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Identification technological capabilities factors and comparison in internal development with under license projects in Iran automotive industry by using fuzzy Delphi, DANP & TOPSIS analytical methods

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Abstract

Iran automakers have achieved technological capabilities in two ways, Under license, and internal design and development. This research seeks to identify and compare the technological capabilities factors created by these two methods. By the library studies and the opinion of industry experts, 9 factors of the Panda and Ramanathan model were selected. The measurement model was followed by defining 67 sub-factors, which were reduced to 47 by the fuzzy Delphi technique. DANP (DEMATEL+ANP) technique is used to weight the factors and sub-factors. Then, by using the TOPSIS technique and the weights extracted from the DANP step, 6 projects from two groups under license, and internal design and development were ranked and compared according to the level of technological capabilities absorbed. It's found that the SAMAND project (Internal development) has been ranked first in attracting technological capabilities, and both methods are essential in catching up with technology to cover the gap with pioneer car manufacturers.

Keywords: Technological capability, Automotive industry, Ramanathan & Panda Model, Fuzzy Delphi, DANP, TOPSIS
2020 MSC: 62P30, 90C70

1 Introduction

There is no long-term strategy in the Iran automotive industry that can be understood by the decision-makers and policymakers of the automobile sector in the country, and the basic decisions regarding the development model of this industry have not yet been made. That is why, during the last three decades, this industry has constantly faced a constant fluctuation in the movement between the development of the domestic brand and the assembly of foreign cars, and the policymakers have not been able to target a specific path and guide the car manufacturers

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to it. For example, in the 1970s, the policy of increasing the depth of parts localization in Peugeot 405 (an old Peugeot model), Paykan (a very old Avenger model) and Pride (an old KIA/FORD model) cars, and after that, the design and production of SAMAND cars were put on the agenda. But shortly after that, the country's passenger car manufacturers strategy changed its direction towards the assembly of French cars at the beginning of the 80s, and the assembly of Peugeot 206 and Renault L90 became the main work of car manufacturers. Then, in the second half of the 80s, IRANKHODRO moved towards the design of domestic engines, and at the beginning of the 90s, the design and production of the TIBA and RUNA cars became the goal of car manufacturers, but later and after the signing of the JCPOA (5+1 nuclear deal) in 2017, both IRANKHODRO and SAIPA (two big car manufacturers in IRAN) signed a long-term car assembly contract with Peugeot-Citroen(PSA), but these two contracts did not come to fruition due to the withdrawal of the United States from the JCPOA in 2018, and again from the end of the same year some new additional sanctions were acted on Iran Auto Industry, both IRANKHODRO and SAIPA companies again turned to internal design, development and production [2].

The category of technology evaluation is one of the challenges of today's managers of industrial companies, especially since most companies are consumers of technology rather than creators and owners of technology [10]. Organizations basically choose three strategies to achieve technological capabilities [5]:

1. Internal research and development
2. Technology transfer from the countries (companies) that own the technology
3. Joint method in the form of integration of internal research and development of some technologies and transfer of others

Until 1991, Iran's automotive industry mainly used the second method to produce and supply cars to the Iranian market. But since this year, when the "automotive industry development strategy document" was compiled and published, the first and third methods were also put on the agenda. New Research and development centres for new products were established in major automobile companies so that they could acquire knowledge of product design and vehicle assemblies. Of course, the transfer of production technology by the method of buying license rights, which was popular in Iran's automobile factories before this date, continued again.

Iranian car manufacturers have caused the dissatisfaction of Iranian customers by supplying products with low standards and quality, inappropriate prices and long delivery times, compared to the products of foreign companies. This situation has caused government policymakers to always have a supportive view of this industry, because of the age of this industry in Iran and the huge number of investments made in the past years, and most importantly, the high level of employment created (about 400,000 employees), and on the other hand, considering the non-competitive structure of Iran's economy (an oil export base economy), unfortunately, this industry has not reached the expected level of growth and maturity.

The results of the last two researches in above table, form the main framework of this research. Lee and Lim, two university professors from South Korea, showed that different industries in this country have followed different patterns to achieve technology catching up with American, European and Japanese companies, some of these patterns such as Hyundai and Samsung were successful but some others like Daewoo did not achieve the desired results. They examined the experiences of six selected industries in Korea to identify the realities formed in the process of creating technological capabilities. They presented a model to explain effective factors on these patterns.

Ramanathan and Panda [9], conducted a study to evaluate the technological capabilities of two power plants in Thailand. They defined technological capability (TC) as "a set of functional capabilities" that are reflected in the firm's performance through various Technological activities, the ultimate goal of which is to manage value at the firm level by developing imitable organizational capabilities. Technological capabilities can be divided into three main categories:

The first category, strategic technological capabilities, includes the creation of capabilities, design and engineering and construction (In this research: Part Making). The second category, tactical technological capabilities, includes all functional capabilities such as production, marketing and sales and services.

The third category includes: complementary technological capabilities, requiring the acquisition and support capabilities (training, planning, information support and networking, technology sales, and safety and security).

This model is based on the evaluation of organizational capability in creating added value and through these main criteria, technology is evaluated. It is both a qualitative and quantitative approach that considers all aspects of technology in an organization. In this model, both implicit and explicit aspects of technology are analyzed [7].

Table 1: The background of researches in technology capability assessment

Authors	Research Title	Finding & Results
[12]	Presenting a Model for Evaluating Technological Innovation Capability for Attaining Engine Turbocharger Technology	The researcher's effort is to define criteria to evaluate the level of technological innovation in the turbocharger technology of the car engine. Based on the comprehensive study, 6 main capabilities The ability of strategic planning and economic performance at the lowest level and the ability of learning and research and development have been evaluated in favorable conditions. Marketing ability and resource allocation were also average.
[11]	Development of Dynamic Capabilities for Thailand Automotive Industry Performance under Disruptive Innovation	This research emphasizes the role of intervening variables in the innovation system. The results of this research show that dynamic capabilities including management and leadership capabilities have a direct impact on the organization's performance, but the two capabilities of innovation and identification and management of competitive advantages interfere with the organization's performance.
[4]	Evaluation and prioritization of technological capabilities with a developed model in Iran automotive industry - a case study of SAIPA company	Based on the methodology of this research, 8 capabilities have been selected using technology capability assessment models and a total of 29 indicators have been defined for these capabilities. The average of all indicators has been evaluated through a questionnaire of 30 senior and middle managers of SAIPA Company. And finally, the company has been placed in the beginner category in the ranking table of technological capabilities.
[3]	Evaluation criteria and technology level selection in the Iran automotive industry using DANP	a conceptual model was presented using Panda and Ramanathan's model, and key evaluation indicators in three dimensions and 9 indicators were selected based on this model. The analysis has shown that the capability of creativity has the most impact and the capability of engineering design and acquisition capability has the most impact. Three dimensions and 9 indicators have been weighted and ranked by using DNAP technique.
[6]	Patterns of technology, progress, findings from South Korean industries	six industries, including automobiles, have been studied. Factors such as the nature of technology, predictability of technology have been evaluated as criteria for the pattern of progress and absorption of technology. mobile, personal computer, in terms of fluidity and innovation rate, electronic industry is at the highest level, and automobile is at the average level.
[9]	Technology capability assessment in Thailand Electricity Industry	In this research, a model of 9 indicators of technological capability has been presented in the form of three dimensions of macro-level capability, which was later used in many researches in different countries and for different industries. In this model, the evaluation is presented using the opinion of experts and the result is presented as the percentage of technology absorption with Likert numbers.

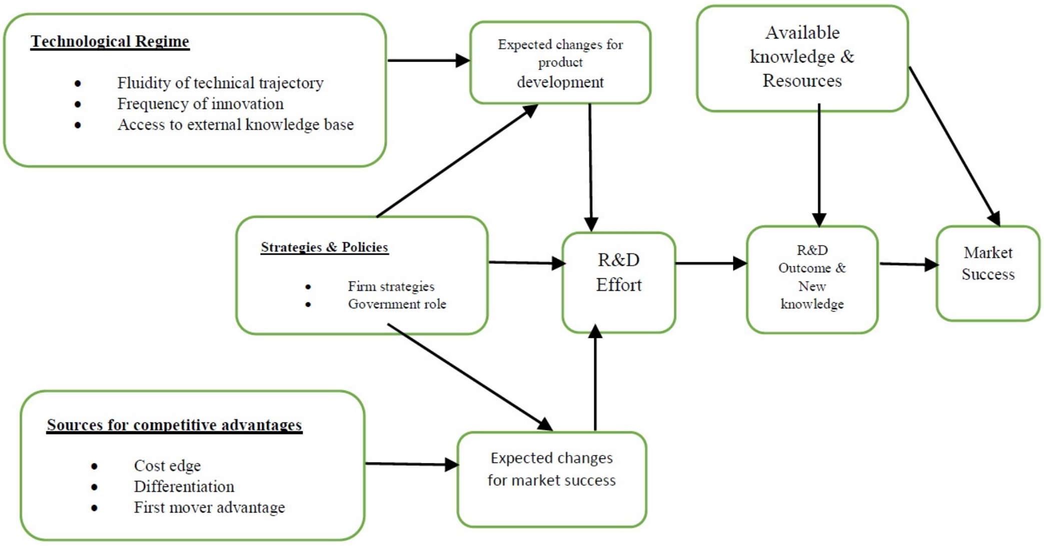

Figure 1: Lee and Lim Research Policy [6] Model of Technological and Market Catch up

2 Research Method

First, we needed to design indicators to measure the factors. Based on the industry expert's opinion (15 experts with more than 10 years' experience in Iran Automotive industries) Ramanathan and Panda model with 9 criteria (Technology capability factors) has been conceptually selected. In Ramanathan and Panda model, building capability

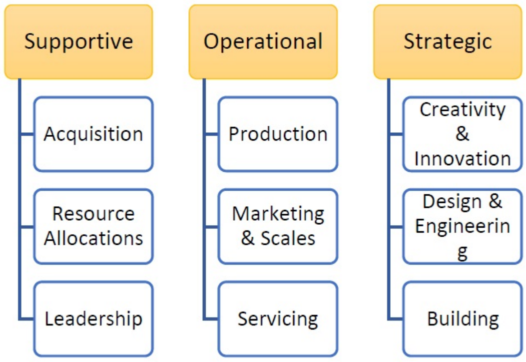

Figure 2: Ramanathan and Panda Technology Capabilities Factors Model [9]

referred to electricity plants which have a process nature, but in automotive industry which has a product/process nature we need to notice to manufacturing capability, because of importance of supply chain in automotive sector, the criteria "Building Capability" replaced to "Part Making Capability" in our model. In the first stage, a questionnaire with 67 indicators (questions) was defined. By selecting a group of 15 experts from the automotive industry who had more than 10 years of experience in this industry, and by the fuzzy Delphi technique and performing three periods of removing the indicators, 47 indicators were finally remained and approved. The validity of questionnaire has been approved by expert's opinion and reliability of questionnaire confirmed by Alpha Cronbach coefficient.

Table 2: Cronbach Alpha Calculation

Factors	**Cronbach Alpha**
Creation & Innovation	0.683
Design & Engineering	0.701
Part Making	0.743
Production	0.654
Marketing & Sale	0.653
After sales	0.709
Technology Acquisition	0.745
Source Allocation	0.762
Leadership	0.752

This result (table 2) shows an acceptable reliability for designed questionary.

In the next step, with the help of DANP (DEMATEL+ANP) combined technique [13], we weighted 9 factors of technological capabilities and 47 indicators. In this method 3 steps have been defined:

Step 1: Creating unweighted supper matrix

Total affected matrix will be resulted DEMATEL method. Each column will be normalized to obtain total affected matrix $T_C = [t_{ij}]_{n\times n}$. And T_D will be obtained through calculation of T_C with factors, $T_D = [t_{ij}^D]_{m\times m}$. Then supper matrix T_C will be normalized by using matrix T_D weighted dimensions.

$$T_c = \begin{array}{c c} & \begin{array}{ccccc} D_1 & & D_j & & D_n \\ c_{11}\dots c_{1m_1} & \cdots & c_{j1}\dots c_{jm_j} & \cdots & c_{n1}\dots c_{nm_n} \end{array} \\ \begin{array}{cc} D_1 & \begin{array}{c} c_{11} \\ c_{12} \\ \vdots \\ c_{1m_1} \end{array} \\ \vdots & \begin{array}{c} c_{21} \\ c_{22} \\ \vdots \end{array} \\ D_i & c_{2m_2} \\ \vdots & \vdots \\ D_3 & \begin{array}{c} c_{n1} \\ c_{n2} \\ \vdots \\ c_{nm_n} \end{array} \end{array} & \begin{bmatrix} T_c^{11} & \cdots & T_c^{1j} & \cdots & T_c^{1n} \\ \vdots & & \vdots & & \vdots \\ T_c^{i1} & \cdots & T_c^{ij} & \cdots & T_c^{in} \\ \vdots & & \vdots & & \vdots \\ T_c^{n1} & \cdots & T_c^{nj} & \cdots & T_c^{nn} \end{bmatrix} \end{array} \tag{2.1}$$

Anew matrix T_c^a will be made as it is shown in equation (2.2)

$$
\boldsymbol{T}_c^{\alpha} = \begin{array}{c} D_1 \\ \vdots \\ D_i \\ \vdots \\ D_n \end{array}
\begin{array}{c} c_{11} \\ c_{12} \\ \vdots \\ c_{1m_1} \\ c_{21} \\ c_{22} \\ \vdots \\ c_{2m_2} \\ \vdots \\ c_{n1} \\ c_{n2} \\ \vdots \\ c_{nm_n} \end{array}
\overset{\begin{array}{ccccc} D_1 & & D_j & & D_n \\ c_{11}\ldots c_{1m_1} & & c_{j1}\ldots c_{jm_j} & \cdots & c_{n1}\ldots c_{nm_n} \end{array}}{
\begin{bmatrix}
\boldsymbol{T}_c^{\alpha 11} & \cdots & \boldsymbol{T}_c^{\alpha 1j} & \cdots & \boldsymbol{T}_c^{\alpha 1n} \\
\vdots & & \vdots & & \vdots \\
\boldsymbol{T}_c^{\alpha i1} & \cdots & \boldsymbol{T}_c^{\alpha ij} & \cdots & \boldsymbol{T}_c^{\alpha in} \\
\vdots & & \vdots & & \vdots \\
\boldsymbol{T}_c^{\alpha n1} & \cdots & \boldsymbol{T}_c^{\alpha nj} & \cdots & \boldsymbol{T}_c^{\alpha nn}
\end{bmatrix}} \tag{2.2}
$$

Through normalizing T_c^{a11} with T_c^{ann} on equation (2.3), matrix T_c^{a11} will be obtained (Equation: (2.4)).

$$
d_{ci}^{11} = \sum_{j=1}^{m_1} t_{ij}^{11},\ i = 1, 2, ..., m_1 \tag{2.3}
$$

$$
T_c^{\alpha 11} = \begin{bmatrix}
t_{c11}^{11}/d_{c1}^{11} & \cdots & t_{c1j}^{11}/d_{c1}^{11} & \cdots & t_{c1m_1}^{11}/d_{c1}^{11} \\
\vdots & & \vdots & & \vdots \\
t_{ci1}^{11}/d_{ci}^{11} & \cdots & t_{cij}^{11}/d_{ci}^{11} & \cdots & t_{cim_1}^{11}/d_{ci}^{11} \\
\vdots & & \vdots & & \vdots \\
t_{cm_1 1}^{11}/d_{cm_1}^{11} & \cdots & t_{cm_1 j}^{11}/d_{cm_1}^{11} & \cdots & t_{cm_1 m_1}^{11}/d_{cm_1}^{11}
\end{bmatrix} = \begin{bmatrix}
t_{cl1}^{\alpha 11} & \cdots & t_{c1j}^{\alpha 11} & \cdots & t_{clm_1}^{\alpha 11} \\
\vdots & & \vdots & & \vdots \\
t_{ci1}^{\alpha 11} & \cdots & t_{cij}^{\alpha 11} & \cdots & t_{cim_1}^{\alpha 11} \\
\vdots & & \vdots & & \vdots \\
t_{cm_1 1}^{\alpha 11} & \cdots & t_{cm_1 j}^{\alpha 11} & \cdots & t_{cm_1 m_1}^{\alpha 11}
\end{bmatrix} \tag{2.4}
$$

Let the overall influence matrix correspond and be placed in the dependency clusters. The above result is the unweighted matrix, which is based on the displacement of the normal influence matrix T_c^a by dimensions (clusters), that is, $w = (T_c^a)$.

$$
\boldsymbol{W} = (\boldsymbol{T}_c^{\alpha})' = \begin{array}{c} D_1 \\ \vdots \\ D_i \\ \vdots \\ D_n \end{array}
\begin{array}{c} c_{11} \\ c_{12} \\ \vdots \\ c_{1m_1} \\ c_{21} \\ c_{22} \\ \vdots \\ c_{2m_2} \\ \vdots \\ c_{n1} \\ c_{n2} \\ \vdots \\ c_{nm_n} \end{array}
\overset{\begin{array}{ccccc} D_1 & & D_j & & D_n \\ c_{11}\ldots c_{1m_1} & & c_{j1}\ldots c_{jm_j} & \cdots & c_{n1}\ldots c_{nm_n} \end{array}}{
\begin{bmatrix}
\boldsymbol{W}^{11} & \cdots & \boldsymbol{W}^{i1} & \cdots & \boldsymbol{W}^{n1} \\
\vdots & & \vdots & & \vdots \\
\boldsymbol{W}^{1j} & \cdots & \boldsymbol{W}^{ij} & \cdots & \boldsymbol{W}^{nj} \\
\vdots & & \vdots & & \vdots \\
\boldsymbol{W}^{1n} & \cdots & \boldsymbol{W}^{in} & \cdots & \boldsymbol{W}^{nn}
\end{bmatrix}} \tag{2.5}
$$

If the W^{11} matrix is empty or 0 as shown in equation (2.3), the matrix between clusters or measures is independent and not interdependent. Other values of W^{nn} are as above.

$$
\boldsymbol{W}^{11} = (\boldsymbol{T}^{11})' = \begin{array}{c} c_{11} \\ \vdots \\ c_{1j} \\ \vdots \\ c_{1m_1} \end{array}
\overset{\begin{array}{ccccc} c_{11} & \cdots & c_{1i} & \cdots & c_{1m_1} \end{array}}{
\begin{bmatrix}
t_{c11}^{\alpha 11} & \cdots & t_{ci1}^{\alpha 11} & \cdots & t_{cm_1 1}^{\alpha 11} \\
\vdots & & \vdots & & \vdots \\
t_{c1j}^{\alpha 11} & \cdots & t_{cij}^{\alpha 11} & \cdots & t_{cm_1 j}^{\alpha 11} \\
\vdots & & \vdots & & \vdots \\
t_{c1m_1}^{\alpha 11} & \cdots & t_{cim_1}^{\alpha 11} & \cdots & t_{cm_1 m_1}^{\alpha 11}
\end{bmatrix}} \tag{2.6}
$$

Step 2: Obtaining weighted supper matrix. Each column will be added to be normalized.

$$T_D = \begin{bmatrix} t_D^{11} & \cdots & t_D^{1j} & \cdots & t_D^{1n} \\ \vdots & & \vdots & & \vdots \\ t_D^{i1} & \cdots & t_D^{ij} & \cdots & t_D^{in} \\ \vdots & & \vdots & & \vdots \\ t_D^{n1} & \cdots & t_D^{nj} & \cdots & t_D^{nn} \end{bmatrix} \tag{2.7}$$

The total influence matrix T_D is normalized and the new matrix T_D^a is obtained, where $t_D^{aij} = t_D^{ij}/d_i$.

$$T_D^\alpha = \begin{bmatrix} t_D^{11}/d_1 & \cdots & t_D^{1j}/d_1 & \cdots & t_D^{1n}/d_1 \\ \vdots & & \vdots & & \vdots \\ t_D^{i1}/d_i & \cdots & t_D^{ij}/d_i & \cdots & t_D^{in}/d_i \\ \vdots & & \vdots & & \vdots \\ t_D^{n1}/d_n & \cdots & t_D^{nj}/d_n & \cdots & t_D^{nn}/d_n \end{bmatrix} = \begin{bmatrix} t_D^{\alpha 11} & \cdots & t_D^{\alpha 1j} & \cdots & t_D^{\alpha 1n} \\ \vdots & & \vdots & & \vdots \\ t_D^{\alpha i1} & \cdots & t_D^{\alpha ij} & \cdots & t_D^{\alpha in} \\ \vdots & & \vdots & & \vdots \\ t_D^{\alpha n1} & \cdots & t_D^{\alpha nj} & \cdots & t_D^{\alpha nn} \end{bmatrix} \tag{2.8}$$

Let the total influence matrix T_D^a complete the unweighted super matrix to obtain the weighted super matrix.

$$W^\alpha = T_D^\alpha W = \begin{bmatrix} t_D^{\alpha 11} \times W^{11} & \cdots & t_D^{\alpha i1} \times W^{1j} & \cdots & t_D^{\alpha n1} \times W^{1n} \\ \vdots & & \vdots & & \vdots \\ t_D^{\alpha 1j} \times W^{i1} & \cdots & t_D^{\alpha ij} \times W^{ij} & \cdots & t_D^{\alpha nj} \times W^{in} \\ \vdots & & \vdots & & \vdots \\ t_D^{\alpha 1n} \times W^{n1} & \cdots & t_D^{\alpha in} \times W^{nj} & \cdots & t_D^{\alpha nn} \times W^{nn} \end{bmatrix} \tag{2.9}$$

Step 3: Limit of weighted supper matrix

The weighted super matrix is bounded by raising it to a very large power K until the super matrix converges to a long-term stable super matrix to obtain global priority vectors (called DANP weights), such as $\lim_{h\to\infty}(W^a)^h$.

Then, from the statistical population of 15 industry experts and with the help of the TOPSIS technique and applying the weights obtained in the previous step, we were able to come to the final table (table 4) that shows the product development projects from two internal design and development and external collaborations methods in creating technological capabilities How effective has technology been for Iran Khodro compared to each other.

Based on the above table, ranked weight of 9 factors is shown in below chart

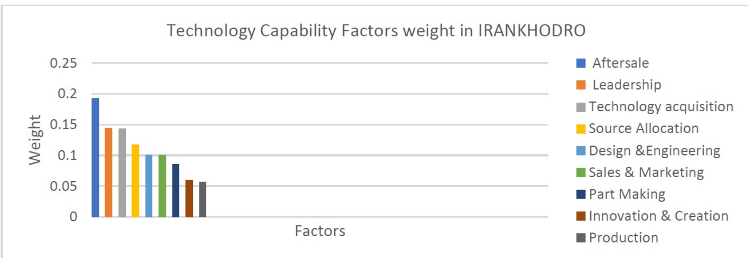

Figure 3: Ranked weight of 9 technology capabilities factors

2.1 Calculation of technological capabilities acquired by product development projects with TOPSIS technique

TOPSIS method is one of the techniques used in multi-criteria decision making. The general philosophy of the TOPSIS method is that two hypothetical options are defined using the available options. One of these options is a set of the best values observed in the decision matrix. We call this option the positive ideal (the best possible state). Meanwhile, another hypothetical option is defined that includes the worst possible cases. This option is called negative ideal. Criteria can be positive or negative in nature, and their measurement unit can also be different [13].

Table 3: The final weight of the dimensions, factors and indicators, DANP result

Dimensions	Factors	Weight	No	Indicators	Weight
Strategic capabilities Weight; 0.2460	Creativity and innovation capability	0.0597	1	Encouraging creativity and innovation	0.0099
			2	Creativity and innovation in new products	0.0101
			3	Innovation in production processes	0.0103
			4	Innovation in marketing and sales methods	0.0146
			5	Innovation at all organizational levels	0.0149
	Design and development capability	0.1005	6	Design and engineering capability	0.0211
			7	Ability to develop new products	0.0358
			8	Ability to design and develop the vehicle platform	0.0179
			9	Obtaining technology through reverse engineering	0.0117
			10	Having experienced and expert personnel in the engineering design department	0.0140
	The ability of part building	0.0858	11	Existing of supply chain management process	0.0155
			12	Evaluating the capabilities of suppliers in the sourcing stage	0.0108
			13	The impact of engineering design capability in evaluating the capabilities of suppliers	0.0153
			14	The factor of technology management in capabilities evaluating of suppliers	0.0283
			15	Having good quality parts and assemblies from suppliers	0.0159
Operational capabilities Weight; 0.3503	Production capability	0.0576	16	Ability to design and build production lines	0.0150
			17	Ability to produce in all press production lines, body welding, paint, decoration assembly and final test	0.0097
			18	Optimal efficiency of quality systems of production lines	0.0191
			19	Using advanced systems such as Kanban and lean production in production lines	0.0139
	Marketing and sales capability	0.1002	20	study and clear understanding of the managers of the country's car market	0.0280
			21	Using new marketing and digital sales methods	0.0266
			22	Having experienced, skilled and trained personnel in the field of marketing and sales	0.0195
			23	Department for handling customer complaints existing and using advanced methods	0.0261
	Capability of after-sales service	0.1924	24	good management of the after-sales service process in Iran Khodro	0.0287
			25	Acceptable service fee for customers of Iran Khodro products	0.0357
			26	Easy access for customers of Iran Khodro products to spare parts	0.0183
			27	Having quality and reasonable price of spare parts of Iran Khodro products in the market	0.0158
			28	Customer satisfaction from the network of Iran Khodro dealers	0.0245
			29	Iran Khodro's strong and reliable after-sales service brand in the eyes of customers	0.0227
			30	Having a network of Iran Khodro dealers with trained and skilled repair personnel	0.0239
			31	Customer satisfaction with the quality, price and delivery time of the repairs performed	0.0228
Support capabilities	Technology acquisition capability	0.1432	32	Technology strategy development capability	0.0277
			33	The ability to localize technology	0.0194
			34	Ability to commercialize technology correctly and on time	0.0237
			35	Ability to implement technology transfer contracts in cooperation projects with foreign automobile companies	0.0265
			36	The ability to monitor and manage the technologies available in global markets	0.0207
			37	Ability to prioritize existing technologies for use in own products and processes	0.0162
	Supporting capability and resource allocation	0.1167	38	Proper planning, resource allocation to product development projects in IRANKHODRO	0.0147
			39	Failure to stop product development projects due to lack of funding	0.0253

		40	Estimating and properly allocating budget and expert manpower for product development projects	0.0193
		41	Good allocation of production lines to product development projects in the pilot production phase and collaboration of production personnel with the project team	0.0329
		42	Favorable and acceptable budget share for product development projects	0.0245
Leadership capabilities	0.1438	43	leadership process and strategic planning	0.0450
		44	Clear and effective policies in the field of product	0.0369
		45	Specific and effective leadership ability in the market field	0.0203
		46	Experienced and expert personnel in the field of management	0.0264
		47	A clear and effective strategy in the field of new technologies	0.0152

The criteria for calculating scores in the TOPSIS method is that the options are as close as possible to the positive ideal option and far from the negative ideal option. Based on this, a score is calculated for each option and the options are ranked according to these scores. In the continuation, all six product development projects have been ranked based on level of technology capabilities achieved.

Table 4: Technological Capability acquired Ranking of the product development projects obtained by TOPSIS technique

Project Name	**Project Type**	d_i^+	d_i^-	CL_i	**Rank**
SAMAND	Internal Design & Development	0.0074	0.0122	0.6213	1
Peugeot 206	Under License / Foreign Collaboration	0.0078	0.0103	0.5704	2
Peugeot 2008		0.0093	0.0102	0.5232	3
Renault Logan (L90)		0.0101	0.0086	0.4580	4
DENA	Internal Design & Development	0.0102	0.0075	0.4255	5
RUNA		0.0131	0.0059	0.3118	6

Regardless of the position of each of the mentioned projects in the creation of technological capabilities for IRANKHODRO, the question of this research seeks to show the concept of "whether IRANKHODRO has attracted more technological capabilities from internal design and development projects in the past thirty years (Research Time Scope), or from under license projects/ Foreign cooperation?" Is it possible to answer this question separately? The research of many researchers in the automobile industry shows that none of these methods alone cannot be chosen and followed as an independent strategy and way of working by the automobile company.

To show the results of experts' opinions and using the TOPSIS software for two categories of product development projects through internal research and development and product development projects through external cooperation, the following table 5 is the result of calculation:

Table 5: Weighted average of experts' opinions on two methods of product development projects

Dimensions	**Factors**	**Weight (Impact Factor)**	**Internal Research & Development Projects**			**Under License Projects**		
			SAMAND	DENA	RUNA	P206SD	L90	P2008
Strategic Capabilities	Innovation & Creative capabilities	0.0597		0.294			0.352	
	Design & Engineering Capabilities	0.1005		0.625			0.510	
	Part Making Capabilities	0.0858		0.480			0.590	
Operational Capabilities	Production Capabilities	0.0576		0.365			0.418	
	Marketing & Sales Capabilities	0.1002		0.490			0.564	
	Aftersales Capabilities	0.1924		1.09			1.18	
Supportive Capabilities	Technology Acquisition Capabilities	0.1432		0.769			0.850	
	Leadership Capabilities	0.1167		0.717			0.758	
	Resource Allocations Capabilities	0.1438		0.819			0.882	
Weighted Average				0.623			0.678	

3 Results / Summary of Key Findings

In table 5, the weight of the model factors was extracted and applied from the output of the DANP software, and the average opinion of the experts was also used from the second stage of the TOPSIS technique. As can be seen, "both methods have almost the same weighted average. The result of this table shows that none of the two methods alone can turn an automobile company into a successful company in the international arena". "No automobile company can achieve the technologies it needs without interacting with other technology owner companies". Undoubtedly, it cannot be denied that Iranian engineers and technicians learn from the engineers of companies such as Peugeot, Citroen, Renault, Kia Motors, Mazda, Mercedes-Benz, Suzuki, etc. In other words, these two methods should be as a parallel strategy for Iranian automakers. As Lee and Lim [6] mentioned, Success of firm depends on success of product development projects and reasonably result of these projects depends on accumulated knowledge of the previous projects which developed internally and new knowledge and learning from new projects resulted from new foreign collaboration.

4 Conclusion

Companies can act in two ways to acquire technology, either through internal research and development (endogenous capabilities) or through cooperation and technology transfer from technology-owning companies (exogenous), This research has compared the level of technological achievements in the above two methods for IRANKHODRO company.

According to [8], companies should choose between these two strategies.

- Leadership of technological innovation, in which companies seek leadership in the market by relying on the ability of technology leadership. This strategy requires the company's serious commitment to creativity and risk-taking, close ties with the main sources of new and relevant knowledge on the one hand, and customer needs and reactions on the other.
- Imitation of technological innovation; In which, companies enter the market later by relying on imitation (learning) from the experience of technology pioneers. This strategy requires serious adherence to the competitor's analysis and his knowledge of reverse engineering (testing, evaluating and separating the components of competing products to understand how they work and produce them and the reasons why they are attractive to customers) and reducing the cost of learning in production. [1] in his book entitled "South Korea's Automotive Industry" believe that the most important policy used in the Korean automobile industry was to emphasize the manufacture of Korean automobiles and the manufacture of its parts inside the country as much as possible. The basis for the implementation of such a policy was based on the long-term plan for the development of the automobile industry, which was approved by the Korean government in May 1974.

Table 4 shows that the SAMAND project, without a doubt, according to the opinion of all the experts, has brought the highest technological achievement for the IRANKHODRO company and has rightly earned the title of "SAMAND University". The scope of this project in the fields of product technologies and production process and services was able to bring a great learning for Iran Khodro. It has the second place after the 206 Sedan project, and for the first time, Iran Khodro was able to do a joint design project with a global car manufacturer like Peugeot. After the launch of the 206-hatchback in Iran, the feedback from the market showed that according to the taste of Iranian customers, the trunk box is desirable, so IRANKHODRO and Peugeot experts came to the conclusion that the 206 Sedan can sell well in Iran. According to this result, the characteristics of these two projects (SAMAND and 206SD) were their expansion in different parts of the automotive value chain, and the next feature was the non-sanctioned conditions that provided open interaction with all foreign companies for IRANKHODRO. The 206 Sedan project helped the engineers of Iran Khodro to become familiar with the design and engineering standards of European automakers. The presence of the new 2008 project in the third place next to big projects like SAMAND and L90 indicates a great truth and the fact that experts believe that internal research and development without interaction with leading companies in modern automotive technologies cannot contribute to the technology capability of IRANKHODRO. The 2008 project is the result of the establishment of the Joint venture company "IKAP". Experts seem to believe that in the conditions that the sanctions will be lifted, the cooperation strategy of establishing joint ventures in which both parties are required to invest is considered the best way for foreign cooperation with global car manufacturers. On the other hand, in the discussion of product selection, the 2008 project is considered a success for Iran Khodro, because this product has an attractive design and up-to-date technical standards, and it was able to attract the attention of Iranian customers in the very first steps of its release to the market. unfortunately, with the application of the second round of sanctions in 2017 and the suspension of all foreign cooperation in Iran's automobile industry (except with Chinese automobile companies), this project has been stopped and all the investments made have remained unused.

The L90 project was started in 1382 in order to achieve a common platform with the French Renault company, and it was supposed to be produced in a joint venture company with Renault in addition to production in Iran Khodro and Pars Khodro. The lack of acceptance by the market as expected, the launch of the joint venture was canceled. This project, despite the promises and agreements mentioned in its contract, has many goals, including product export and technical support and training of Iranian engineers in using the platform of this product to design two new products by two Iranian automobile companies for the Iranian market, did not reach the transfer of technology in this contract did not happen in the field of component manufacturing and product design, and the project did not have technological achievements for Iranian automobile manufacturers in these fields.

The DENA and RUNA projects were a move to use the existing SAMAND and 206 platforms, so that IRANKHODRO could offer two products with a new appearance to the Iranian market under the sanctions, although due to the impossibility of interacting with foreign companies, the technological achievements of these two projects, as experts have commented and is placed at a lower level than the other four projects

4.1 Applicable suggestions for Iran Automotive Industry Managers

- Recovery of strategic planning capabilities in the fields of market, product, process, technology, foreign cooperation and human resource management
- Re-engineering the product development process according to the sanctions conditions through the development of cooperation with foreign design and engineering companies (accessible) and the use of domestic knowledge-based design and engineering companies.
- Reviewing the product development processes of suppliers and helping to improve their design and engineering capabilities through cooperation with world-renowned suppliers in order to transfer modern parts manufacturing technologies.
- Establishing a technology management department at the appropriate organizational level and paying attention to this expertise by the senior management and using experts in this field and the results of studies in this department.

4.2 Future research

It is suggested that based on the mentioned indicators defined in this research, a new modeling could be done for the empowerment of the automobile industry for the 9 main capabilities that have the nature of technological capabilities.

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