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PRIORITIZATION OF THE BARRIERS AFFECTING TECHNOLOGY TRANSFER (CASE STUDY: PERSIAN GULF SHIP BUILDING COMPLEX)

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ABSTRACT

Nowadays, technology is a key element in economic, industrial, and commercial development, and investment in development, expansion, and adoption of new technologies has been considered as the engine for the development and globalization of economic enterprises throughout years. In the industrial world of today, technology is of the factors specifying the success and failure of organizations. Given the importance of technology in the competitive ability of technological firms, technology management, as one of the branches of management, has had a significant development. Technology management studies planning, managing, and development of activities, technology transfer, innovation and technology management are to gain competitive advantage, and discuss important knowledge and experience of management in this regard. Thus, the discovery of barriers affecting technology transfer and determining the importance of each of these factors is important. The present study used experts' opinions to identify the barriers affecting the technology transfer and providing solutions for its transfer in Persian Gulf Ship Building Complex (PGSBC). The population of the study was 10 managers of PGSBC in Bandar Abbas. Chang's fuzzy hierarchical process analysis technique was used to prioritize the barriers affecting technology transfer. According to this, ineffective and non-efficient management, lack of attention to research and development activities, lack of close cooperation between the research center and industry, inability of the parties in technology transfer, lack of government support, lack of attention to internal absorption capacities, and lack of market access ranked 1 to 7, respectively in this regard.

Keywords: *Technology Transfer Barriers, Ship Building, Fuzzy Analytical Hierarchy Process.*

INTRODUCTION

The importance of technology as the main factor and the engine of economic development is known well in the today's world. Technology develops through knowledge, and it is possible to discover or create knowledge application in human life through the field of research and development. Iran is 20 to 40 years lagging behind the developed countries due to oppression and neglecting the importance of technology. The creation of technology calls for investment in research and development and training of human resources. The investment rate of developing countries, including Iran, on research and development is much lower than the developed countries (the term “developing countries” mainly refers to countries with low levels of economic development. This is usually connected to the social development of in education, health, life expectancy, and so on in some part. The term expresses a kind of degradation in developing countries.) In 1990, developed countries spent 5.2 to 8.2% of their gross domestic

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production (GDP) for this, whereas this figure was less than 0.3 percent in the thirty developing countries, and according to the site of Science and Technology Information in a discussion with Lizena, nowadays 80% of the world's research budget is spent by developed countries, which is 33.5% in America, 13.4% in Japan, and 32.5% in Europe. Thus, with this long-term process of converting research ideas into productive economies, technological gap between developing and developed countries is increasing day by day. Thus, there is no doubt that the only practical way to make compensations for the backwardness of a country or an economic firm is to use other successful experiences in the new arena. In other words, there are not enough human resources, capital, and time to do the same that others have done during a century or two, with many tangled and misguided resources (Hempson, 1995).

Technology transfer is a shortcut to achieve the fruits of other countries' research in solving industrial problems in the country. By studying the development history of developing countries, especially the east Asian countries, it is noted that in their development to accelerate the solution of the problems of the industrial sector, they have strengthened the technology of their country through its transfer from other developed countries, and then with establishing an appropriate economic infrastructure has sought to strengthen academic centers and research (Ansari and Zaire, 2009). Studies at the United Nations Conference on Science and Technology for Development approved of this point as well (The San Francisco Conference in November of 1966 with the participation of 43 countries, including Iran). Vienna Program of Action states that "if developing countries as another solution look for acquiring the necessary scientific and technical knowledge necessary for economic development without using existing knowledge, which is the result of research by researchers and thinkers of the world, this is not only a difficult task, but also a waste of money. Moreover, achieving such a solution in a time that underdeveloped countries have considered to do so seems to be impossible. If such an idea prevails in the world, the technical progress of all countries of the world, including the industrialized countries, will be disturbed." Moreover, achieving such a goal in short-run is not possible. Therefore, for reducing the technological distance between advanced and developing countries, the transfer of scientific and technological knowledge is the best option (Farsijani and Teimourian, 2009).

Technology transfer is a process allowing the flow of technology from one source to one receiver. In the case of this resource, the resource is the owner of knowledge, whereas the beneficiary is knowledge. The resource can be a person, a company or a country. Technology is the expression and tools of human creativity. Technology transfer is the best option for reduction of the technological gap between developed and developing countries. For this purpose, one has to pay close attention to the elements that make up the technology. Technology means all the knowledge, products, processes, tools, methods, and systems used in creating products or providing services. One of the areas of applying technology management needing comprehensive and introspection is technology transfer (Ansari and Zaire, 2009). Nowadays, industrialization is profoundly dependent on technology transfer. In today's world, there is a direct relationship between the development of technology and the economic, social, political and cultural development of a country. One can state that technology is a fundamental factor for wealth creation, capability and knowledge of countries and a powerful tool in national development. Overall, developing countries can receive valuable lessons from the successful experience of some industrialized and newly industrialized countries, especially the ones in eastern Asia and Latin America, such as South Korea, Taiwan, Brazil and Mexico that have

reached those states by imports and exports and foreign technology transfer - as emerging industrialized countries in East Asia and Latin America. Therefore, technology transfer is an important category in promoting the level of technology of a country and ultimately moving towards development, and the lack of attention to this is an important obstacle to the development and economic, political and cultural development of less developed or developing countries that are incapable of producing advanced technologies (Foad, 2009). Thus, the main focal point of this study is to identify barriers affecting technology transfer and to provide appropriate solutions for removing these obstacles.

REVIEW OF LITERATURE

Ansari and Zaire (2009) studied the factors affecting the technology transfer and selection. By doing all this, we have tried to discuss the process of selecting and transferring technology; and according to this, we have described an algorithm for qualitative and quantitative technology selection. The purpose of the study was to introduce the appropriate criteria for the selection of technology. Therefore, after reviewing the literature of technology and technology transfer mechanisms and development, we examined a checklist of factors affecting the process of technology selection. Later on, with the help of experts, 66 factors affecting the technology selection were considered that resulted in selection of 23 applied factors in car body-part production unit in IranKhodro Company (Ansari and Zaire, 2009).

Mehdizadeh et al. (2010) studied the factors affecting technology transfer. The purpose of their study was to become familiar with the factors that affect the transfer of technology in Iran's industries. In doing so, we have dealt with the definitions of technology, technology transfer process, and barriers to technology transfer in Iran and the success factors of technology transfer of developing countries. Considering the key factors identified in the process of technology transfer, taking into account all different aspects of effective, an appropriate model for the factors affecting the transfer of technology was developed with eight main factors. these factors include efficient and effective management titles, effective government support, cooperation, proximity of research and industry centers, attention to research and development activities, the good capability and capacity of the receiving country, the availability of sufficient market, the willingness and ability of the transferring and receiving technology and the policy of export development. The results of this study can be used as a guide for improving the efficiency and effectiveness of technology transfer projects (Mehdizadeh et al., 2010).

In a study entitled the use and comparison of AHP, Topsis, and Electric methods in transferring technology for the production of dry resinous transformers, Bagherimoghaddam and Zarei (2007) studied the technology transfer options and prioritized them according to a number of quantitative and qualitative indices. At the end of the study, it was seen that the answers obtained from AHP method were more in line with the decision makers' point of view, and their bachelor's considerations are more widely used in the decision model. Kabaranzad conducted another study with the aim of identifying factors that affect the evaluation and selection of technology transfer methods to understand the existing gas company in Tehran in terms of the impact of each of the five technology components on technology transfer process.

Kazemnejad, Vagefi, and Musikhani (2009) examined the technology transfer in the production of diesel engines (analysis of the components of technology). The purpose of this study was to analyze the dimensions of technology and the knowledge of its transmission in the

manufacturing and production of diesel engines in Iran to get the best possible solutions. The results of t-test showed that the hypotheses related to the hardware and software variables and the human resources were confirmed, but orgaware was not approved. Moreover, there was not a meaningful relationship between the variables of experience, education and people age about their point of view (Kazemnejad et al., 2009). Valizade & Akbari (2010) conducted a paper entitled "Technology transfer and its success in developing countries, defining management technology and transferring it to the implementation process and its successful patterns in Asian countries (Japan and Korea)." Considering specific cultural, political, social and economic conditions in Iran, they have proposed some suggestions to make effective use of the technologies of the day.

Ebrahimi examined the intellectual property rights and technology transfer and stated that a large part of the country's economic growth depends on its technological development, and technology transfer means regular chains of targeted activities to utilize the set of technology elements in a place other than the original location. This is an important step in the process of industrialization and economic development in less developed countries and in the vast majority of countries unable to produce advanced technologies. Therefore, the governments and nations of the world with update technology have devised laws and guidelines to support and monitor the intellectual property of technology creators, and have made other countries comply with them and enforce these laws. Amin Naseri and Zanganeh (2008) examined and evaluated the role of organizational capability for the transfer of technology in Iranian offices and stated that today transfer of new and superior technologies is considered as one of the ways to maintain competitive advantage in the firms. Due to the high rate of failure of technology transfer projects in many firms, attention to identifying the factors that block and accelerate the attraction and development of technology is very important. One of the important factors in failure of technology transfer projects is organizational factors or corporate ability of firms in creating compatibility between new technologies with corporate structure, corporate culture and corporate resources. The results showed that organizational capability in Iranian firms has a significant effect on the effectiveness of technology transfer. From among the organizational capacity-building variables, seven variables have had high effects on eleven variables out of the variables that comprise the effectiveness of technology transfer in Iranian offices. The results can be used to improve the effectiveness of technology transfer projects in similar Iranian firms (Amin Naseri and Zanganeh, 2008). Boustani (2011) focused on prioritizing barriers to technology transfer with fuzzy logic. Finally, the cultural factor was considered as the most important factor (Boustani, 2011).

METHODOLOGY

According to the studies by Thomas Hmpson, technology transfer improves the competitive performance of organizations. These studies show a strong connection between technology acquisition (including technology transmitted from abroad and domestically developed technology) and competitive priorities. James Lester conducted a study for technology assessment. Technology evaluation is a tool for prospective thinking, especially when we are analyzing trends and strategies for solving opportunities and threats. Evaluation is used as a more technical evaluation for quantitative calculations in some construction projects. Cost evaluation is among the most common evaluations. In the present study, we used the views of

the experts to identify the barriers affecting the technology transfer and provide solutions for its transfer in PGSBC.

The present study was applied in terms of purpose and in terms method a survey. In doing so, firstly, we examined the related literature, and academic staff and experts and experts familiar with the problem to extract and find effective barriers. After collecting and refining the barriers, to determine the effectiveness of each of the factors, we collected the ideas of the experts and university professors' familiar with the subject to determine the effect of each of the variables through a questionnaire.

RESULTS

In this part of the study, using Group Fuzzy Analytical Hierarchy Process technology developed by Chang, we prioritized the identified barriers to technology transfer. For this purpose, we used the opinions of 10 experts. Table 1 describes the descriptive and fuzzy expressions used in Group Fuzzy Analytical Hierarchy Process developed by Chang:

Table 1: Equivalence of descriptive expression

Inverse triangular fuzzy number	Triangular fuzzy number	Descriptive phrases (linguistic)	Fuzzy numbers
(1/11, 1/9, 1/7)	(7,9,11)	Absolute Importance	$\tilde{9}$
(1/10, 1/8, 1/6)	(6, 8, 10)	Very strong importance	$\tilde{8}$
(1/9, 1/7, 1/5)	(5, 7, 9)	Strong importance	$\tilde{7}$
(1/8, 1/6, 1/4)	(4, 6, 8)	Average to high importance	$\tilde{6}$
(1/7, 1/1, 1/3)	(3, 5, 7)	Average importance	$\tilde{5}$
(1/6, 1/4, 1/2)	(2, 4, 6)	Average to low importance	$\tilde{4}$
(1/5, 1/3, 1)	(1, 3, 5)	Weak importance	$\tilde{3}$
(1/4, 1/2, 1)	(1, 2, 4)	Very weak importance	$\tilde{2}$
(1, 1, 1)	(1, 1, 1)	The same importance	$\tilde{1}$

Table 2 shows pairwise comparison of the matrix of the comparison of technology transfer barriers based on fuzzy numbers:

Table 2: Showing the matrix of pairwise comparison of technology transfer barriers based on fuzzy numbers

Obstacles	A	B	C	D	E	F	G
A	$\tilde{1}$	$\tilde{2}^{-3} * \tilde{1}^{4} * \tilde{3}^{3}$	$\tilde{3}^{4} * [\tilde{3}^{-1}]^{2} * \tilde{1}^{2} * \tilde{2}^{2}$	$\tilde{3}^{5} * \tilde{3}^{-1} * \tilde{1}^{2} * 2 * \tilde{2}^{-1}$	$\tilde{3}^{4} * [\tilde{3}^{-1}]^{2} * \tilde{1}^{3} * \tilde{2}^{-1}$	$\tilde{4}^{2} * \tilde{3}^{-1} * \tilde{2}^{2} * \tilde{3}^{4} * \tilde{2}^{-1}$	$\tilde{2}^{4} * \tilde{3}^{-1} * \tilde{1}^{2} * \tilde{3}^{3}$
B		$\tilde{1}$	$\tilde{2}^{2} * \tilde{3}^{2} * \tilde{1}^{3} * \tilde{2}^{-1} * \tilde{3}^{-1} * \tilde{5}$	$\tilde{2}^{3} * \tilde{3}^{-1} * \tilde{1}^{3} * [\tilde{2}^{-1}]^{2} * \tilde{3}$	$\tilde{2}^{2} * \tilde{3}^{4} * \tilde{1} * \tilde{2}^{-1^{2}} * \tilde{3}^{-1}$	$\tilde{2}^{2} * \tilde{1}^{2} * \tilde{2}^{-1} * \tilde{3}^{-1^{2}} * \tilde{3}^{3}$	$\tilde{2}^{3} * [\tilde{2}^{-1}]^{2} * \tilde{1} * \tilde{3}^{-1} * \tilde{3}^{3}$
C			$\tilde{1}$	$\tilde{3} * \tilde{3}^{-1} * \tilde{5}^{3} * \tilde{1}^{3} * \tilde{4} * \tilde{2}$	$\tilde{3}^{2} * \tilde{3}^{-1} * \tilde{5}^{3} * \tilde{1}^{3} * \tilde{4}$	$\tilde{1}^{3} * [\tilde{3}^{-1}]^{2} * \tilde{3}^{2} * \tilde{2}^{3}$	$\tilde{3}^{-1} * \tilde{1}^{3} * \tilde{3}^{2} * \tilde{2}^{4}$
D				$\tilde{1}$	$\tilde{3}^{2} * \tilde{3}^{-1} * \tilde{1}^{3} * \tilde{5} * 2^{2} * \tilde{2}^{-1}$	$\tilde{1}^{2} * [\tilde{2}^{-1}]^{3} * \tilde{2}^{2} * \tilde{3}^{3}$	$\tilde{2}^{2} * \tilde{3}^{3} * \tilde{1}^{3} * [\tilde{3}^{-1}]^{2}$
E					$\tilde{1}$	$\tilde{4}^{2} * \tilde{3}^{-1} * \tilde{1}^{3} * \tilde{3}^{3} * \tilde{2}^{-1}$	$\tilde{3}^{2} * \tilde{3}^{-1} * \tilde{1}^{3} * \tilde{5} * 2^{2} * \tilde{2}^{-1}$

F						$\tilde{1}$	$\tilde{2}^{-3} * \tilde{1}^{4} * \tilde{3}^{3}$
G							$\tilde{1}$

Explanations: Ineffective and non-management (A), lack of close collaboration between research centers with industries (B), lack of attention to research and development activities (C), inability of technology transfer of the parties (D), lack of government support (E), lack of attention to capacity and internal absorption capacity (F), lack of market access (G)
According to Table 1, fuzzy numbers in Table 2 are converted to triangular fuzzy numbers:

Table 3: Representation of the matrix of pairwise comparison of barriers to technology transfer based on triangular fuzzy number

	A	B	C	D	E	F	G
A	(1,1,1)	(1.62, 1.13 , 0.66)	(2.51, 1.43 , 0.72)	(2.57, 1.55 , 0.74)	(1.9, 1.16 , 0.63)	(3.59, 1.97 , 0.85)	(2.82, 1.64 , 0.85)
B	(1.52, 0.88 , 0.62)	(1,1,1)	(2.21, 1.4 , 0.83)	(2.14, 1.19 , 0.63)	(2.51, 1.39 , 0.65)	(1.78, 1.07 , 0.65)	(2.46, 1.34 , 0.65)
C	(1.39, 0.7 , 0.4)	(1.2, 0.71 , 0.45)	(1,1,1)	(2.89, 2 , 1.27)	(2.96, 2.08 , 1.27)	(2.09, 1.23 , 0.72)	(2.4, 1.47 , 0.85)
D	(1.35, 0.65 , 0.39)	(1.59, 0.84 , 0.47)	(0.79, 0.5 , 0.35)	(1,1,1)	(2.21, 1.4 , 0.83)	(2.14, 1.63 , 0.66)	(2.14, 1.28 , 0.72)
E	(1.59, 0.86 , 0.53)	(1.54, 0.72 , 0.40)	(0.79, 0.48 , 0.34)	(1.2, 0.71 , 0.45)	(1,1,1)	(2.14, 1.34 , 0.74)	(2.21, 1.4 , 0.83)
F	(1.18, 0.51 , 0.28)	(1.54, 0.93 , 0.56)	(1.39, 0.81 , 0.48)	(1.52, 0.61 , 0.47)	(1.35, 0.75 , 0.47)	(1,1,1)	(1.62, 1.13 , 0.66)
G	(1.18, 0.61 , 0.35)	(1.54, 0.75 , 0.41)	(1.18, 0.68 , 0.42)	(1.39, 0.78 , 0.47)	(1.2, 0.71 , 0.45)	(1.52, 0.88 , 0.62)	(1,1,1)

Explanations: Ineffective and non-management (A), lack of close collaboration between research centers with industries (B), lack of attention to research and development activities (C), inability of technology transfer of the parties (D), lack of government support (E), lack of attention to capacity and internal absorption capacity (F), lack of market access (G)
At this stage, the total row of each row in Table 3 must first be computed. Subsequently, the inverse of the sum of the sum of the rows is multiplied in each of the rows in Table 3. Moreover, at this stage, the magnitude of each criterion is calculated relative to other criteria. Non-normalized and normalized weights are then computed:

Table 4: Final weights of technology transfer barriers

Options	Total rows in Table 4-8	Multiplying the total row in reverse "Total sum of rows"	Degree of magnitude compared to other options							Non-normalized weights	Normalized weights
			A	B	C	D	E	F	G		
Ineffective and non-efficient management	(5.45, 9.88, 16.01)	(0.480, 0.188, 0.065)	1	1	1	1	1	1	1	1	0.168

Lack of close collaboration between research centers with industries	(5.03, 8.27, 13.62)	(0.409, 0.157, 0.060)	0.92	1	0.95	1	1	1	1	0.92	0.154
lack of attention to research and development activities	(5.69, 9.19, 13.93)	(0.418, 0.175, 0.072)	0.96	1	1	1	1	1	1	0.96	0.161
Inability of technology transfer of the parties	(4.42, 7.3, 11.22)	(0.387, 0.139, 0.053)	0.85	0.94	0.88	1	1	1	1	0.85	0.143
Lack of government support	(4.29, 6.51, 10.47)	(0.314, 0.124, 0.051)	0.80	0.89	0.83	0.95	1	1	1	0.80	0.134
Lack of attention to capacity and internal absorption capacity	(3.92, 5.74, 9.60)	(0.288, 0.103, 0.047)	0.72	0.81	0.75	0.87	0.92	1	1	0.72	0.121
Lack of market access	(3.72, 5.41, 9.01)	(270, 0.103, 0.045)	0.71	0.80	0.73	0.86	0.91	1	1	0.71	0.119
Sum of the sum of the rows	(32.8, 52.3, 83.86)	Investigation of inconsistency rate by Googoos and Boucher method									
		CR ^{g}	CI ^{g}							CR ^{m}	CI ^{m}
Inverse of sum of the sum of the rows	(0.012, 0.019, 0.030)	0.05	0.06							0.07	0.05
As the values of each of the four high indices are less than 0.1, it can be concluded that the pairwise comparison matrix of this section of the study is fuzzy consistent.											

DISCUSSION AND CONCLUSION

Nowadays, technology is a key element in economic, industrial, and commercial development, and investment in development, expansion, and adoption of new technologies has been known as an engine for the development and globalization of economic enterprises for many years. Technology transfer process allows the flow of technology from one source to one receiver. In this case, the source is the owner of the knowledge, while the receiver is the beneficiary of such knowledge. The source can be a person, a company or a country. Technology is the expression and the tool of human creativity. One of the areas of technology management requiring comprehensive and introspection is technology transfer. Nowadays, industrialization deeply depends on technology transfer. Technology transfer is an inevitable requirement to reduce the technology gap between developed countries and developing countries. In doing so, one should pay close attention to the elements forming technology. Technology is all the knowledge, products, processes, tools, methods, and systems used in creating products or providing services. Technology transfer is a complex and difficult process. Buying and transferring technology without studying will not only be ineffective, but also lead to weakening national technology, besides wasting capital and time. Technology transfer can increase efficiency and effectiveness, reduce the time of production and supply of products to the market, and ensure the success of

the business. Lack of enough familiarity of industries and commercial enterprises in obtaining or transferring technical and technological expertise can cause incomplete or inadequate technical knowledge from foreign parties and technology owners. In today's world, there is a direct relationship between the development of technology and the economic, social, political and cultural development of a country, so that one can say that technology is a fundamental factor in creating wealth, ability and knowledge in countries and a powerful tool in national development. Generally, developing countries can receive valuable lessons from the successful experience of some industrialized and newly industrialized countries, especially the ones in eastern Asia and Latin America, such as South Korea, Taiwan, Brazil and Mexico that have reached those states by imports and exports and foreign technology transfer - as emerging industrialized countries in East Asia and Latin America. Thus, if technology transfer is carried out properly, it will not only promote companies, but also can lead to over taking rival countries such as Korea, the UAE, and can boost its industrial activities in all areas. Thus, technology transfer is an important and vital category in promoting the level of technology of a country and ultimately moving towards development. Furthermore, lack of attention to this category is an important barrier to the development of the economic, political and cultural development of the less developed countries and, in the vast majority of countries, unable to produce advanced technologies. Therefore, identification of the barriers affecting technology transfer and providing solutions to its transfer to PGSBC is of great importance. The purpose of this study was to provide a model for identification of the barriers affecting the implementation of technology and providing solutions for its transfer to PGSBC. The results indicated that According to this, ineffective and non-efficient management, lack of attention to research and development activities, lack of close cooperation between the research center and industry, inability of the parties in technology transfer, lack of government support, lack of attention to internal absorption capacities and lack of market access ranked 1 to 7 respectively. Thus, these barriers are considered strategic categories compared to other categories and should be considered more. Thus, solutions are presented as Table 5 to address those barriers.

Table 5: Appropriate solutions to overcome the main obstacles

Main barriers	Solution
Ineffective and non-efficient management	Considering cultural differences
	Complete transfer of information about technology by supplier
	Receiver and sender agreement on the level of human resources utilization
	Reviewing the efficiency and non-regular evaluation of imported technology
	Selecting the most suitable technique transfer technique
Lack of close collaboration between research centers with industries	Cooperation with technology park
	Cooperation of government - industry-university
Lack of attention to research and development activities	Existence of educational programs abroad
	Fundamental attention to R & D
	Existence of domestic training programs
Lack of market access	Ensuring access to international markets and competition conditions
Lack of government support	The existence of a large domestic market inside the country
	Government support and good diplomatic relations with the technology-owning country

	Eliminating cumbersome rules
Lack of attention to capacity and internal absorption capacity	Attention to internal capabilities such as: human resources, capital, so on
	Adaptation of imported technology to the goals and values, facilities and needs of the country
Inability of technology transfer of the parties	The existence of a national or institutional determination to overcome obstacles and problems
	The readiness and ability of the technology transfer parties

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