

The Causal Model of Environmental and Internal Factors of the University on the Process of Technology Transfer to Industrial Centers

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Abstract. This research has been conducted with the aim of developing a model for explaining the technology transfer process at entrepreneurship university. The research methodology is inductive and relies on the grounded theory. First, the background of research is presented in the field of technology studies, technology transfer process, entrepreneurship university, technology transfer process at the University of the Entrepreneurs, then has been interviewed with 9 technology management experts. Then, with the foundation's data approach, the nature of the technology transfer process in the Entrepreneurship University and its

formation are identified and the position of each of its constituent elements has been presented in the form of a conceptual model. The extracted model includes factors such as environmental factors of the university, internal factors of the university, the management structure and technology transfer strategy, transactions, and features of the company is in the campus of entrepreneurship university. The results showed that Achieving the technology transfer process at the Entrepreneurship University requires a number of steps and actions based on grounded theory. In this study, open and deep interviewing, library documents and notes were used to collect data. Sampling method is theoretical sampling. Theoretical sampling is a purposeful sampling The researcher tries to examine the subject and the phenomenon by using the knowledge and knowledge of the most informed individuals about the subject of research. Theoretical sampling continued until the categories reached theoretical saturation.

Keywords: Technology; Technology Transfer Process; Entrepreneurship University; Grounded Theory.

1. Introduction

The evolution of society has transformed the duties of higher education to the point where Peter Drucker (1997) predicted that there would be only one memorial building from big universities for thirty years. But now the mission of the university as the most thoughtful institution responsible for the realization of the goals of national development is to adapt its development plans to the development of its pillars. It can no longer be accepted that the university is only able to fulfill its traditional duties. Because, without responding to the individual and social needs of the present and future, higher and higher education will be regarded as unconventional and alien to the needs of the country and the expectations of the community. Making application of science and the use of knowledge in every work, the comprehensive development and growth of the country will increase the abundance of productivity. Therefore, the university is at a turning point in the history of science and technology and national development. Today, the role of the university has changed in most countries of the world, and the mission of the university is not limited to the training of skilled and expert human

resources, but universities and research institutes are considered, in fact, the hopes of societies, and play the most important and constructive role in the evolution of society and the solution its problems that is completely different with its original and traditional role (Tabibi, 1997). One of the concerns of higher education is the distance between universities and science centers and industrial-manufacturing units. Although universities have abilities and capacities and have always been active in conducting research in the form of dissertations of graduate students or research projects of professors, but the results of research findings in industrial-manufacturing units are less used (Heidrizadeh Et al., 2008). However, conducting research projects involves spending a lot of costs, especially in the field of technical-engineering is done by professors and students. It seems that the use and development of technologies derived from scientific-research activities in industrial and manufacturing processes requires the use of strategies to guarantee their implementation. One of these strategies is technology transfer. Access to technology in manufacturing firms is possible only through technology transfer (Radfar, 2012). Commercialization of academic research results is one of the important steps in the innovation system that guarantees the sustainability of the research and, in addition to providing significant economic value for organizations, also accelerates the economic growth of the knowledge-based society. (Mueller, 2006) There is an elemental innovation center known as the "Entrepreneurship University". This element is the advanced technology production and facilitating the technology diffusion process through intermediaries such as technology transfer offices, as well as the establishment of growth centers and science parks, and the production of research and development support for existing companies or to help create new companies (Walshok & Shapiro, 2014). In recent years, due to the four factors in the development of new and high technology such as computer science, molecular biology and materials science, the role of the university has intensified as a source of technological advances in collaboration with the university and industry. Etzkowitz (1983) used the term of entrepreneurship university to describe a set of changes that reflect the more active role of the university in promoting the direct and active transfer of academic researchers. However, technology transfer is

challenging because private companies and research universities have very different missions, and there is often a lack of mutual trust (Slaughter & Leslie, 1997). Entrepreneurship university is also the development of the techniques, strategies and competitive conditions as well. Accordingly, the Entrepreneurship University is also involved in networks and relationships with government and private organizations that are in the sphere of cooperation and interaction (Guerrero & Urbano, 2010). Commercialization of academic research is in the simplest form of a set of transactions between a university and a business company, which ultimately will be related to the interests and objectives of the two sides. Universities are themselves sophisticated bureaucracies with rewards rules and specific incentive structures. In addition, compared with business-driven with the aim of financially motivated companies, universities have different goals that include various educational and social goals, as well as the interests of faculty members and, on a larger scale, the scientific community (Bercovitz & Feldman, 2006). The technology transfer process involves the transfer of discoveries and innovations from academic research to the business sector. This process typically starts with the registration of innovations by academic researchers and ends with the commercialization of technology through the mechanisms of technology transfer (Bozeman, 2000). Now, according to what was said researcher wants to develop a model to explain the process of technology transfer at the University of Entrepreneur. This research seeks to explain and formulate a model for explaining the process of technology transfer in the entrepreneurship university. Therefore, the research questions are presented as follows: How the environmental factors of the university with a focus on transaction-oriented affect technology transfer process to industrial centers? How the internal factors of the University with transaction-oriented factors affect the process of technology transfer to industrial centers? How the characteristics of a transaction-oriented company that affects the process of technology transfer to industrial centers? How the structure and strategy of transaction-oriented technology transfer affect the process of technology transfer to industrial centers?

2. Literature Review

In this research, the review of theoretical foundations has been done in two stages. The first step before entering the data analysis phase and the second stage during data analysis and in the phase of conceptual model formation based on the data foundation approach. In this regard, the key concepts of research based on the main questions are expressed in terms of the tasks of the universities. Transition from elitist higher education to inclusive education, along with other developments such as the growth of information and communication technologies, the explosion of knowledge and the emergence of the "knowledge society", in particular, to the increasing trend of globalization on the one hand and competitiveness on the other hand has been led to experience transitional and challenging transition in the last two decades by higher education. Paradigms, concepts and structures are changing, and higher education deeply feels that must think to creative adaptability and environmental changes, more diversification, proportionate to social and market demands, quality deployment, continuous improvement, satisfaction of resource providers, and also Customers, and accountability (Nemati, 2005). Universities have had two revolutions in their history that have affected their missions and functions, and have evolved their role in society. Until the early nineteenth century, universities only were the responsible for the role of education, which, with changing global conditions and the needs of societies, the role and function of research was added to it. Since then, universities have two missions of education and research and they are called as research universities. By continuing changes and intensifying global competition, as well as the emergence of a knowledge-based economy and the transformation of knowledge into competitive advantage, universities in the late 20th century also entered the realm of economic and social development. In these circumstances, universities are moving toward the entrepreneurship university pattern. The need for universities to participate in national and regional development through innovation in techniques and problem solving in the social environment is due to the new reasons for the need for research at universities (Sanial, 2000). Over the last decade, there has been much debate about how the universities are more effective in increasing wealth in different countries, especially in European countries. As the introduction of a new economy with knowledge-based economics

or learning economics and national innovation systems, the key role of universities became more prominent. At the same time, the importance of universities and higher education institutions for the realization of economic development by various scholars has been well documented in the numerous books and articles that have been presented. Undoubtedly, in all these works, the main role of the university "to provide education and research implementation" has been cited as expected. But in the last decade, universities have committed themselves to doing a wide range of other activities, "Communicating with the community." In addition to this movement of universities, a growing tendency to classify companies and even government agencies as "learning organizations" is also being used more than before (Danaeifard, 2004). Audretsch, D., & Lehrmann (2005) at German universities aimed at: do the technical colleges are more successful than research colleges in research commercialization. The results showed that the technical qualities of the faculty had no advantage in performance of the company. Debackere and Veugelers (2005) aimed at documenting and analyzing the evolution of effective mechanisms for the transfer of university-oriented research technology at the University of the Catholic Leuven University. O'Shea et al., (2005) analyzed the reasons for why universities in some universities became more successful than others in establishing subsidiaries, and observed the link between university resources and differences in this field. Yokoyama (2006) at the Universities of Japanese and English has evaluated the organizational changes in universities that involved in entrepreneurship activities. His findings revealed that new organizational strategies (governance, management, leadership, and budget) and relationships with other institutions lead to create different types of academic entrepreneurship. O'Shea and et al. (2008) at the University of MIT have studied the structure of an entrepreneurship university, which evidences showed that the entrepreneurship university has four important characteristics of individuals, organization, culture and environment in supporting its subsidiary activities. Technology is all the knowledge, products, processes, tools, methods, and systems that are used in creating products or providing services. Technology transfer can be defined as the transfer of intellectual properties, such as skills, knowledge, equipment, and methods of construction from a site produced

or developed to another, by conventional or non-conventional methods (Ali Ahmadi et al., 2003). In continue we review the definitions provided in the field of technology transfer: Gibson & Smilor (1991) know that technology transfer is often an irregular process involving groups and individuals who may have different views on the value and potentials of technology. According to them, technology often has no definite meaning or value, and researchers, developers, and users most probably tend to have different perceptions of technology. Levin (1993) defines from the perspective of the social sciences, technology transfer as a technical - Social process including cultural skills transfer with machinery, equipment and tools. This definition includes the physical transfer of the essentials and cultural skills embedded therein. Autio & Laamanen (1995) proposed a broader definition of technology transfer that involves intentional and targeted interaction between two or more social institutions in which the technology science store stays stationary, or increases through the transfer of one or more components of the technology. Levine (1996) considers technology transfer as the use of scientific principles to solve practical problems. Technology transfer is far broader than acquiring physical assets. The exchange of technology and technical knowledge between companies should include the resources and competencies of both organizations, and the nature of knowledge, which is transferability and transparency, are critical factors in the success of the technology transfer process (Lynskey, 1999). Chung (2001) attracted the transfer of technology as knowledge transfer according to local conditions. The concept of technology transfer is not only about the transfer of technical knowledge or information, but also includes the ability of technology recipients to learn and capture technology in operations of production (Maskus, 2003). Most previous studies have defined technology transfer as the transfer or movement of knowledge as a process. This includes the process, how does an organization or a country transfer scientific or technological achievements, new uses of technology, designs, and technical knowledge that can be used in production? (Chang, 2007).

3. Method

In many studies, the dominant scientific approach in explaining the variables of research and inferring their causal relationships is based on deductive thinking; hence, as long as the collected data and evidence confirms this theory, that theory is still accepted and used as the basis for future research. The striking problem of this approach is the vacuum of the theory in new subjects, as well as the acceptance of the theories derived from deductive thinking in environments other than the contexts of the formation of that theory. In the current study and in view of its purpose and in order to overcome such problems, the research method based on the grounded theory (using the Strauss and Corbin approach), has been used which is a subset of the qualitative research method with a deductive approach. Based on the concepts and grounded theory, research is not based on hypothesis; research is faced with a research problem, which has no previous answers or guesses to answer (Strauss & Corbin, 2008). Therefore, relations between variables and research components are not predetermined; they are based on observations and data collected, and according to their differences and similarities, and in this way, the necessary preconditions for Theorizing is provided.

4. Findings

Achieving the technology transfer process at the Entrepreneurship University requires a number of steps and actions based on grounded theory. In this study, open and deep interviewing, library documents and notes were used to collect data. Sampling method is theoretical sampling. Theoretical sampling is a purposeful sampling. The researcher tries to examine the subject and the phenomenon by using the knowledge and knowledge of the most informed individuals about the subject of research. Theoretical sampling continued until the categories reached theoretical saturation. Theoretical saturation is a stage in which new interviews do not add data to previous categories and do not change relations between categories (Bazargan, 2008). Accordingly, according to the questions and sources of data collection, the open source coding step began. In the open coding process, 9 technology management experts have been selected as interviewees. After careful review and study, the technology transfer points were extracted in entrepreneurship universities and their requirements. The result of this process is notes

that were considered as initial data, in which concepts were extracted from their hearts. To ensure the validity of this research, the following measures were taken:

- Adaptation of members: Participants have presented their views on the research report, the analysis process and the categories and, according to their views; the results have been reviewed and revised.
- Fellow review: Opinions, templates and categories were shared with three technology management professors and two technology management student students and their views were used to enhance research.
- Collaborative research: To increase the validity of the research, participants, especially those with relevant and excellent education and experience, were assisted in coding, analyzing and interpreting the data. The reliability of the research was controlled through the preparation and implementation of the codified framework for the interview. This codified framework was used after the confirmation of the professors and ensuring its effectiveness in covering the research objectives in all interviews.

In the data analysis stage, first 54 code (words, sentences, or sentences) were extracted in an open coding format, which are set up in the framework of the tables and then are again classified based on the frequency of the repetition or emphasis in the interviews and the various sessions. The result of this stage is the achievement of the basic concepts in the form of the sixth concept.

According to Strauss & Corben (2008), when concepts are created, it is necessary for the analyst to group them under terms with more explanatory power, called "categories". In the next stage of the research, we tried to categorize the propositions of the research process according to the main questions of the research; hence, in the next step of the research, through the comparative process, similarities and differences Concepts, extracted and reviewed, and concepts similar to each other are placed in a category or category. After defining the concepts and categories, the categories are classified according to the views of Strauss and Corbin (2008) as the main categories and categories of wisdom.

Table 1 shows the categories derived from the data analysis with their code.

Table 1. General and small categories

Row	Proposition	Proposition code	Category	Code of the category	Concept	Concept code
1	Government willingness to market	A1	Governance structure	B1	University Environmental Factors	C1
2	Stable and real exchange rate and interest rates	A2				
3	Low inflation	A3				
4	Effective policies on technology transfer by policy makers in the country	A4	Entrepreneurship supportive measures	B2		
5	Legitimate and up-to-date law on intellectual property rights	A5				
6	The tendency of countries to transfer technology to Iran	A6				
7	Promoting the culture of supporting domestic product by the media	A7	Entrepreneurship training method	B3		
8	A true understanding of the needs of society	A8				
9	Promoting the spirit of risk taking in society	A9				
10	Promoting teamwork culture	A10	Patterns and reward systems	B4		
11	Close cooperation between the Entrepreneurship University, Industrial Centers and the Government	A11				
12	Establishing appropriate rules for increasing risky investments	A12				
13	Educational system with the aim of increasing entrepreneurship spirit in students	A13	Human Capital	B5	Internal factors of the university	C2
14	IMS training	A14				
15	Determine the R & D team with the cooperation of the Entrepreneurship University and Partner Industrial Centers	A15				
16	Concluding a contract between the University of Entrepreneurs and volunteer industrial centers	A16	Financial resources	B6		

Row	Proposition	Proposition code	Category	Code of the category	Concept	Concept code
17	The widespread use of unofficial methods of technology transfer, including scientific and technical exchanges, in attracting new technologies by the entrepreneurship university and selling it to industrial centers	A17				
18	Statutory tax system to support entrepreneurship university contracts	A18				
19	Technology Transfer Office at Entrepreneurship University	A19				
20	Office of Industry Relations at the Entrepreneurship University	A20	Physical resources	B7		
21	The ability of universities in meetings, seminars and conferences	A21				
22	High Potential for Domestic Specialist Training	A22				
23	Has a young workforce	A23	Condition and credit	B8		
24	Feasibility studies on domestic demand technologies	A24				
25	Confronting Oil Economy and Oil Price Crisis	A25				
26	Product production and commercialization with the aim of producing and selling more technology	A26	Business incentives	B9		
27	Achieving economic stability to increase risk averse investment	A27			technology transfer structure and strategy	
28	The proper context of import of capital goods in the country	A28				C3
29	Consider the lifecycle of proposed technology for transfer	A29	Technology Transfer Charter	B10		
30	Determine the exact methodology for transferring technology from Entrepreneurship University to cooperative industrial centers	A30				
31	Attracting more priority technologies	A31	Industry characteristic	B11	Company features	
32	The coincidence of selected	A32				

Row	Proposition	Proposition code	Category	Code of the category	Concept	Concept code	
	technology with the conditions of selected industrial centers					C4	
33	Active participation of the industrial center at all stages of the technology transfer process	A33					
34	Keep pace with rapid advances in technology in the world	A34	Company goals	B12			
35	Market access with high potential for purchasing technological products in Iran	A35					
36	Attraction of advanced technology for industrial production by technological centers	A36					
37	Effective management in industrial partner centers with Entrepreneurship University	A37	The size and capability of the company	B13			
38	Close collaboration between the Entrepreneurship University and Industrial Centers	A38					
39	Economic motivation for technology transfer in industrial centers	A39					
40	The close proximity of the industrial center to the University of Entrepreneurs	A40					
41	Holding regular meetings between entrepreneurs university and industrial partner center at the University	A41	Location position	B14			
42	The possibility of installing and equipping the required equipment at the industrial partner center with the Entrepreneurship University	A42					
43	Identifying Strategic Industries at Entrepreneurship University	A43	Protected researches	B15	Transactions	C5	
44	Shorten the learning curve in product production	A44					
45	Support for the transfer process by the Technology Transfer Office of the Entrepreneurship University	A45					
46	Concentrated Technology	A46	Intellectual	B16			

Row	Proposition	Proposition code	Category	Code of the category	Concept	Concept code
	Transfer Policy in Iran		1 Property License			
47	Special attention to research and development activities at industrial centers working with Entrepreneurship University	A47				
48	Creating a ground for innovation in society	A48				
49	Attract foreign investors to enter into technology	A49	Launch a new company	B17		
50	The entry of oil revenues into the field of technology transfer and production in Iran	A50				
51	Strengthening Export Development Policy in Iran	A51				
52	Identify potential technologies and prioritize them by entrepreneurship university	A52	Academic Entrepreneurship	B18	Academic Entrepreneurship	C6
53	Developing the capacity of commercialization of imported technology at the Entrepreneurship University	A53				
54	Transfer of technologies used in the development of strategic industries at the Entrepreneurship University	A54				

Selectable encoding continues the axial coding at a more abstract level. In fact, at this stage, the researcher comes to the theory based on his own data. Selection coding is the process of integration and improvement of categories; therefore, in order to confirm the exploratory categories in this research as well as confirmation of the discovered relationships, they again interviewed the participants of the research, and after several times the study and returns which was done between data and concepts and categories and codes. Finally, after reviewing the categories and verifying the experts, the final pattern of research was presented in Figure 1.

5. Discussion and Conclusions

In this section, first, a comparison of the proposed model with existing models will be discussed, and further the evaluation of grounded theory

is described. In the previous section, four models with the titles of Siegel et al., Nodnjoao et al., Barcoquitz and Feldman, and finally Guerrero and Urbano, were studied. The model presented in this section has the following differences with the models presented so far:

In the model of Siegel et al is a 7-stage linear model with one-way process in the whole model; while the proposed model has only 13 stages in the central section, some of which are two-way. In addition, other factors in the general model presented in the model of Siegel et al. have not been considered.

The Nodnjao model is a four-stage model, and this model only seeks to transform the results of academic research into economic value. This model has a one-way process in four steps. The weakness of this model

Is that each process has a linear effect on other processes and they have a one-way relationship, in addition to these environmental factors have not been considered. However, these cases have been discussed in the proposed model.

In the Bercovitz & Feldman model, the transfer process has been observed in all cases of two sides; however, the process has not been clearly explained, and the beginning and the end of it are not clear; in the presented model, starting and ending of the process has been specified completely.

The proposed model of Guerrero & Urbano has not described technology transfer as a process; however, this model has been carefully studied in the proposed model. In their model, Guerrero & Urbano have tried to outline the factors affecting the process in two groups of internal and external factors. Considering the importance and variety of influencing factors in the present model, they have been carefully studied in five categories of factors. In addition, the present model has considered other internal influential factors, including effective factors.

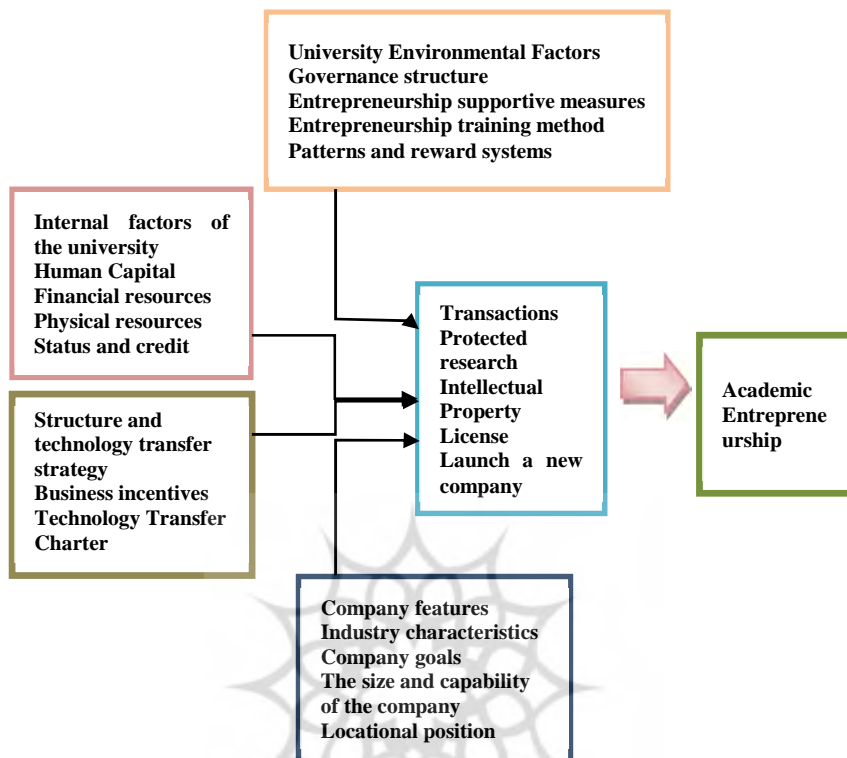


Figure 1. Technology transfer model at entrepreneurship university

In total, it has been tried that the present model, in addition to compensating for the deficiencies of the previous models of strong points such as considering the internal factors of Iran and also the effective factors on the technology transfer process. In this section, after the presentation of the model, the results of the research are summarized. The proposed model for Siegel et al., In 2003 for an entrepreneurship university process is a linear model that has seven stages. This model has seen entrepreneurship university as a process that includes 7 steps. However, since this model sees the process linearly, it cannot correctly explain all the angles of academic entrepreneurship. Ndonzuau et al., In 2002, introduced four stages in converting the results of academic researches into economic value, of course, through the creation of split companies. This model, unlike the Siegel model, assumes that each of the four steps is a process in itself. The weakness of this model is that each process has a linear effect on other processes and has a one-way

relationship. Bercovitz & Feldman, in 2006, presented a model for reviewing the process of entrepreneurship university. This model has somewhat eliminated the weaknesses of the previous models, but in this model cultural and social barriers have not been considered; while, according to existing literature and studies, these cases can undergo a process of change. On the other hand, the process of technology transfer is not exactly specified. Guerrero & Urbano, in 2010, have also developed a new model for reviewing the technology transfer process at the entrepreneurship University, which is far more intriguing than other models. Although this model has not paid attention to the evolution of global markets, on the other hand, the process of technology transfer has not been accurately defined. But with the Barcoquitz and Feldman model, it can provide a suitable framework for studies in this field. Strauss and Corbin (1987) have proposed three aspects of the grounded theory evaluation criteria. The first is credible and reliable data, the second is the satisfaction of the research process and the third judgment on the empirical basis of the findings of the research (Stress and Corbin, 1987). They pose seven questions as criteria for the basis of experience in the study, which way to answer them is a criterion for evaluation, and determines the extent to which the findings are empirical. According to the research findings and in order to implement the present model, the following suggestions are presented: The requirements of the present model include the stable and real rate of exchange and interest, low inflation, the willingness of countries to transfer technology to Iran and the tax system in order to support university contracts. In order to prepare for the transformation of universities into an entrepreneurship university, a genuine understanding of the needs of the society, the proper field for importing capital goods in the country, and the spirit of coping with the oil economy and the crisis of oil price reduction, should be strengthened. The training required to transfer technology to entrepreneurship universities involves promoting the promotion of domestic product by the media, promoting the spirit of risk taking in society, promoting teamwork culture, and educating the educational system with the aim of increasing the entrepreneurship spirit in students and educating the Internal expert force. The prerequisites for technology transfer in entrepreneurship universities include the establishment of

effective policies for the transfer of technology by policy makers in the country, the creation of a framework for innovation in the community, and the establishment of effective policies for the transfer of technology by policy makers in the country. The necessary platforms for technology transfer in entrepreneurship universities include the government willingness to market, a focused technology transfer policy in Iran, the strengthening of export development policy in Iran, and the establishment of appropriate rules for increasing risk capital investments. Appropriate specialized training should be used in order to inform the traditional managers and correcting their negative beliefs in the use of new sciences and techniques of attracting and employing human resources.

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