization that they need to seize the emerging opportunities of financial support from the private sector and adapt to them due to the decline in the general support of most governments, particularly, in some research areas. A sign of this turn of approach is the establishment of technology transfer offices in universities.

Technology transfer from universities and other government research institutes have been the specific purpose of policy makers and the public, in the past decade. The motivations arisen from two factors of the need for improvement of private sector's access to the government's research results and budget constraints have induced politicians to provide reasons in support of commercialization of university technologies. One of the most important of these reasons is the Morrill act which came into force in the U.S back in 1980 and according to it, universities were granted intellectual property rights for new technologies. Afterwards, policy makers in other countries followed the U.S example. At that time, the general opinion was that research activities should have had tangible commercial advantages and that universities and other government research organizations should have met these new demands through increasing technology transfer activities (Buenstorf, 2006).

Commercialization of knowledge and technology has a long history. Although, the knowledge and technologies gained from scientific research were rarely commercialized or introduced to the market, in the past. However, it seems that commercialization of knowledge and technologies first began with the arguments about cooperation of universities and industries and it was with the Morrill act in 1862 wherewith the university system was given the right to give land grants. This cooperation has a long history. For instance, the defense department of the U.S regarded research

and development cooperation with the universities as the main agent of progress during the world war two when competing with the Soviet Union. It may not be evident enough but the interaction of the university and the industry truly shapes the processes and outputs of commercialization of research and technology (Markman et al., 2008).

Reviewing the past research in the literature, Chang et al (2009) found two main streams of research for the commercialization of university research. First, the “technology transfer” stream (Debackere and Veugelers, 2005; Etzkowitz and Leydesdorff, 2000; Siegel et al., 2003). Drawing from the 1980’s literature, it is argued in this stream of research that commercialization of university research should be viewed as a technology transfer process from the university to the industry. In order to improve the commercialization of university research, the university should focus on the barriers to the technology transfer process and on the conflicting interests among stakeholders by creating a motivational gap.

The second stream of research is related to “institutional and organizational resources” (e.g. Di Gregorio and Shane, 2003; Wright et al., 2006). Having emerged in the early twenty first century, it avers that having desirable institutional and organizational resources such as supportive commercial sub-structures, organizational incentives, strong research basis and access to venture capital has a major role in improving the commercial performance of the university research.

Most of the definitions on university entrepreneurship have a special focus on commercialization of knowledge produced in universities and some researchers (Toole and Czarnitzki, 2007) regard both terms as interchangeable. There have been different definitions proposed by researchers with each focusing on particular aspects of this phenomenon. In defining university entrepreneurship, some researchers argue that it involves all the commercialization activities beyond the education and research conventional obligations (Klofsten and Jones-Evans, 2000), while other researchers pay more attention to newly emerged activities, particularly spin-offs. For example, Etzkowitz (2003) argues that the entrepreneurial university is a natural development center with commercial and intellectual supportive structures and a combination of them for the students and the faculty when launching new ventures. Wright et al (2007), too, view university entrepreneurship as the development of commercialization and

argue that there is more to it than the traditional focus on giving out intellectual property grants including activities to create spin-offs from the knowledge and technologies produced in the universities.

Sometimes, university entrepreneurship is defined as an effort to increase revenues and to achieve personal or institutional influence and prestige through developing and marketing research ideas or products based on research (Louis et al., 1989) or to integrate roles and new resources in the present context of the organization and to create new models to help researchers with what they need to do (Colyvas and Powell, 2003). In some other researches on university entrepreneurship, a field of entrepreneurship has been devised that seeks to understand and describe new business ventures and products that have originated from the universities' intellectual properties (Llano, 2006).

There are also other researchers that view university entrepreneurship as encompassing all the university's entrepreneurial activities which are not limited only to licensing, creating new firms in the university, technology transfer, development centers, science and technology parks, patent assignment and regional development (Rothaermel et al., 2006).

The entrepreneurial university links economic development as a new university function with education and training. This is called "knowledge capitalization" which harbors the new core mission of the university and solidifies the link between the university and knowledge users and leads the university to economic practicality (Etzkowitz, 1998). In the literature, commercialization of university research and technology transfer are used synonymously for the most part (Chang et al., 2009).

Generally, technology transfer involves the transferring of idea, method or research results in an environment that results in products, services or processes using any method. Technology transfer is the official transfer of new discoveries and innovations produced from scientific research that non-profit research institutes and universities run in cooperation with commercial sectors to gain general advantages.

Many other researchers have also provided definitions for commercialization: Urabe (1988) defines commercialization as producing a new idea and implementing it on a new product, process or service which results in dynamic growth of the national economy and increase in

employment rate and the net profit for innovative firms (Urabe, 1988). Reviewing different definitions including Jolly (1977) who considers commercialization a process which begins with an insight into the technology-market and ends with sustainable functions of the product proportionate to the market, Spilling offers a comprehensive definition arguing that commercialization is a process of transferring and converting existing theoretical knowledge in academic institutions to some types of economic activities (Spilling, 2004). Similar to Siegel et al. (2003), Bandarian (2007) defines commercialization as the conversion or transferring of technology to a profitable setting. And technology here entails skills, techniques, processes of receiving patents or other private ownerships, material, equipment, systems, etc. (Bandarian, 2007).

Referring to the definition of Utterback (1979) who suggested that commercialization begins with inventions and creativity, Robert (2007) argues some researchers include exploiting inventions in the commercialization of research and posit that unless the commercialization is successful the invention will not make it as an innovation and therefore, will not be introduced to the market (Roberts, 2007). Chang et al (2009) offered a practical definition for commercialization of university research as encompassing the faculty members who seek to exploit their research results via receiving patents, franchising and participating in the ownership of spin-offs.

Examining different existing views toward commercialization of research findings, three main approaches were revealed depending on at what stage the research process begins and at what stage it ends (Ghazinouri, 2005):

The responsive/reactive commercialization approach:

In this method, after running a research project and obtaining the results, the considerations about the commercialization stage will begin. This method is more applicable to technologies that are the lateral results of large research projects.

The guaranteed commercialization approach (contractual research):

In this method, the commercialization activities (e.g. making contract with business partners) are carried out before starting the research project. This

method is more applicable to technologies that their nature and state of performance are determined or the product of the technology could be clearly defined or when the researcher is highly positive he will obtain the desired results.

The parallel commercialization approach:

In this method, the commercialization activities begin before the inception of the research project and the commercialization considerations are completed, stage by stage and in parallel with the research project.

Creating the contexts for commercialization of research findings and introducing knowledge to the market and society leads to technical and economic development and improvement of welfare in the society, and moreover, it significantly promotes the economic values in research organizations. Being so important, many studies and much research have been done about commercialization and introduction to the market in different institutes.

In a nutshell, commercialization is the act of converting new findings and research ideas to products and services and marketable technologies. In other words, commercialization refers to a set of efforts that are undertaken with the purpose of selling research works and with the aim of making profit and placing education and research even more in line with economic and social objectives. Given the above definitions, commercialization could be defined as introducing an idea or an innovation to the market. Commercialization of research results is one of the important steps of the innovation process, which ensures the stability and continuity of researching and accelerates knowledge-based economy development and fosters significant economic values for organizations, as well. Commercialization is a process by which profits are made when implemented into the market place while it has no value profit-wise in the development stage. If shelved, technology will not yield any revenue.

Methodology

The present study has a qualitative approach and takes advantage of the benefits associated with Delphi method. The Delphi method, which was developed by Norman Dalkey (Dalkey & Helmer, 1963), is an iterative

process through which judgments of experts are collected and distilled, using a series of questionnaires. The researchers concentrate on problems, opportunities, solutions, forecasts, or feedbacks and are usually promoting a list of judgments as the research results. Each questionnaire is revised based upon the information gained through the previous questionnaire(s). The process ends when the research questions are sufficiently answered (Dalkey and Helmer, 1963; Juri, 1971).

Delphi method has been used in a variety of studies and in different fields (Adler & Ziglio, 1996; Delbeq et al., 1975; Rowe & Wright, 1999; Skulmoski & Hartman, 2002). This method is used for structuring a series of judgments in order to facilitate group problem solving (Linstone & Turloff, 1975).

There are a series of advantages associated with Delphi method, which are (Rowe and Wright, 1999): Anonymity of Delphi participants; Ability to revise their ideas (Iteration); controlled feedbacks and informing participants of other's judgments, and statistical aggregation of group responses. While some authors believe in the quantitative approach of the Delphi method (e.g. Tapio, 2011), others adhere to this belief that it could be used with qualitative techniques (e.g. Mason, 1996). This study is structured as follows:

1. Defining and elaborating the research problem. Considering the nature of the problem and its logistical considerations which arose from the topic and problem in question.
2. Preparing the preliminary questionnaire, based on the literature review. Also, we asked about the participants' view about new questions to be asked in the next steps.
3. Acquiring qualitative feedback through preliminary questionnaires answered by the participants. A list of obstacles and solutions is achieved in this step, and participants commented on the accepted and relevant questions.
4. Preparing the final questionnaire based on analyzing the preliminary questionnaire. We considered the privacy of the participants, anonymously reviewing their views.
5. Gathering and analyzing the data, and concluding the study with research findings.

It should be noted that the participants were individuals aware of the topic being investigated, as a panel which McKenna (1994) defines as “panel of informed individuals”. Nineteen experts participated in the study and shared their knowledge through the Delphi study. The authors used purposive sampling based on the assumption that a researcher’s knowledge about the population could be considered in order to choose the cases (Polit & Hungler, 1997). The experts were informed of the topic and agreed to participate in the study.

Data collection and analysis were done through three steps: the discovery of views and opinions, determining the most important issues, and data analysis. Although the literature shows that two or three rounds are preferred (Proctor & Hunt 1994, Beech 1997, Green et al., 1999) and four rounds suffice (Young & Hogben 1978), we determined to iterate the questionnaires for five rounds. To analyze the qualitative data, content analysis technique was used. Data gathered in the initial stages were analyzed by grouping the similar issues. The respondents were coded to become traceable. Finally, the results were finalized and the outcomes appeared.

Discussion

Nowadays commercialization of university research and R&D innovations is considered as a significant factor in economic stability of the countries (Nevens et al., 1990; Arora et al., 2001). Although the process of commercialization seems to be simple and conventional, it has its own obstacles and solutions. Evidently, it could be noted that turning an idea into an innovation and subsequently into a commercial product/service, is a complex effort.

In the present study, we conducted a series of interviews with experts who were familiar with these kinds of effort, and have dealt with commercialization affairs in their academic or professional career. The obstacles and solutions are identified and offered in an Iranian context. The main obstacles are as follows:

1. Researches and technologies are not completely based on customer needs

According to the literature, one of the most important issues about researches and technological innovations is their potential to be commercialized. In this respect, their consistency with market needs is of paramount importance. The interviewed experts believe that the current researches and innovations are not completely in line with customer needs, which could result in useless researches and wasting the knowledge potential.

2. Lack of solid rules and regulations for protecting Intellectual Property (IP) rights

Intellectual Property rights are of paramount importance in research commercialization. That is to say that commercialization of research and innovations, without considering IP is something strange. According to the interviewees' view, existing rules and regulations are not sufficient and even comprehensive. Thus, it could be a challenging issue for commercialization of research and technological innovations.

3. Lack of appropriate evaluation of ideas and innovations in a national entity

Ideas and innovations are registered in different organizations in the country, but there is not any integrated organization or entity to evaluate the ideas with a unified system. The evaluation criteria are different according to the selected organization, and do not follow a national standard. Moreover, the evaluation process is somewhat traditional. Since there is not a realtime system for registering the innovations and achievements, there is the possibility to register some ideas and innovations for several times, and just after objection to illegal registration, the court will consider the issue. This could lead to several problems for beneficiaries of the research or innovation.

4. Inadequate relationship with regional and global market

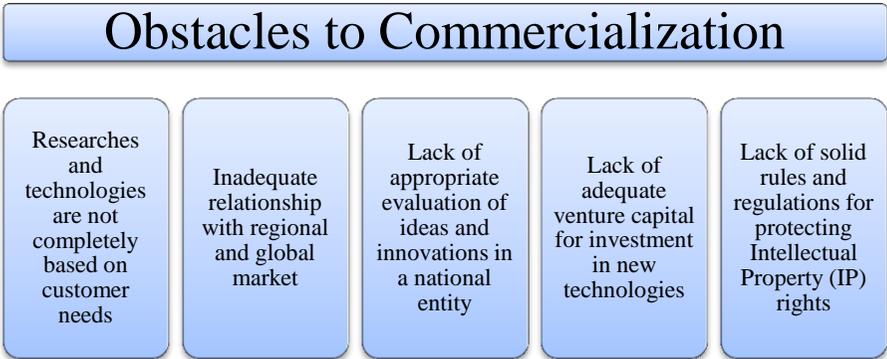
According to the limitations posed to the researchers and innovators in the country and obstacles in registering and protecting their achievements, the relationships with global markets would encounter some problems. In this regard, it could be considered as a critical obstacle to research commercialization.

5. Lack of adequate venture capital for investment in new technologies

Although there are some institutions which are established, especially after 2009, to provide venture capital and entrepreneurial funds for researchers

and innovators, still there is a gap to be filled. Interviewees were stressing on the importance of this issue for several times and mentioned that venture capital providers could significantly change the existing status.

Table 1: Obstacles to commercialization of researches and innovations



Participants in this research mentioned a variety of solutions to deal with highlighted obstacles, which were classified in a coding process. Main solutions are:

1. Proposing a roadmap for research and technology commercialization in which the research priorities are highlighted.

A roadmap for commercialization of research and innovation is a mandatory need for development of the process. In addition, determining the research priorities based on market needs and social problems could direct the resources in a more effective way and make resource allocation more efficient.

2. Providing an appropriate environment for research and technological interactions in regional, national, and international levels

Experts believed that business environment and commercialization of the research and innovation have a close relationship. Therefore, providing an appropriate environment could pave the way for commercialization and capitalization of the knowledge. This solution considers the contextual

aspects of the process and tries to answer to the challenges in different levels.

3. Institutionalizing the documentation and evaluation systems in order to better protect IP rights

An intellectual Property right constitutes a significant part of the commercialization process and plays a critical role in this respect. Documentation and evaluation of the products and services which are going to be commercialized, helps the existing systems to protect the rights of the researchers and innovators in a better way. Also, this could lead to promote the motivation of the beneficiaries.

4. Proposing an appropriate regulatory structure and revising the existing rules and regulations

Rules and regulations could protect or destroy an innovation on its way to commercialization. A comprehensive and comprehensible regulatory structure is a necessity to overcome a significant number of commercialization problems. The interviewees offered that government should revise the regulations and facilitate the process.

5. Financing researches and innovations with both governmental and non-governmental budgets and funds

Like any other activity, commercialization needs financial support. Lack of enough financial facilities and institutions might result in an unsuccessful commercialization. It should be noted that both governmental and non-governmental funds are needed to turn an idea into a marketable service or product. All the interviewees mentioned the same point.

6. Offering tax exemptions in order to motivate investors

Tax exemption is a critical point to investors, especially in the countries in which tax rates are quite high. In the present study, experts believe that considering tax limitations of the interested investors could turn the investment potentials into reality, and increase the rate of propensity to investment.

7. Developing sales and marketing sectors in commercialization entities

Marketing and sales departments play a significant role in commercialization of researches and innovations. Thus, empowering those departments will eliminate a variety of obstacles in the commercialization process.

8. Sharing the benefits associated with commercialized researches and innovations with researchers and innovators

One of the most important solutions to juice up the performance of commercialization is to consider a method to share the outcomes in a fair way. Therefore, the interviewees were emphasizing upon this fact and argued that a fair and motivating system would result in improvements in the commercialization process.

Proposing a roadmap for research and technology commercialization in which the research priorities are highlighted
Providing an appropriate environment for research and technological interactions in regional, national, and international levels
Institutionalizing the documentation and evaluation systems in order to better protect IP rights
Proposing an appropriate regulatory structure and revising the existing rules and regulations
Financing researches and innovations with both governmental and non-governmental budgets and funds
Offering tax exemptions in order to motivate investors
Developing sales and marketing sectors in commercialization entities
Sharing the benefits associated with commercialized researches and innovations with researchers and innovators

Table 2: Solutions to eliminate the obstacles of commercialization of researches and innovations

Conclusions

As mentioned earlier, commercialization of university researches and innovation is of paramount importance, both practically and theoretically. Of course, there could be a variety of obstacles and problems to reach this goal, which we have to identify and decide how to handle those issues. This research seeks to identify those obstacles and find appropriate solutions to

face them. In order to answer the research questions, the Delphi method is used and expert views are collected, coded and finalized.

The main identified obstacles are as follows: Researches and technologies are not completely based on customer needs, Inadequate relationship with regional and global market, Lack of appropriate evaluation of ideas and innovations in a national entity, Lack of adequate venture capital for investment in new technologies, and Lack of solid rules and regulations for protecting Intellectual Property (IP) rights.

In order to face these obstacles, the following solutions are proposed: Proposing a roadmap for research and technology commercialization in which the research priorities are highlighted, Providing an appropriate environment for research and technological interactions in regional, national, and international levels, Institutionalizing the documentation and evaluation systems in order to better protect IP rights, Proposing an appropriate regulatory structure and revising the existing rules and regulations, Financing researches and innovations with both governmental and non-governmental budgets and funds, Offering tax exemptions in order to motivate investors, Developing sales and marketing sectors in commercialization entities, and Sharing the benefits associated with commercialized researches and innovations with researchers and innovators.

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