

**IDENTIFYING AND PRIORITIZING FACTORS AFFECTING TECHNOLOGY TRANSFER AND STRATEGIES FOR SUCCESS IN AUTOMOTIVE INDUSTRY OF IRAN
(Case Study: Pars Khodro)**

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ABSTRACT

Current work was carried out aiming at identifying and prioritizing factors affecting technology transfer and strategies for success in the automotive industry of Iran. Descriptive research method was applied and it is of Survey-analytic method. Instead of using statistical methods, pairwise comparison method AHP is applied in this study. Statistical method is not used and the statistical population, sampling and questionnaire are not considered in study population. We used 5 people expert in terms of experience, organizational position, education and etc. in automotive industry and they are called expert and decision making in the present study. Calculation steps were in to parts; first identification and selection of the main factors affecting technology transfer in automotive industry and then prioritizing these factors. Influencing factors were identified based on library studies and interviews with experts and primary selection and classification of the factors was done. The primary classification included seven main factors including 1. Technological factors, 2. Cultural factors, 3. Structural factors, 4. Global factors, 5. Infrastructural factors, 6. Factors related to receiver country, 6. Factors associated with uptake and utilization of technology transfer.

KEYWORDS: Automotive Manufacturing, Cultural factors , Human life, Technology, Technology Transfer;

INTRODUCTION

In a comprehensive definition, technology is considered as all knowledge, products, tools, methods and systems which are utilized so that a product is manufactured or a service is provided. Thus, technology is the process of transfer and conversion of recourses to product through knowledge, experience, information and tools (Arabi, 2007). Technology transfer has an extensive meaning and there are different perceptions of it. Technology transfer can be described as a tool for minimizing investment and risk in increasing technological level (Ghazi Nouri, 2004). Technology transfer process includes various complex aspects. Productivity, quality, reliability, overall benefits, increased unique cooperation and continuing modernization of equipment and processes in developing countries are factors which increase tendency to technology transfer (Shahidi, 2002). Considering great advancements in information and communication technologies in the world, awareness of these changes and keeping pace with them is not impossible. The technology facilitates quick access to products, services and global markets and it can be considered as part of globalization concept (UNIDO, 2007). Musaei (2008) proposed a model for ranking factors affecting technology transfer in railway using TOPSIS technique. Also, Delavari (2008) integrated various decisions making models on technology transfer and found a model with five components. Valizadeh and Akbari (2010) investigated success factors of technology transfer in order to achieve world class and used structural equations for testing hypotheses and found positive relationship between successful technology transfer and achieving world class. There is a considerable distance between Iran's automotive industry and other automotive manufactures and its relatively stable production has been possible with the help of domestic monopoly.

The country's automotive industry would become fragile and vulnerable with elimination of monopoly. The requirement for stable production and presence in automotive industry is providing products with updated technology level and capabilities, high quality, after sale services, safety and suitable price. Current performance of Iran's automotive industry results from its management procedures and policies of the past 50 years which does not meet today's needs in comparison with automotive manufacturers, management level, technical knowledge, skill, productivity and technology in this industry. Necessary will for organizing and promoting it to achieve products with world class quality is not observed and provided products cannot compete and domestic sale is done through domestic monopoly. In other words, despite of attempts of authorities over lifetime of this industry, its progress trend was not acceptable in comparison with other competitors. Issues related to technological development of the country's automotive industry indicates unfortunately technology transfer process faces various inhibitor obstacles in this

industry. Automotive industry strategy should be based on improving competitive capacity of domestic industries through technology transfer. Otherwise, not only we lose our share in the international market, but also national market will be open to international automotive manufacturers and national industry will be damaged (Baghi, 2013).

A look at automotive industry history in the country indicates automotive industry has turned to an industry which can largely be independent and produces products independently without foreign dependencies. Manufacturing such automotive as Samand, Tiba, Rana and large part of components of Tondar 90 denotes this fact. Domestic automakers have been able to track about 80% of their components of automotive manufacturers domestically and only 20% of the parts required to be imported from abroad. Lack of involvement of automakers and component manufacturer in production of the components is largely due to lack of economic justification for it. Since circulation of the automobile industry in the country is much lower than the international car makers, the investment for production of some components is not economically justified and thus import would be higher. It causes that related technologies are not entered to the country. Of course sanctions in recent years can also be considered. Economic sanctions caused some obstacles for technology transfer to the country in automotive sector, thus component makers could not manifest their capabilities in this regard. Speed of changes in today world in manufacturing technologies is very high. For example, a famous automotive maker brand is able to change its technology regarding production of plastic, glass, and other components used in the car over one year. Thus, the fact that component maker sector of the country was distanced to first technological class of the world for three years can make some problems for this sector and thus for automotive maker companies (Ghorbani, 2013). One of the loops which is not considered on technology transfer in automotive industry is lack of applied research works in automotive companies. Current works helps identifying current status of technology transfer and influencing factors and planning for improvement of technology transfer success.

Considering facts mentioned on importance of technology transfer, current research aims at finding an answer for this question: what are factors affecting technology transfer and strategies for its success in automotive industry? Which factors are in higher priority? That is, which factors have stronger influence on technology transfer success? Various works have been written on technology transfer and many research works have been conducted in this regards. Mahdizadeh (2010) identified factors affecting technology transfer. His findings showed eight main factors influence technology transfer: Effective and efficient management, favorable government support, close cooperation between research institutes and industry, paying attention to research and development activities, good quality and capacity of the technology recipient country, sufficient market access, willingness and ability of the transmitter and receiver of technology and development export policy. Tahmasbi (2009) studied social factors affecting success of technology transfer in Iran's automotive industry. According to stepwise multiple regression analysis, education and staff satisfaction among internal variables and competition and research among external variables have higher influence on dependent variable. Reisman provides a classification for technology transfer, aspects of which include actors, transfer characteristics, transfer motives, and related scientific fields, and based on which it is possible to plan or document technology transfer process. Such documentation is investigated based on the figures and factors and sub-factors (Muhammad *et al.*, 2010).

MATERIALS AND METHODS

Current research study is descriptive and analytic survey type in terms of data collection method. Calculation steps were in to parts; first identification and selection of the main factors affecting technology transfer in automotive industry and then prioritizing these factors. Influencing factors were identified based on library studies and interviews with experts and primary selection and classification of the factors was done. The primary classification included seven main factors including 1. Technological factors, 2. Structural factors, 3. Cultural factors, 4. infrastructural factors, 5. Global factors, 6. Factors related to receiver country, 7. Factors associated with uptake and utilization of technology transfer. It is clear that degree of significance and influence of factors differs. Thus, a questionnaire was designed so that significance of the factors is evaluated and factors with lower significance are eliminated and hence the problem gains logical and acceptable aspects. Selected elements related to each of seven main factors (1. Technological factors, 2. Structural factors, 3. Cultural factors, 4. infrastructural factors, 5. Global factors, 6. Factors related to receiver country, 7. Factors associated with uptake and utilization of technology transfer) were mentioned in each part of the Experts, and respondents were asked to score (between 1 – 9; 1: lowest significance, 9: highest significance) and specify significance of the factors. In addition, they were asked to mention other factors affecting technology transfer, if any. This questionnaire was distributed among five experts of automotive industry. Following data collection and

extraction, total scores of the proposed factors were calculated and the mean was obtained. According to idea of experts, factors with mean scores of less than 7 were eliminated and factors with mean score above 7 were selected as final factors. Finally considering obtained results and indexes proposed by respondents, final factors were selected. Following specifying final factors, AHP multi-criteria decision model was formulated in order to describe them. It was used due to solving multi-criteria problems with hierarchy structure. Data required for implementing this model should be collected. It is the main step after model formulation, since all inferences, conclusions, recommendations and suggestion will be made based on results taken from calculations of these data. Thus, require data were collected through experts.

RESULTS AND DISCUSSION

The results shows below:

Q1: What are factors affecting technology transfer?

Seven factors were identified as affecting factors following collection of expert ideas.

1. Technological factors,
2. Structural factors,
3. Cultural factors,
4. Infrastructural factors,
5. Global factors,
6. Factors related to receiver country,
7. Factors associated with uptake and utilization of technology transfer

Q2: How is prioritization of factors affecting technology transfer in automotive industry?

Designing AHP Model

Modeling in AHP is based on hierarchy tree which denotes the problem under study. Level 1 includes the purpose and last level includes competing choices and intermediate levels are decision criteria. In modeling of current problem, the purpose is identifying and prioritizing factors affecting technology transfer in automotive industry. Competing choices are final factors which are selected following statistical analysis. Seven factors (1. Technological factors, 2. Structural factors, 3. Cultural factors, 4. Infrastructural factors, 5. Global factors, 6. Factors related to receiver country, 7. Factors associated with uptake and utilization of technology transfer) were selected as decision criteria for evaluating choices. That is, technology transfer in automotive industry is influenced by seven factors.

Prioritizing Affecting Factors Using AHP and Expert Choice Software

In order to specify comparison matrix priority of these factors as shown in table, geometric mean was used for integration of matrixes since current research study is based on collective decision making.

Table 1: Integrated matrix of main factors

Main Factors	Technological factors	Structural factors	Cultural factors	Infrastructural factors	Global factors	Factors related to receiver country	Factors associated with uptake and utilization of technology transfer	Geometric Mean (W)
Technological factors	1	4/1	4/1	4/1	4/1	4/1	4/1	3.281
Structural factors	1/4	1	2/3	3/2	3/2	3/2	4/1	1.123
Cultural factors	1/4	3/2	1	4/1	3/2	4/1	4/1	1.668
Infrastructural factors	1/4	2/3	1/4	1	3/2	4/1	4/1	1
Global factors	1/4	2/3	2/3	2/3	1	4/1	4/1	1.024
Factors related to receiver country	1/4	2/3	1/4	1/4	1/4	1	3/2	0.436
Factors associated with uptake and utilization of technology transfer	1/4	1/4	1/4	1/4	1/4	2/3	1	0.351

After the calculation of main factors weight, the priority of main factors is shown in Table 2: priority of main factors is specified as follows:

Table 2. The weight of each of main factors effective on technology transfer

Main criterion weight	Main Factors	No.
0.369	Technological factors	1
0.188	Cultural factors	2
0.126	Structural factors	3
0.115	Global factors	4
0.112	Infrastructural factors	5
0.049	Factors related to receiver country	6
0.039	Factors associated with uptake and utilization of technology transfer	7

Table 3- The weight of each sub criterion effective on technology transfer

Final weight of sub-criterion	Sub-criterion coefficient	Main criterion weight	Sub-criteria	Main criterion
0.107	0.289	0.369	The extent of supporting the receiving technology	Technological factors
0.090	0.245		Technology price	
0.056	0.151		Complexity and simplicity of technology	
0.046	0.126		Access to technology	
0.038	0.102		The standard quality of technology	
0.014	0.039		The development and improvement of technology based on internal needs	
0.000	0.0001		The language of working with technology and its documents	
0.054	0.288	0.188	Creating information in technology transfer method	Cultural factors
0.029	0.154		The presence of research forces with cultural and scientific capabilities	
0.028	0.150		Modification of cultural value system	
0.025	0.134		Appropriate and effective education system	
0.021	0.112		Improving behavioral views and world view	
0.017	0.092		National effort to eliminate the barriers to technology development	
0.013	0.069	0.126	Commitment to success of transference	Structural factors
0.037	0.294		Valid private companies in design and engineering	
0.036	0.286		Creating received technology consistency with environmental conditions	
0.019	0.149	0.115	The standards to use the required industry	Global factors
0.017	0.133		The presence of local entrepreneur leaders	
0.008	0.064		Using managers with high education	
0.008	0.062		Using the managers that were in other countries already	
0.002	0.013		Using process-based managers	
0.034	0.297		Absorbing the most capable global specialists in technology	
0.027	0.236		Using foreign managers and lecturers	
0.017	0.151		Training the employees in multi-national companies owning technology	
0.012	0.106		Presenting all the documents and information about equipment by the technology owner	
0.009	0.081		Collaboration in technology development plans in the country owning the technology	
0.006	0.048	Establishing close political-economic relation between the sender and receiver		
0.039	0.344	0.112	Trading liberalization in investment	Infrastructural factors
0.020	0.179		Technology infrastructure	
0.015	0.135		Social infrastructure	
0.013	0.117		Economic infrastructure	
0.010	0.093		Physical infrastructure	
0.009	0.083		Cultural infrastructure	
0.005	0.048		Organizational infrastructure	
0.011	0.021	0.049	Regional infrastructure	Factors related to receiver country
0.010	0.202		Dedicating budget to research and development	
0.009	0.176		Long-term strategic plan for technology development	
0.007	0.153		Industrial policies at national level	
0.006	0.121		Creating required investment by government	
0.005	0.105		Creating policy making and planning system in sciences and technology	
0.003	0.063		Considering sustainable state rules to develop technology	
0.010	0.261		Developing management and organizing skills	
0.008	0.202	0.039	Educating informed and capable management forces	Factors associated with uptake and utilization of technology transfer
0.007	0.180		Creating strong and suitable information networks	
0.006	0.160		presence of innovative people and research institutions	
0.003	0.083		The relationship between manufacturing and research sectors	
0.003	0.071		Sending the experts to international fair and visit	
0.002	0.043		Relationship between manufacturing factories and obtaining information from them	
0.002	0.043		Establishing the center and organizations related to technology absorption	

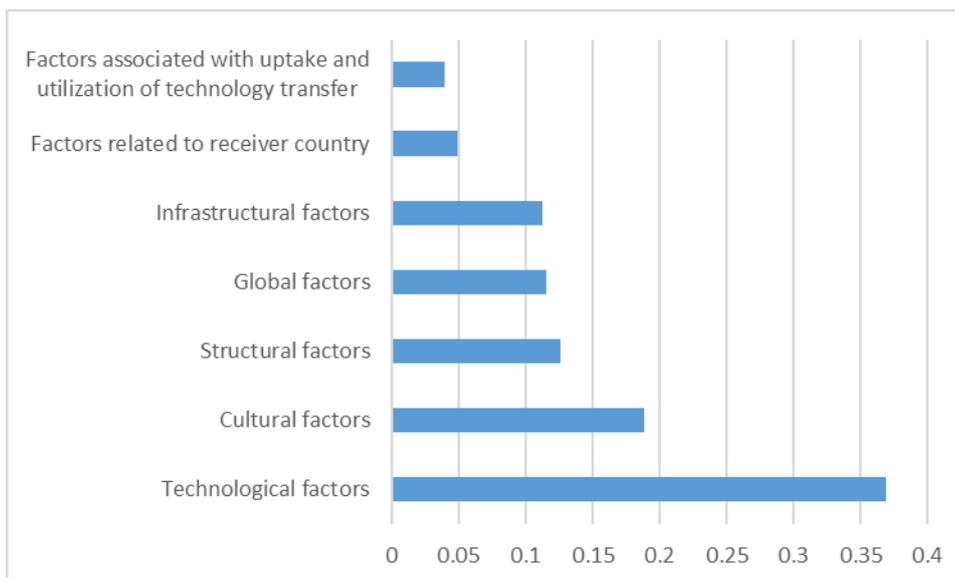


Diagram 1: Prioritization of main factors based on calculated weights and related adjustment rate

Thus, technological factors are identified as the main factor and factors related to the uptake are considered as less important factors. Then, based on calculation of the main factors weight, the weight of each of sub-criterion of main criteria is computed as shown in Table 3:

DISCUSSION AND CONCLUSION

Findings in this work suggest that technology transfer is an important and basic issue in promoting technological level of the country and movement toward sustainable development. Of course, it requires attention to research centers and providing economic and political supports for such activities. The main determinants of technology transfer highly include a combination of technology transferor tendency to provide technology and technical knowledge and ability of technology receiver to acquire and uptake technology. Importance of selection of technology transfer ways forced many developing countries to test various types of technology acquisition methods for selecting the most suitable ones. Considering rapid growth of novel technologies and their importance in terms of provision of national security, public welfare and economic growth, negligence of them makes gap to the technology. Thus, the ways should be sought for that make achievement to technology feasible in the quickest way.

Seven factors were identified as affecting factors following collection of expert ideas.

1. Technological factors,
2. Structural factors,
3. Cultural factors,
4. Infrastructural factors,
5. Global factors,
6. Factors related to receiver country,
7. Factors associated with uptake and utilization of technology transfer

Findings regarding Q2 and prioritization of factors affecting technology transfer in automotive industry indicated priorities of the factors as follows: 1. Technological factors, 2. Cultural factors, 3. Structural factors, 4. Global factors, 5. Infrastructural factors, 6. Factors related to receiver country, 6. Factors associated with uptake and utilization of technology transfer. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings showed technological factors affect technology transfer in automotive industry. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings indicated structural factors affect technology transfer in automotive industry. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings indicated cultural factors affect technology transfer in automotive industry. The other factors which affect technology transfer are cultural motives and factors and obstacles which explicitly affect various activities of this transfer (Arvanitis et al., 2008). Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings indicated infrastructural factors affect technology transfer in automotive industry. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings indicated global factors affect technology transfer in automotive industry. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings indicated factors related to receiver country affect technology transfer in automotive industry. Developing countries can take valuable lessons from successful experience of some industrial and newly industrial countries especially countries located in East Asia and Latin America regarding Industrial and Technology Development. Their successful experience indicate that extensive learning and transfer of suitable and modern technologies to these countries enable them to increase their productivity and thus it leads to rapid industrial development in these countries. For example, such countries as South Korea, Taiwan, Brazil, and Mexico are introduced as newly industrialized countries in East Asia and Latin America via imports and foreign technology transfer. Overall, success factors in these countries can be divided into internal and external factors. Inside these countries, there is national will for technologic development and it is a top priority in all planning and measures and all grounds and necessary structures are provided for its realization. In external part, due to saturation of investment in advanced countries, western investors and international companies seek for joint cooperation and investment in these countries. Although these countries can be made distinctive from other countries due to some macro-economic indexes and features such as per capita income, economic size, their resources and industrialization trends, investigation of their success factors can be useful for other countries which seek for following their similar industrial development pattern. Probability of failure in technology transfer can be minimized by effective and efficient management, favorable government support, close cooperation between research institutes and industry, and paying attention to research and development activities. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Findings indicated factors associated with uptake and utilization of technology transfer affect technology transfer in automotive industry. In a study by Link and Siegel (2005), environmental, international, and organizational uptake factors were mentioned as influencing technology transfer. Findings of this work are consistent with findings by Mahdizadeh (2010), Bagherzadeh (2011), Tavakoli Moghadam (2010) and Kayanzad Ghadim (2009).

Mahdizadeh (2010) identified factors affecting technology transfer. His findings showed eight main factors influence technology transfer: Effective and efficient management, favorable government support, close cooperation between research institutes and industry, paying attention to research and development activities, good quality and capacity of the technology recipient country, sufficient market access, willingness and ability of the transmitter and receiver of technology and development export policy.

Bagherzadeh (2011) investigated factors affecting technology transfer in the view of managers of companies in compressor field. They mentioned management role and national economic conditions, environmental conditions, role of human resources (expert force and technical staff), importance of research and development role as factors which affect success or failure of technology transfer. Tahmasbi (2009) mentioned social factors affecting technology transfer in the view of automotive component makers in SAIPA Group (SAIPA SAZE GOSTAR) including: Management style, learning, satisfaction, management commitment, rewarding system, research and competition.

Ansari (2009) investigated factors affecting technology transfer and selection in IRAN KHODRO Co. in the view of top, intermediate managers and staffs and found technologic, technical, environmental, financial, commercial, and organizational factors as effective in technology transfer.

Naseri and Zanganeh (2008) studied and measured role of organizational competency on technology transfer effectiveness in Iranian institutes. They interviewed academic experts and top managements with experience in technology transfer field and found three effective factors: organizational culture, organizational structure and ability to combine resources.

Kayanzad Ghadim (2009) identified factors affecting evaluation and selection of appropriate way of technology transfer in Tehran Gas Co. the way of contracting and implementing contracts, selecting suitable method for technology transfer, research budget, human resources and compatibility were found as factors affecting technology transfer.

Following review of related literature and proposed models as well as interviewing with experts on automotive industry field, following factors were identified which affect technology transfer: technological factors, structural factors, cultural factors, infrastructural factors, global factors, factors related to receiver country, and factors associated with uptake and utilization of technology transfer.

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