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Technology Assessment Model with Dynamic Capabilities Approach in Small and Medium Enterprises

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Abstract. In the technology-driven industries like automotive industry, the success of the companies depends on their ability to provide new and continuous innovations to the market. In this regard, technological capabilities lead to a competitive advantage. The purpose of this study is to identify the effective factors in the technology assessment based on the dynamic capabilities of small and medium automotive supply chains. In this study, by using the principal components analysis (PCA) method, the identification of the important factors according to the views of automotive industry experts has been addressed. The results show that from the perspective of dynamic capabilities, Absorbency and learning, Innovative capability and integration capabilities are the most effective factors. In terms of technology assessment, Processes and organizational structure and level of technology development are the most important factors identified in order to assess the technology of these companies. In addition, in this study, due to the effective factors, a new technology assessment model with

dynamic capabilities approach has been proposed and a relevant questionnaire has been developed. The results of reliability analysis show that the proposed questionnaire has an appropriate accuracy and reliability in technology assessment of small and medium automotive supply chain companies.

Keywords: Technology Assessment; Dynamic Capabilities; Supply Chain; Small and Medium Businesses.

1. Introduction

In the technology-driven industries like automotive industry, the ability of designing and developing of new products is a critical element to success of organization. The product portfolio and capabilities of the company are formed when companies adapt to changing environment. Various changes in the environment, such as changes in customer needs or technological advances, threaten existing products and services, and create new opportunities for new products and services. Companies need to enhance their resources and capabilities in order to increase product innovation with the aim of avoiding these threats as well as taking advantage of the forthcoming opportunities (Jantunen et al. 2012) Improving this capability requires high adaptability to environmental and technological conditions, the ability to integrate and coordinate organizational resources with the changing needs of the community and technology. Therefore, it is necessary to examine the use of internal resources and foreign business networks for the success of the company according to the dynamic capabilities perspectives. (Wei-ping & Junfeng, 2016). In this regard, the necessity of technology evaluation lies in the following: (Ershadi & Cees et al., 2013):

- Assessing the organization's capability to commercialize internal technology with regard to the strengths and weaknesses associated with its R & D or commercialization, and identifying the stage of the technology life cycle for competitive position of technology
- Understanding the status of the life cycle of technology whether existing technology is worn out or not
- Identifying strengths and weaknesses of existing technology in the organization and identifying the value of organization technology for

customers

- Identifying the environmental factors affecting the development of technology by determining technology gap in comparison with competitors and the extent and manner of exploiting the technologies inside and outside the organization

Finally, it can be said that organizations need to analyze all the aspects of technology entry before their acquisition of technology which can be done by applying a technology assessment model that is comprehensive. Finding such a model that shows the impact of the capabilities of the actual technology level of organizations is the main subject of this study. Technology capabilities align the resources, organizational capabilities, and support them to achieve business strategies and gain competitive advantages. Based on Resource-Based View (RBV), it is not possible to improve the capabilities without investment. Therefore, according to existing literature on technology assessment and technology enhancement, a dynamic approach is proposed. According to this view, the value of the company is changing rapidly and new perspectives for companies have been created (Mikalef and Pateli 2017).Therefore, dynamic capabilities can be transformed into the capacity to share opportunities and threats to seize opportunities and to maintain competitiveness through the promotion, combination, protection and the identification of tangible and intangible assets of business entities. Dynamic capabilities include the unmatched capabilities needed to adapt to technological opportunities and customer changes (Teece 2012). Due to the fact that the automotive industry in Iran has a special position and is one of the most important industries for increasing the GDP, it is necessary to use the latest management and engineering methods to improve its position. Currently, the strategy of supplying auto parts in the world has a special place and various units of automobile companies act to supply parts and contract with suppliers using a predetermined methodology. In such a situation, depending on the position and importance of the piece in the company, the procedure for contracting with the suppliers will be different. Therefore, there is not a constant method to supply all the parts. The rapid change has transformed the automotive industry over the past few years and pushed car makers and suppliers to strengthen centre cores by gaining expertise, increasing efficiency, focusing on resources and reducing costs (Samizadeh 2016).

Due to the product lifecycle and short term profitability of companies, dynamic changes in products or a complete replacement of products are needed. In this research, we first examine the literature in two areas of technology assessment and dynamic capability. Then, we study the relevant models in small and medium size companies in the automotive supply chain, and the research gap in both fields is presented. In the next step, we will extract the important factors in each model of technology assessment and dynamic capability. For this purpose, statistical techniques like analyzing the main factors are used and the main factors are determined by applying the opinions of industry experts and academic experts. Moreover, the factors obtained from the research gap are weighted. Then, the main factors that are recognized in dynamic capability are added to technology assessment as influencing factors. Finally, in order to validate the new technology assessment model, the opinion of industry experts and academic experts are applied.

2. Literature review

Given that in this research we are looking for a model for technology assessment based on dynamic capabilities, we need to describe these two concepts. Technology assessment tries to predict the direct or indirect implications of a variety of technologies. In other words, it predicts and evaluates the implications and impacts of different technologies on society and people. In fact, technology assessment identifies goals and policies to improve the desired outcomes and minimizes unpredictable outcomes. The review and evaluation of technology is done to ensure that the technology can be properly recognized, studied, and compared to other technologies used by similar organizations. Therefore, this method is a tool that helps organizations to have better understanding about their existing technologies and helps them to identify and plan for opportunities and threats ahead. In this process, the strengths and weaknesses of the organization are discovered by comparing with other organizations and technologies, as well as focusing on the problems and issues arising from the application of a particular technology. In essence, this approach focuses on the strengths that need to be relied upon and addresses the weaknesses. In general, there is a targeted look at technological changes in technology assessment and technology assessment seeks to identify the status of technology in order to manage

and develop the status of technology. Therefore, technology assessment measures the strength of each of the technology parameters, whenever there is a gap, and the need for technology in each of these parameters is revealed. Each technology assessment model has dimensions and axes that have their own definitions. In short, the definitions relating to the dimensions of the technology assessment are shown in Table 1.

Table 1. Definition of technology assessment axes

Technology Assessment axes	Definition
Processes and organizational structure	Organizations intend to have matrix structures in which the processes are the first dimension and task-oriented structures are the second dimension
Sources and technology infrastructure	Technology infrastructure consists of a set of basic prerequisites, without which the process of technology development will decrease and the efficiency of the related activities will be reduced
Strategic Technology Capabilities	Applying an operational strategy that can be interpreted the overall strategy of the organization in the field of technology and it determines the method of obtaining the highest competitive position for the organization through the development of the organization's technologies
The charm of technology	Understanding technology, the effects of development or deployment of technology, identification and evaluation of opportunities, and risks and technological threats
The level of technology development	The level of technology development of organizations through highlighting the weaknesses and strengths of organizations' technology provides suitable criteria for managing and focusing investments and studies on the weaknesses and strengths. On the other hand, the presentation of the best state of technology in each industry will bring efficient and effective planning horizons to decision makers and policy-makers.
Transmission capability	The capability to exploit and use existing technologies in the technology transfer process. Exploitation, repairs, production, planning and production control are parts of transmission capability.
Sales capability	The capability to sell and service, and finding new markets are parts of sales capability.
Acquisition capability	The capability to supply and provide new sources, evaluation of proposals and powerful bargaining are parts of acquisition capability.
Conversion Capability	The capability to improve the components of technology and management processes to increase the efficiency and effectiveness are parts of conversion capability.
Design capabilities	Capability to design, re-design, change product, and create new products for future markets are parts of design capability.
Creation Capability	The innovation and commercialization of innovations, the capability to carry out research and development, the preparation of a prototype of the product are parts of creation capability.

Various definitions of dynamic capabilities are presented, which are given in Table 2 (Mathivathanan et al. 2017).

Table 2. Dynamic capabilities concepts (Mathivathanan et al, 2017)

Dynamic capabilities	Definition
Sensitivity	Ability to identify or create new opportunities
Form	Permanent responsiveness to market trend sensation based on auto set networks capabilities
Seize	Ability to respond and exploit the opportunity or threat posed by implementing new products / changing products, processes, and services, or by adopting alternative methods.
Evolution	Ability to use network capabilities to identify and exploit opportunities
Re-configuration	Ability to implement measures to maintain potential and coordinate the organization for continuous change, through the integration of tangible and intangible assets
Lever	Ability to apply performance success trends or another work system
Learning	Ability to develop skills to do better and more efficient
Creative merge	Ability to integrate multiple and diverse resources into the reorganization of new resources
Merge / Coordination	Ability to combine and synchronize and merge resources or activities to develop new operational capabilities
Strategic competitive capability	Ability of the company to move in line with strategic competition
Adaptive capability	Ability to create a balance between resources to develop new products to deliver what market demands.
Absorbency	Ability to use external knowledge and information in line with the interests of the company
Innovative capabilities	Ability to develop new products or even new markets
Strategic decisions	Capabilities of different working groups, specialization of individuals in line with strategic goals
Procedure of unity and acquisition	Development of the ability of attracting resources through external sources
Pre-acquisition procedure	Assessing cultural characteristics and homogeneity of stability in the company's vision
Post-acquisition procedure	Validation of combination and transfers of assets throughout the company
Propagation and Exchange procedure	Develop the ability to replicate, transfer, and combine knowledge-based resources
Resource allocation procedure	A guidance in resource allocation
Knowledge creation	Processes of creating new thinking skills
Exit procedure	Resources that do not provide competitive advantage are excluded.
Quality of personnel research	Researchers of high quality in order to achieve successful innovation
The process of forming an alliance	It includes processes of effective collaboration between individuals and individual efforts.
Continuous evolution of	Continuous capability change and organizational restructuring to

Dynamic capabilities	Definition
organizational forms	achieve competitive advantage in a changing environment
Capabilities	Ability to monitor the company in the external environment and use the results
Logistic flexibility	Ability to respond to changes and provide products at an affordable cost
Flexibility of supply	Ability to respond to customer requests
Flexibility in the operating system	Ability to change operations in response to changing customer needs
Flexibility of the market	Ability to develop new products or improve existing products
Organizational flexibility	Ability to change an organization in response to customer needs
Flexibility of the information system	Ability to deliver the information required by the organization
Flexibility of technology	Ability to import and absorb new technical knowledge
Sharing knowledge	It includes exchange and transfer of knowledge among the company
Shared IT systems	It includes the establishment of communication in order to facilitate the transfer and exchange of knowledge and ultimately to create clean management, reduce costs, proper logistics and appropriate coverage.
Issuing permit	Company licenses and trademarks in the business
Achieving and assessing knowledge	Ability to obtain new knowledge, assess information and use them
Development of knowledge sharing	Ability to develop, exchange and transfer knowledge between companies
Partnership development plans	The process of developing partnerships between companies and partners with related activities
Improving supply chain efficiency	Ability to improve supply chain performance through collaborative efforts between companies and partners
Training participants	Knowledge transfer processes and partners' awareness of product improvement

Based on Winter's definition (2003), the first level of dynamic capabilities includes normal capabilities. Based on the hierarchical approach, for the definition of organizational dynamic capabilities, Helfat (2007) defined dynamic organizational capabilities based on organizational hierarchy and referred to varying degrees of complexity. These complexities have been created in related literature due to the structure of dynamic capabilities and its different definitions. Teece et al. (1997) defined dynamic capabilities based on the organization's capabilities. Eisenhardt and Martin (2000) also refered to organizational practices. Wang and Ahmed (2007) defined capabilities based on "behavioral trends." Teece et al. (1997) also argued that the external environment is an essential factor in understanding the concept of dynamic capabilities, and as an organization's capabilities organizes market fluctuations. In contrast, Wang and Ahmed (2007) considered

dynamic capabilities as an organization's ability to manage core organizational capabilities. .(Mohamud & Sarpong, 2016). Given that the variables of this research include dynamic capabilities and technology assessment, according to the research literature and the obtained results, it can be assumed that dynamic capabilities affect the level of technology and ultimately affect competitive advantages. In order to measure this relationship, we consider the dimensions extracted by the researcher in two fields of dynamic capabilities and technology assessment as independent variables. The theoretical framework of research can be described as follows:

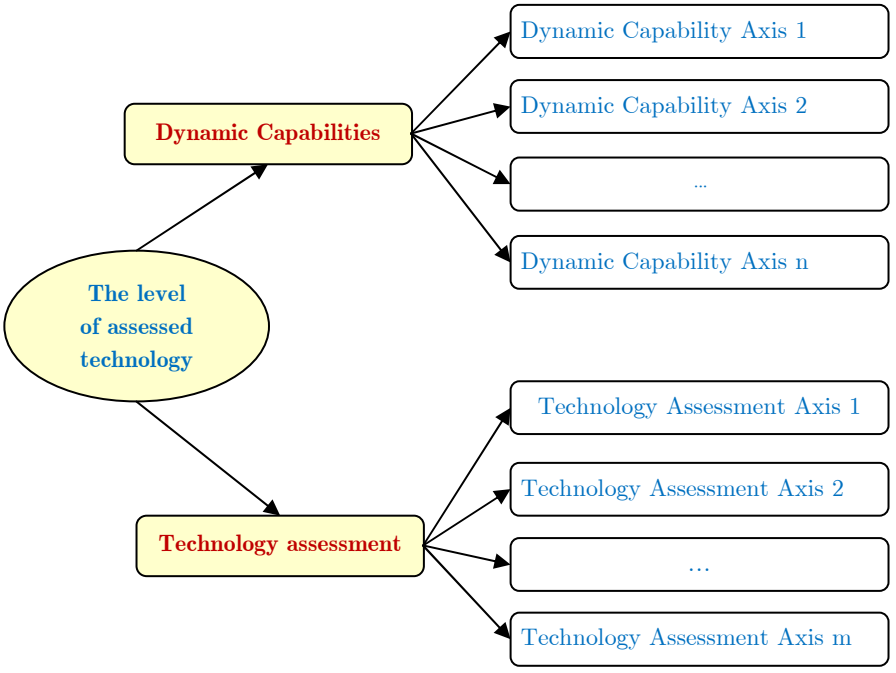

Fig.1. Research theoretical framework

Regarding the subject of the research, we first describe the background of the research in the field of technology assessment and describe the related models and their characteristics. In the second section, we look at the background of research on the applications of dynamic capabilities. In the third section, we describe the similar studies carried out in small and medium enterprises, and ultimately we present the innovations and

research gap. Many definitions of the concept of technology have been made through many researchers that reflect their attitude to their expertise. Moreover, for different perspective of sciences, various definitions of technology have been made. As a case in point, from the economic viewpoint, technology turns the input into an outlet. "Somans and David" recognized technology as a service or product that is tangible or intangible in the market. Mansfield sees technology as knowledge of an effort and an effective, productive effort. Seung recognized technology as a tool or a method, product, process, physical equipment or methods or hardware, by which human capabilities emphasize the mechanical aspect of technology (technology in a particular sense). Technology or technology of hardware and equipment (hardware); techniques, practices and instructions (software); knowledge of how to use these tools in specific ways (hardware) are used in order to increase efficiency in the process of converting inputs into outputs (conversion process) (Khalil, 2013).

Table 3. Classification of technological capability assessment models (Khamseh, Alimoradian, 2010)

Technology gap design models	**Models of evaluation of the causes of technological gap**	**Models of providing a solution to compensate for technology gap**
Atlas technology model	Ford model	Ford model
Porter model	Lindsay model	Lindsay model
Panda and Ramanatan model	Atlas technology model	Horoscope model
Floyd model	Floyd model	Garcia Aurola Model
The technology needs management model	The technology needs management model	Lin model
Technology Content	The model of the levels of technology capability	The technology needs assessment model
Evaluation Model		Model of Information
Technology Position		Systems Management
Assessment Model		Science and Technology
Economic Value Added Model		The technology needs management model

With the increasing trend of industrial, economic and technological

development and the elimination of geographical boundaries, there has been a tight competition in the area of production and service delivery, and technology growth has become one of the critical strategic goals of managers in organizations (Matin & Toloui, 2014). It can be said that technology is the key to wealth creation, acquisition of knowledge and a powerful tool for national development (Saedi nia, 2014). There are different models related to the assessment of technological capability , which are categorized in three general sections as follows: (Khamseh, Alimoradian, 2010).

Elay et al. (2011) presented a new model for technology assessment development. In this model, they evaluated technology to improve the demographic, poverty and vulnerability of developing countries using a macro-environmental perspective. In their model, an evaluation of the technology has been carried out to evaluate social, environmental, universities and other popular institutions. Moreover, a broad-based model has been presented. Over the past two decades, due to a competitive advantage and a resource-based perspective, a focus has been placed on the dynamic capabilities of the organization. In order to succeed in dynamic capabilities, companies must first identify the resources and capabilities they need to enhance their performance, and then, according to their needs, determine the methods of supplying needs (C. Lin and Tsai 2016). Teece (2007) has developed a framework for integrating dynamic capabilities, including: exploring opportunities and threats, understanding opportunities, reassessing the company's intangible assets. Investigating opportunities and threats is related to market scanning, learning and internal and external interpretive activities of the company. (Lee & Rha, 2016). Studies in the field of dynamic capabilities approach have identified the structures, processes, influences, and contributions of dynamic capabilities to strategy, and most researchers believe that dynamic capabilities enhance competitive advantages (Lin & Wu, 2014). Organizational processes have three roles: the role of coordination and integration, learning and re-shaping (the role of transformation). The excellent performance of organizations depends primarily on the level of internal and external coordination of the organization. Internal coordination refers to the degree of coordination between the internal components of the organization

(including different organizational units, technology and organizational strategies). External coordination is in line with changes in the micro environment and the micro-organization (Teece et al, 1997). Makkonen et al examined the impact of dynamic capabilities on firm performance in the post-2009 financial crisis. They considered constant environmental assessment, the creation of knowledge (with emphasis on research and development knowledge), the integration of knowledge created in enterprise processes and products, re-configuration, employee learning, and leverage of human resource capabilities as dynamic capabilities. The results showed that dynamic capabilities lead to changes in the organization and acceptance of changes in the organization resulted in higher performance of innovation and it led to more adaptation of the organization to the external environment (Makkonen et al, 2014). Jiao et al. (2013) reviewed the relationship between dynamic environment, dynamic capabilities and enterprise performance. They considered the ability to recognize opportunities, re-configuration capability, enterprise flexibility, and the flexibility of technology as dynamic capabilities. Their results indicate that the ability to identify opportunities and the ability to re-configure the firm's performance are highly influential. Navarro et al. (2010) examined the effects of firm behavior on foreign markets. They have considered indicators of price, product differentiation, distribution, promotions and communications, human resources and cost as competitive advantages. Their results indicate that competitive advantage influences the firm's external performance. Some strategies have been created in order to create dynamic capabilities to improve future productivity. The vision of dynamic capabilities is definitely an attempt to understand the factors that affect the success of companies in a competitive environment. In this regard, Chatterji & Patro (2014) offered features of internal and external dynamic capabilities of Google's product development. Lin & Wu (2014) have also considered dynamic capabilities as an intermediary between resources and organizational performance. In addition, Lin & Wu (2014) examined direct and indirect impacts of dynamic organizational capabilities on performance. (Cirjevskis, 2017). Čirjevskis (2017) examined the factors influencing the dynamic capabilities of the successful transportation companies in Asia and the Pacific. They studied the understanding of dynamic capabilities

to achieve competitive advantage. The results showed that strategic decision-making is the root of the dynamic organizational capabilities and the ability to integrate vertically strategic, diversity in the application of technology can be effective factors in the development of dynamic organizational capabilities. Helfat et al. (2007) presented dynamic supply-chain practices for dynamic capabilities that provided the condition of reconfiguration for dynamic capabilities for the supply chain (Beske et al., 2014). Jayaram et al (2014) argued that appropriate information systems, infrastructure, and technology capabilities could improve supply chain activities and logistics costs would be reduced. Moreover, appropriate customer relationship management could be provided. (Jayaram et al. 2014). Claudia et al. (2016) examined the technology assessment and the development of a model to measure its performance on the company. In this study, using the Fuzzy AHP method, they examined the criteria and developed the model. The results showed that enhancement of technology, processes and procedures, learning mechanisms, coordination and access were the most important factors influencing technology capabilities to improve company performance. Considering the background of the research, it can be said that no research has been done on the combination of dynamic capabilities in technology assessment while providing a model for assessing technology based on dynamic capabilities can measure the impact of dynamic capabilities on the actual technology level of organizations in different situations with different perspectives. On the other hand, one of the excellences of this research is the use of a robust statistical approach to prioritize the topics of technology assessment and dynamic capabilities as well as the final validation of the resulting model for the level of technology. This research is also the first study to provide a model for assessing technology in small and medium-sized automotive supply companies.

3. Method

The overall process of research is as follows:

1. Collecting and studying literature on topics related to current research such as technology and its assessment methods, dynamic capabilities, and its various models.

2. Introduction small and medium-sized companies in the automotive supply chain and investigating the nature of their activities
3. Reviewing the concepts of technology assessment and dynamic capabilities in these companies by applying the views of industry experts and academic experts
4. Identifying the appropriate base model to assess technology in these companies
5. Identifying the important indicators of dynamic capabilities in these companies
6. Combination of the important indicators of dynamic capabilities in the basic model of technology assessment and proposing a new model of technology assessment based on dynamic capabilities
7. Verification of the new technology assessment model by using expert questionnaires and opinions
8. Analyzing opinions of experts and accepting or rejecting the validity of the model
9. Summarizing, concluding, and proposals

The research steps can be summarized as follows:

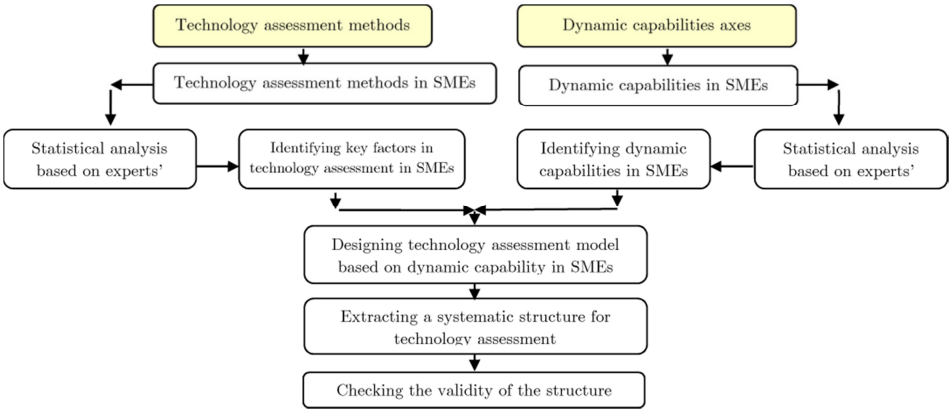

Fig. 2. Research steps

The statistical population of the research includes:

1. The statistical community of industry experts in the field of dynamic capability models includes experts and managers in strategic

management departments, research and development, commerce, manufacturing, and human resources in 450 small and medium automotive car supply companies.

2. The statistical community of industry experts in the field of assessment technology models includes experts and managers in research and development, product engineering, process engineering, manufacturing engineering, sales, and production in 450 small and medium automotive car supply companies.

3. The statistical community of industry experts in the field of dynamic capability models includes experts and managers in strategic management departments, industrial engineering, system engineering, quality assurance, and systems and procedures in 450 small and medium automotive car supply companies.

Based on random sampling from the statistical population and based on Morgan's table, 200 samples were considered and 81 questionnaires were gathered for dynamic capability. For the technology evaluation variable, a questionnaire with 59 questions was extracted. Before distributing the questionnaire, validity and reliability of the questionnaires were examined. The validation of the external model of the technology assessment and dynamic capability questionnaire was evaluated. Finally, 9 questions were removed from the technology assessment questionnaire and 50 questions remained. Dynamic capabilities inventory questionnaire also eliminated 16 items and finally left 65 items. A total of 115 questions have been designed.

4. Findings

In order to analyze the data obtained from the questionnaire, various statistical methods have been used which are described in the following subsections. In this study, the principal components analysis (PCA) and Varimax rotation are used. In this case study, the questions of the research were identified and evaluated by specialized interviews. A total of 65 questions were designed. Exploratory factor analysis has been used for clustering components. Before applying the factor analysis method, it is necessary to ensure that the sample size is sufficient for factor analysis. One of the best methods for examining the adequacy of a

sample is Sampling Adequacy index, which is represented by KMO. SPSS software output for KMO statistics is as follows:

Table 4. SPSS software output for KMO

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.727
Bartlett's Test of Sphericity	Approx. Chi-Square	5976.830
	df	3240
	Sig.	.000

If the KMO index is more than 0.7, the sample size is appropriate for factor analysis. The KMO value is 0.72 and reaches within the acceptable range. So, the second stage begins. The main component analysis results before the rotation in the SPSS software output are similar to Table 5. According to this table, seven factors have a specific value higher than 1 and account for about 72% of variance of measured variables. The component Matrix is used to extract the components. The component Matrix in SPSS software output in this study identified 7 clusters which means that the problem has 7 factors. Identification of components is performed before rotation.

Table 5. Identification of dynamic potential factors with exploratory factor analysis

Extracted factors	Eigen value amount	Percentage of variance deprived by factor	Total percentage of deprived variance
Factor 1	7.234	19.339	19.339
Factor 2	6.5	17.025	36.363
Factor 3	4.341	12.359	48.722
Factor 4	2.892	9.570	58.293
Factor 5	2.748	7.393	65.686
Factor 6	2.559	5.160	70.845
Factor 7	2.409	2.974	73.820

Extraction of questions occurs after the rotation of variance. Rotated Component Matrix table is used to extract questions after rotation

Table 6. Research constructs and distribution of questions of each construct before exploratory factor analysis

Main constructs	Dimensions (Factors)	Symbol	Number of questions	questions
Dynami Capabilities	Perceptual Perceptions	D01	17	1-17
	Absorbency and learning	D02	14	31-18
	Compatibility and coordination	D03	13	44-32
	Ability to rearrange	D04	14	58-45
	Innovative capability	D05	9	67-59
	Networking capability	D06	8	75-68
	Merge and integration capabilities	D07	6	76-81

Table 7. Summary of statistical results and the study of factor construct after exploratory factor analysis

Main constructs	Dimensions (Factors)	Symbol	Deleted questions	Number of questions	questions
Dynamic Capabilities	Perceptual Perceptions	D01	1, 7	15	15-1
	Absorbency and learning	D02	18, 20, 23, 24, 28, 30	8	23-16
	Compatibility and coordination	D03	32, 36, 43, 44	9	32-24
	Ability to rearrange	D04	45	13	45-33
	Innovative capability	D05	-	9	54-46
	Networking capability	D06	74	7	61-55
	Merge and integration capabilities	D07	78, 79	4	65-62

The KMO value for the exploratory factor analysis of the technology assessment construct was 0.74 and acceptable within the acceptable range. So, the second stage begins.

Table 8. SPSS software output for KMO

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.742
Bartlett's Test of Sphericity	Approx. Chi-Square	2927.185
	df	1711
	Sig.	.000

The next step is the extraction of the components. For this purpose, factor load must be calculated. A summary of the results of the main component analysis before the rotation in the SPSS software output is presented in Table 9. According to this table, five factors have Eigen value amount higher than 1 and deprive for about 742% of variance of measured variables. Component matrix is used to extract the components. The matrix of components in the SPSS software output in this study identified 5 clusters which means that the problem has 5 factors.

Table 9. Identification of dynamic potential factors with exploratory factor analysis

Extracted factors	Eigen value amount	Percentage of variance deprived by factor	Total percentage of deprived variance
Factor 1	12.746	21.603	21.603
Factor 2	4.796	18.129	39.732
Factor 3	2.769	14.693	54.424
Factor 4	2.388	14.048	68.472
Factor 5	2.253	7.818	76.290

Extraction of questions has taken place after Varimax rotation. According to the calculations, questions with factor load value greater than 0.3 are selected and are the other questions are ignored

Table 10. Components of technology assessment and distribution of their questions before exploratory factor analysis

Main constructs	Dimensions (Factors)	Symbol	Number of questions	questions
Technology assessment	Processes and organizational structure	D08	16	1-16
	Resources and technology infrastructure	D09	11	17-27
	Strategic capabilities of technology	D10	18	28-45
	Technology attractiveness	D11	5	46-50
	The level of technology development	D12	9	51-59

Table 11. Summary of statistical results and the study of factor construct after exploratory factor analysis

Main construct	Dimensions (Factors)	Symbol	Deleted items	Number of questions	questions
Technology assessment	Processes and organizational structure	D08	1,13,15	13	1-13
	Sources and technology infrastructure	D09	20,27	9	14-22
	Strategic capabilities of technology	D10	29,32,36	15	23-37
	Technology attractiveness	D11	-	5	38-42
	The level of technology development	D12	57	8	43-50

Therefore, 7 main factors for dynamic capabilities have been identified: Perceptual Perceptions, Absorbency and learning, Compatibility and coordination, Ability to rearrange, innovation capability, innovation capabilities, networking capability, and merge and integration capabilities. Moreover, 5 main factors for the technology assessment construct are identified: processes and organizational structure, resources and technology infrastructure, Strategic capabilities of technology, the charm of technology and the level of technology development. A second-order confirmation factor analysis has been used for validation. Verifying the validity of the questionnaire based on the confirmatory factor analysis is called construct validity. Confirmation factor analysis assesses the relations of the questions with constructs.

The results of the factor analysis of the measures are presented in Fig 3. The observed factor load in all cases is greater than 0.3, which indicates that the correlation between hidden variables with visible variables is acceptable. The value of the t-value statistics is greater than 1.96, which indicates that the observed correlations are significant.

Table 12. Question distribution and reliability results

Main constructs	Dimensions (Factors)	Symbol	Deleted questions	Number of questions	questions	Cronbach's alpha
Dynamic Capabilities	Perceptual Perceptions	D01	1,7	15	1-15	.925
	Absorbency and learning	D02	18,20,23, 24, 28,30	8	16-23	
	Compatibility and coordination	D03	32,36,43, 44	9	24-32	
	Ability to rearrange	D04	45	13	33-45	
	Innovative capability	D05	-	9	46-54	
	Networking capability	D06	74	7	55-61	
	Merge and integration capabilities	D07	78,79	4	62-65	
Technology assessment	Processes and organizational structure	D08	1,13,15	13	1-13	.831
	Resources and technology infrastructure	D09	20,27	9	14-22	
	Strategic capabilities of technology	D10	29,32,36	15	23-37	
	Technology attractiveness	D11	-	5	38-42	
	The level of technology development	D12	57	8	43-50	

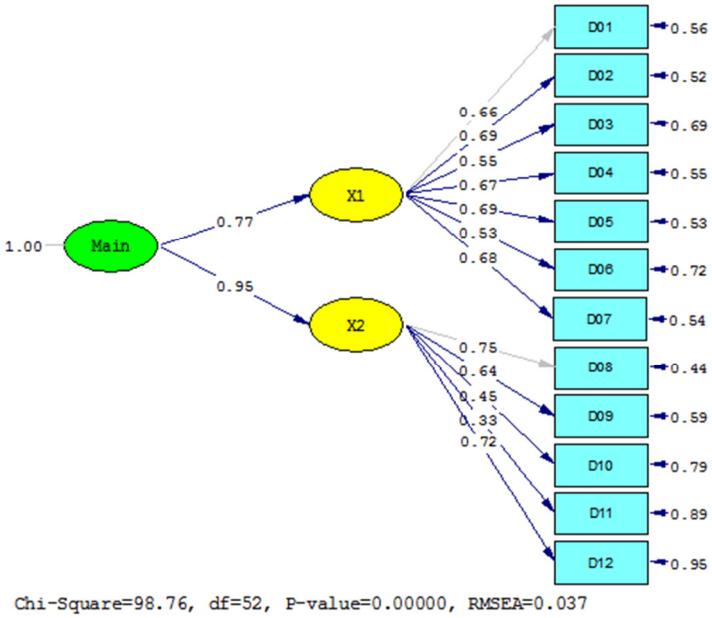

Fig. 3. Second-order standard confirmation factor analysis

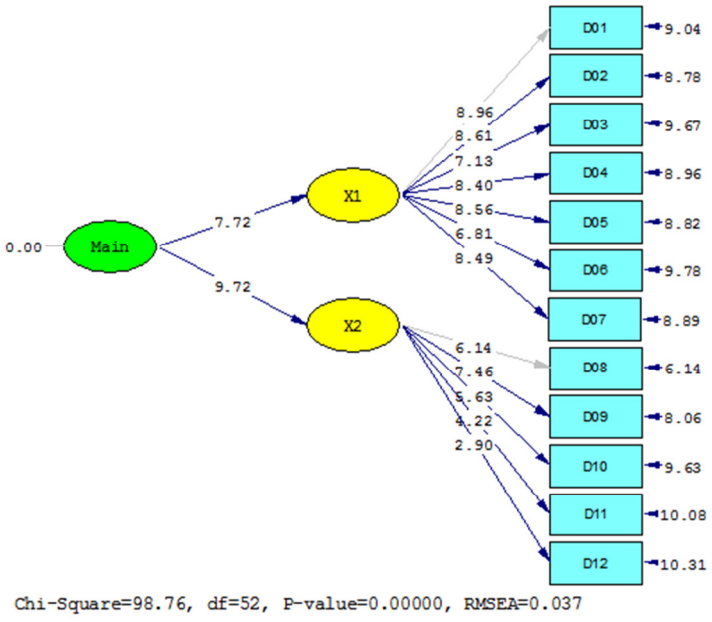

Fig. 4. Second-order confirmation factor of t statistics (significance)

Since second-order confirmation factor analysis is used, the relationship between hidden variables with the level of evaluated technology is also examined. In both cases, the standardized load factor is greater than 0.6 that shows there is a high correlation between the measurement dimensions of dynamic capabilities and the technology assessment with the level of assessed technology. The t- statistics value in all cases is greater than the critical value of 1.96 and it indicates that the dimensions of the level of assessed technology correctly measure this construct which is shown in Figure 4.

Table 13. Summary of the results of the confirmatory factor analysis of the second-order construct of the level of assessed technology

Main construct	Hidden variables	Symbol	Number of Dimensions	Standard factor load	Test statistic
The level of assessed technology	Dynamic Capabilities	X1	7	0.77	7.72
	Technology assessment	X2	5	0.95	9.72

Also, the RMSEA index is used in most of the confirmatory factor analysis and structural equation models as a fitting index. If this index is smaller than 0.05, then it is desirable. In the saturated model of the present study, the RMSEA index is 0.037, which indicates that fitting of the model is desirable.

$$x^2/_{df} = 1.89; RMSEA = 0.037; GFI = 0.96; NFI = 0.96; SRMR = 0.035$$

In this study, the chi-square normal value is 1. 89. RMSEA index is 0.037 and SRMR is equal to 0.035 that indicates that the fitting of the model is desirable. According to the fitting of the model, the final model of this study is presented as follows:

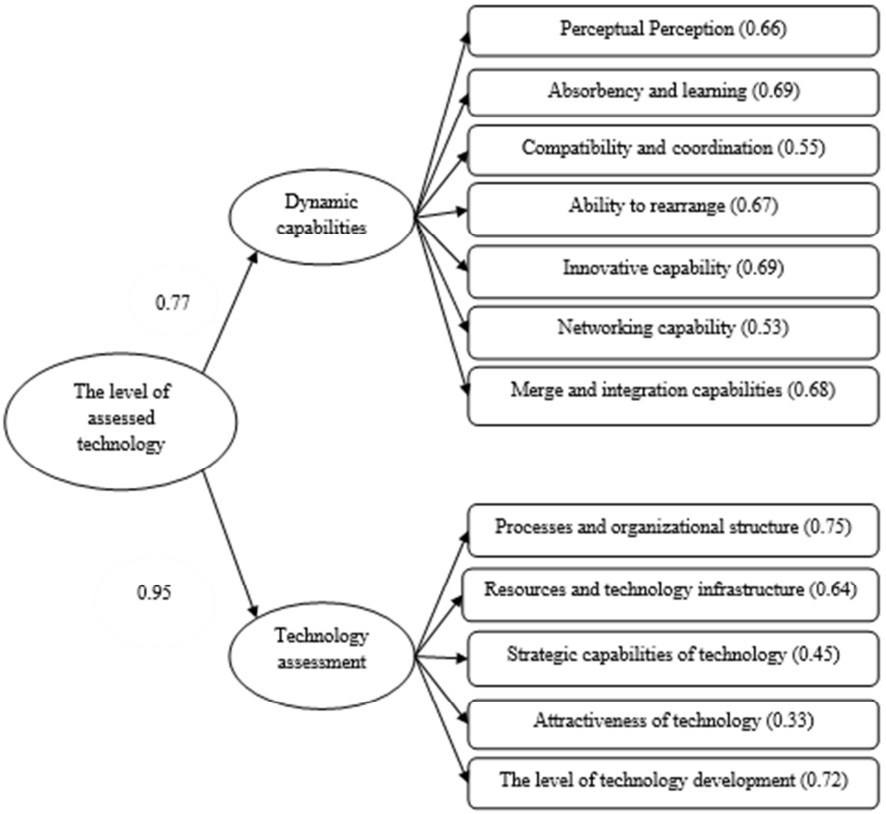

Fig. 5. Final research model

According to the above model, in order to assess the technology of small and medium enterprises in the automotive supply chain supply chain, it is necessary to consider the dimensions of dynamic capabilities.

5. Conclusion

Among the sub-criteria of technology assessment, strategic capabilities of technology assigned the lowest amount of correlation. The reason for the lack of importance of this component can be the limited car industry and limited manufacturers in the industry. The presence of competitive forces in an industry can increase the incentives for improving organizational capabilities. Consequently, creating a competitive environment in the automotive industry can lead to improved competition between suppliers and upgraded technological capabilities to supply parts with the aim of

the latest technologies. Among the sub criteria of technology assessment, processes and organizational structure assigned the highest amount of correlation. Therefore, it is necessary to apply flexibility in the tasks to improve supply chain management due to the fact that most of the companies in the industry are under the supervision of a holding company and the existence of bureaucracies and a tendency to mechanical features in the organizational structure of this kind huge companies can lead to problems in managing the supply chain. Among the sub criteria of technology assessment, the level of technological development assigned the second rank in terms of correlation. Suppliers of automobile parts due to the changing market conditions should use modern methods for the production of parts. In this regard, it is required to set up research and development teams, allocate capital, establish appropriate infrastructure for technology transfer, and apply appropriate international business contracts in order to develop their technology capabilities. Among the sub criteria of dynamic capabilities, absorbency and learning capability and learning assigned the first rank from the importance viewpoint. Companies supplying automotive parts are required to develop the ability to learn to develop their technology level. In this regard, it is necessary to help develop organizational learning capabilities. They should acquire passive technologies (emerging technologies) by attracting and improving them in order to enter the stage where the country's industry is able to acquire emerging technologies and actually create new technology. Among the sub criteria of dynamic capabilities, merge and integration capabilities assigned the second rank. In developing organizational capabilities, it is required to apply an appropriate system vision to assess the environment and promote creativity in the production and supply of products by the use of open innovation. Among the sub criteria of dynamic capabilities, networking capability assigned the lowest amount of correlation. The reason for the lack of importance of this component can be the limited car industry and competitive environment entity ,so They could not use appropriate strategies in order to develop their ability to collaborate with their partners and by using knowledge teams, try to improve their ability to communicate with their colleagues by creating and exploiting inter-organizational relationships to supply their resources. By reviewing

and fitting the model, in order to increase technology assessment level as a result ,the Automotive OEM should be considered the dynamic capabilities variables as a enablers, Therefore, automotive OEM need to pay attention to the extent of their progress in technology of supply chain management by considering of their dynamic capabilities in order to meet the changing needs of the market.

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