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Key factors in the transfer of knowledge-based technologies with the fourth generation approach to technology foresight in the vehicle industry

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ABSTRACT: Technology transfer is a process involving a variety of dimensions that serves as a tool to reduce the technological gap between developed and developing countries. Over the past century, technology foresight has gone through three eras and is now entering its fourth generation. The purpose of this study is to identify the key factors in the transfer of knowledge-based technologies in the vehicle industry with the fourth generation technology foresight approach that emphasizes soft technologies. Research method used Mixed research approach (qualitative-quantitative) by conducting interviews with automotive industry experts including 10 managers and conducting library studies to identify factors in the design of the article model and also 138 engineering experts working in Pars Khodro to rank Key factors have been taken. The initial model consisted of 6 main groups and 44 subgroups which were analyzed using the results of fuzzy Delphi analysis and structural equations into 6 main groups and 26 subgroups and ranked using AHP method. The results show that research and development and political factors such as sanctions have the greatest impact on technology transfer in the vehicle industry.

Key Words: Soft Technology, Fourth Generation Technology Foresight, Technology Transfer, Knowledge-Based Technology, Vehicle Industry

I. INTRODUCTION:

Today, the vehicle industry in the country accounts for a large part of employment, per capita production and industrial value added and constitutes a significant share of gross national income. Peter Drucker calls the vehicle industry the industry of industries and refers to it as the mother of industries. Important industries that are closely related to the vehicle industry include steel, aluminum, copper, glass, rubber, textiles, electronics, paints and chemicals, which are considered as the upstream industries of the vehicle industry . In fact, the vehicle industry is a symbolic form of economic and industrial development of a country and its operations range from production to distribution and consumption and after-sales services. As the vehicle industry and its technology are changing rapidly, the industry is forced to keep pace with these developments by using appropriate methods to effectively transfer technology, especially through FDI foreign direct investment and joint ventures with companies. The world-renowned JV will maintain and enhance its industrial existence. The production of an average of one million vehicles per year in the country and the employment of about 50,000 people directly in this industry and one million indirectly show the importance of this industry for the economic and technical growth and development of the country. But the past and present study of this industry shows that despite the efforts made in the effective transfer of technology and reaching relative standards in gaining the satisfaction of domestic customers, penetrating global markets, designing new products and the ability to compete quantitatively and qualitatively with other leading countries. The vehicle industry is still facing various challenges. In line with the goals of the vision document of the Islamic Republic of Iran on the horizon of 1404, with emphasis on software movement and production of science and achieving the first economic, scientific and technological position in the region (Central and Southwest Asia), the vehicle industry The country's industry

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can be effective in achieving the country's vision by creating scientific and technical capabilities and capabilities. Based on this, the vision of the vehicle industry is determined as follows: achieving the first position of the vehicle industry in the region, the fifth rank in Asia and the eleventh rank in the world through competitiveness based on technology development. In order to achieve the vision of 1404 countries and produce three million vehicles, one million of which is the share of exports, it is not possible to cooperate with other automakers and the current situation of Iranian automakers based on the opinion of industry experts, so in this article By identifying the key factors in the transfer of knowledge-based technologies with the fourth generation approach, technology foresight in the vehicle industry has provided a suitable model for the transfer of knowledge-based technologies in the vehicle industry with the fourth generation technology foresight approach as well as previous generations For decision makers and managers of this industry.

II. THEORETICAL FOUNDATIONS:

2-1- The concept of knowledge-based technology:

Knowledge-based technology is technology that, in order to increase science and wealth, economic development based on knowledge and achieve scientific and economic goals in one direction (expansion of invention and innovation) and finally commercialization of research and development results (including design and production of goods And services) in new scientific and industrial fields. (Regulations for identifying companies and institutions of knowledge, 2017)

2.2 Knowledge-based technologies in the vehicle industry

2-2-1- Technologies related to clean fuel in the car:

Some of the knowledge-based technologies in this industry: Polymer tank - Fuel leak warning - Gas or gasoline base - ORVR system (this system prevents fuel vapors from leaking out of the tank during refueling and air pollution is much less) - Automatic refueling system - Nanotechnology Car - Fuel Catalyst Converter - Canister System

2-2-2- Other technologies:

V2V technology (warning of approaching another car that is not in front of you and automatic braking) - Cars - Virtual reality dashboards - Power storage panels - Electronic communication with the car via mobile phone

2-3- Technology foresight:

Technology foresight provides a series of inputs to systematize policies and strategies. In addition, foresight in technology supports creativity and motivation and helps people involved in technology and its transfer to achieve effective competition and development. Today, foresight, especially in the field of science and technology, has become an important tool for decision-making, policy-making and strategic planning due to the development and evolution of its concepts and methods. (UNIDO Technology Foresight Guide, Sonia ShafieiArdestani, 2008)

Table 1 - Comprehensive Technology Foresight (GeowingJin, 2016)

Content	stage and features	Time period
The first generation	to predict the harsh technologies	1920s and 1930s and after World War I
The second generation	combines hard technology and the market	1960s decade
The third generation	focuses on hard technology foresight and the integration of social, economic and environmental dimensions	1990s decade
The fourth generation	of futurism in both soft and hard technologies, integration of various social, economic and environmental dimensions	2000 onwards

2-4- Soft technology:

Soft technology forms the rules, mechanisms, tools, rules, methods and procedures that participate in the development, adaptation or control of the human mental and objective world. Soft technology considers the internal psychological activities and external behaviors of human beings as its operational subject and its content and levels are determined by focusing on the ways of thinking and modes of action of human beings. (Mehdi Hamzehpour, 2017) Soft technology is a human-centered intellectual technology that results in innovations created through value systems, individual behavior, organizational behavior, and social behavior. In firms that are at a higher level in terms of

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technology complexity, the impact of soft technologies, ie, human-centeredness and human resources, becomes much more pronounced. (ManouchehrManteghi, 2016)

2-5- Studies conducted in the field of transfer management process and technology foresight:

Table 2 - Results of studies conducted in the field of technology transfer management

Row	researchers	year	Focused Items
1	James Cunningham	2018	In order to transfer the appropriate technology, in addition to policies and processes, we must also pay attention to this process from macro, medium and micro angles. In other words, it considered the role of actors such as employees of technology transfer departments, universities, professional research organizations, technology departments, and scientists.
2	Johan Scott and Edward Steinmuller	2018	Three Frameworks for Innovation Policy: The first framework for establishing a government agency to support science and research and development on the premise that it contributes to market growth and the failure of the market to provide new knowledge privately. Second in the world is the 1980s and its emphasis on competition, shaped by national innovation systems for knowledge creation and commercialization. The above policy focuses on creating connections, clusters and networks and stimulating education. The third framework is identified with contemporary social and environmental challenges such as the goals of sustainable development and calls for change and transformation, and is distinguished from the two primary frameworks that refer to the socio-technical system.
3	Anika Lorenz, Michael Rowan and Kenneth Blind	2017	The role of standardization as a useful and vital mechanism for technology transfer tools and is of particular importance
4	Adam Mazurkiewicz and BeataPutralska	2017	Barriers and Challenges of Technology Transfer in Research and Development Organizations There are three groups of technical, organizational, economic, and systemic barriers that must be properly considered during technology transfer.
5	Cheryl Martin and Helena Laurent	2017	Environmental concerns are evident in all innovations and initiatives.
6	SumonTakakova and IwikaWaza	2014	Structural changes in the world economy, product architecture, information technology, research and development, intellectual property rights, human resource management and organizational communication are important factors in the competitive environment and important in technology transfer.
7	Jiayou Zhou	2013	Technology transfer in China's vehicle industry is examined and addressed to issues such as government policies in the vehicle industry , over-reliance of Chinese companies on R&D and technology transfer to foreign companies, foreign

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			direct investment, environmental impact , Clean energy technology and appropriate fuel consumption, knowledge base and learning and skills of engineers with training and development capabilities
8	Ali MoslehShirazi, Ali Mohammadi, Abbas Abbasi	2016	Soft technology is effective as a new paradigm in technology transfer. Soft technology includes production optimization literature and business services (lean manufacturing, total quality management, ISO, Kanban, human resource planning, global branding, marketing, etc.) which is in favor of more competition in the organization.
9	Mahmoud Samiei Nasr, ParivashJafari	2012	Components of successful technology transfer have been extracted and presented the general model of effective technology transfer in the vehicle industry . These components include macro-environmental factors, transfer process, communications, research and development, foreign direct investment, joint ventures, innovation, and technology transfer center.
10	MojganMarashi, NedaAbdolvand	2017	Technology transfer governance jointly refers to the role of government, policies, protocols and efficient management frameworks, a network of people involved, communications, contracts, knowledge, manpower.
11	HojjatAshouri, Seyed Mohammad SeyedHosseini, Reza Radf	2016	Indicators and factors affecting technology transfer in each stage of the technology transfer process are identified and on the category of education, documentation, design and deployment of management systems and structures, forecasting and forecasting, cycle curve analysis The life of technology, the relationship between industry and university is one of the main issues mentioned in this article.
12	Morteza Musa Khani, DavoodGharakhani	2013	Factors affecting technology transfer have been identified and ranked. Such as product life cycle, government policies, culture, research and development, education and communication can be mentioned.
13	Vehicle industry Experts in IRAN	2018	Experts consider these factors to be effective in technology transfer: research and development, technical knowledge, management systems, processes and systems, machinery, tools, equipment and hardware, sanctions conditions, conditions of distrust and lack of Security, unwillingness to transfer technology, structural changes in the economy of Iran and the world, effective government support, attention to the market and customers, human capital, national and organizational culture, human resource development, environmental and energy challenges

In the present study, the experts were a group of deputies, managers and senior experts of Pars Khodro Company who were selected based on the four characteristics of knowledge, experience,

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organizational position and willingness to participate in the interview and completion of the questionnaire. After presenting the questionnaire to the selected experts and completing them, these forms were completed and the results were obtained as shown in the table below.

Table 3 - Output results of expert opinions from fuzzy Delphi method

The main parameter	code	sub-parameter	(l, m, u)	S1	Accept or reject
A Soft Technology Foresight	A1	Existence of innovation and creativity	(0.7,0.8,0.95)	0.81	√
	A2	system in the vehicle industry	(0.83.0.88.0.98)	0.89	√
	A3	Research and Development (R&D)	(0.7.0.8.0.95)	0.81	√
	A4	Industry relationship with universities and	(0.75.0.8.0.86)	0.8	√
	A5	knowledge-based institutions	(0.7.0.75.0.85)	0.76	√
	A6	Know how	(0.62.0.7.0.79)	0.7	√
	A7	Management systems Experiences	(0.6.0.7.0.8)	0.7	√
	A8	training and knowledge management	(0.6.0.65.0.7)	0.65	X
	A9	Processes and systems	(0.5,0.6,0.7)	0.6	X
	A10	Localization and dissemination of	(0.47,0.57,0.67)	0.57	X
	A11	technology at the national level	(0.45,0.5,0.65)	0.53	X
		Quality of complete technology transfer package			
		Overseas training programs			
		In-country training programs			
B Hard technology foresight	B1	Machinery	(0.75,0.8,0.85)	0.8	√
	B2	Tools	(0.73,0.88,0.98)	0.86	√
	B3	Equipment, Hardware , computers	(0.72,0.75,0.85)	0.77	√
	B4	Product life cycle	(0.75,0.76,0.88)	0.79	√
	B5	Infrastructure includes water, electricity,	(0.5,0.6,0.7)	0.6	X
	B6	gas and telecommunications	(0.62.0.65.0.68)	0.65	X
		Alternative technologies			
C Political factors	C1	Political relations with countries	(0.75,0.8,0.95)	0.83	√
	C2	Terms of sanctions	(0.7.0.8.0.9)	0.8	√
	C3	War risk conditions	(0.73,0.8,0.93)	0.82	√
	C4	Technology transmitter tendency	(0.71,0.81,0.92)	0.81	√
	C5	Previous international experience in both	(0.55.0.65.0.75)	0.65	X
	C6	countries	(0.55,0.58,0.65)	0.59	X
	C7	Technology receiver capability	(0.59.0.63.0.75)	0.65	X
		Ensuring access to international markets			
D Economic factors	D1	Foreign Direct Investment	(0.7,0.8,0.9)	0.8	√
	D2	Policies (export development, import	(0.65,0.85,0.95)	0.81	√
	D3	substitution, etc.)	(0.65,0.75,0.95)	0.78	√
	D4	Structural changes in the world and Iranian	(0.69,0.81,0.9)	0.8	√
	D5	economies	(0.65,0.79,0.89)	0.77	√
	D6	Effective government support	(0.55.0.6.0.75)	0.63	X
	D7	Pay attention to the market and customers	(0.5,0.6,0.7)	0.6	X
	D8	Providing stakeholder	(0.55.0.6.0.65)	0.6	X
		Resources Stakeholder satisfaction with the results of the technology transfer project			
		Determining the criteria for selecting the appropriate technology by the government			
E Social factors	E1	Human capital	(0.65,0.8,0.95)	0.8	√
	E2	National and organizational culture	(0.75,0.8,0.9)	0.81	√
	E3	Social challenges	(0.7.0.8.0.85)	0.78	√
	E4	Intellectual property rights	(0.65.0.8.0.95)	0.8	√
	E5	Organizational Structure	(0.55.0.6.0.65)	0.6	X
	E6	human recourse development	(0.5,0.6,0.65)	0.58	X

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	E7 E8	Cultural differences between source and receiver of technology Job creation	(0.6.0.65.0.7) (0.55.0.6.0.65)	0.65 0.6	X X
F Environmental factors	**F1** **F2** **F3** **F4**	Environmental Challenges energy consumption Internal and external laws, regulations and Instructions Technology compatibility with the environment	(0.85,0.9,0.95) (0.85,0.9,0.95) (0.55.0.6.0.75) (0.55.0.65.0.75)	0.9 0.9 0.63 0.65	√ √ X X

Finally, in order to derive the desired criteria, we consider a limit for accepting or not accepting thatcriterion. In this study, according to the law 30-70, the acceptability limit of the criterion is about seven (Hsu et al., 2010). If the de-fuzzy value of the triangular fuzzy number is close to 0.7 or higher according to experts, it is accepted as an acceptable criterion and otherwise will not be accepted. Based on the above table, the proposed research model with the removal of items below 0.7 includes the following items.

3- The proposed conceptual model of technology transfer with the approach of the fourth generation of technology foresight

Based on the opinions collected from the elites of the vehicle industry who had a managerial background in this industry and the majority had an average of twenty years of experience and had high engineering experience and education, the fuzzy Delphi method was used in designing the model. From the studies on the technology transfer management process, which are also mentioned in Table 3, the most important cases were selected and included in each of the parameters of the fourth generation model.

In the proposed model, the larger factors of soft and hard technology futures are considered as the model shell. In other words, in order to transfer the knowledge-based technology of the vehicle industry in Iran, we must first address the implications of the knowledge-based soft and hard technology-based technology mentioned in the previous pages. Became political, economic, social and environmental. Each of these factors includes the following factors listed in the table below.

3-1- Introducing the main factors and sub-factors extracted:

Table 4 - The main factors and sub-factors of the fourth generation technology foresight model

A	Soft Technology Foresight	**B**	Hard technology foresight
A1	Existence of innovation and creativity system	B1	Machinery
A2	Research and Development (R&D)	B2	Tools
A3	Industry relationship with universities and institutions	B3	Equipment, Hardware , computers
A4	Know how	B4	Product life cycle
A5	Management systems Experiences		
A6	Training and knowledge management		
A7	Processes and systems		
C	Political factors	**D**	Economic factors
C1	Political relations with countries	D1	Foreign Direct Investment
C2	Terms of sanctions	D2	Policies (export development, import substitution)
C3	War risk conditions	D3	Structural changes in the world and Iranian economies
C4	Technology transmitter tendency	D4	Effective government support
		D5	Pay attention to the market and customers
E	Social factors	**F**	Environmental factors
E1	Human capital	F1	Environmental Challenges
E2	National and organizational culture	F2	Energy consumption
E3	Social challenges		

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E4	Intellectual property rights		

Table 5 presents the sources of the fourth generation sub-factors of technology foresight, which are the articles and books studied, as well as the opinions of experts in the Iranian vehicle industry in Pars Khodro Company.

Table 5 - Roots of extracting factors from library and field studies

Source	A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5	F1	F2
James Cunningham		*	*	*									*							*							
Johan Scott and Edward Steinmoeller	*									*									*				*		*		*
Anika Lorenz, Michael Rowan and Kenneth							*								*				*								
Blind Adam Mazurkiewicz and BeataPutralska				*			*					*						*									
Cheryl Martin and Helena Laurent										*														*		*	
SomonTakakova and IvikaWaza		*							*								*			*							
ZhiaingZhio				*		*										*								*	*	*	*
Ali MoslehShirazi, Ali Mohammadi, Abbas Abbasi	*	*				*									*					*							
Mahmoud Samiei Nasr, ParivashJafari	*	*								*					*	*			*	*			*				
MojganMarashi,				*	*							*									*						

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NedaAbdulvand																										
HojjatAshuri, Seyed Mohammad SeyedHosseini, Reza Radfar			*		*	*					*					*							*				
Morteza Musa Khani, DavoodQarakhani		*	*			*				*	*									*		*					
Iranian Vehicle industry experts		*		*	*		*	*	*	*			*	*	*		*	*	*	*	*	*		*	*	*	*

In the following, we will introduce the mentioned factors and sub-factors and try to express comprehensive and complete concepts of each one clearly.

A) Soft technology foresight:

A-1) Existence of creativity and innovation in the vehicle industry : Creativity is an intellectual process that leads to the production of ideas. Creativity is the use of the ability to visualize and imagine to create a new thought or concept. Innovation is the implementation of new thoughts and ideas that originate from creativity. In fact, creative innovation has been implemented. Creativity and innovation do not have the same meaning. Creativity is the production of new and pure ideas, while innovation refers to the application of the idea, if we consider the idea as "seed", it is the plant innovation that results from the cultivation of the seed of the idea. In innovation, value is added to the idea without which the idea remains merely a crude idea, nothing more. Creativity requires innovation. When an idea reaches the implementation stage, it is no longer creativity, but innovation.

A-2) Research and Development: According to the Organization for Economic Co-operation and Development, research and development is "creative work that is done systematically to add to existing knowledge and use that knowledge to invent new applications."

A-3) The relationship between industry and universities and knowledge-based institutions: The relationship and cooperation between universities and industry is an important component in the development of knowledge-based countries and in most developed countries the root of scientific growth in universities can be focused on close cooperation with industry Conversely, industrial development in a competitive environment is due to having a purposeful and demand-driven relationship with industry. (GilanNiknejad; Akbar Akbari; AfsanehShahabi and ParvinTaherifar, 2014).

A-4) Know-how: It is a term for expressing knowledge and practical knowledge about how to do something. Trick or technical knowledge usually includes tacit knowledge that is the opposite of explicit knowledge. Technical knowledge describes how to do a task that is related to the skills required or the ability to perform a particular activity.

A-5) Management Systems: Over the past few decades, management tools have become an important part of the lives of organizational leaders. Organizational leaders strive every day to take steps such as increasing revenue, innovating, improving quality, planning for the future, and the like using management tools. Systems such as ISOs, the way of production of reputable car companies Renault SPR, Nissan NPMS and ...

A-6) Experiences, training and knowledge management: Technical skills are acquired through education, internship and experience. Gaining experience in the workplace and recording it with knowledge management and providing it to stakeholders, workshop training, skills training and

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on-the-job (OJT) schools, training planned for different organizational levels and science and technology education all in line Increase skills and technical knowledge are effective.

Knowledge management means the systematic availability of information and scientific resources, so that when needed, they are available to people who need them so that they can do their daily work more efficiently and effectively.

A-7) Processes and Systems: Thomas Davenpor (1992) considers business processes as a set of activities that are logically related to each other and are performed to achieve a specific achievement in business. Processes have two important characteristics: First, each process has a customer or customers to whom the process output is provided (or benefits from) the output. These customers can be in-house or out-of-town, and systems fall into all of the methods used in production lines, including instructions, operating methods, and operations flow (SOS).

B) Hard technology foresight:
B-1) Machinery: A tool consists of one or more components that use energy to do the desired job. In the vehicle industry , all robots, cranes, guns, conveyors, machines for transporting materials and products, and the like are all part of the machine collection.

B-2) Tools: Tools are tools that are used to produce something or do something but are not used during the production process. Simply put, a tool can be a process used to achieve a specific goal. Tools used in the vehicle industry include measuring and testing tools, precision instruments, pneumatic tools and equipment, pneumatic, general, workshop and repair shop, turning, welding, electrical equipment, high pressure, etc.

B-3) Equipment and hardware and computers: All equipment and hardware used in production lines that in the production process from the stage of manufacturing parts and body building, paint and assembly, including PLCs, modules, hardware used in the lines Production such as Pocket PCs, industrial computers, industrial control and automation are used.

B-4) Product life cycle: Product life cycle is the rate of progress of one stage in four stages of its life in the market. The four stages of the life cycle are defined as: emergence, growth, maturity, and decline. Each product has a life cycle and the time spent in each stage varies from product to product.

C) Political factors:
C-1) Political relations with countries: Due to the political and special conditions of Iran in the Middle East, in some cases, such as exports or joint ventures, political relations with other countries should be done with special attention.

C-2) Conditions of sanctions: The Islamic Republic of Iran has always been involved in the conditions of sanctions due to the hostile policies of arrogant countries such as the United States. These conditions cause the transfer of technology to take place with special conditions and also the owners of technology have less interest in the transfer of technologies to Iran. The conditions after JCPOA(Comprehensive joint action plan) provided a suitable ground for technology transfer and concluding contracts with developed countries, but with the withdrawal of the United States from the JCPOAagreement, practically all these connections were cut off. (Renault, Peugeot, Citroen and Brilliance exit the production cycle)

C-3) Risk of war: The shadow of war due to the hostile policies of the United States has led to less foreign direct investment as well as private domestic investment.

C-4) Tendency to transfer technology: Technology-owning countries are less inclined to transfer technology to some countries, such as Iran. Some of these factors are due to political and security issues that are sometimes observed that the transfer of technologies with a dual use of industrial-military causes the technology transferor is not very willing in this regard.

D) Economic factors:
D-1) Foreign Direct Investment (FDI): According to the definition of the United Nations Conference on Trade and Development (UNCTAD) is the creation and acquisition of sustainable benefits for individuals and legal entities in an economic activity (shareholding in companies and. ..) located in another country, so that these lasting benefits imply the existence of a long-term relationship between direct investment on the one hand and the subject of investment on the other.

D-2) Policies (export development, import substitution, etc.): The transparency of the type of policies in a country's economy will be a bright

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light for investors and artisans. Import substitution policies or export development policies, depending on their choice, will influence the decisions of investors and artisans.

D-3) Structural changes in the world economy and Iran: The world economy has faced extensive changes in financial and economic balances in the shadow of the emergence of new industrial and service giants such as China and India. Technological change and the arrival of the information age and the expansion of communication networks have had a significant impact on the labor force and the world economy. Economic instability, government influence and private companies in various industrial sectors are important aspects of structural changes in Iran's economy. (Shokooh Sadat Seyed Ali Akbar, 2017)

D-4) Effective government support: Government support for industry will increase the growth rate of production and reduce unemployment. Items such as providing the currency needed by industries, paying working capital facilities to manufacturing companies, tax exemptions for manufacturers, enacting appropriate laws to protect industries such as import tariffs and incentives for the final export of products and auto parts, ease of importing raw materials And customs assistance are things that governments can do to effectively support industry. (Special package of government support for industry, 2018)

D-5) Attention to the market and customers: The market is a place that meets the potential needs of buyers as well as sellers. The market may have a physical or virtual entity, or it may be local or global. (Philip Cutler, 2010)

E) Social factors:

E-1) Human capital: Human capital is a set of characteristics, life experiences, knowledge, creativity, innovation and energy that people use in their work. (Leslie and Zarley, 2003)

E-2) National and organizational culture: a set of norms, behaviors, beliefs, customs and values shared by an independent nation. (Helena Almedia and Bernard Squire, 2019) Organizational culture as beliefs, assumptions, values and ways of interaction that lead to a unique social and spiritual environment of an organization (Daniel Dennison, 2000)

E-3) Social challenges: Issues such as water supply crisis, traffic, unemployment, air and soil pollution crisis, polarization and class differences in society, elite migration, urban renewal, etc. are some of the social challenges in Iran. . (Saeed Madani; MarwaVamqi, 2018)

E-4) Intellectual property rights: It is said to be rights that give its owners the right to benefit from human intellectual and innovative activities and have economic value and tradeability, but the subject is not a specific material object. (SeyedHosseinSafaei, 2003)

F) Environmental factors:

F-1) Environmental Challenges: The environment is a set of energy sources, inanimate matter (water, soil and air) and living organisms (plants, animals and humans) that these factors are constantly related to each other. The basic condition in environmental protection is to establish a balance between its constituent factors .. (Mohammad Reza Imani, 2004) Currently the most important environmental challenges in Iran, air pollution, scarcity and pollution of water resources, climate change, waste, food pollution And transportation, noise, oil pollution, deforestation, soil erosion and biological extinction. (Research Center of Environmental Research Institute of Iran University of Medical Sciences, 2017).

F-2) Energy consumption: Due to the increase in energy consumption in the production and use of cars, limited natural resources, moving in the direction of sustainable development plan and environmental protection should be avoided as much as possible energy wastage and waste. (Ismail Fatehi far, Saeed Paknia, 2014)

3-2- Proposed research model In the proposed model, each of the political, economic, social and environmental factors have been rooted and effective parameters have been identified using library studies and expert opinions. Also, relying on technology foresight, this model has been designed that the role of forecasting and foresight has been recognized as very important. At the same time, technology foresight has been emphasized as an important point of the fourth generation.

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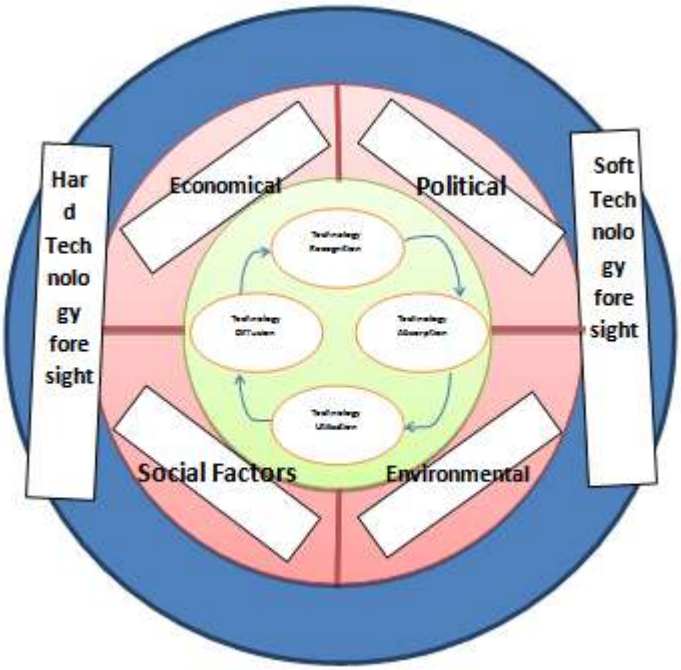

Figure 1 - Proposed Conceptual Model of Knowledge-Based Technology Transfer with the Fourth Generation Technology Foresight Approach

3- Analysis: The proposed research model was prepared as a questionnaire and was provided to 138 employees of production, quality, engineering and planning departments of Pars Khodro Company. The data collected through a questionnaire will be analyzed using appropriate statistical techniques and the results will be presented using descriptive and inferential statistical techniques. Descriptive statistics such as frequency, percentage, table and graph have been used. Relationships between research variables were tested using structural equation modeling using Amos software version 18 and SPSS version 22.

3-1- Description of research variables In the following descriptive findings of the research, statistical indicators such as mean, median, fashion, standard deviation, variance, skew ness, elongation are presented for all research variables. Table 4-5 shows the descriptive findings of the research variables.

3-2- Calculating the reliability of the whole questionnaire Reliability was calculated using Cronbach's alpha coefficient for 26 questions, which is 0.949.

3-3- Confirmatory factor analysis of research components AMOS18 software was used to confirm the construct validity for each model separately. The measurement model represents the factor loads of the observed variables (factor) for each latent variable. The strength of the relationship between the factor (hidden variable) and the visible variable is indicated by the factor load. The condition for the normality of univariate variables is that the critical ratio of skewness or elongation is less than 2.58 and the condition for the normality of multivariate is that the critical ratio of the Mardia coefficient in the last row is less than 2.58 (Ghasemi, 2010). Both conditions must be met to perform structural equations. The results of the normality test are given in Table 7.

Table No. 7 - Test results for the normality of the general technology transfer model

Variable	Min	Max	Tilt	Critical ratio	Skewness	Critical ratio
q26	2.000	5.000	-.185	-.887	-.275	-.660
q25	1.000	5.000	-.496	-2.380	.478	1.146
q24	1.000	5.000	-.173	-.829	.242	.581

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Variable	Min	Max	Tilt	Critical ratio	Skewness	Critical ratio
q23	1.000	5.000	-.810	-3.884	1.218	2.520
q22	1.000	5.000	-.465	-2.230	.233	.558
q21	1.000	5.000	-.611	-2.928	.725	1.740
q20	1.000	5.000	-.422	-2.025	.274	.658
q19	1.000	5.000	-.474	-2.273	.630	1.511
q18	1.000	5.000	-.174	-.836	-.183	-.439
q17	1.000	5.000	-.661	-3.169	.543	1.301
q16	1.000	5.000	-.625	-2.996	-.040	-.095
q15	1.000	5.000	-.401	-1.925	.395	.948
q14	1.000	5.000	-.205	-.984	-.308	-.738
q13	1.000	5.000	-.562	-2.698	.609	1.461
q12	1.000	5.000	-.454	-2.179	.466	1.117
q11	1.000	5.000	-.403	-1.931	.190	.456
q10	1.000	5.000	-.357	-1.713	.004	.010
q9	1.000	5.000	-.117	-.563	-.071	-.170
q8	1.000	5.000	-.301	-1.444	-.168	-.403
q7	1.000	5.000	-.751	-3.601	.655	1.571
q6	1.000	5.000	-.867	-4.159	.602	1.444
q5	1.000	5.000	-.258	-1.239	-.217	-.520
q4	1.000	5.000	-.565	-2.708	.316	.757
q3	1.000	5.000	-.355	-1.701	.456	1.093
q2	1.000	5.000	-.548	-2.628	.531	1.274
q1	1.000	5.000	-.560	-2.684	.171	.410
Multi Variable					3.810	.587

According to Table 7, the absolute value of the critical elongation ratios of the questions is less than 2.58, so the questions have a normal univariate distribution. Also, the critical ratio of "Mardia coefficient" in the last line is less than 2.58 (0.587). Therefore, the above 26 variables have a normal multivariate distribution. As shown in Figure 2, the overall model is measured and explained by 26 questions, including q1-q26.

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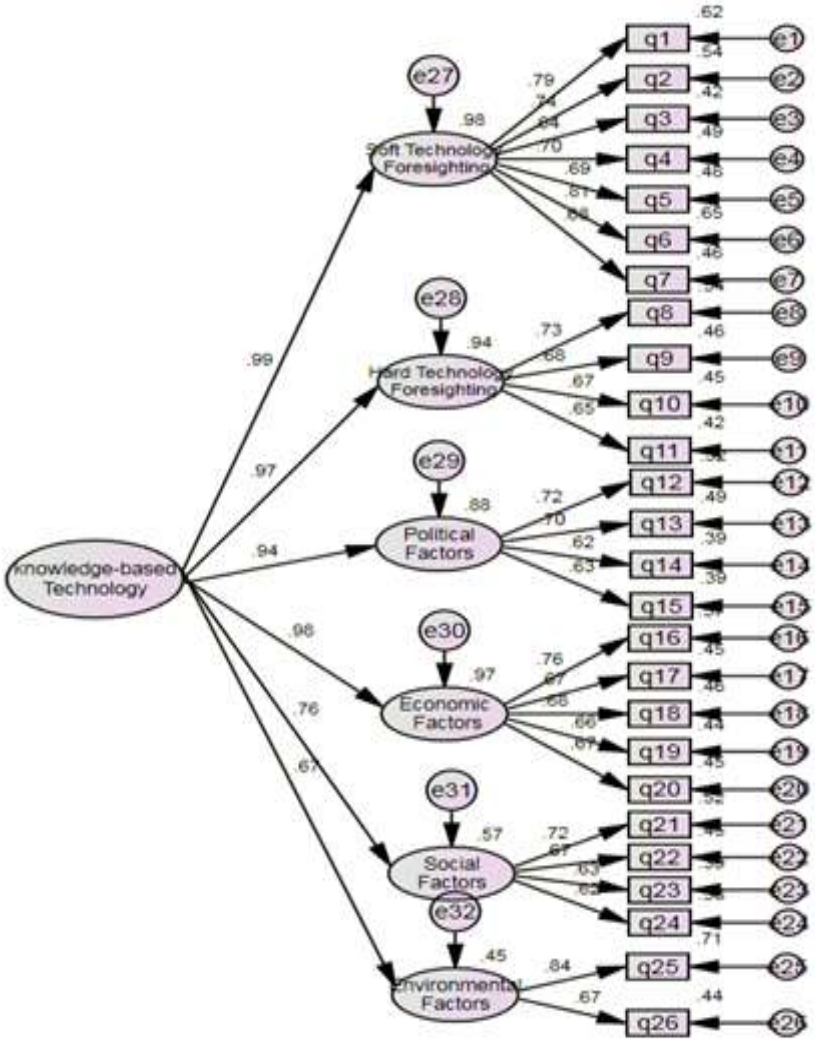

Figure 2– Confirmatory factor analysis of technology transfer model with standard coefficient

3-4- Identifying the indicators and presenting the AHP hierarchical model

3-4-1- Hierarchical analysis for the main groups:

To perform the first hierarchical analysis, the main criteria were compared in pairs based on the purpose. AHP technique is a ranking technique and ranking in this technique is based on pairwise comparisons. Paired comparisons are very simple and all elements of each cluster should be compared in pairs.

Table 8 - Determining the priority of the main criteria

	Soft Technology Foresight	Hard Technology Foresight	Political factors	Economic factors	Social factors	Environmental factors	Geometric mean	Eigenvector
Soft Technology Foresight	1	4.447	2.244	4.367	3.81	6.654	3.215	0.378
Hard Technolo	0.225	1	0.431	5.228	2.855	4.953	1.388	0.163

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gy Foresight								
Political factors	0.446	2.320	1	5.754	4.947	6.274	2.386	0.28
Economic factors	0.229	0.191	0.174	1	0.322	2.605	0.431	0.051
Social factors	0.262	0.35	0.202	3.106	1	5.802	0.833	0.098
Environmental factors	0.15	0.202	0.159	0.384	0.172	1	0.262	0.031

Based on the special vector obtained:
Soft technology foresight criterion with normalized weight of 0.378 has the highest priority.
The criterion of political factors with a normal weight of 0.28 is in the second priority.
Hard technology foresight criterion with a normal weight of 0.163 is in the third priority.
The criterion of social factors with a normal weight of 0.098 is in the fourth priority.
The criterion of economic factors with a normal weight of 0.051 is in the fifth priority.
The criterion of environmental factors with a normal weight of 0.031 is in the last priority.

3-4-2- Hierarchical analysis for the following factors:

Graphical representation of priority of all sub-criteria is given. Expert Choice 11 software was used to perform the relevant calculations. The results of the calculation and the weights related to the indicators are shown in Figure 3. As the results show, among the 26 factors selected by vehicle industry experts, R&D has the highest coefficient with a score of 0.147. After that, the conditions of sanctions are 0.141, creativity and innovation are 0.095 and machines are 0.091. This research shows that the position of research and development in the transfer of knowledge-based technologies in the vehicle industry has a high reputation.

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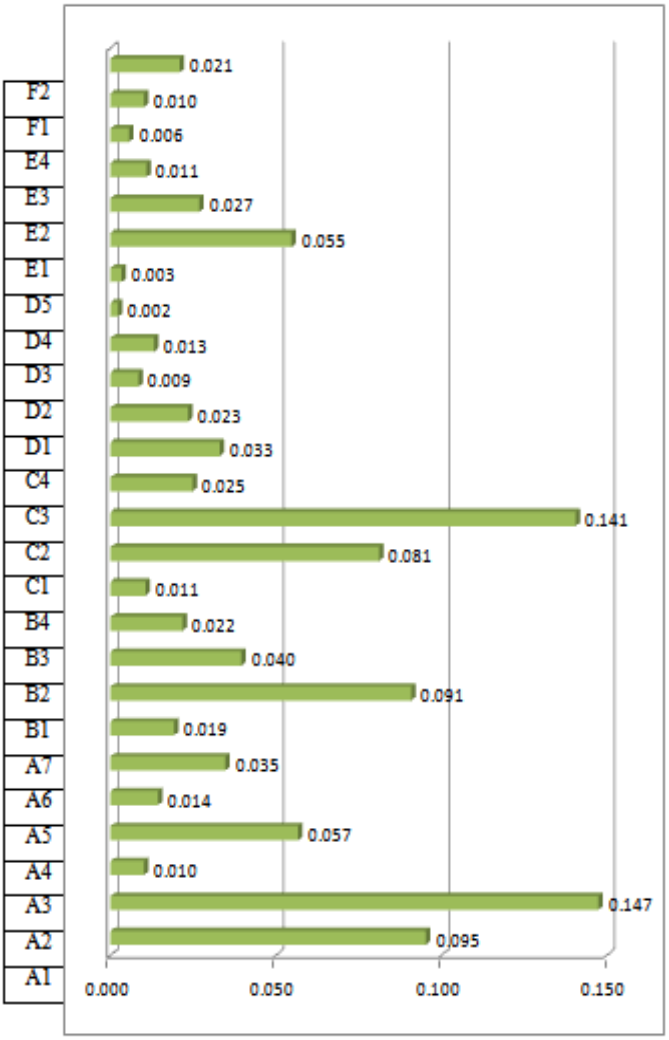

Figure 3 - Determining the final priority of indicators with AHP technique

III. CONCLUSION:

Iran's automobile industry has faced many setbacks and benefits over the years since its inception. The onset of the storm in the early 1940s and the production of world-class products, followed by the revolution and the imposed war and the failure to establish macro-strategies, as well as problems such as sanctions, caused the Iranian car industry to lag behind the world car industry. Is. Although automakers have had some success in manufacturing and assembling cars from the bodybuilding, paint, assembly and production stages, but due to the lack of attention to the transfer of appropriate and effective technology, only products that are designed and assembled are produced and researched. And the development of these products is done by foreign companies and the transfer of knowledge-based technologies is not done. To achieve a suitable position, both quantitatively and qualitatively, the Iranian vehicle industry can rely on the conceptual model presented in the text of this article with the approach of fourth generation technology foresight to each economic, social, political and environmental factors in the form of foresight. Soft and hard technology to achieve success. Each of these factors includes parameters that, if fully paid attention to, can draw a clear horizon for the Iranian car industry. Undesirable will not be able to compete in the vehicle industry in the world and will not provide consumer satisfaction. Attention to the fourth generation foresight including soft technology foresight (existence of creativity and innovation system in vehicle industry , research and development, industry relationship with universities and knowledge-based institutions, technical knowledge, management systems, education and knowledge management, processes and systems) Hard technology foresight

(machinery, tools, equipment and hardware and computers and product life cycle), political factors (political relations with countries, conditions of sanctions and war and the tendency of technology transferrs), economic factors (foreign direct investment) , Policies, structural changes in the economy of Iran and the world, effective government support, attention to the market and customers), social factors (human capital, national and organizational culture, social challenges and intellectual property rights) and environmental factors (environmental challenges) Environment and energy consumption) makes the Iranian car industry have a say in the global competition. But most importantly, according to the results of this study, the factor of research and development and creativity and innovation in the vehicle industry , as well as solving the problem of sanctions on the vehicle industry and having political relations with other countries has a higher degree of credibility.

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