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Designing a model for selecting a company growth strategy based on market and product success forecasts by comparing FIS and ANFIS methods

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Abstract

Company growth is an important factor in economic growth. Specifically, high-growth companies have attracted considerable attention in governments and political societies, mostly in advanced countries [52]. The role of small and medium-sized enterprises (SMEs) in developing countries is critical due to their capability to respond to systematic economic shock and their potential to create a job [35]. While the literature in this area indicates the high importance of SMEs in the economy of the countries, the growth of these companies is important too. So many discussions are generated in the area of small and SMEs' growth due to the importance of these enterprises. In this regard, company growth theories were always considered an important factor in the evolution of the commercial literature. The variety of influential factors on the company growth is the characteristic of literature relevant to the area that tries to explain influential factors on the company growth [44]. Given the diversity of the economic and cultural environment, there is no agreement on the influential factors on the growth of the companies.

Keywords: growth strategy, market and product success, ANFIS, FIS
2020 MSC: 91B54, 91B74

1 Introduction

Empirical studies have indicated that there are fewer large and new companies in Europe [20, 53], and the average dynamicity of the companies is less in most European countries than in the United States of America [13, 17, 37]. These discussions have affected Europe Strategy 2020. However, the commission of the European communication innovation union, one of the seven flagship initiatives of Europe 2020, explicitly specified supporting companies having small and medium growth as a political goal [25]. Moreover, the share of the innovative fast-growing companies is suggested as an indicator of measuring Europe's strategy development 2020 [39]; however, the importance of fast-growing companies is well known for the creation of job opportunities [36, 57], little information is available for the destination of the fast-growing companies. To specify when a company has grown, a certain rating should be defined

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for it [27, 28]. Three major groups of indicators are introduced in this regard, including indicators relevant to the organization size, such as the number of employees; components of financial or accounting assessment like the rate of change in the assets and indicators related to the performance like the market's share [24].

There are two approaches in the growth theories of the companies; one is certainty theory, and another is stochastic growth theory. Certainty theory explains the growth of the companies based on special cause and effect patterns, while stochastic theory claims that the growth of the companies is accidental and random [59]. Although there is some criticism regarding both approaches, and some researchers have questioned these approaches in their studies [10], the market growth model produced by Ansoff contributes to identifying new opportunities for high growth. According to this model, four strategic options are provided for a company. These four strategic options include market penetration, market development, product development, and differentiation [6, 21, 30, 45]. The final aim of the market strategy product is the selection of a good market in which the organization can compete [50]. In the published literature regarding strategic management, it is claimed that business strategies compose the selection of the market-product range. According to the opinion of Veiga and Franco [62], the most important concepts and views regarding strategic planning and strategy of a company are in Anoff's work. Accordingly, the growth strategy of a company can be predicted based on the main elements of this model, i.e., market-product, and determine an appropriate strategy for the company's growth based on the influential factors on the success in the market and the product.

In the meantime, studies conducted in Iran [3, 11, 32, 43] indicated that no specific pattern is provided for the growth of the companies and most of these studies are focused on the accounting patterns in the growth. Providing appropriate patterns for selecting a growth strategy based on the market-product factors contributes to the companies studying the influential factors on the success of their market-product strategies as well as the growth patterns that fit the company.

Investigating different studies concerning the companies' growth indicates four research flows. The first flow focuses on the determination of influential factors in the growth of the company [31, 33, 63], and the second flow returns to the flows in which the nature of the company's growth is discussed [1, 61]. The flow considers the growth from an accounting viewpoint and tries to analyze the influential factors on the growth from an accounting viewpoint [19, 26]. In the meantime, there is a fourth flow which is less frequent compared to the three previous flows. Studies related to this flow try to consider different strategies of the market and the product without pointing out to the company's growth that the final conclusion of selecting the appropriate strategy can lead to the growth of the company [12, 65]. Accordingly, it seems t how to select a company's growth strategy and how to access the growth in the company has been ignored as one of the most important growth drivers. This issue indicates a research gap in the growth area and selecting appropriate strategies for it; therefore, this study has considered this matter and its importance for the domestic companies seeking to provide a selection pattern for the company's growth strategy based on the Ansoff matrix.

2 Literature review

No specific studies have been conducted regarding the conducted studies in the area of selecting a company's growth strategy based on the Ansoff matrix (market-product) inside the country. Hajipour et al. [34] studied the effect of product-market strategy and marketing properties of the company on the market performance and concluded that the product-market strategy and marketing potential of the company has a positive and significant effect on the performance.

In the area of external foreign studies, in addition to the initial work of Ansoff [6] in explaining market product strategy, different studies have paid attention to the components of this model. In the recent studies, [64] in a study titled "Evolution of the Market Entry Strategies", compared two companies of Southwest and JetBlue, from the market entry strategies viewpoint. [12] in a study named "Corporate Social Responsibility, Product Market Perception and Firm Value", concluded that corporate social responsibility indirectly increases the firm value by improving product market perception.

Zhou et al. [64], in a study, "Unleashing the Dynamics of Product-Market ambidexterity in the Pursuit of International Opportunities", knew the selection of market-product strategy as a bilateral potential for acquiring international opportunities and growth. Chen et al. [18], in a study, "Application Developers' Product Offering Strategies in Multi-Platform Markets", concluded that in so many companies, the dominant strategy is the introduction of a new product later than competitors; however, in some cases, firms may change their priority for setting up a new product sooner than their competitors to have longer selling time. Iria and Soares [41] investigated in a study the real-time of offering several products to several power markets. Researchers in this study provided appropriate strategies for the new

product for the new markets based on pricing and concluded that product providers based on this strategy could offer several products to different markets without jeopardizing customers' convenience and preferences. Sharifi et al. [58], in a study titled "Supply Chain Strategy and Its Impacts on Product and Market Growth Strategies: A Case Study of SMEs", studied the effects of supply chain strategy product-market strategies on the growth of the company and concluded that supply chain strategies could influence their growth through market-product strategies.

3 Selecting strategy and research model

The selection strategy resulted from understanding this issue that the organizations are a group of different occupations and functional units and that everyone has a set of goals for themselves and these goals are not necessarily the same [54]. Different levels for the organizations are recognized based on the strategic focus and type of the organizational lever created. Strategy in the organizations is studied based on three levels. These three levels are the level of the company, commercial level, and functional level. The operational level, which is considered the same as the functional level, exists in some organizations. The strategy of the organization's level deals with comprehensive subjects which do not always include economic activities, while the level of the business and functional strategies of the firm are formulated for synchronization with the strategies of the company so that helping it to reach its desired goals [47]. Business portfolio models are techniques for categorizing businesses and scaling them based on their attractiveness. Analyzing portfolios enables organizations to identify strategic options that can help them in their performance improvement for empowering their business. Selection exists both at the organizational cooperative and business level. At the strategy level of the companies, the selection strategy includes Boston Matrix and GE-McKinsey Matrix, while Porter's generic growth and Ansoff's product-market models are the options for selecting on the business level.

3.1 Company growth

A study about the economic importance of developing companies is generated from the discussions related to the share of small-sized companies in the creation of job opportunities. Breach [15, 16] claimed that SMEs totally generate a large disproportionate share in the creation of job opportunities in the U.S. Davis et al. [22, 23] discussed these findings in detail. They claim that these findings are obtained through a method that is objected to an error of the regression, and it makes it unsuitable for concluding about the association between the number of employers and the creation of job opportunities. During this discussion, it is claimed that these are not small companies that create job opportunities among small-sized companies. The creation of job opportunities in small companies is just among a few companies that have high growth [56]; therefore, some researchers of entrepreneurship and small businesses focus their attention on high-growth companies. At the same time, there is reliable literature in this area [39]. Recent evidence from international comparative studies and the studies inside the countries indicated that a small share of all companies could be categorized as rapid-growth companies. These companies have an important role in the economy during an economic recession and economic prosperity periods [8, 9, 17]. Henrekson and Johansson [36] conducted a useful survey on the 19 studies that used different methods for the identification of high-growth companies. Despite different methods and scales, they found the results that were related significantly to the details of the definition of the rapid-growth enterprises, time period, and coverage of the companies. This research obtained these facts [36]:

1. A few rapid-growth enterprises create the newest job opportunities inside groups of companies of the same age.
2. Results regarding the total number, such as total job growth in the economy, are not specified. Studies indicated that in some countries (U.S and U.K), high-growth enterprises are responsible for the creation of all job opportunities, while other studies (especially about Scandinavian countries) had more moderating effects.
3. While the most developing enterprises are SMEs, an important sub-category of large companies has high growth too.
4. It seems that rapid-growth enterprises have less history compared to the average companies in this industry.
5. High-growth enterprises exist in all industries. There is no evidence to support that pioneers have become more prominent in high-tech industries. Anyway, high-growth companies in knowledge-based service industries become over-highlighted [4, 36]. Acs et al. [2] stated about the U.S that the percentage of high-growth enterprises was significantly different during the time. It indicated that a high-growth company is an economic and not a technological phenomenon [38]. These findings indicated that just a small number of high-growth enterprises have a significant influence on the economy. But creating job opportunities should be considered in more broad areas of industrial dynamics. Usually, disturbance, i.e., entry and exit of the new firms, is considered as one of the important elements in creating gross job opportunities and gross opportunities are for the destruction of the jobs as the most entered and exited companies are small (e.g., Hölzl and Reinstaller [40]). It indicated

that the creation and destruction of job opportunities are distributed among so many companies. However, the importance of a few high-growth companies among the remaining enterprises to create job opportunities indicated that creating a job in growth has been very interesting.

Studies related to the influential factors on growth are diverse, and every researcher addresses development from different perspectives. Lee et al. [48] knew the role of financial power and innovation influential in a company's growth. Tran et al. [60] addressed the effect of local financial development on the company's growth in a study. Yuan and Nishat (2019) considered the investment in research and development as the main factor of growth in their study. Kang et al. [42] prioritize knowledge strategies for growth. Peng and Liu [51] consider the effect of government subsidies on the growth of Chinese entrepreneurial companies as an influential factor.

3.2 Market- product strategy

The ultimate goal of the market-product strategy is to select the appropriate market to compete in it [50]. Based on the strategic management literature, business strategies affect the selection of the product-market domain [55]. Ansoff offered a model to discover new opportunities for concentrated growth, which is known as the product-market development model. According to this model, the enterprises have four strategies ahead for growth and development indicated in Fig. 1 [5, 6, 21, 30, 45].

Newmarket	Existing market	
Market development strategies	Market penetration strategy	Existing product
Diversification strategy	Product development strategy	New product
Newmarket	Existing market	
Market development strategy	Market penetration strategy	New product
Diversification strategy	Product development strategy	New product

Figure 1: Different Kinds of Market-Product strategies

Table 1 indicates the influential factors in the selection of the market-product strategy and the adjustment of the market-product strategies with the situation of the organization.

Table 1: effective factors in the selection of the market-product strategies [14]

Market-product feature	**Strategy**	**Effective factors in the selection of the market strategy (Symbol)**
Existing product-Existing market (EP-EM)	Market penetration (MP)	Raising in demand for the product demand (for existing customers and new customers)
		Advertisement and personal sell to existing customers
		Market stabilization and ownership
		Competitive price and offering discount
New product-Existing market (NP-EM)	Product development (PD)	Increasing efforts for the research and development and innovation
		Paying more attention to the customers' need
		First changes in a product category
		Increasing total efficiency of the consumers
Existing product-New market (EP-NM)	Market development (MD)	New distribution channels
		Amending existing products for use by a new set of the customers
		New geographical regions
		Bolding new dimensions
		Market segmentation- new pricing policies
New product- Newmarket (NP-NM)	Diversification (De)	New products in new markets
		technology and new skills (De1)
		Enough investment- financing models (De1)
		Facilities and new business
		High risk-taking

3.3 Conceptual model of the study

In the designed framework, there are four fuzzy inference systems in the first level and a final fuzzy inference system. The inference engine in these systems infers and assesses the rules using inference algorithms (in this article, based on the existing defaults, Memdani inference has been applied) and will change to the explicit or numerical value after aggregation of the outputs rules by defuzzifier unit. In this study, the task of the inference engine in the designed system, given the designation of the fuzzy inference system, is to offer fuzzy output from Memdani inference.

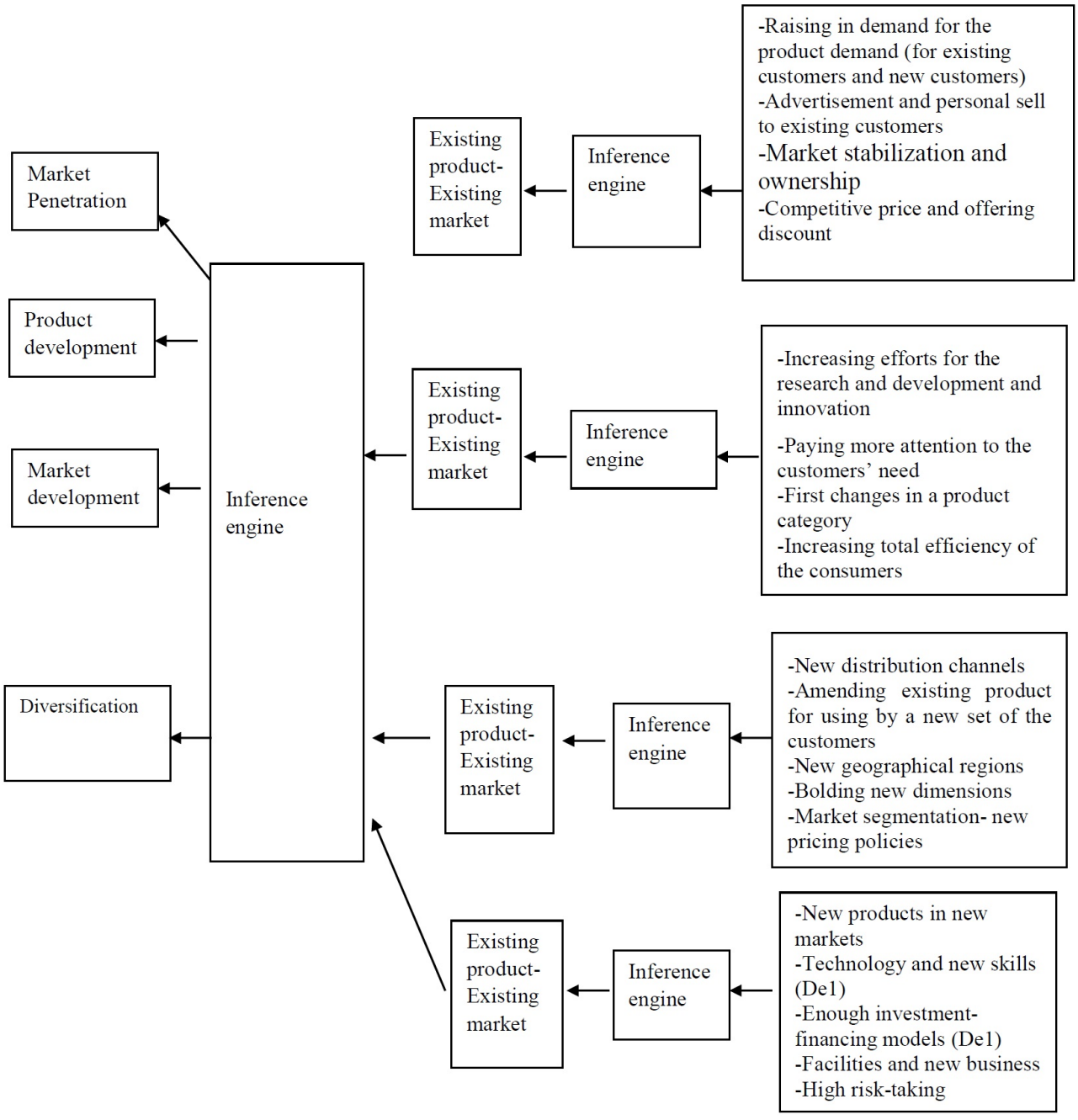

Figure 2: The framework of the designed model in this study

4 Methodology

This study is applied on the basis of the objective and descriptive from a methodology viewpoint. In this study, for selecting a company's growth strategy based on the market-product strategies, a two-level fuzzy inference system has

been designed. For this purpose, in the first step initially, a questionnaire is designed for the determination of effective factors in the selection of market-product strategy based on the factors in Table 1. Research validity in this section was measured using exploratory factor analysis and its reliability by Cronbach's alpha coefficient; the results related to the validity and reliability are provided in Table 2. The study population in this section includes the managers of industries producing chemical materials and products in East Azarbaijan province, and 124 questionnaires were given to them.

In the next step and after determination of the effective factors in the selection of the market-product strategy, initially, a fuzzy inference system was designed based on the market-product feature in MATLAB software. In designing the first-level fuzzy inference systems, effective factors in the selection of the market-product strategy are inputs for each system, and every feature of the market produces an output of the system. In the second level as well, market-product features are considered as the second level inputs, and the output in this section is the market-product strategy. To design each system at different levels, 10 experts were applied as the expert group. Of these 10 experts, 3 were marketing and sales directors of medicine firms with more than 20 years of experience in the sales and marketing area, 3 top managers of these companies with more than 20 years of management experience, and 4 university professors in the field of marketing with an associate degree and higher. These experts contributed to the research team in the formulation of the rules and the assessment of the output behavior of each system. Based on Fig. 2, strategies of market penetration, market development and diversification are the ultimate strategies of the system that will indicate the appropriate strategies for the company's growth.

4.1 Express system rules and inference method

After making fuzzy input parameters, the next step is to express fuzzy rules. Fuzzy rules are the statements with the structure of "if-then it is fuzzy" in each of these rules; the combined effects of the indicators used are determined from the desired viewpoint. The number of required rules depends on the number of indices and the number of classes of each index and is calculated according to the below relationship.

$$I = k_{1x}k_{2x}...k_{nx} \tag{4.1}$$

where I is the number of the rules, n is the number of the index, and 4 is the number of the classes for each index. There are several methods for fuzzy inference that the most practical of which is the Memdani Max-Min Inference System [29]. This method is applied to inflectional rules or those in which AND is used for their explanation. First, from the degree of membership of the different inputs, which are affected by the fuzzy rule, the minimum value is selected and transferred to the output. Now, the membership function resulting from a rule is obtained. After the implementation, these actions are determined and will be introduced as the final output resulting from all rules.

4.2 De-fuzzification output fuzzy values

An important issue is to apply fuzzy results obtained from modeling and calculations and governed relationships on the fuzzy sets. Although many issues in our everyday life are fuzzy, most decisions taken by humans or machines are zero or one, and as the machine does not empower to understand human language, the results obtained by the fuzzy analysis should be changed to classic numbers. After calculating and obtaining a fuzzy number as output, the obtained answer should be changed to a crisp state as the decision-maker may need a deterministic (crispy) number to continue the calculation. This process is termed de-fuzzification. To change a fuzzy quantity to a classic number, there are various methods, including the center of gravity, mean maximum, the center of the sums, and the weighted mean method.

Center of gravity method

In this method which is one of the most common methods to change a fuzzy quantity to a classic one below equation is used to calculate Z^* [46].

$$Z^* = \frac{\int \mu_i(x)xdx}{\int \mu_i(x)dx} \tag{4.2}$$

where Z^* is defuzed output value, μ_i is the membership function and (x) is the output variable. The below figure indicates the center of gravity method.

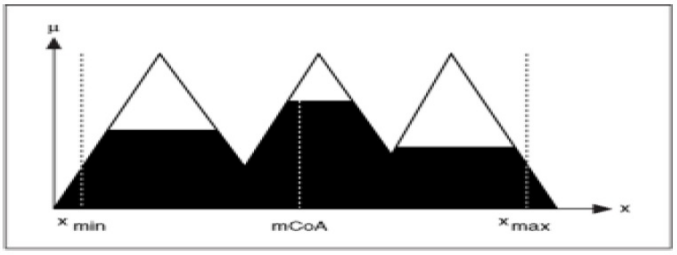

Figure 3: The center of gravity method

Mean Maximum method

In this method, the point with the maximum degree of membership is considered as Z^*. the deterministic output (Z^*) is calculated using the below equation [49]:

$$Z^* = \frac{\min core(A) + \max core(A)}{2} \qquad core(A) = \left\{ x \in X | \mu_A(x) = \sup_{x \in X} \mu_A(x) \right\} \tag{4.3}$$

Consider the reference set X and fuzzy subset A of it. A set of elements of X which is $0 < (X)\mu_A$, is called A and is shown as $\sup A$ (Supremum). In the A set, $\sup(\mu_A(x))$ is called the height of the fuzzy set. The below figure indicates the maximum mean method.

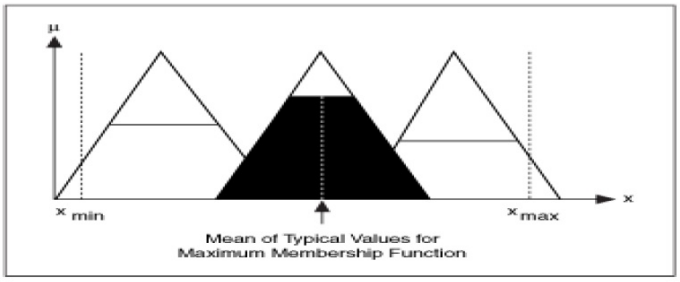

Figure 4: The maximum mean method

Center of the Sets Method

In this method, instead of aggregation, the algebraic sum of the output fuzzy sets is used separately to calculate z^*. The problem with this method is that the shared areas of the output fuzzy sets are added two times in the calculation of z^*. This method is, to some extent, identical to the weighted mean method.

$$z^* = \frac{\int_z \overline{z} \sum_{k=1}^{n} \mu_{\underset{\sim}{C}_k}(z) dz}{\int_z \sum_{k=1}^{n} \mu_{\underset{\sim}{C}_k}(z) dz} \tag{4.4}$$

$\overline{z}$ is the distance from the center of each associated membership function. The below figure indicates the maximum mean de-fuzzification method.

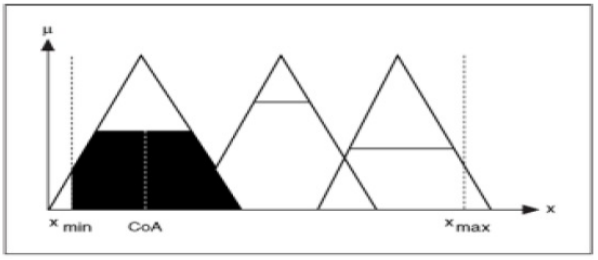

Figure 5: The maximum mean de-fuzzification method

Weighted mean method

This method is used for the symmetric output membership functions, and below algebraic equation is applied.

$$z^* = \frac{\sum \mu(x)_i \times W_i}{\sum \mu(x)_i} \tag{4.5}$$

In this equation, z^* is defuuzzified output, μ_i is the degree of membership in the output singleton, and W_i is the fuzzy output weight for the output singleton i.

5 Findings

In this study, the first exploratory factor analysis was conducted on the effective factors on the selection of the market-product strategy in order to determine whether the factors influencing the selection of the market-product strategy are included in a certain structure as a measure while checking the validity of the questionnaire; for this purpose factor loadings, KMO index and Bartlett's test were used. Factor loadings higher than 0.5 is considered appropriate, and factor loadings higher than 0.3 is considered weak but acceptable. KMO amount is between zero and one; whatever approach to one will be more suitable. Meanwhile, the significance level of Bartlett's test must be lower than 0.05. The results of factor analysis are provided in Table 2.

Table 2: the results of factor analysis for the features of the market product in addition to Cronbach's alpha

Market-product features	**Symbol**	**Factor loading**	**KMO**	**the significance level of Bartlett's test**	**Cronbach's alpha coefficient**
Existing product-Existing market (EP-EM)	MP1	0.76	0.862	0.000	0.892
	MP2	0.72			
	MP3	0.84			
	MP4	0.79			
New product-Existing market (NP-EM)	PD1	0.83	0.854	0.000	0.882
	PD2	0.86			
	PD3	0.78			
	PD4	0.80			
Existing product- new market	MD1	0.89	0.791	0.000	0.769
	MD2	0.83			
	MD3	0.74			
	MD4	0.71			
	MD5	0.79			
New market- new product	De1	0.87	0.800	0.000	0.909
	De2	0.89			
	De3	0.88			
	De4	0.81			
	De5	0.84			

The results of the Table 3 indicated that with the omission of the amendment index of the existing product for the use of the new sets of customers (MD2), factor loading values, KMO, significance level, Bartlett's test, and Cronbach's alpha coefficient improved for the existing product-new market feature.

Table 3: Second-order factor analysis for the existing product-new market feature

Market-product features	**Symbol**	**Factor loading**	**KMO**	**the significance level of Bartlett's test**	**Cronbach's alpha coefficient**
Existing product-Existing market (EP-EM)	MD1	0.92	0.836	0.000	0.855
	MD3	0.83			
	MD4	0.82			
	MD5	0.87			

Further, fuzzy systems were designed based on Fig. 1. For designing fuzzy systems, first-level systems were designed in which inputs include the effective factors in the selection of the market-product strategy, and the output of each

system includes market-product features. In the second level, market-product feature output from the first level is as the inputs of the second level. At this level, inputs include market-product strategies. The final system designed in MATLAB software is indicated in Fig. 6.

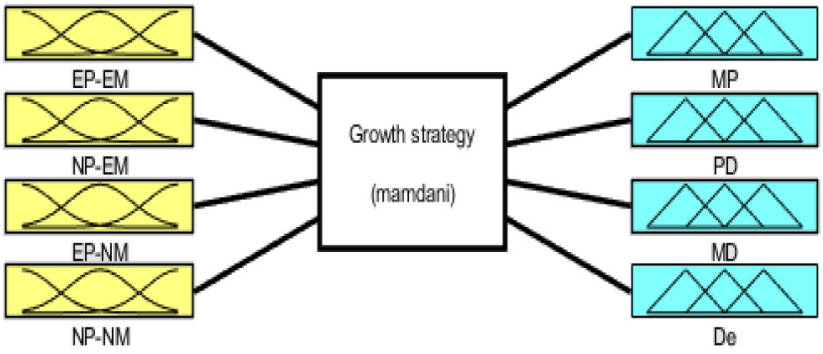

Figure 6: The second level system, determining the company's growth strategy

For designing the systems, the first output and input variable were fuzzified based on the language words and equivalent fuzzy numbers. Table 4 indicates the samples of the language words and the equivalent fuzzy numbers for the first level outputs and the second level outputs. For the first level outputs, these language words have been applied too.

Table 4: Linguistic terms and equivalent fuzzy numbers for system outputs

First level outputs	New product-new market	Existing product-new market	New product-existing market	Existing product-existing market	Equivalent fuzzy number
	inappropriate	inappropriate	inappropriate	inappropriate	(1,1,3)
	somewhat appropriate	somewhat appropriate	somewhat appropriate	somewhat appropriate	(1,3,5)
	appropriate	appropriate	appropriate	appropriate	(3,5,5)
Second level outputs	Diversification	Market development	Product development	Market penetration	Equivalent fuzzy number
	inappropriate	inappropriate	inappropriate	inappropriate	(1,1,3)
	somewhat appropriate	somewhat appropriate	somewhat appropriate	somewhat appropriate	(1,3,5)
	appropriate	appropriate	appropriate	appropriate	(3,5,5)

Given that every language word has been indicated based on the fuzzy triangular numbers, then they can be shown as Fig. 7 in MATLAB software.

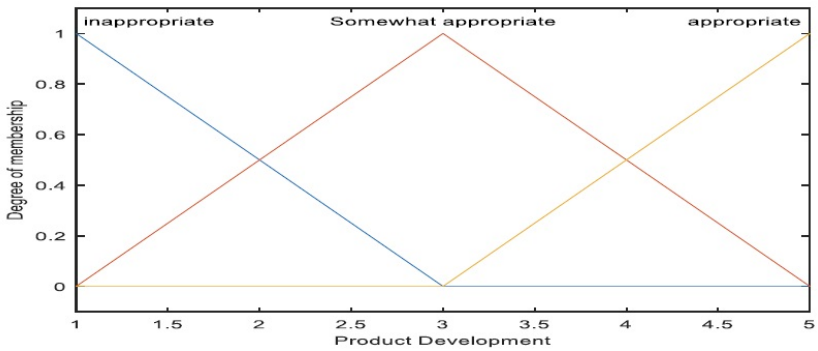

Figure 7: Triangular fuzzy numbers used in the study

After fuzzification of the output and input variables at different levels, fuzzy rules have been formulated. For this purpose, the first maximum rules have been codified. Considering that five systems exist in the model provided whose variables are divided into three language words, therefore, the maximum number of the codifiable rules will be k^n.

This equation indicates the number of the language words and indicates the number of the input variable to each system. For example, the first level system of the existing product-existing market has four inputs, each divided into three language words; therefore, we will have 32=81 as a rule for this system.

The same has been done for other systems too. At the second level, as the system's output is more than one output, then accordingly, initially preliminary rules were codified based on the mentioned discussions, and then these rules were given to the experts. Experts of the study finalized 27 rules after several reviews by the Delphi method. For example, one of the second-level rules has been codified as below:

If the market-product features for the "existing product-existing market" are appropriate, for the "new product-existing market" somewhat appropriate, for the "existing market-new market" inappropriate and for the "new product-new market" inappropriate, then "market penetration strategy" will be appropriate, "product development strategy" will be somewhat appropriate, "market development strategy" will be inappropriate and "diversification strategy" will be inappropriate. After codifying the rule to study output behaviors and its adjustment with research literature and the experts' expectations, output behaviors were investigated. Fig. 8 indicates four output behaviors in the ultimate system.

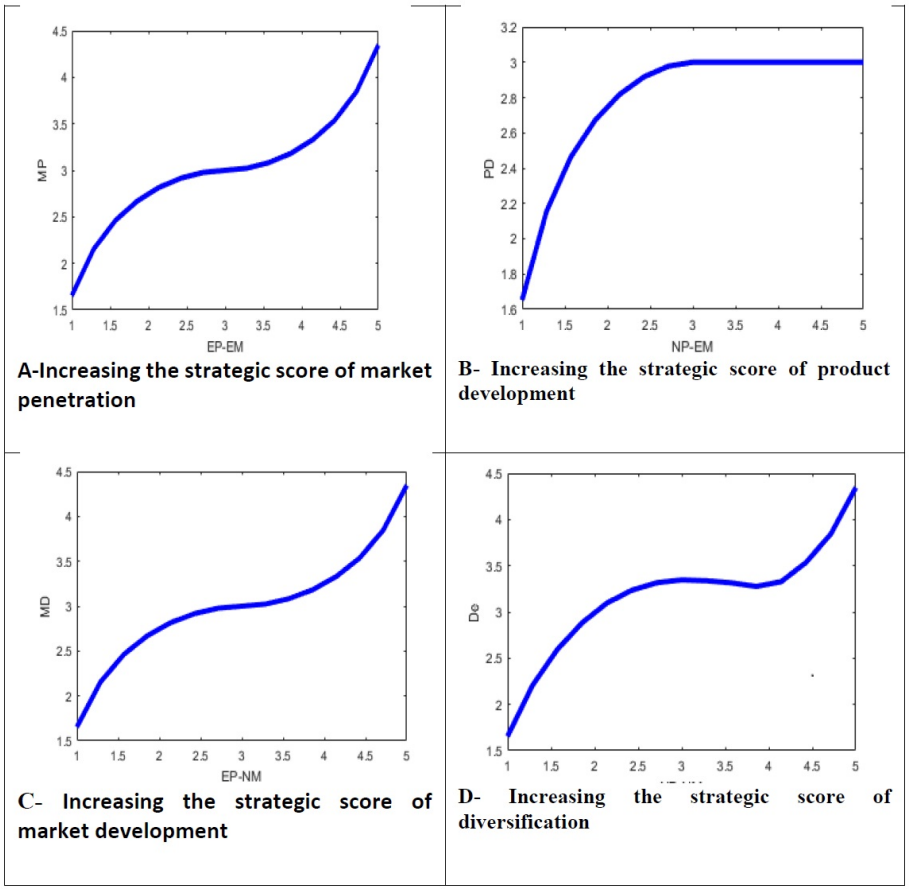

Figure 8: Output behaviors of the ultimate system for selecting the growth strategy of the companies

Next, designed systems were used to select the appropriate growth strategy. For this purpose, initially, the growth strategy has been determined for all companies producing chemical materials and products. In such a way, results obtained from the questionnaires collected from the managers for each influential factor in the selection of the market-product strategy (first-level inputs) were calculated and entered into first-level inference systems. Every first-level inference system generated a score that indicates the output of the first stage, i.e., product-market feature. Fig. 8 provides the results for this section.

Outputs of Table 5 were entered into the growth strategy selection system, which was that of the final system as input, and a score was obtained for each strategy that with the determination of its membership degree, the appropriate strategy can be determined. The results for this section are provided in Table 6 and Fig. 9. The results of Table 6 indicated that among the company's growth strategies, firstly market development strategy is recommended in the

Table 5: input and output values of the first-level inference system

Input	Input value to the inference system	System output	Output value
MP1	2.31	Existing product- existing market	3.00
MP2	4.72		
MP3	2.27		
PD1	3.68	New product- existing market	3.15
PD2	4.39		
PD3	2.87		
PD4	2.46		
MD1	3.93	Existing product- Newmarket	4.05
MD3	4.13		
MD4	3.98		
MD5	4.054		
De1	3.78	New product- new market	2.93
De2	2.93		
De3	2.77		
De4	3.16		
De5	3.88		

appropriate set due to 0.135 degree of membership for the company producing chemical materials and products, and diversification with the degree of membership of 0.110 is recommended at the appropriate setting for the enterprises. Other strategies are next in priority for these companies. So that the market penetration strategy is the third priority, and the product development strategy is the fourth priority.

Table 6: input and output values into the second-level inference system (final)

Strategy	Output value	Language words	Degree of membership
Market penetration	3.01	inappropriate	0.000
		somewhat appropriate	0.995
		appropriate	0.005
Product development	3.00	inappropriate	0.000
		somewhat appropriate	1
		appropriate	0.000
market development	3.27	inappropriate	0.000
		somewhat appropriate	0.865
		appropriate	0.135
Diversification	3.22	inappropriate	0.000
		somewhat appropriate	0.890
		appropriate	0.110

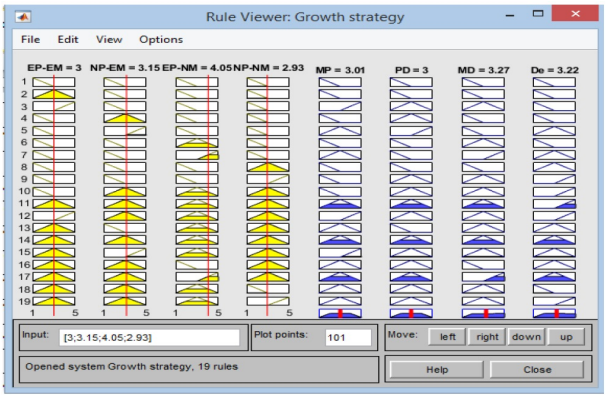

Figure 9: Final system outputs for selecting growth strategies of the companies producing chemical materials and products

Given that the main objective of this study is using an inference system as a decision support system for the selection of the strategy for each enterprise, then the designed system is used further for the selection of the strategy of each company. The results of the five enterprises are provided in Table 7 as the sample.

Table 7: company's growth strategy selection for the sample companies

Company	Strategy	Output value	Language word	Degree of membership	Selected strategy
1	Market penetration	3	inappropriate	0.000	Market development
			somewhat appropriate	1.000	
			appropriate	0.000	
	Product development	3	inappropriate	0.000	
			somewhat appropriate	1.000	
			appropriate	0.000	
	Market development	3.61	inappropriate	0.000	
			somewhat appropriate	0.695	
			appropriate	0.305	
	Diversification	3.04	inappropriate	0.000	
			somewhat appropriate	0.980	
			appropriate	0.020	
2	Market penetration	3.08	inappropriate	0.000	Market penetration
			somewhat appropriate	0.960	
			appropriate	0.040	
	Product development	2.94	inappropriate	0.030	
			somewhat appropriate	0.970	
			appropriate	0.000	
	Market development	2.82	inappropriate	0.090	
			somewhat appropriate	0.910	
			appropriate	0.000	
	Diversification	3	inappropriate	0.000	
			somewhat appropriate	1.000	
			appropriate	0.000	
3	Market penetration	3.43	inappropriate	0.000	Market penetration
			somewhat appropriate	0.785	
			appropriate	0.215	
	Product development	3	inappropriate	0.000	
			somewhat appropriate	1.000	
			appropriate	0.000	
	Market development	2.97	inappropriate	0.015	
			somewhat appropriate	0.985	
			appropriate	0.000	
	Diversification	3	inappropriate	0.000	
			somewhat appropriate	1.000	
			appropriate	0.000	
4	Market penetration	4	inappropriate	0.000	Market penetration
			somewhat appropriate	0.500	
			appropriate	0.500	
	Product development	2.99	inappropriate	0.005	
			somewhat appropriate	0.995	
			appropriate	0.000	
	Market development	3.01	inappropriate	0.000	
			somewhat appropriate	0.995	
			appropriate	0.005	
	Diversification	3.98	inappropriate	0.000	
			somewhat appropriate	0.510	
			appropriate	0.490	

5	Market penetration	3.15	inappropriate	0.000	Diversification
			somewhat appropriate	0.925	
			appropriate	0.075	
	Product development	3	inappropriate	0.000	
			somewhat appropriate	1.000	
			appropriate	0.000	
	Market development	2.92	inappropriate	0.040	
			somewhat appropriate	0.960	
			appropriate	0.000	
	Diversification	3.28	inappropriate	0.000	
			somewhat appropriate	0.860	
			appropriate	0.140	

Results of the Table 7 indicated that, for example, the appropriate strategy for company 1 is market development and for company 4 is market penetration, and for company 5, the most appropriate strategy will be diversification.

Results of table 7 indicated that, for example, the appropriate strategy for company 1 is market development and for company 4 is market penetration, and for company 5, the most appropriate strategy will be diversification.

6 Discussion and conclusion

This study seeks to design an appropriate model for the selection of the company's growth strategy based on the Ansoff matrix and by using a fuzzy inference system to support managers' decision-making in selecting an appropriate growth strategy. Accordingly, a two-level fuzzy inference system was codified in this article based on the Ansoff pattern from the companies' growth strategies. At the first level, four fuzzy inference systems were designed whose inputs were influential factors in the selection of the market-product strategy and output if each system was market-product features. First-level outputs were entered as the inputs to the second-level inference system, and the output of this stage was a score for each market-product strategy. The results of the designed system were first calculated for all companies, next for five companies as the sample. Results obtained for the companies producing chemical materials and products based on the membership degree of each strategy indicated that the most appropriate strategy is a market development strategy and, after that, diversification, market penetration, and product development strategies, respectively. Results analysis indicates that among different Ansoff strategies [5, 6, 5], market development strategies mean offering new products to new geographical or demographic regions. This strategy, with the recognition of the customers' needs, enters the markets where it was not before. Market development, contrary to product development and diversification strategies that need more investment, can be performed by relying on the available resources and without additional investment through the methods such as export and different pricing for various parts of the market. Due to the limitation of the domestic markets for the industrial companies producing chemical materials and products that cause these companies to have activity in a small area and cannot grow, a market development strategy can be considered the best strategy. This strategy, by taking into account new distribution channels, amendment of existing products for using a new set of customers, new geographical regions, and market segmentation-new pricing policies, causes the companies to find new customers and reach more and faster growth. Market development strategy can play an important role in times of economic recession and economic prosperity. The system designed in this article is a support system for decisions and will enable the companies' managers to select an appropriate strategy for their business at different times based on this system.

Based on the results of this study, companies' managers were suggested to take into account market development, following appropriate marketing plans, amendment of different dimensions of the product such as packaging and the appearance of the product, as well as market studies and new geographical regions for their growth. In this regard, export can be considered as one of the appropriate methods. It is also suggested to use online sale methods to reach new distribution channels and with the cooperation of the international online distribution firms having newer markets for their products. Meanwhile, managers are suggested to use the designed model in this study for the determination and selection of appropriate strategies in various life cycles of the industry to guarantee their decisions.

The limitation of the theoretical framework of the research in the selection of the companies' growth strategies and its influential factors to the Ansoff [5] framework is the limitation of this study. Given that in different studies, effective factors on the companies' growth have been investigated from different perspectives, future researchers are suggested to use other available frameworks in their next studies and expand the proposed model in this study, especially in the

section on effective factors on the growth (inputs). The next limitation of this study was the use of a fuzzy inference system for the selection of the company's growth strategy. Due to the assumptions of this method, obtained results should be analyzed in the framework of this approach. A fuzzy inference system is in the category of unsupervised artificial intelligence methods that limits the comparison of the results obtained from this model with actual data. Accordingly, future researchers are suggested to use supervised artificial intelligence methods such as neuro-fuzzy inference systems and support vector machines to select growth strategies for their future studies and expand the proposed model.

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