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Effective Components of Knowledge Commercialization Based on Knowledge Management

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ABSTRACT

Research findings play a significant role in promoting human life quality, developing level of welfare of society and international economic and social developments. However, the findings will not be important unless cannot be applied and are not marketed or available to applicants. Knowledge is driving force of knowledge-based development and has an increasing role in the growth of organizations and communities. Terms such as learner organization or in larger scale, learner society and learner nation are used to provide an illustration of organizations and societies with the greatest use of knowledge in its full cycle. Commercializing research achievements of universities is a complex and complementary activity and the chain of transforming idea into technology which leads to wealth creation, entrepreneurship and financial autonomy of universities. The purpose of present study was to determine and explain effective knowledge commercialization factors of commercializing research results and explaining relationships between these factors. This descriptive study is from survey type. The used method of present study was combined research method (quantitative and qualitative) and its statistical population included senior managers, research and technology directors, faculty members of the technical and professional university, senior managers and research and technology directors contract organizations with this university and experts related to this topic. Purposeful sampling method was used to select sample in qualitative section and sample of quantitative section was selected using stratified random sampling method. Data gathering tools included Semi-structured interview and author-made questionnaire. Content validity[1] and viewpoints of six experts in this field were used to determine the reliability of measurement tool. Reliability of the questionnaire was

[1] also known as logical validity

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obtained equal to 0.8541 using Cranach's alpha. Data from interviews were clustered and analyzed through coding and statistical tests such as T-test, Friedman were used to analyze quantitative data.

The obtained results indicated the effect of knowledge commercialization factors including government forces, economic forces, educational system, macro laws and regulations, technological advancements, competitors and competitiveness, customer orientation and other issues on commercializing research results.

Keywords: knowledge commercialization, knowledge management, faculty members of the technical university

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1. INTRODUCTION

Process of knowledge management involves creating knowledge, documenting knowledge, distributing and disseminating knowledge and ultimately applying knowledge. Nowadays, Knowledge and intellectual capital of organizations are one of the main advantages of competition and it can be argued that knowledge is the heart of global economy. It is no doubt that government and private organizations, manufacturing companies or services should play a role of leading organizations through designing and deploying a proper knowledge management system. Most governmental organizations seek to deploy their own knowledge management system to maximize their existing knowledge of policy making and create and maintain competitive advantage in domestic and international environment. Rapid changes in today's world have led organizations to face variety of challenges. Leading organizations utilize from available opportunities to achieve organizational goals through management tools and new technologies. Zareinejad et al., 2014). Research findings play a significant role in promoting human life quality, developing level of welfare of society and international economic and social developments. However, the findings will not be important and not offset the research costs unless cannot be applied and are not marketed or available to applicants. Involving researchers in commercialization of their research is one of the effective factors in development of research in developed countries.

Social and technical infrastructures needed to implement knowledge management in organization

Today, the global perspective to knowledge management infrastructure is a technical and social look (Rosenthal, 2005). Infrastructures are important aspects of organizational capability, and these and key infrastructures of knowledge management include technical, structural and cultural infrastructure (Gold et al., 2012) and the infrastructure associated with individuals. Here, the effect of each of these infrastructures on implementation of knowledge management has been described.

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The effect of organizational culture on implementation of knowledge management

Organizational culture is one of the infrastructure variables for implementation of knowledge management (Gold et al., 2012). Clearly, organizations should establish an appropriate culture to implement knowledge management. Trust culture increases mutual trust and relation among members of organization and individuals will be more willing to implement knowledge management with this culture. Organizations also need a continuous learning environment or culture to successfully implement knowledge management (Nedlela & Toit, 2001), so that learning takes place at all levels of organization. In a learning culture, people search for problems and are encouraged to learn and enhance learning management through learning tools such as training. Strengthening learning culture increases the capacity for implementation of knowledge management. Three concepts can be considered to create learning capacity in the organization: learning, changing initiative and changing culture (Daneshfard, 2013). In the future, those organizations will be successful and sustained which are ahead and continuously learning from others (Najaf Beigi, 2004). Also, organizations need to have supportive relationships, collaborative efforts and creating space of intimacy and friendship (culture of cooperation) for realization of knowledge management. In such a culture, individuals support and help each other and provide each other with knowledge needed to carry out organizational activities in order to easily provide the condition of utilizing knowledge and creating ideas and new methods in the organization. Tendency or lack of tendency of organizations to culture of power can affect the implementation of knowledge management (Davel & Snyman, 2007).

The effect of organizational structure on implementation of knowledge management

In centralization dimension, implementation of knowledge management is related to decision making authority in the organization. Decentralization structures[2] distribute

[2] Decentralization is a type of organizational structure in which daily operations and decision-making responsibilities are delegated by top management to middle and lower-level mangers within the organization, allowing top management to focus more on major decisions.

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decision-making powers. In such structures, the amount of creative solutions increases sharply. Communication channels of centralized structures are very slow and time consuming, while a decentralized structure provides an environment in which employees participate voluntarily in the implementation of the KM process. Therefore, decentralization is one of the facilitating dimensions of this process.

The effect of information technology on implementation of knowledge management

Information technology and its support ort can be associated with implementation of knowledge management. Tools such as Internet, intranet, extranet and so on enhance implementation of knowledge management. The purpose of technology development is to solve a problem or dilemma in society or promote better resources and create opportunities for growth and development (Sarafizadeh, 2007). Managers of leading and knowledge-based organizations utilize from information technology as a driving force and effective factor in the progress and success of knowledge management. In the other words, technology is one of the success factors of knowledge management. Information technology can play a variety of roles in supporting knowledge management and knowledge management initiatives cannot be effective without support of information technology (Kim, 2011 and (María Paredes Chacin et al., 2017).

In recent years, different organizations and companies have started to join the knowledge process and new concepts, such as knowledge work, knowledge guru, knowledge management and knowledge organization indicate intensification of this trend. Using By using these term, Peter Drucker has announced to creation of a new type of organization where power of mind dominates instead of e power of the arm. According to this theory, those societies can expect development and progress in future which are more knowledgeable. In this way, the availability of natural resources cannot be as important as knowledge. A knowledge organization achieves the capabilities that can make a tremendous amount of power (Abtahi and Salavati, 2014: 3). Such organizations are faced with new challenges. Nowadays, the competitive environment of organizations is becoming increasingly complex and changing. This space is changing rapidly so that its speed is far beyond the speed of

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responsiveness and adaptability of most organizations. Continuous knowledge changes have also created a new imbalance for organizations. The endless flow of knowledge has made markets in a constant change condition, which the matter forces organizations to continually change (Mashbaki and Zarei, 2014: 39). In the other, learner organizations can be named as knowledgeable organizations where creation of new knowledge, inventions and innovations is not a specialized work, but a kind of common behavior and is a method that all members of the organization act according to it. In other words, knowledge-based organization is an organization in which every individual is a creative and knowledgeable person. In this organization, thinking, collective discussion and discovering new ideas and thoughts are encouraged and innovators are grown (Senge, 1990, Translated by Hedayat and Roshan, 2007).

Each year, more than $ 1,000 billion is spent on research and development, accounting for about 2 percent of the world's gross domestic product and this figure is up to 4 percent in some developed countries. The increase in global trade in last two decades and reaching $ 31 trillion has largely been attributable to commercialization of research achievements. Researchers are continually striving to innovate and market new products that are not already existed or have new features. Transfer of knowledge and use of research results for decision-makers is quite clear in developed and developing countries (Sediqi, Majdzadeh, Nejat & Yazdani, 2007).

Research findings play a significant role in improving quality of life and developing community's welfare level, but these findings do not matter and not compensate high cost of research and production of science as long as they are not applied and are not available to applicants. Low-income countries face many challenges in applying knowledge due to the lack of resources (Santesso & Tugwel, 2006).

Researchers and scientific institutions are interested in producing, distributing and using their scientific findings. Competition between organizations, efforts to continuously improve, emphasizing on privatization and financial independence of organizations as well as new challenges facing human beings have made governmental and nongovernmental organizations interested in searching for logical solutions and achieving innovative and innovative tools and processes. In response to these conditions, universities have turned into commercialization and have seen

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revenue-generating activities as an important part of their strategic plan in order to access more resources and income (Bok, 2013).

In such a space, student are considered as customers and consumers, universities and research centers considered as moneymaking centers, education as a marketable product, research as intellectual property and academic leaders as senior executive directors (Feldman, 2014).

In Iran, knowledge-based development is one of the components of Iran's 20-year vision[3] plan and necessary to find effective solutions to reduce the time interval between scientific transformations and large volume of scientific production of practical applications and knowledge for e knowledge-based development. Solutions have so far been used to convey scientific achievements and apply them to decision making have not made much progress and this suggests that applying research results is difficult and complex and requires existence of several factors such as a powerful intellectual framework, creativity, skill, awareness and perseverance at the organizational level (Kitson , Ahmed , Harvey , Seers & Thompson, 1996).

It is vital for competitiveness and survival of communities and organizations to identify factors, processes and methods that are effective in transforming knowledge into a strategic source.

Investigating changes of university in Iran indicates the beginning of business activities and tendency of this institution to market. Increasing contact and impact of economic and social factors on academic research can lead researches' movement and innovation to commercialization of research outputs.

On the other hand, one of the policies and actions of higher education in fourth development plan is approval and notification of the rules of researchers' participation in profit from commercialization of research results (MSRT 2005).

Establishment and activity of vice president of science and technology, establishment of development centers and Science and technology parks, adoption of law on Protection of knowledge based enterprises and elite and researchers support laws are among other issues that increase the incentives of researchers to produce applied

[3] Also known as 20-Year Perspective Document for Iran

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science and technology. Currently, universities face problems such as lack of financial resources, insufficient trust of customers and stakeholders about ability of universities to solve problem and meet the needs and multiplicity of competitors in production and supply of knowledge, methods, tools and processes required by organizations. They are trying to bring themselves closer to the generation of successful universities, namely Entrepreneur University. Commercialization of research findings as the main feature of Entrepreneur University requires prerequisites, expertise and many factors. In the meantime, external environment of knowledge commercialization has an important role due to its facilitating and stimulating role. Commercialization is a process by which knowledge, skills and invention produced in universities and research results in the form of methods, inventions, tools, processes and training courses and are became available and used by organizations and society and research results means various types of services and academic and research achievements of universities, such as research projects, books, essays, advice, inventions and education available on the market (community), which utilizing from them makes it possible to produce goods, design and use of methods, processes, tools, develop human resource capabilities and provision of social services. The factors of knowledge commercialization investigated in present study include those conditions and characteristics of environment around the university which provide context of incentive to commercialize research findings. Given the lack of clarity of these factors and the relationships between them, it seems necessary to determine effective commercialization factors in commercializing research results and explain the relationship between these factors in order to help universities, researchers and decision makers in the field of research and technology to introduce research findings to social life environment and production of wealth from science, which the matter has been investigated in present study.

Explaining the problem

Commercializing research results and its effective knowledge commercialization factors is the process of introducing goods or services into commercialization of economic trades (IRPHE, 2013). Commercialization of research results means transfer of an idea, method, tool, skill, technical knowledge of intellectual property

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and discovery or invention of scientific research implemented in the academic sector into an industrial environment with or without partners, which may lead to development or improvement in products or services (Ktepe 2014). Universities play a role in obtaining legitimacy and revenue in response to market expectations and value creation for how researchers contribute to profit from commercialization of research results (MSRT, 2005).

Establishment and activity of vice president of science and technology, establishment of development centers and Science and technology parks, adoption of law on Protection of knowledge based enterprises and elite and researchers support laws are among other issues that increase the incentives of researchers to produce applied science and technology. Currently, universities face problems such as lack of financial resources, insufficient trust of customers and stakeholders about ability of universities to solve problem and meet the needs and multiplicity of competitors in production and supply of knowledge, methods, tools and processes required by organizations. They are trying to bring themselves closer to the generation of successful universities, namely Entrepreneur University. Commercialization of research findings which is the main feature of Entrepreneur University requires several prerequisites, specializations and factors. Meanwhile, external environmental factors (knowledge commercialization) play an important role in facilitating and motivating them.

commercialization of research results includes transfer of an idea, method, tool, skill, technical knowledge, intellectual property, discovery or invention resulting from scientific research implemented in academic sector (in partnership with or without partners) to an industrial environment which can lead to development or improvement of products or processes (Ktepe, 2004).

Universities have placed their emphasis on responding to market expectations and producing value for customers in order to gain more legitimacy and more revenue. Science has entered marketing literature as a service or product since the topics of customer satisfaction and marketing of academic products to academic field were posed (Plewa & Quester, 2005: Nowotny, 2006). Transformation of knowledge into wealth becomes possible through formation of innovation process and production and

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sale of new products and by this, science becomes value, wealth and ultimately social welfare (Iran National Science Foundation, 2009). Production and service organizations are also dependent on environmental actors in production of science in order to provide their capabilities and resources and universities and their professional members are valuable resources for achieving this goal (Lin Lee & Hung 2006). University scholars coat a science-based cover to performance of industries by presenting the scientific fields of technology and bring them into the overflow of technological knowledge generated at university (Dietz & Bozeman, 2015). Iranian universities have no brilliant history of facing environment and its changes for many reasons. While the external environment has been heavily influenced by technological change, universities in the country have not shown much of their innovation in increasing funding sources, creation of information networks of new educational and research methods and scientific capabilities (Arasteh 2000). The survive environment of organizations is dynamic and constantly changing. Various environmental identities or more clearly, environment forces outside the organizations affect continuously affect them and control their behaviors. For this reason, no organization can be considered completely independent or self-governing. Arasteh et al (2000) have studied the effect of technological characteristics of produced product and market potential on commercialization of technology. The obtained results showed that the probability of technology commercialization would be higher if produced technologies have certain features of innovation in terms of generality, simplicity and flexibility, having potential customers, having a desirable market. Karlsson (2004) has also considered three environmental factors of private sector capital availability, ownership rules of research results and government programs effective in the success of research commercialization. Therefore, the purpose of present study was to investigate the effect of knowledge commercialization factors on commercializing research results.

Questions of present study

1. What are the knowledge commercialization factors of research results?
2. What are relationships between effective knowledge commercialization factors of commercializing research results?

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3. METHODOLOGY

Present study is an applied one in the term of its purposes and a combined survey study in the term of data gathering method, because qualitative tools of interview and quantitative tools of questionnaires were used to gather required data. The statistical population of present study included senior managers and research and technology directors and faculty members of the technical and professional university and senior managers and managers related to research and technology of manufacturing and service organizations associated with this university. In interview section, the statistical population also included other experts in the field of scientific and executive related to the subject of present study and with effective compilations or executive history in commercializing research results in addition to above mentioned population.

The statistical population of present study was 521 individuals. Among them, 156 individuals were selected as sample size using Cochran formula and sample modification. Purposeful sampling method was used in qualitative section of the study to conduct a semi-structured interview and gather required data.

Cranach's alpha method was used calculate reliability of questionnaire, which the amount of 0.9641 was obtained. The calculated Cranach's alpha coefficient for different sections of questionnaire indicates its proper reliability (Table, 2).

Table (2), Cranach's alpha coefficient for all sections of the questionnaire

Section	Variables	Number of questions	total items	Cranach Alpha amount	Total reliability
First: Experience	Commercialization experience	11	11	0.87	0.87
Second: Effective components on	Government forces	5	59	0.70	0.94
	Economic forces or market	6		0.66	
	Customers and Customer Orientation	8		0.74	

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knowledge commercialization based on knowledge management	Competitors and Competitiveness	5		0.75	
	Technological advancements	4		0.72	
	Plans, laws and regulations	6		0.81	
	Understanding and believing in religious teachings	5		0.88	
	Venture Capital Funds	4		.077	
	Science and technology development parks and centers	7		0.82	
	Information and Communications Technology (ICT)	5		0.83	
	Education	4		0.75	

Ad Hoc method was used to analyze data obtained from interviews with 15 researchers and research directors and technology related to the commercialization of research results at a technical and professional university or in organizations under research and production contracting contract with this university. Production of meaning by Ad Hoc method is the most common form of interviewing analysis to produce meanings, because it simultaneously utilizes other approaches to analyze data from interview, such as tabulation, classification of meanings, and structuring of meanings through quotations and interpretation of meanings (Kvale, 1996). Descriptive and inferential statistic methods were used to analyze quantitative data. Pearson correlation test was also used to formulate correlation matrix of variables.

factors	**Items**	**Frequency**
Government forces	Government policies and orientations in relation to research and technology	**8**
	Encouraging inventors and entrepreneurs and paying attention to privatization	**3**

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	Establishing a vice president Science and Technology Assistant, Support Fund for Researchers and ...	**5**
	Establish a technology department along with research disruptions in universities and other organizations	**4**
Economic forces	Having knowledge-centered economy	**5**
	relative growth of a knowledge-based, multi-product and oil-independent economy	**7**
Customers	Customer satisfaction and responsiveness to them	**4**
	Having a position among government agencies	**3**
	History and reputation of university among employers and customers	**6**
Competitors and Competitiveness	Competition of companies with each other on the level and type of their knowledge	**4**
	Creating a new product or improving quality of previous products with competitive advantage	**5**
	Create a safe and healthy environment for competition	**6**
Technological advancements	Establishing laboratory and workshop facilities, advanced equipment, establishing site for testing products and similar in the university and industry to complete .research chain	**3**
Plans, laws and regulations	Faculty Promotion Regulations	**4**
	Macro national laws and regulations	**4**
	Development plans	**4**
	existence of major supportive laws and observing them	**8**
	Optimizing laws to encourage research and business activities of organizations in order .to become knowledge oriented	**5**
	Utilizing from legal capacity of fourth development plan and commercialization laws	**4**

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Belief in religious teachings	Recognition, Belief and observation of religious teachings	**3**
	Familiarity and belief in teachings of Qur'an and Hadith and Islam	**3**
Venture Capital Funds	Full funding of university and industry from researchers	**6**
	Many risky-taking supports and investments in a legal context	**4**
	Use of financial and equipment providers	**3**
	Venture-makers and entrepreneurs who are aware of commercialization and entrepreneurship	**7**
Science and technology development parks and centers	Activities of knowledge-based corporations, parks and centers of science and technology development	**4**
	importance of parks and development centers as infrastructures of knowledge economy of the country	**3**
	Observing laws and regulations regarding the activities of parks and centers for development of science and technology	**4**
Information and Communications Technology (ICT)	Strong and continuous interactions between faculty members and managers and organizations in the field of information and communication technology	**3**
	Creation of information and communication infrastructure	**4**
	Use of IT capabilities	**6**
Education	Having a research-centered and problem solving-based education system	**4**
	Train negotiation and communication skills to faculty members	**3**
	Training entrepreneurship and commercialization skills	**2**
	Training how to market and attract foreign capital	**4**

4. FINDINGS

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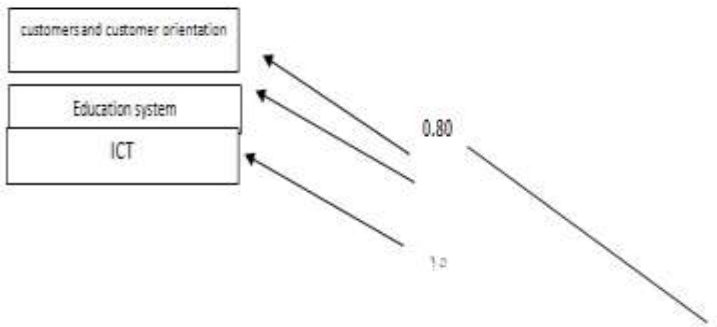
Question 1: What are effective components of knowledge commercialization based on knowledge management?

Effective components of knowledge commercialization based on knowledge management: research results of universities are diverse and they have different effect on the Technical University from viewpoint of interviewees. According to interviewed experts, knowledge commercialization factors mentioned in Table (3) have effect on commercializing research results of universities. Extracted factors from interviews and items related to the knowledge commercialization factors have been shown in Table (3).

Table (3), conclusion of factors and items related to knowledge commercialization extracted from interviews

Table (4), statistical indicators of the effective organizational factors model in commercialization of research results

In Table (4), the variable of government forces has been fixed at 1 in order to solve the indeterminacy problem for latent variables[4]. Results obtained from confirmatory factor analysis indicated that estimation of all factors was significant at the level of 0.001. The highest amount of factor load (0.80) was related to customers and customer orientation and the least related to competitors and competitiveness. Also, latent factor of knowledge commercialization explained 64% of variance of this variable.



[4] In statistics, latent variables (from Latin: present participle of lateo (“lie hidden”), as opposed to observable variables), are variables that are not directly observed but are rather inferred (through a mathematical model) from other variables that are observed (directly measured).

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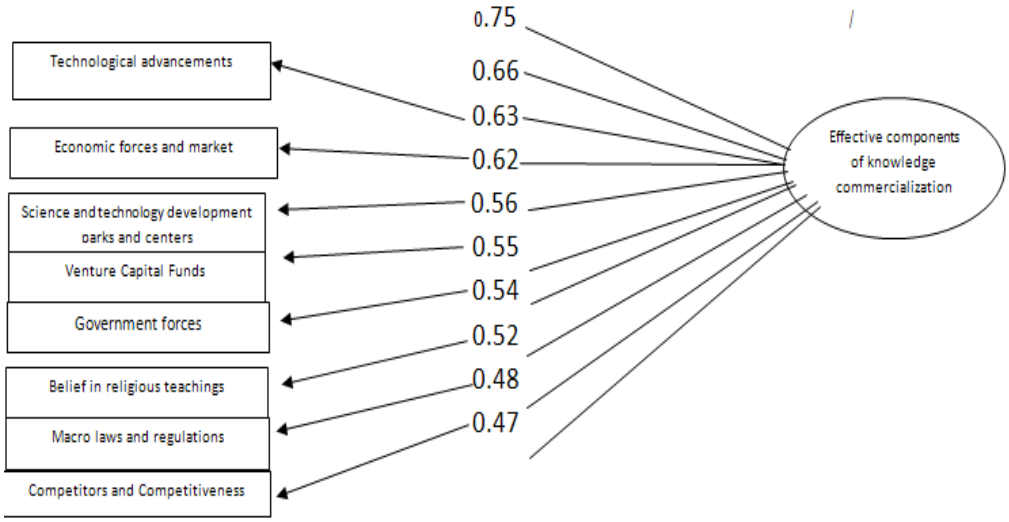

Figure (1) Effective components of knowledge commercialization based on knowledge management

Question 2: What are relationships between effective components of knowledge commercialization based on knowledge management? According to the correlation matrix of variables (Table, 5), there is a correlation relationship between most variables and this relationship is significant. In this table, numbers inside gray rectangles indicate correlation coefficients and numbers below them represent the significant level.

It can be said that all factors affecting knowledge commercialization have interaction with each other based on knowledge management and change in each of them causes change in other factors.

Table (5), Correlation matrix of present study's variables

Research variables					
1. Government forces	1				
2. Economic forces	0.39	1			
	0.00	0.00			
3. Customers and Customer Orientation	0.26	0.32	1		
	0.00	0.00	0.01		
4. Competitors and Competitiveness	0.30	0.41	0.36	1	
	0.00	0.00	0.00	0.00	
	0.32	0.27	0.24	0.47	1

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5. Technological advancements	0.00	0.00	0.00	0.00	0.00						
6. Plans, laws and regulations	0.42	0.55	0.32	0.59	0.40	1					
	0.00	0.00	0.00	0.00	0.00	0.00					
7. Belief in religious teachings	0.20	0.22	0.07	0.39	0.27	0.46	1				
	0.01	0.00	0.35	0.00	0.00	0.00	0.00				
8. Venture Capital Funds	0.32	0.32	0.27	0.37	0.46	0.47	0.23	1			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
9. Science and technology development parks and centers	0.40	0.48	0.44	0.41	0.34	0.61	0.31	0.44	1		
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
10. Information and Communications Technology (ICT)	0.25	0.34	0.30	0.32	0.3	0.43	0.27	0.27	0.63	1	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
11. Education system	0.28	0.33	0.29	0.36	0.42	0.36	0.17	0.31	0.35	0.44	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00

5. DISCUSSION AND CONCLUSION

1. Considering the role of customers and competitors in commercialization of research results, universities and research centers should design and implement their activities based on the needs of the audience of each of scientific areas' audiences. This is not possible due to increasing and reviewing the authority given to research council of universities and Colleges.
2. Special units in universities should assume the responsibility of identifying and documenting operational information and scientific and technological needs of manufacturing and service organizations and experiences of their managers.
3. Considering the relatively significant role of education in commercializing research results, short (but comprehensive) training courses should be scheduled and held for faculty members, managers and experts in the field of research findings' commercialization and related issues such as the process and methods of commercialization of intellectual property rights, marketing science and technology, challenges and solutions for university and industry communication and compilation of a research project with a commercialization approach.

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4. According to the findings of present study about weak position of competitors and competitiveness in research and technology activities of universities, it is recommended to develop and implement rules and guidelines for autonomy of universities in decision making and financial affairs in order to propel them into competition for survival and development. Expansion of private knowledge-based enterprises, implementation of research-based PhD courses, ranking of universities on the basis of specific revenues and making universities compete in the implementation of wealth-rich research can be useful.
5. It is recommended to define and explain a cooperative competition between industry and university, strengthening and mutual benefit between them and the possibility of realizing their goals through realization of other side's goals.
6. The number of venture capital funds and risk-taking institutions should be increased and systematized in order to support researches and innovations of universities and governmental and nongovernmental research institutions and other researchers.
7. Information infrastructures should be developed and provided for customers and decision makers to access information from research and technology produced by universities and research centers. Also, it is recommended to develop virtual collaboration networks and exchange of ideas and research findings at national and international levels to meet the needs of production and service organizations.

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