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Studying Knowledge Commercialization

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Abstract
Research ideas and findings of learners can be led to wealth creation, entrepreneurship and finally development and economic and social welfare. In order to realize knowledge commercialization it is necessary to determine the constituent processes, methods and factors to be used in decision-making for commercialization. Knowledge commercialization in engineering and construction management of national Iranian south oil company was studied in this survey in viewpoint of some effective inter-organizational factors on it including role of senior management, market centrality and customer focus, participation and interaction, intellectual property management and role of individual factors. The survey was conducted using descriptive-field method and the statistical population consisted of management experts and researchers. Simple random sampling was conducted and researcher self-made questionnaire was tool of data collection. Statistical tests like t-test and Kolmogoroff-Smirnoff test were used for data analysis. Results indicate engineering and construction management has knowledge commercialization and role of individual factors in Friedman ranking test has the highest potential. Participation and interaction, intellectual property management, role of senior management and market centrality and customer focus are the next factors.

Keywords: Participation and interaction ,Role of individual factors ,Intellectual property , Knowledge commercialization Role of senior managementو Market centrality and customer focus

1- Introduction

Importance of knowledge as the stimulant of economic growth and the factor to increase productivity is emphasized by most governments and academic and industrial sectors across

the world. Today production of knowledge in economy beside its successful dissemination and effective application has been converted into a global purpose in the production field.

Given to the emphasis of the Future Outlook of the Islamic Republic of Iran in the Horizon of the Next Two Decades on the necessity of technology development and growth, the Expediency Discernment Council referred reinforcement of national resolution for growth and development of knowledge and technology; policy-making and compilation of strategic plans and modifying the structure of managerial system; determining the priority in supporting knowledge and technology; emphasizing education of human force and keeping and attracting human capitals; enhancement of self-assurance and self-reliance; strengthening and organizing of cooperation among university; research centers and academies with private and public industrial, technical and service sectors; modifying and completing the rules and regulations especially in business and customs sectors with the purpose of changing the import process from foreign countries to the process of knowledge and technology transfer; spiritual reinforcement and infrastructure to develop applied, developmental and innovative researches; enhancement of academies' role; reinforcement of international cooperation in the first article of total policies of the government for technology growth and development in the country entitled "technology development to improve Iran's status in the global technology, knowledge production, gaining wealth and enhancement of national power" and serious attempt for qualitative level of basic sciences and scientific orientation of researches in knowledge and technology scope; development of industries and services on the basis of modern knowledge and technologies; renovation of industries and modifying as well as completing the existing capacities of knowledge and technology; stressing increased portion of research in technology from gross domestic product; production support and export of products and domestic and traditional technologies and supporting establishment and development of townships and science and technology parks in the second article entitled "reinforcement of substructures and national capacities of technology in the country".

Knowledge commercialization and supporting its process and using scientific and technological findings for the country's development are more emphasized At second chapter of fifth development program at articles "د " and " ه " clauses 16 and 17 completely , and articles " ز " , " ط " and " ی " clause 18 , in compare to fourth development program, more emphasized on knowledge commercialization , supporting its process and using scientific and technological findings for developing country . establishment and activities of scientific and technological deputy of president , developing grow centers and scientific and technological parks and approving laws for supporting elites and researchers are other items which caused for raising researchers motives for creating science and technology. Since the oil sector in Iran's economy is highly important and paves the way for many changes in the country change in this sector can affect other economic and social sectors. Research in the oil industry is accomplished in various grounds such as exploitive studies and production storages, processes of making complex petroleum derivatives, chemicals, catalysts and even designing new units. Research activities in oil industry are in a way that they consider appropriate scientific and practical strategies to eliminate problems and productive and operational pressures besides paying attention to recent scientific achievements and the modern technology so that reduction of wastes and expenses, increased revenue and enhanced productivity have been obtained by applying and implementing of research results.

Applied and developmental researches are the key of technology development and self-reliance in making of equipments and materials inside the country. Freeing from the oil-based economy depends on passing through researches and organization of capitals. If we accept the viewpoint that the society's capability in utilizing the results of engineering and construction management researches is increased which could be commercialized potentially, knowledge commercialization in this management is an important missing link towards the country's development, wealth and revenue production and solving the economic problems. Therefore, effective factors on the process of knowledge commercialization in engineering and construction management were examined to study knowledge commercialization in this organization in the present survey besides dealing with necessity of accomplished investments in research and technology sector in the society.

2- Literature review and research background

2-1 Definition of knowledge commercialization

Having reviewed the presented definitions in journals, books and specialized texts of technology management field generally, three distinct viewpoints are discernible regarding the definition of knowledge commercialization**:**

The first viewpoint is the view of specialists who consider knowledge commercialization as a continuous chain from idea generation to sale and knowledge application by the final customer. For instance, Goldsmith regarded commercialization as the development process of a business through feasibility study of an idea and its application to its acceptance in the market. According to this viewpoint, commercialization is a process that is converted into successful economic products. Commercialization is harmonization of technical and commercial decision-making processes (and results of these decisions) that is conducted for successful transfer of a new product or service from idea creation to purchasing in the market. The product commercialization framework contains major arrangement of all inseparable stages in the development process of a product. Commercialization is the process of technology transfer or an innovative concept from the idea stage to the market. In other words, knowledge commercialization is usually defined as a process of creating a product that is suitable for a special market with an acceptable price which can satisfy market needs.

Specialists who are adherents of the second viewpoint believe knowledge commercialization is synonymous with knowledge transfer. For example, Jane defined knowledge commercialization as knowledge and technology transfer from one person or group to another person or group in order to use it in the product system, process or course of action. According to this viewpoint, knowledge is transferred only from research centers to the existing industries or new businesses.

The third viewpoint is allocated to specialists of marketing field or new product development in companies. These specialists believe knowledge commercialization is the last activity of new product development cycle. One of the most popular members of this viewpoint states that commercialization is a process which includes the last step among eight steps of new product development process. Idea of manufacturing the new product from this viewpoint passes various stages and through these stages the company studies whether the idea must be developed further or its development process should be stopped. But in the commercialization

stage, the product is prepared to be supplied to the market. In this step management should decide regarding the time, place and manner of introducing the product (Gudarzi et al, 2012).
Given that each of the proposed definitions considers various aspects of the term commercialization, the most important proposed definitions in this regard are represented in table (1). The below definition of knowledge commercialization that is suitable to human force atmosphere was inferred based on reviewing and analyzing the existing definitions: knowledge commercialization is a process through which the produced ideas, skills and invention in the organization (results of research in the form of methods, tools, processes, educational workshops, consulting services, etc) are available and could be exploited by other organizations and the society (Jahed, 2012).

Table 1- The most important definitions proposed about commercialization

Row	Definitions
1	Knowledge commercialization is a process that converts the produced knowledge in universities and research organizations into suppliable products in the market or industrial processes. This process necessities serious cooperation and interaction of higher education centers and governmental research organizations, industrial companies, financial and investment organizations, entrepreneurs and scientists (Fakour, 2005).
2	Commercialization includes producing a new idea and implementing it on a new product, process or service that is led to dynamic growth of national economy, increased employment and enhancement of net profit for the innovative firm (Astebro, 2003).
3	Commercialization of researches is a process that converts the produced knowledge in research organizations into suppliable products in the market or industrial processes (Salter & Martin, 2001).
4	Commercialization is the process of developing a business through feasibility study of an idea and applying it until its acceptance in the market (Rosa & Rose, 2007).
5	Commercialization is a process that begins from technology-market insight and ends to stable functions of the product proportional with the market (Jolly, 1997).

2-2 Research background

Knowledge commercialization has a long history. Although obtained technologies of scientific researches were supplied to the market and commercialized in the past even in a limited form but it appears that knowledge commercialization started with issues of cooperation between university and industry. Cooperation between university and industry was started by the beginning of Morrill Act in 1862 that the academic system launched granting of lands (Karlsson, 2007). Many of the clear-sighted believe the interaction between university and industry really forms processes and outputs related to knowledge commercialization (Markman et al., 2008). Researchers identified two waves of commercialization during the history of commercialization development. The first wave was started at the beginning of the 1980's. It can be identified by establishment of "traditional" science parks that were conducted with the purpose of attracting

advanced companies. Increasing of private budgets for academic researches was a sign of increased cooperation with existing industries. The second wave that was accelerated in the second half of the 1990's is separable from the first wave by more concentration on branch companies, granting or submitting patents with regard to general cooperation with industry and activity of most students in commercialization projects (Rasmussen & Gulbrandsen, 2006). Later on this new approach developed a set of major elements that include technology transfer and licensing offices, incubators' facilities and mutual investment corporations (Etzkowitz, 2000).

Having reviewed previous articles and studies, there are two main streams of research that study knowledge commercialization. One is the "technology transfer" stream that in the 1980's proposed commercialization should be viewed as a process of technology transfer from university to industry. In order to enhance knowledge commercialization, university should pay attention to obstacles and opposition among beneficiaries involved in this process. The second stream is that of "institutional and organizational resources". This was proposed at the beginning of the 21st century and indicates favorable institutional and organizational resources include supportive commercial infrastructures, organizational motivations, having access to risky capital and investment and plays a major role in enhancement of commercial performance of research (Chang et al, 2009).

Given to the limited volume of paper, effective factors on knowledge commercialization are summarized in table (2) that have been presented by researchers and research institutions.

Table 2- Effective factors on knowledge commercialization (researcher made)

Effective factors on knowledge commercialization	Resources
Market centrality and customer focus	Jolly (1997), Rosa & Rose (2007), G.ktepe (2004), Cooper (1981), Sarmad Saeidi & Mamaghani (2011), Musaee (2009), Bernt & Monta (1993), Jahed (2012)
Role of senior management	Cooper (1981), Fakour & Haji Hosseni (2009), Fakour (2007), Migunpouri et al (2012), Sigel et al (2003), Lester (2009), Bernt & Monta (1993), Jahed (2012)
Intellectual property management	Howard (2005), G.ktepe (2004), Fakour & Haji Hosseni (2009), Fakour (2007), Pourezzat et al (2011), Debaker & Golz (2005), Jahed (2012)
Participation and interaction	Yadollahi Farsi & Amini (2012), Howard (2005), G.ktepe (2004), Fakour & Haji Hosseni (2009), Fakour (2005)
Role of individual factors	Hashemnia et al (2003), Migunpouri & Ahmadi (2013), Chiu & Chang (2009), Gradi (2002), Jahed et al (2012)

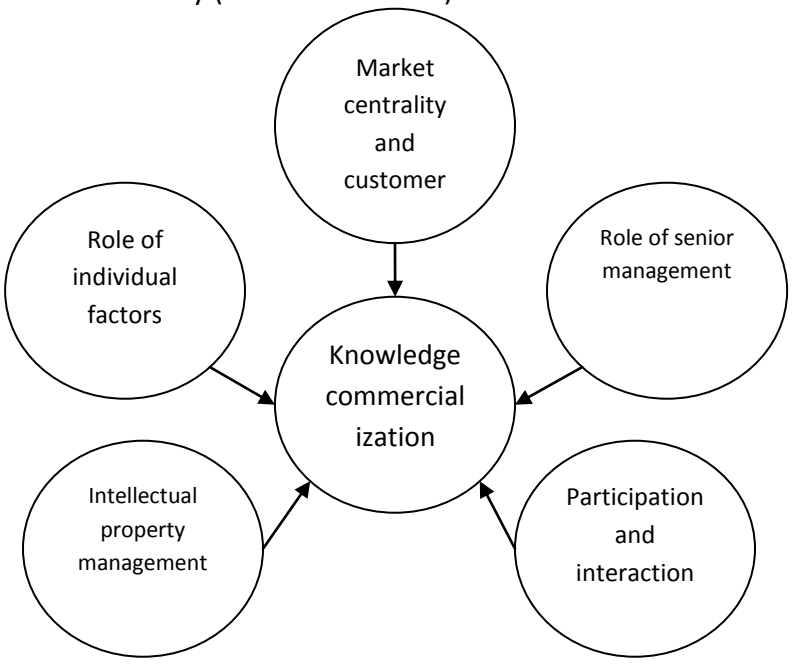
Conceptual model

Conceptual model of survey is presented to show the relationship among research elements.

Therefore, it was considered to enrich report results, organizing of interviews, data collection and management in all steps and not to exert a kind of orientation. What is certain, there is no fixed standard for knowledge commercialization since commercialization is affected by society customs, paradigms of the organization, market environment, policies of the government and many small and large components which make its modeling difficult. On the other hand, knowledge commercialization is not a simple and linear process; rather it is a complex process in which various players play their role with different capabilities. This process requires skills such as product development, market evaluation, market strategies, financial resources management, production engineering and management, accounting, etc (Jahandide, 2006).

Each strategy, model, concept and tool has different factors that are effective on the process of commercialization, but purpose of the present survey is not to deal with all these factors and concepts. It was tried here to consider those factors which had been proposed as critical success factors in different accomplished studies. Critical success factors are divided into two internal and external classes (Kohan, 2010; Migopouri, 2012). As major portion of these factors is internal, considering them could compensate deficiencies of external factors to some extent and influence of the organization on external factors (infrastructures, national innovative system, universities and research centers, risk-taking funds, etc) is on the other side difficult. Thus the most important internal and external critical success factors are dealt with that include market centrality and customer focus, role of senior management, intellectual property management, role of individual factors, participation and interaction and the issue of role of individual factors from different resources.

Conceptual model of survey (researcher made)



4- Methodology

The present survey was conducted using descriptive-field method. The statistical population consisted of experts and researchers in the field of research and technology of engineering

management and construction of oil-rich areas in the south and they worked in these posts when the survey was conducted (2013). It was estimated equal to 44 persons using Cochran formula and samples were selected through simple random sampling method. Data collection was accomplished in two ways of historical study and researcher self-made questionnaire. The questions and items were compiled using research literature. A questionnaire with 45 items about effective factors on knowledge commercialization was proposed from sum of the exploited components of interviews and was delivered to five experts. They suggested to conduct a pilot study and the final questionnaire was prepared with 11 questions about market centrality and customer focus, 5 questions about the role of senior management, 7 questions about intellectual property management, 5 questions about participation and interaction and 17 questions about the role of individual factors in addition to demographic information section. Forty three questionnaires among the fifty distributed questionnaires were selected and applied given to the degree of precision and completeness in responding to questions.

Content validity was used to determine validity of the measurement tool that depended on experts' judgment. There were five research experts in the above organization. Cronbach alpha was applied to calculate reliability of the questionnaire that its amount for each variable in table 3 illustrates its suitable reliability.

Descriptive and inferential statistics methods were used for data analysis. Kolmogoroff-Smirnoff test, t-test and Friedman test were used to examine normality of data distribution, effect of variables and ranking of factors respectively.

Table 3- Amount of Cronbach alpha for each variable

Variable	Amount of Cronbach alpha
Market centrality and customer focus	0.73
Role of senior management	0.77
Intellectual property management	0.74
Participation and interaction	0.79
Role of individual factors	0.76

5- Research findings

Analysis of data to verify hypotheses for each type of research has a special importance. Today data analysis is regarded as the most important section in most researches that rely on the collected data about the topic under study. Raw data is analyzed through statistical techniques and users can use them in the form of information after being processed.

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Table 4- Results of Kolmogoroff-Smirnoff test on variables

Variable / Characteristics	Market centrality and customer focus	Role of senior management	Intellectual property management	Participation and interaction	Role of individual factors
Number	43				
Mean	3.03593	3.11163	3.21272	3.53023	4.13819
Standard deviation	0.588212	0.567874	0.509721	0.583722	0.530775
Absolute	0.133	0.152	0.229	0.197	0.360
Positive	0.124	0.113	0.229	0.197	0.142
Negative	0.133-	0.152-	0.143	0.089-	0.360-
Kolmogoroff-Smirnoff	0.872	0.997	0.436	1.289	0.842
Significance level	0.433	0.273	0.554	0.072	0.536

Null hypothesis in Kolmogoroff-Smirnoff test is that data follows normal distribution. The alternative hypothesis is that data does not follow normal distribution given to the illustrated significance level in the above table for each independent variable that is higher than 0.05 (significance level is considered equal to 95%) and not rejecting the null hypothesis indicates data distribution is normal.

Table 5- T-test with test value equal to 3

Variable	Number	Mean	Standard deviation	t	Degree of freedom	Significance level	Mean difference
Knowledge commercialization	43	3.4057	0.50387	5.280	42	0.000	0.40574
Market centrality and customer focus		3.21163	0.567874	7.401		0.047	0.035930
Role of senior management		3.23593	0.588212	8.289		0.045	0.111628
Intellectual property management		3.27127	0.509721	2.737		0.009	0.212721
Participation and interaction		3.53023	0.583722	5.957		0.000	0.530233
Role of individual factors		4.13819	0.530775	14.062		0.000	1.138186

Given that there is normal distribution, one-sample t-test with test value equal to 3 and confidence level 95% (error 0.05) has been used to interpret research variables. As it is observed in Table 5, amount of significance level is less than 0.05 for each variable that shows the variable under study has knowledge commercialization. Given to mean of the factor under study that is more than 3, this factor is strong in the statistical population.

Table 6- Friedman test to rank variables under study

Priorities	Variable	Mean of ranks
1	Role of individual factors	4.16
2	Participation and interaction	3.66
3	Intellectual property management	2.44
4	Role of senior management	2.41
5	Market centrality and customer focus	2.29

Table 7- Chi-square test to determine monotonous distribution of variables

Number	43
Chi-square	97.638
Degree of freedom	4
Error level	0.000

Given that the calculated chi-square statistic is more than the critical amount 11.07 with degree of freedom equal to 4 and error level 0.05, it is rejected that ranks of five variables are equal.

Results in Table 6 illustrate the highest mean is related to the role of individual factors and on the other side the lowest mean is related to market centrality and customer focus. Managers can take necessary actions to increase knowledge commercialization in each variable that is more considered by them given to the above ranking and comparing it with their expected purposes.

6- Discussion and conclusion

Results and findings of each survey are the most important part which are resulted in improvement and excellence by testing the findings and confirming the hypotheses. Obtained results of statistical tests reveal all variables under study have the potential of commercialization in engineering and construction management (with significance level less than 0.05) and since mean of each variable is more than 3 these factors are observed strongly in the statistical population. "Role of individual factors" variable has the highest potential and "market centrality and customer focus" has the lowest potential. And among them are variables of "participation and interaction", "intellectual property management" and "role of senior management" respectively.

Given to results of the quantitative section to eliminate weaknesses of the organization, the following are suggested to managers and researchers to be considered in researches about knowledge commercialization:

It is suggested to the organization to perform future projects of technology development and research to determine important technological priorities during various time periods and inform their researchers about these priorities.

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