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Article

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Operations Research Perspectives

Provided in Cooperation with:

Elsevier

Suggested Citation: Khanmohammadi, Ehsan; Malmir, Behnam; Safari, Hossein; Zandieh, Mostafa (2019) : A new approach to strategic objectives ranking based on fuzzy logarithmic least squares method and fuzzy similarity technique, Operations Research Perspectives, ISSN 2214-7160, Elsevier, Amsterdam, Vol. 6, pp. 1-14,
<https://doi.org/10.1016/j.orp.2019.100122>

This Version is available at:

<https://hdl.handle.net/10419/246397>

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A new approach to strategic objectives ranking based on fuzzy logarithmic least squares method and fuzzy similarity technique

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ARTICLE INFO

Keywords:

Balanced scorecard
Strategy map
Strategic objectives
Fuzzy similarity method
Logarithmic least square method

ABSTRACT

In this paper, we discuss the ratings of strategic objectives in a strategy map. In order to have a more useful strategy map and also improve efficiency in the stage of strategy implementation, the significance level of the strategic objective in a strategic map must be determined. In the current study, objectives have been ranked based on strategic destinations, employing a combination of the fuzzy logarithmic least squares method and fuzzy similarity techniques. First, the former is used to obtain the weight of strategic destinations, and then the objectives are ranked through the latter. For this purpose, a company is selected to implement the proposed model with the collaboration of its senior management. The results of the case study indicate that the most important strategic objectives of this company fall under the aspect of learning and growth, helping the company the most to achieve its strategic destinations in this regard.

1. Introduction

The recent daily increases in the complexity of activities and intense business environment changes have made managers realize that traditional planning will no longer be able to solve their problems. Hence, strategic management is introduced as a necessity in organizations, and through its application, managers are seeking appropriate navigation for directing their organizations in today's uncertain environment. Companies possess lots of strategic tools, along with the knowledge of their positive effect on business. Nevertheless, there is still no particular theory or a framework to integrate these tools. Several studies in the last two decades have shown that a 60–80% of companies do not achieve their strategic objectives. According to these studies, the reason for more than 70% of failures lies in the implementation stage [1]. The primary problem of the unimplemented strategies is the gap between the operational and strategic layers. To succeed in strategy implementation, these two layers must be linked, and this is done via balanced scorecards (BSC) in the current study. The BSC method has been regarded beyond a measurement system for more than one decade and has been used as a strategic management system for long-term administration and navigation of organizations. Even though the balanced scorecard method is widely applied in today's organizations, it does embody weaknesses. Kaplan and Norton have defined the four perspectives of financial, customer, internal processes, and learning and

growth as the key elements of organization strategy that require measurement.

Despite successful achievements of balanced scorecard as a strategic management tool, there have been many criticisms and limitations about this approach (see e.g. [2–6]). Some papers have already proposed ways to resolve problems of this method or deal with its limitations (Table 1). Some of these criticisms refer to the phase of formulating strategic goals. However, McAdam and O'Neil [3] believed that the Balanced Scorecard is more an effective tool for measuring strategies than developing them. Therefore, the SWOT analysis must be considered as an instrument to construct strategic objectives for the balanced scorecard. Another criticism is that the implementation stage of the balanced scorecard is qualitative, and the acceptance rate of results could be increased through quantitative methods. On the other hand, in strategy implementation phase, over 70% of organizations' strategic initiatives face failure [7]. When strategic initiatives are not implemented, an organization is not able to achieve its vision. Some of the reasons that organizations fail to conduct their initiatives are limitations in time and budget during times of crisis. In order to reduce the deviation of an organization's codified strategic plan in such times, it is necessary that organizations' strategic objectives are ranked, and the limited budget is used more efficiently through implementing the most important objectives.

The main purpose of this research is to present a comprehensive model in order to translate organizational perspective into strategic

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<https://doi.org/10.1016/j.orp.2019.100122>

Received 14 December 2018; Received in revised form 5 September 2019; Accepted 5 September 2019

Available online 06 September 2019

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Table 1
Previous research on the balanced scorecard.

Research field	Tools and methods	Research area	Reference article
Formulating strategic objectives	Balanced scorecard	General	[8]
	Balanced scorecard	Metalworking firm	[9]
	Balanced scorecard	Health Care Organizations	[10]
	Balanced scorecard	Ministry of Youth and Sports of Turkey	[11]
	Balanced Scorecard	Indian handmade carpet industry	[12]
	Scenario planning for strategy map	An Iranian post company	[13]
	Balanced Scorecard	The Spanish electricity sector	[14]
	Balanced Scorecard	Passenger transport companies	[15]
Prioritizing strategic objectives/ strategy	The technique for order of preference by similarity to ideal solution (TOPSIS)	General	[16]
	Analytic hierarchical process (AHP)	Biopharmaceutical firm	[17]
	AHP and TOPSPS	Iranian mining sector	[18]
	Analytic network process (ANP)	Pittsburgh-based commercial building company.	[19]
	ANP and zero-one goal programming	General	[20]
	Fuzzy AHP	A Spanish financial software factory	[21]
	Grey systems theory	General	[22]
	Determining quantitative targets for performance measures in the BSC using response surface methodology	An oil company	[23]
	Path analysis and structural equation modeling (SEM), ANP and DEMATEL	General	[24]
	Fuzzy DEMATEL	Science and technology in Taiwan	[25]
Strategy Map Designing	Fuzzy cognitive maps (FCMs)	Trading Company in Iran	[26]
	System dynamic approach	General	[27]
	Decision-making trial and evaluation laboratory (DEMATEL)	General	[28]
	Path analysis	Banking institutions	[29]
	AHP and linear programming	University of Science and Technology in Iran	[30]
	ANP	General	[31]
	DEMATEL and linear programming	General	[32]
	ANP and DEMATEL	General	[33]
	Fuzzy DEMATEL and linear programming	A manufacturing company	[34]
	Fuzzy analytic hierarchy process (FAHP), SAW, TOPSIS and VIKOR	A particular enterprise of the banking sector	[35]
Performance evaluation	fuzzy analytic network process (FANP)	Banking performance Evaluation	[36]
	Non-additive fuzzy integral	A manufacturing firm	[37]
	Fuzzy Delphi method (FDM) and ANP to construct a sustainability balanced scorecard	High technology firm	[38]
	DEMATEL, ANP and VIKOR	In the semiconductor	[39]
		Three extension education centers of universities	[40]
	DANP (DEMATEL-based ANP)	Hoteling in Taiwan	[41]
	The UTASTAR method	Health care organizations	[42]
	Fuzzy linguistic method	Health care organizations	[43]
	ANP and COPRAS (CComplex PProportional ASsessment) technique	Oil producing companies	[44]
	Fuzzy ANP	The recreation and leisure industry	[45]
	Fuzzy ANP, Fuzzy DEMATEL and MOORA	European airlines	[46]
	DANP (DEMATEL-based ANP) and VIKOR	International airports	[47]

goals and performance indicators, and also implementing it across all organizational layers using BSC tool. The proposed method removes criticisms of the balanced scorecard to some extent. This is done through adding the SWOT analysis to the development stage of the strategy. The strategic objectives prioritizing is considered as a multi-criteria decision making problem and so, the strategic destinations which is similar to the long-term company objectives or goals of Fred & Forest's model [48] and the strategic themes of company in Kaplan & Norton's model [1], were assumed as the criteria for this problem. The Strategic objectives are ranked based on how much they could help the company, so it can achieve its destinations. Therefore, the strategic objectives were ranked using the proposed fuzzy similarity method and the weights of strategic destinations were calculated using fuzzy logarithmic least squares method.

The main contributions of this research include: (a) presenting a comprehensive methodology to formulate organizational strategies using the BSC tool, and (b) proposing a new methodology to rank the organizational goals based on their effectiveness in reaching organizational strategic destinations, which are, in fact, a translation of organizational vision. In the times of crisis, organizations are not able to follow all their objectives or preform initiatives. This is when organizations fail to achieve their destinations and vision. Based on the proposed approach when an organization faces budget deficit, dedicating a

large portion of budget to more critical objectives may result in the least deviation from organizational strategic destinations. Given the uncertainty in goal ranking process, logarithmic least squares method and similarity technique were used in fuzzy environment. The ranking method used in this fuzzy development research is Deng's similarity method introduced above.

The rest of this paper is organized as follows: The literature review section discusses the use of BSC method. Section 3 presents the proposed methodology along with the fuzzy logarithmic least squares method and the proposed intuitionistic fuzzy similarity-based method. Section 4 thoroughly investigates an application of the proposed approach. Finally, managerial implications and conclusions are presented in Section 5 and 6, respectively.

2. Literature review

Norton and Kaplan [49] developed the balanced scorecard in 1992. The most important strength of BSC is to make a balance in integrating financial and non-financial indexes, which translates the organization's strategic objectives into a set of related criteria [1]. Scorecard designers believe that a company's growth requires good financial conditions. The financial perspective of a company originates from customer perspective, which is formed by factors such as customer satisfaction,

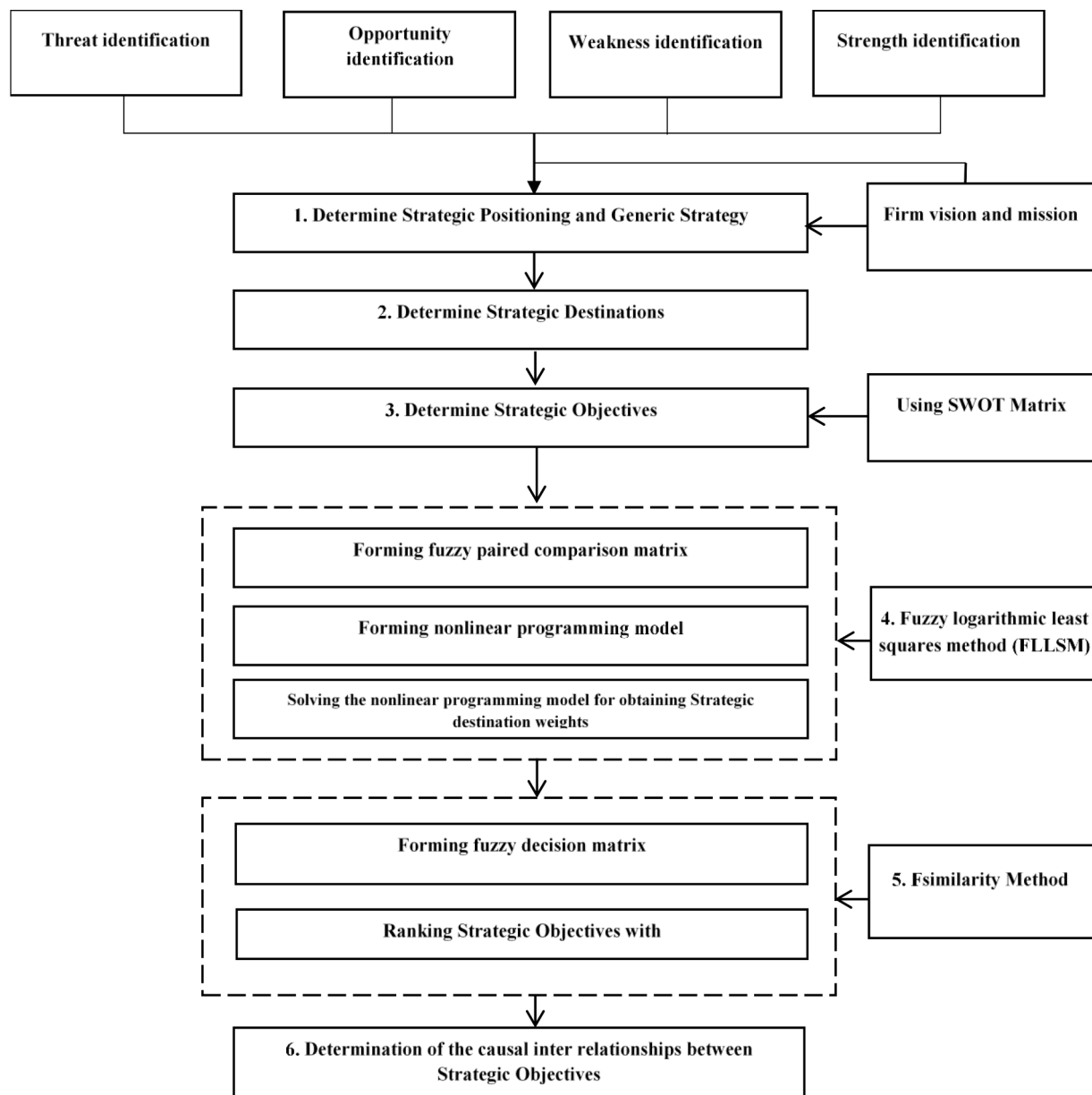


Fig. 1. Stages of the proposed methodology.

Table 2
The Group fuzzy pairwise comparison matrix.

\tilde{B}	Criteria 1	Criteria 2	...	Criteria n
Criteria 1	$(1, 1, 1)$	$\left\{ \begin{matrix} (l_{121}, m_{121}, u_{121}) \\ \dots \\ (l_{12e_{12}}, m_{12e_{12}}, u_{12e_{12}}) \end{matrix} \right\}$...	$\left\{ \begin{matrix} (l_{1n1}, m_{1n1}, u_{1n1}) \\ \dots \\ (l_{1ne_{1n}}, m_{1ne_{1n}}, u_{1ne_{1n}}) \end{matrix} \right\}$
Criteria 2	$\left\{ \begin{matrix} (l_{211}, m_{211}, u_{211}) \\ \dots \\ (l_{21e_{21}}, m_{21e_{21}}, u_{21e_{21}}) \end{matrix} \right\}$	$(1, 1, 1)$...	$\left\{ \begin{matrix} (l_{2n1}, m_{2n1}, u_{2n1}) \\ \dots \\ (l_{2ne_{2n}}, m_{2ne_{2n}}, u_{2ne_{2n}}) \end{matrix} \right\}$
\vdots	\vdots	\vdots	\vdots	\vdots
Criteria n	$\left\{ \begin{matrix} (l_{n11}, m_{n11}, u_{n11}) \\ \dots \\ (l_{n1e_{n1}}, m_{n1e_{n1}}, u_{n1e_{n1}}) \end{matrix} \right\}$	$\left\{ \begin{matrix} (l_{n21}, m_{n21}, u_{n21}) \\ \dots \\ (l_{n2e_{n2}}, m_{n2e_{n2}}, u_{n2e_{n2}}) \end{matrix} \right\}$...	$(1, 1, 1)$

profitability, retention, new customer attraction, and organizational image. Meanwhile, the situation of an organization from the customer's perspective depends on the internal processes of that organization. The cost and quality of such processes determine the customer satisfaction and retention. The appropriate conduction of the process depends on the ability or inability of the organization in terms of growth and

learning perspectives (physical capital management, human communication and information management). In order to maintain constant growth and improvement of an organization, there should exist a good connection and balance between the organization's four perspectives.

After introducing the basics of the strategies, they must be put into practice. In this regard, the first step is creating a strategy map. Without

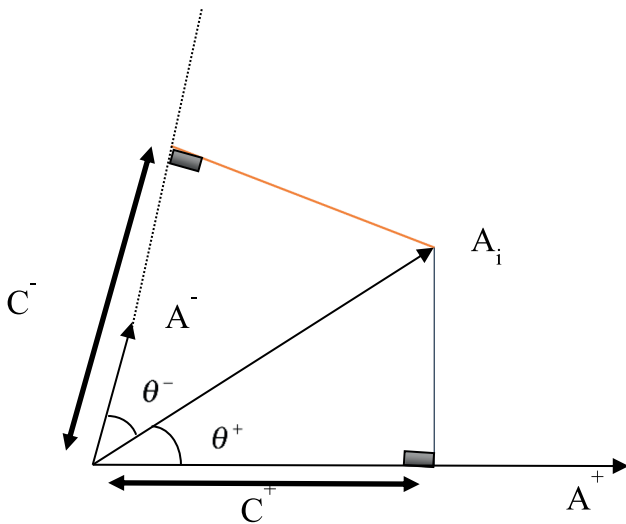


Fig. 2. Degree of conflict between A_i and A_i^\pm .

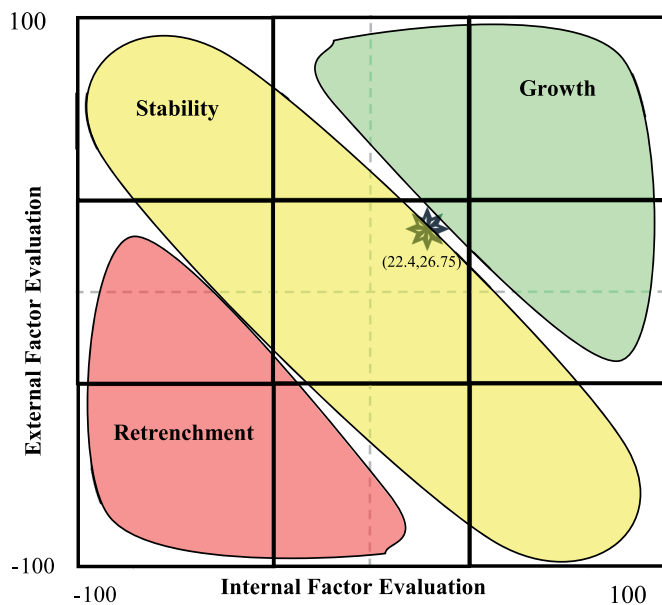


Fig. 3. The internal-external matrix of Alpha Company.

a strategy map, the balanced scorecard would only be an executive scorecard which reports the important measures for implementation. Being developed around the causal structure that links the four perspectives, a strategy map forces an organization to clarify the value creation logic and its target [50]. It claims that every strategy is a hypothesis of the causal relationships between destinations, starting from learning and growth and ending in financial perspective.

The strategy map could be regulated based on a strategic theme – a set of related strategic objectives in the map. Most strategic themes are vertical combinations of objectives that originate from the process perspective – where the strategy is operated. A process-oriented strategic theme could link to the customer and financial consequences, and enabling objectives in the learning and growth aspect in bottom-up and top-down ways respectively [11].

A part of BSC literature includes studies that have combined the balanced scorecard approach with multi-criteria decision-making techniques. Organizations can use these techniques to select the visions, strategies, or resource allocation schemes for implementing their strategies or achieving their goals. They could also evaluate their performance through the combination of the four perspectives of balanced

scorecard and its indicators with these techniques.

To investigate the literature of BSC, four types of studies can be taken into consideration: (a) performance evaluation, (b) strategy map designing, (c) formulating strategic objectives, and (d) prioritizing strategic objectives/strategy.

The first category includes methods which evaluate an organization based on BSC structure. In this approach, different units or sections of an organization are ranked based on BSC, using organizations multi-criteria decision-making methods. Some of the most significant papers in this regard are listed in Table 1.

The second research category includes strategy map designing papers. These papers use different methods to determine the causal relationships between strategy map objectives. One of the most important approaches in this regard is DEMATEL. According to this approach, the experts determine direct relations between the objectives. After performing the method procedures and by taking the direct and indirect relationships into account, the general relations between strategic objectives are eventually determined.

In order to draw the strategy map, this method is presented in different studies as a definite method [29] or as a fuzzy method (see e.g. [26,51]) or as combined with ANP method (see e.g. [25,34]) or as a combination of DMATEL method and linear programming (see e.g. [33,35]). In these papers, after general determination of relationships between the objectives using DMATEL method, a linear programming model is proposed to select the best relationships. Other methods used for determining relationships are path analysis method [24,30] and Fuzzy cognitive maps method [27].

Formulating strategic objectives constitutes the third category of BSC literature, which investigates the determination of strategic objectives. For instance, Jafari et al. [13] designed different scenarios for the strategic map and investigated several probable conditions based on Net present value (NPV) level of performing each scenario. Their proposed method would help producing the most effective strategic map. In another research, the strategy map was presented based on Financial, Customers, Internal Processes, Learning and Growth, Environmental and Legal perspectives to show the strategies and common objectives of the Spanish electricity supply companies [14]. In their study, Tubis and Werbińska-Wojciechowska formulated Balanced Scorecard model for Polish passenger transport sector [15].

The last category consists of articles discussing the prioritizing strategic objectives/strategy.

Huang et al. [17] ranked the strategic map objectives using AHP method based on BSC perspectives. In their model, the perspectives were selected as the first level criteria and objectives as the sub-criteria. This research was conducted in the field of biopharmaceutical. In another study, goals and KPIs were ranked using AHP method, but the experiment was performed in a fuzzy environment [21]. In Fouladgar et al.'s [18] study, the organizational strategies were first formulated using SWOT tool and then ranked based on BSC indicators. For this purpose, they combined AHP and TOPSIS [52] methods.

Tjader et al. [19] ranked BSC indicators by the use of ANP method. Initially, they determined the relationships between indicators and then identified the most important indicators. In Wudhikarn's [20] proposed methodology, first formulated the strategies, then each strategic objective and KPI of each strategy are defined. Next, KPIs are ranked by the use of ANP method and finally budgeting is done using zero-one goal programming method. Jahantigh et al. [22] presented a combined method based on focus group interviews and grey system theory as qualitative and quantitative methods, respectively. Farokhi and Roghanian [23] conducted another study in the field of strategic map to set strategic objective targets using response surface methodology. Table 1 presents the most important studies based on the four aforementioned fields.

The current study focuses on the two fields of formulating strategic objectives and prioritizing strategic objectives, simultaneously. For this purpose, a comprehensive method is presented to formulate the strategic objectives. Next the objectives are ranked in line with the organizational strategic destinations and vision. After building the map and ranking the

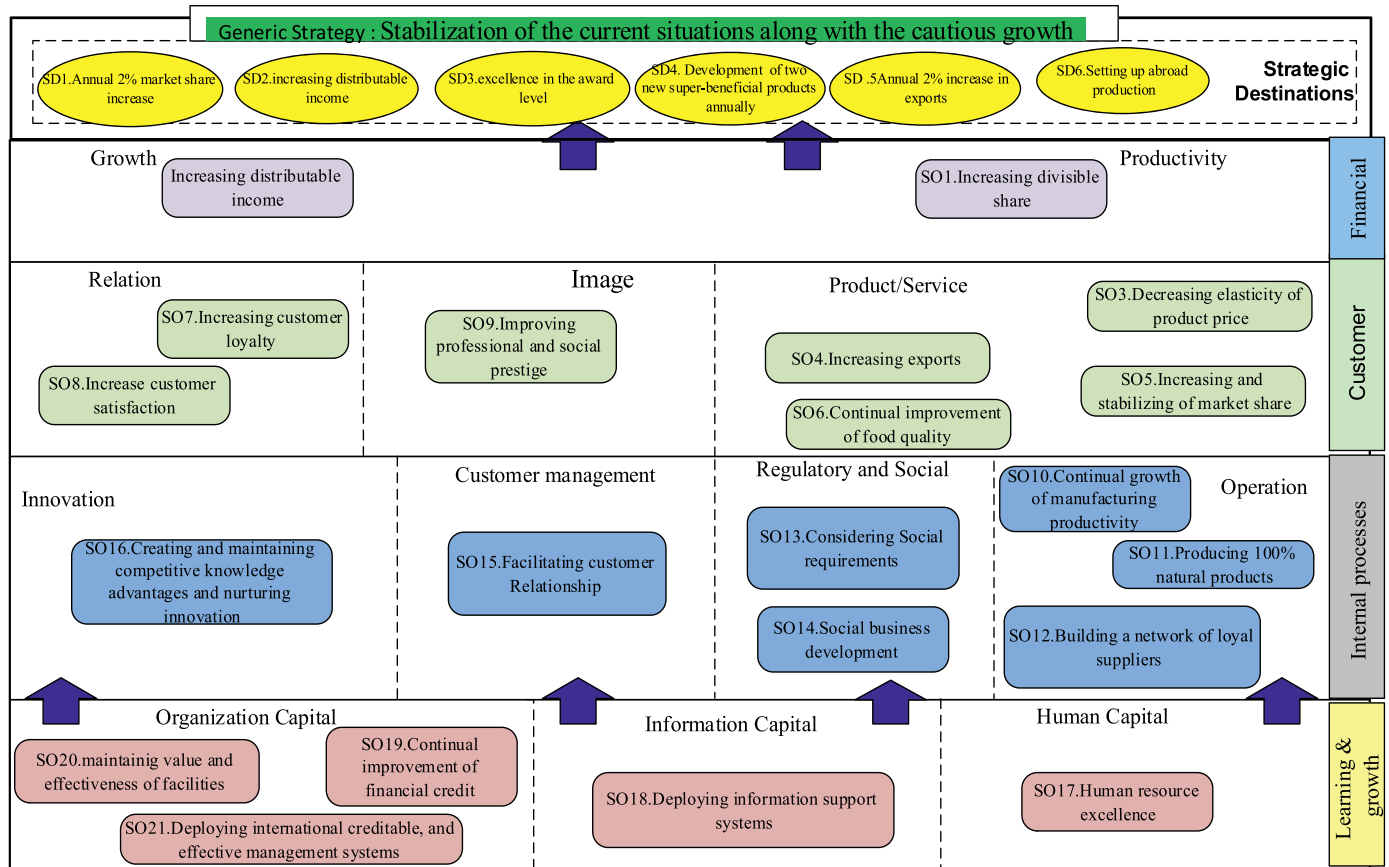


Fig. 4. Generic strategy, strategic destinations, and strategic objectives.

Table 3
Linguistic variable for completing the pairwise comparisons.

Defuzzy	Positive triangular fuzzy number			reciprocal triangular fuzzy number	
9	(Extremely Strong)	ES	(9,9,9)	RES	(1/9,1/9,1/9)
8	(Intermediate)	IVS	(7,8,9)	RIVS	(1/9,1/8,1/7)
7	(Very Strong)	VS	(6,7,8)	RVS	(1/8,1/7,1/6)
6	(Intermediate)	IS	(5,6,7)	RIS	(1/7,1/6,1/5)
5	(Strong)	S	(4,5,6)	RS	(1/6,1/5,1/4)
4	(Intermediate)	IMS	(3,4,5)	RIMS	(1/5,1/4,1/3)
3	(Moderately Strong)	MS	(2,3,4)	RMS	(1/4,1/3,1/2)
2	(Intermediate)	IES	(1,2,3)	RIES	(1/3,1/2,1)
1	(Equally Strong)	EQS	(1,1,1)	EQS	(1,1,1)

objectives, the process of transforming the vision to action plane will be fully proceeded by drawing the map and presenting the initiatives.

One of the important criticisms about the BSC is that it does not provide a method for formulating the objectives of the strategy map. In the proposed methodology, the organization's perspective is translated into strategic goals. The objectives of the map are based on the Swot matrix

Table 4
Decision makers' pairwise comparison results between strategic destinations.

SD.1	SD.2	SD.3	SD.4	SD.5	SD.6
SD.1 (EQS, EQS, EQS, EQS, EQS)	(IES, EQS, EQS, RIES, RIES)	(IMS, IES, IES, EQS, IES)	(S, IMS, MS, IES, MS)	(MS, IES, MS, MSMIMS)	(MS, MS, MS, MS, IMS)
SD.2 (RIES, EQS, EQS, IES, IES)	(EQS, EQS, EQS, EQS, EQS)	(IES, MS, IES, IES, MS)	(IMS, S, MS, MS, IMS)	(MS, MS, MS, MS, IMS, S)	(IES, IMS, MS, IMS, S)
SD.3 (RIES, RIES, RIES, E, RIES)	(RIES, RMS, RIES, RIES, RMS)	(EQS, EQS, EQS, EQS, EQS)	(IMS, MS, IES, IES, IES)	(IES, E, IES, MS, MS)	(MS, IES, IES, MS, IMS)
SD.4 (RS, RIMS, RMS, RIES, RMS)	(RIMS, RS, RMS, RMS, RIMS)	(RIMS, RMS, RIES, RIES, RIES)	(EQS, EQS, EQS, EQS, EQS)	(RMS, RIMS, EQS, IES, MS)	(RIES, RMS, EQS, IES, MS)
SD.5 (RMS, RIES, RMS, RMS, RIMS)	(RMS, RMS, RMS, RIMS, RS)	(RIES, EQS, RIES, RMS, RMS)	(MS, IMS, EQS, RIES, RMS)	(EQS, EQS, EQS, EQS, EQS)	(IES, IES, EQS, EQS, EQS)
SD.6 (RMS, RMS, RMS, RMS, RIMS)	(RIES, RIMS, RMS, RIMS, RS)	(RMS, RIES, RIES, RMS, RMS)	(IES, MS, EQS, RIES, RMS)	(RIES, RIES, EQS, EQS, EQS)	(EQS, EQS, EQS, EQS, EQS)

and formulated to achieve strategic goals. On the other hand, during the crisis, organizations are not able to focus on all their goals. For this reason, in the proposed methodology, strategic destinations were ranked using the FLLSM method of Fuzzy AHP methods and map objectives were ranked using the fuzzy similarity method. Organizations are able to focus on more important destinations and objectives. In this study, Deng's similarity method has been developed to rank the objectives. Deng [53] elucidated why his proposed model is more effective than that of TOPSIS method. Intuitionistic Fuzzy Numbers (IFN) was employed in this proposed method on account of uncertainty in the strategic management realm.

3. Methodology

For a successful strategy implementation, the strategic layer must be linked to the executive layer. This starts with designing the balanced scorecard on the foundation of strategy mapping. In this study, a comprehensive approach is provided to develop and prioritize the strategic objectives of a strategy map, which is summarized in Fig. 1.

In this study, first the strengths, weaknesses, opportunities and threats affecting the company are identified. Then, considering the obtained

Table 5
Weights of strategic destinations.

Strategic destinations	SD1. Annual 2% market share increase (0.22,0.27,0.31)	SD2.increasing Profit (0.25,0.31,0.35)	SD3.excellence in the award level (0.12,0.16,0.21)	SD4. Development of two new super-beneficial products annually (0.06,0.07,0.09)	SD5. Annual 2% increase in exports (0.08,0.09,0.01)	SD6.Setting up abroad production (0.06,0.07,0.09)
Weight						

Table 6

The importance and weights of decision makers.

Decision makers	Linguistic variable	Weight
1	L9	0.183673
2	L7	0.15873
3	L5	0.113379
4	L4	0.090703
5	L4	0.090703
6	L4	0.090703
7	L4	0.090703
8	L4	0.090703
9	L4	0.090703

Table 7

Linguistic terms used to derive the alternative ratings and the importance of the decision makers.

Linguistic Variable	IFNs
Very Very-Low	L1
Very-Low	L2
Low	L3
Middle-Low	L4
Medium	L5
Middle-High	L6
High	L7
Very-High	L8
Very Very-High	L9
Extremely-High	L10

matrix (SWOT), the strategic position and generic strategy of the company are determined, and strategic objectives are specified at the four perspectives of the balanced scorecard model. The next step is to prioritize the objectives based on the organization's strategic destinations as follows.

A group fuzzy pairwise comparison matrix is formed, and the criteria weights are obtained through the fuzzy logarithmic least squares method (FLLSM). The strategic objectives priority problem is solved through considering the destinations as the criteria, using the fuzzy similarity technique (FSimilarity). Deng introduced this method in 2007 [53] and Safari et al. [54] reformed it [54]. This study presents the proposed fuzzy similarity method. In the last step, the cause and effect relationships between the strategic objectives are obtained and the strategy map is drawn.

3.1. The fuzzy logarithmic least squares method

There are two categories of the techniques used to extract the weights of the fuzzy pairwise comparisons. The first one includes techniques in which the obtained weights are in the form of real numbers, like the fuzzy preference programming [55] and logarithmic fuzzy preference programming [56] methods, and the weights in the second are extracted as fuzzy numbers, such as the LAMBDA-Max approach [57], the linear goal programming method [58,59], credibility theory [60], and FLLSM [61].

In this study, the FLLSM method is applied; a method able to extract weights from the group pairwise comparison matrix as fuzzy numbers by solving a non-linear programming problem as shown below:

$$\begin{aligned}
 \text{Min } Z &= \sum_{i=1}^n \sum_{j=1, i \neq j}^n \sum_{k=1}^{e_{ij}} \left[\left(\ln w_i^L - \ln w_j^U - \ln a_{ijk}^L \right)^2 + \left(\ln w_i^M - \ln w_j^M - \ln a_{ijk}^M \right)^2 \right. \\
 &\quad \left. + \left(\ln w_i^U - \ln w_j^L - \ln a_{ijk}^U \right)^2 \right] \\
 \text{Subject to } &\begin{cases} w_i^L + \sum_{j=1, i \neq j}^n w_j^U \geq 1 \\ w_i^U + \sum_{j=1, i \neq j}^n w_j^L \leq 1 \\ \sum_{i=1}^n w_i^M = 1 \\ \sum_{i=1}^n (w_i^L + w_i^U) = 2 \\ w_j^U \geq w_j^M \geq w_j^L \geq 0, i = 1, \dots, n \end{cases}
 \end{aligned}
 \tag{9}$$

Table 8
The ratings of the alternatives.

[illegible]

When the group fuzzy paired comparison \tilde{B} (Table 2) is formed, the fuzzy weights of criteria can be extracted without aggregating comments by solving Model (9). Where $\tilde{a}_{ijk} = (l_{ijk}, m_{ijk}, u_{ijk})$ are triangular fuzzy judgments with $\tilde{a}_{ijk} = \tilde{a}_{jik}^{-1} (1/u_{ijk}, 1/m_{ijk}, 1/l_{jik})$ for $i, j = 1, \dots, n, i \neq j, k = 1, \dots, e_{ij}$, n indicates the number of criteria, and e_{ij} indicates the number of decision makers.

For Matrix \tilde{B} , there should exist a normalized triangular fuzzy weight vector $W = (\tilde{w}_1, ..., \tilde{w}_n)^T = ((\tilde{w}_1^L, \tilde{w}_1^M, \tilde{w}_1^U), ..., (\tilde{w}_n^L, \tilde{w}_n^M, \tilde{w}_n^U))^T$ where $\tilde{a}_{ijk} = (l_{ijk}, m_{ijk}, u_{ijk}) \approx \tilde{w}_i/\tilde{w}_j$.

In times of inconsistency $\tilde{a}_{ijk} \neq \tilde{w}_i/\tilde{w}_j$ which in fact the error equals: $\tilde{a}_{ijk} - \tilde{w}_i/\tilde{w}_j = error$, the above equation can be shown as: $\ln \tilde{a}_{ijk} - \ln(\tilde{w}_i/\tilde{w}_j) = error$. The objective function of model (9) aims to minimize the error, and limitations of normalizing model provide output weights of the model.

The weights derived from solving the model $\tilde{W} = (w_i^L, w_i^M, w_i^U)$ are defuzzified using the following equation:

$$W_i = \frac{1}{4}(w_i^L + 2w_i^M + w_i^U), i = 1, ..., n \quad (10)$$

3.2. Intuitionistic fuzzy sets

Intuitionistic fuzzy sets (IFS) have been applied in a variety of areas, including decision-making problems [62-69] and pattern recognition [70,71]. Atanassov [72] first introduced them by extending classical fuzzy set theory (FST) in 1986, and they have turned into a popular method to handle vagueness.

Definition 1. An intuitionistic fuzzy set A in a finite set X is defined as [72,73]:

$$A = \{ \langle x, \mu_A(x), \nu_A(x) \rangle | x \in X \} \quad (1)$$

In which $\mu_A(x)$, $\nu_A(x): X \rightarrow [0, 1]$ are membership and non-membership functions and must meet the following constraint [72,73]:

$$0 \leq \mu_A(x) + \nu_A(x) \leq 1 \quad (2)$$

IFS has another parameter called $\pi_A(x)$, which is referred to as the intuitionistic fuzzy index. It demonstrates the degree of hesitation whether x is a member of A or not [72-73]:

$$\pi_A(x) = 1 - \mu_A(x) - \nu_A(x) \quad (3)$$

Therefore, for every $x \in X$:

$$0 \leq \pi_A(x) \leq 1 \quad (4)$$

A small $\pi_A(x)$ denotes higher certainty about x , and vice versa. We can easily deduce that, if all the elements of the universe have $\mu_A(x) = 1 - \nu_A(x)$, the IFS is reduced to an ordinary fuzzy set [74].

Definition 2. Atanassov [72] has defined the following relationships for intuitionistic fuzzy numbers $A = \{\langle x, \mu_A(x), \nu_A(x) \rangle | x \in X\}$, $B = \{\langle x, \mu_B(x), \nu_B(x) \rangle | x \in X\}$, $C = \{\langle x, \mu_C(x), \nu_C(x) \rangle | x \in X\}$ and the real number n [72,73]:

$$B + C = \{ \langle x, \mu_B(x) + \mu_C(x) - \mu_B(x), \mu_C(x), \nu_B(x), \nu_C(x) \rangle | x \in X \} \quad (5)$$

$$B, C = \{\langle x, \mu_B(x), \mu_C(x), \nu_B(x) + \nu_C(x) - \nu_B(x), \nu_C(x) \rangle | x \in X\} \quad (6)$$

$$nA = \{ \langle x, 1 - (1 - \mu_A(x))^n, (\nu_A(x))^n \rangle | x \in X \} \quad (7)$$

Definition 3. Assume that $s: F(X) \times F(X) \rightarrow [0, 1]$ is a mapping that fits in the following four relations for any intuitionistic fuzzy sets \tilde{A}_1, \tilde{A}_2 and \tilde{A}_3 of $F(X)$ [75]:

- (1) $0 \leq s(\tilde{A}_1, \tilde{A}_2) \leq 1$,
- (2) $s(\tilde{A}_1, \tilde{A}_2) = 1$ if and only if $\tilde{A}_1 = \tilde{A}_2$,
- (3) $s(\tilde{A}_1, \tilde{A}_2) = s(\tilde{A}_2, \tilde{A}_1)$ and

(4) if $\tilde{A}_1 \subseteq \tilde{A}_2 \subseteq \tilde{A}_3$, then $s(\tilde{A}_1, \tilde{A}_3) \leq s(\tilde{A}_1, \tilde{A}_2)$ and $s(\tilde{A}_1, \tilde{A}_3) \leq s(\tilde{A}_2, \tilde{A}_3)$.

Table 9

The aggregated intuitionistic fuzzy decision matrix.

	C01	C02	C03	C04	C05	C06
A1	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.8, 0.07, 0.13)	(0.1, 0.9, 0)	(0.1, 0.9, 0)
A2	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.75, 0.1, 0.15)	(0.1, 0.9, 0)	(0.1, 0.9, 0)
A3	(0.72, 0.12, 0.15)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.65, 0.16, 0.19)	(0.61, 0.19, 0.2)	(0.1, 0.9, 0)
A4	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.8, 0.07, 0.13)	(0.1, 0.9, 0)
A5	(0.8, 0.07, 0.13)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)
A6	(0.61, 0.19, 0.2)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.61, 0.19, 0.2)	(0.1, 0.9, 0)
A7	(0.62, 0.19, 0.19)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.6, 0.19, 0.21)	(0.62, 0.19, 0.19)	(0.1, 0.9, 0)
A8	(0.71, 0.13, 0.16)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.71, 0.13, 0.16)	(0.73, 0.12, 0.15)	(0.1, 0.9, 0)
A9	(0.59, 0.2, 0.21)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.51, 0.25, 0.24)	(0.1, 0.9, 0)
A10	(0.6, 0.19, 0.21)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.73, 0.12, 0.15)	(0.61, 0.19, 0.2)	(0.8, 0.07, 0.13)
A11	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.8, 0.07, 0.13)	(0.1, 0.9, 0)	(0.61, 0.19, 0.2)	(0.1, 0.9, 0)
A12	(0.52, 0.24, 0.24)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.7, 0.13, 0.17)	(0.1, 0.9, 0)	(0.78, 0.09, 0.14)
A13	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.51, 0.25, 0.25)	(0.1, 0.9, 0)	(0.6, 0.19, 0.21)	(0.1, 0.9, 0)
A14	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.1, 0.9, 0)
A15	(0.6, 0.19, 0.21)	(0.1, 0.9, 0)	(0.1, 0.9, 0)	(0.7, 0.13, 0.17)	(0.6, 0.19, 0.21)	(0.1, 0.9, 0)
A16	(0.51, 0.25, 0.24)	(0.1, 0.9, 0)	(0.7, 0.13, 0.17)	(0.61, 0.19, 0.2)	(0.61, 0.19, 0.2)	(0.71, 0.13, 0.16)
A17	(0.6, 0.19, 0.21)	(0.76, 0.09, 0.15)	(0.67, 0.15, 0.18)	(0.6, 0.19, 0.21)	(0.6, 0.19, 0.21)	(0.64, 0.17, 0.19)
A18	(0.6, 0.19, 0.21)	(0.69, 0.13, 0.17)	(0.55, 0.22, 0.23)	(0.5, 0.25, 0.25)	(0.6, 0.19, 0.21)	(0.59, 0.19, 0.22)
A19	(0.61, 0.19, 0.2)	(0.77, 0.09, 0.15)	(0.66, 0.15, 0.18)	(0.71, 0.13, 0.16)	(0.61, 0.19, 0.2)	(0.65, 0.16, 0.19)
A20	(0.4, 0.31, 0.29)	(0.67, 0.15, 0.18)	(0.62, 0.18, 0.2)	(0.5, 0.25, 0.25)	(0.6, 0.19, 0.21)	(0.64, 0.17, 0.19)
A21	(0.4, 0.31, 0.29)	(0.8, 0.07, 0.13)	(0.5, 0.25, 0.26)	(0.4, 0.31, 0.29)	(0.7, 0.13, 0.17)	(0.74, 0.1, 0.15)

Satisfying these constraints, s and $s(\tilde{A}_1, \tilde{A}_2)$ will be called the similarity function of intuitionistic fuzzy sets and the similarity degree between the intuitionistic fuzzy sets \tilde{A}_1 and \tilde{A}_2 , respectively.

The cosine similarity measure which is based on Bhattacharya's distance [76,77] between any two intuitionistic fuzzy sets \tilde{A}_1 and \tilde{A}_2 on the finite universal set $X = \{X_1, X_2, \dots, X_n\}$ can be established as follows [78]:

$$\text{Sim}(\tilde{A}_1, \tilde{A}_2) = \frac{1}{n} \sum_{i=1}^n ((\mu_{A_1}(x_i)\mu_{A_2}(x_i) + \nu_{A_1}(x_i)\nu_{A_2}(x_i) + \pi_{A_1}(x_i)\pi_{A_2}(x_i)) / (\mu_{A_1}(x_i)^2 + \nu_{A_1}(x_i)^2 + \pi_{A_1}(x_i)^2)^{\frac{1}{2}} (\mu_{A_2}(x_i)^2 + \nu_{A_2}(x_i)^2 + \pi_{A_2}(x_i)^2)^{\frac{1}{2}}) \quad (8)$$

3.3. Proposed Intuitionistic fuzzy similarity-based method

Deng [53] offered a method to rank alternatives in a multi-criteria problem through the combination of gradient and variable values. In Deng's approach, each alternative is considered as a vector in an n -dimensional space. Positive and negative ideal vectors are defined, and the alternatives are ranked based on the similarity between alternative A_i and the ideal vectors A_i^{\pm} . The highly preferable option should have the highest degree of similarity in the positive ideal solution and the lowest degree of similarity in the negative ideal solution (Fig. 2).

In this article, a fuzzy similarity method is presented based on Deng's model, consisting of the following steps:

Having $A = \{A_1, A_2, \dots, A_m\}$ as a set of alternatives and $C = \{C_1, C_2, \dots, C_n\}$ as a set of criteria, the intuitionistic fuzzy similarity-based method is performed through the following procedure:

Step 1: Deciding the weights of the decision group, which consist of l decision makers. The intuitionistic fuzzy numbers reflect the importance of the decision makers, which is considered as a linguistic term.

If the rate the k th decision maker is illustrated in the intuitionistic fuzzy number $E_k = [\mu_k, \nu_k, \pi_k]$, its weight is obtained as:

$$\lambda_k = \frac{\left(\mu_k + \pi_k \left(\frac{\mu_k}{\mu_k + \nu_k}\right)\right)}{\sum_{k=1}^l \left(\mu_k + \pi_k \left(\frac{\mu_k}{\mu_k + \nu_k}\right)\right)} \quad (11)$$

and $\sum_{k=1}^l \lambda_k = 1$.

Step 2. Construction of the aggregated intuitionistic fuzzy decision matrix according to the decision makers' opinions and their weights obtained from the last step.

With $D^{(k)} = (d_{ij}^{(k)})_{m \times n}$ as the intuitionistic fuzzy decision matrix of

each decision maker and $\lambda = \{\lambda_1, \lambda_2, \dots, \lambda_n\}$ as the weight of each decision maker, the next step of the process is to construct the aggregated intuitionistic fuzzy decision matrix. In this regard, all the individual decision opinions must be integrated into one single matrix, for which the IFWA operator proposed by [79] is utilized. We have $D = (d_{ij})_{m \times n}$, where:

$$\begin{aligned} d_{ij} &= IFWA_{\lambda}(d_{ij}^{(1)}, d_{ij}^{(2)}, \dots, d_{ij}^{(l)}) \\ &= \lambda_1 d_{ij}^{(1)} \oplus \lambda_2 d_{ij}^{(2)} \oplus \lambda_3 d_{ij}^{(3)} \oplus \dots \oplus \lambda_l d_{ij}^{(l)} \\ &= \left[1 - \prod_{k=1}^l \left(1 - \mu_{ij}^{(k)} \right)^{\lambda_k}, \right. \\ &\quad \left. \prod_{k=1}^l \left(\nu_{ij}^{(k)} \right)^{\lambda_k}, \prod_{k=1}^l \left(1 - \mu_{ij}^{(k)} \right)^{\lambda_k} - \prod_{k=1}^l \left(\nu_{ij}^{(k)} \right)^{\lambda_k} \right] \end{aligned} \quad (12)$$

Also, $d_{ij} = (\mu_{A_i}(x_j), \nu_{A_i}(x_j), \pi_{A_i}(x_j)) (i = 1, 2, \dots, m; j = 1, 2, \dots, n)$.

The aggregated intuitionistic fuzzy decision matrix is thus calculated:

$$D = \begin{pmatrix} d_{11} & \dots & d_{1m} \\ \vdots & \ddots & \vdots \\ d_{n1} & \dots & d_{nm} \end{pmatrix} \quad (13)$$

Step 3. Finding the weights of the criteria.

The differences between the importance of criteria are represented by the different weights (W_j), which are calculated through the FLSSM method and multiplied by the decision matrix as a scalar.

Step 4. Construction of the aggregated weighted intuitionistic fuzzy decision matrix.

Based on the definitions provided in (14) and (15) (Krassimir T [72]), the aggregated weighted intuitionistic fuzzy decision matrix is created according to (16):

$$D' = W \cdot D = \{(x, 1 - (1 - \mu_{A_i}(x))^w, (\nu_{A_i}(x))^w) | x \in X\} \quad (14)$$

And

$$\pi_{A_i \cdot w}(x) = 1 - (1 - (1 - \mu_{A_i}(x))^w + (\nu_{A_i}(x))^w) \quad (15)$$

$$D' = \begin{pmatrix} d'_{11} & \dots & d'_{1m} \\ \vdots & \ddots & \vdots \\ d'_{n1} & \dots & d'_{nm} \end{pmatrix} \quad (16)$$

Where $d'_{ij} = (\mu'_{ij}, \nu'_{ij}, \pi'_{ij}) = (\mu_{A_i W}(x_j), \nu_{A_i W}(x_j), \pi_{A_i W}(x_j))$ is an element.

Step 5. Calculation of the two intuitionistic fuzzy positive-ideal and negative-ideal solutions.

Table 10
The Crisp Weights of strategic destinations.

Strategic destinations	SD1. Annual 2% increase	SD2. Increasing Profit	SD3. excellence in the award level	SD4. Annual development of two new super-beneficial products	SD5. Annual 2% increase in exports	SD6. Setting up abroad production
Crisp weight	0.296177	0.252836	0.133364	0.083662	0.127424	0.106537

If J_1 and J_2 are the benefit and cost criteria, A^+ and A^- will be the intuitionistic fuzzy positive-ideal and negative-ideal solutions respectively, obtained as follows:

$$A^+ = (\mu_{A^+W}(x_j), \nu_{A^+W}(x_j)) \text{ and } A^- = (\mu_{A^-W}(x_j), \nu_{A^-W}(x_j)) \quad (17)$$

Where

$$\mu_{A^+W} = ((\max_i \mu_{A_i.W}(x_j) | j \in J_1), (\min_i \mu_{A_i.W}(x_j) | j \in J_2)) \quad (18)$$

$$\nu_{A^+W} = ((\min_i \nu_{A_i.W}(x_j) | j \in J_1), (\max_i \nu_{A_i.W}(x_j) | j \in J_2)) \quad (19)$$

$$\mu_{A^-W} = ((\min_i \mu_{A_i.W}(x_j) | j \in J_1), (\max_i \mu_{A_i.W}(x_j) | j \in J_2)) \quad (20)$$

$$\nu_{A^-W} = ((\max_i \nu_{A_i.W}(x_j) | j \in J_1), (\min_i \nu_{A_i.W}(x_j) | j \in J_2)) \quad (21)$$

Step 6. Finding the separation measures.

Cosine similarity measure is used to find the similarity measures S_i^+ and S_i^- of each alternative from intuitionistic fuzzy positive-ideal and negative-ideal solutions. The results are provided below:

$$S_i^+ = \frac{1}{n} \sum_{i=1}^n ((\mu_{A_iW}(x_i) \mu_{A^+W}(x_i) + \nu_{A_iW}(x_i) \nu_{A^+W}(x_i) + \pi_{A_iW}(x_i) \pi_{A^+W}(x_i)) / (\mu_{A_iW}(x_i)^2 + \nu_{A_iW}(x_i)^2 + \pi_{A_iW}(x_i)^2)^{\frac{1}{2}} (\mu_{A^+W}(x_i)^2 + \nu_{A^+W}(x_i)^2 + \pi_{A^+W}(x_i)^2)^{\frac{1}{2}}) \quad (22)$$

$$S_i^- = \frac{1}{n} \sum_{i=1}^n ((\mu_{A_iW}(x_i) \mu_{A^-W}(x_i) + \nu_{A_iW}(x_i) \nu_{A^-W}(x_i) + \pi_{A_iW}(x_i) \pi_{A^-W}(x_i)) / (\mu_{A_iW}(x_i)^2 + \nu_{A_iW}(x_i)^2 + \pi_{A_iW}(x_i)^2)^{\frac{1}{2}} (\mu_{A^-W}(x_i)^2 + \nu_{A^-W}(x_i)^2 + \pi_{A^-W}(x_i)^2)^{\frac{1}{2}}) \quad (23)$$

Step 7. Identifying the relative closeness coefficient with respect to the intuitionistic ideal solution.

The relative closeness coefficient of an alternative A_i is given as follows:

$$C_i^* = \frac{S_i^+}{S_i^- + S_i^+} \text{ where } 0 \leq C_i^* \leq 1 \quad (24)$$

Step 8. Ranking the alternatives.

Once the relative closeness coefficient of each alternative is found, this step is carried out on account of C_i^+ having a descending order.

4. An application of the proposed approach

This paper intends to rank the existing strategic objectives of an Iranian manufacturing company (under the pseudonym Alpha) in the strategy map based on their strategic destinations. According to their request, we were not allowed to share their name, vision, mission and SWOT matrix in the current paper. Alpha Company operates in Iran's food and beverage market. Their primary products are various types of chocolate and candies.

First, the internal and external factors were analyzed, based on which the strategic situation of the company has been calculated using the internal-external matrices (Fig. 3).

According to the above figure, the strategic situation of the Alpha Company is within the border of the first and second regions. Therefore, the company is free to choose different types of growth and development strategies to get through this stage. Based on the strategic position, the generic strategy and strategic destinations were determined and further developed. The strategic objectives were formulated in the four aspects of the BSC model using the SWOT matrix. This information was considered as the pre-assumption of this study, as shown in Fig. 4.

The next steps of the proposed methodology are as follows:

Table 11

The aggregated weighted intuitionistic fuzzy decision matrix.

	C01	C02	C03	C04	C05	C06
A1	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.13, 0.8, 0.07)	(0.01, 0.99, 0)	(0.01, 0.99, 0)
A2	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.11, 0.82, 0.07)	(0.01, 0.99, 0)	(0.01, 0.99, 0)
A3	(0.32, 0.54, 0.14)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.08, 0.86, 0.06)	(0.11, 0.81, 0.08)	(0.01, 0.99, 0)
A4	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.19, 0.71, 0.1)	(0.01, 0.99, 0)
A5	(0.38, 0.46, 0.16)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)
A6	(0.24, 0.62, 0.14)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.11, 0.81, 0.08)	(0.01, 0.99, 0)
A7	(0.25, 0.61, 0.14)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.07, 0.87, 0.05)	(0.12, 0.81, 0.08)	(0.01, 0.99, 0)
A8	(0.31, 0.55, 0.14)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.1, 0.84, 0.06)	(0.16, 0.76, 0.08)	(0.01, 0.99, 0)
A9	(0.23, 0.62, 0.15)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.09, 0.84, 0.07)	(0.01, 0.99, 0)
A10	(0.24, 0.62, 0.15)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.1, 0.84, 0.06)	(0.11, 0.81, 0.08)	(0.16, 0.75, 0.09)
A11	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.19, 0.7, 0.1)	(0.01, 0.99, 0)	(0.11, 0.81, 0.08)	(0.01, 0.99, 0)
A12	(0.2, 0.65, 0.15)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.1, 0.85, 0.06)	(0.01, 0.99, 0)	(0.15, 0.77, 0.08)
A13	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.09, 0.83, 0.08)	(0.01, 0.99, 0)	(0.11, 0.81, 0.08)	(0.01, 0.99, 0)
A14	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)
A15	(0.24, 0.62, 0.15)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.1, 0.85, 0.06)	(0.11, 0.81, 0.08)	(0.01, 0.99, 0)
A16	(0.19, 0.66, 0.15)	(0.03, 0.97, 0)	(0.15, 0.77, 0.09)	(0.08, 0.87, 0.06)	(0.11, 0.81, 0.08)	(0.12, 0.8, 0.07)
A17	(0.24, 0.62, 0.15)	(0.3, 0.55, 0.15)	(0.14, 0.77, 0.09)	(0.07, 0.87, 0.05)	(0.11, 0.81, 0.08)	(0.1, 0.83, 0.07)
A18	(0.24, 0.62, 0.15)	(0.26, 0.6, 0.14)	(0.1, 0.82, 0.08)	(0.06, 0.89, 0.05)	(0.11, 0.81, 0.08)	(0.09, 0.84, 0.07)
A19	(0.24, 0.61, 0.15)	(0.31, 0.54, 0.15)	(0.14, 0.78, 0.09)	(0.1, 0.84, 0.06)	(0.11, 0.81, 0.08)	(0.11, 0.82, 0.07)
A20	(0.14, 0.71, 0.15)	(0.24, 0.62, 0.14)	(0.12, 0.79, 0.08)	(0.06, 0.89, 0.05)	(0.11, 0.81, 0.08)	(0.1, 0.83, 0.07)
A21	(0.14, 0.71, 0.15)	(0.33, 0.51, 0.15)	(0.09, 0.83, 0.08)	(0.04, 0.91, 0.05)	(0.14, 0.77, 0.08)	(0.13, 0.79, 0.08)

Table 12

The intuitionistic fuzzy positive-ideal solution and intuitionistic fuzzy negative-ideal solution.

	C01	C02	C03	C04	C05	C06
A*	(0.38, 0.46, 0.16)	(0.33, 0.51, 0.15)	(0.19, 0.7, 0.1)	(0.13, 0.8, 0.07)	(0.19, 0.71, 0.1)	(0.16, 0.75, 0.09)
A ⁻	(0.03, 0.97, 0)	(0.03, 0.97, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)	(0.01, 0.99, 0)

Table 13

Similarity measures and the relative closeness coefficient of each alternative as well as the strategic objective rankings.

		S*	S ⁻	C _i	Rank
A1	Increasing distributable income	0.914	0.998	0.478	19
A2	Improving return on assets	0.914	0.998	0.478	20
A3	Decreasing elasticity of product price	0.956	0.973	0.496	8
A4	Increasing exports	0.918	0.994	0.48	18
A5	Increasing and stabilizing of market share	0.951	0.96	0.498	6
A6	Continual improvement of food quality	0.948	0.985	0.491	13
A7	Increasing customer loyalty	0.951	0.983	0.492	11
A8	Increasing customer satisfaction	0.957	0.973	0.496	7
A9	Improving professional and social prestige	0.947	0.986	0.49	14
A10	Continual growth of manufacturing productivity	0.919	0.944	0.493	9
A11	Producing 100% natural products	0.924	0.991	0.482	16
A12	Building a network of loyal suppliers	0.911	0.953	0.489	15
A13	Considering Social requirements	0.921	0.997	0.48	17
A14	Social business development	0.912	1	0.477	21
A15	Facilitating customer relationship	0.95	0.984	0.491	12
A16	Creating and maintaining competitive knowledge advantages and nurturing innovation	0.926	0.953	0.493	10
A17	Human resource excellence	0.962	0.931	0.508	2
A18	Deploying information support systems	0.961	0.942	0.505	4
A19	Continual improvement of financial credit	0.963	0.928	0.509	1
A20	Maintaining value and effectiveness of facilities	0.948	0.948	0.5	5
A21	Deploying internationally creditable, and effective management systems	0.945	0.926	0.505	3

4.1. Determination of the importance of strategic destinations using the FLLSM

4.1.1. Development of the pairwise comparison matrix

In this step, the pairwise comparison matrix is formed between the strategic destinations. Decision makers are subsequently asked to complete pairwise comparisons using the linguistic variable shown in Table 3.

The number of decision makers in this stage is 5 ($e_{ij} = 5$) which indicates the number of chief directors of the organization.

A group pairwise comparison matrix is composed as follows (Table 4):

4.1.2. Formation of a non-linear programming model of the FLLSM and obtaining the importance of strategic destinations

To calculate the fuzzy weights, the following nonlinear programming model must be solved (Table 5).

$$\begin{aligned}
 \text{Min } Z &= \sum_{i=1}^6 \sum_{j=1, i \neq j}^6 \sum_{k=1}^5 \\
 &((\ln w_i^L - \ln w_j^U - \ln a_{ijk}^L)^2 + (\ln w_i^M - \ln w_j^M - \ln a_{ijk}^M)^2 \\
 &+ (\ln w_i^U - \ln w_j^L - \ln a_{ijk}^U)^2) \\
 \text{Subject to } &\left\{ \begin{array}{l} w_i^L + \sum_{j=1, i \neq j}^6 w_j^U \geq 1 \\ w_i^U + \sum_{j=1, i \neq j}^6 w_j^L \leq 1 \\ \sum_{i=1}^6 w_i^M = 1 \\ \sum_{i=1}^6 (w_i^L + w_i^U) = 2 \\ w_j^U \geq w_j^M \geq w_j^L \geq 0, i = 1, \dots, 6 \end{array} \right\}
 \end{aligned}$$

$$i, j = 1, \dots, 6 \text{ \& } k = 1, \dots, 5;$$

In this study, LINGO software was used to solve the non-linear programming model, through which the strategic destinations' weights are given as follows:

4.2. Ranking strategic objectives

Using the proposed fuzzy similarity technique, the strategic objectives are prioritized based on the strategic destinations as the decision-making criteria in the Alpha Company. The results are presented in the following.

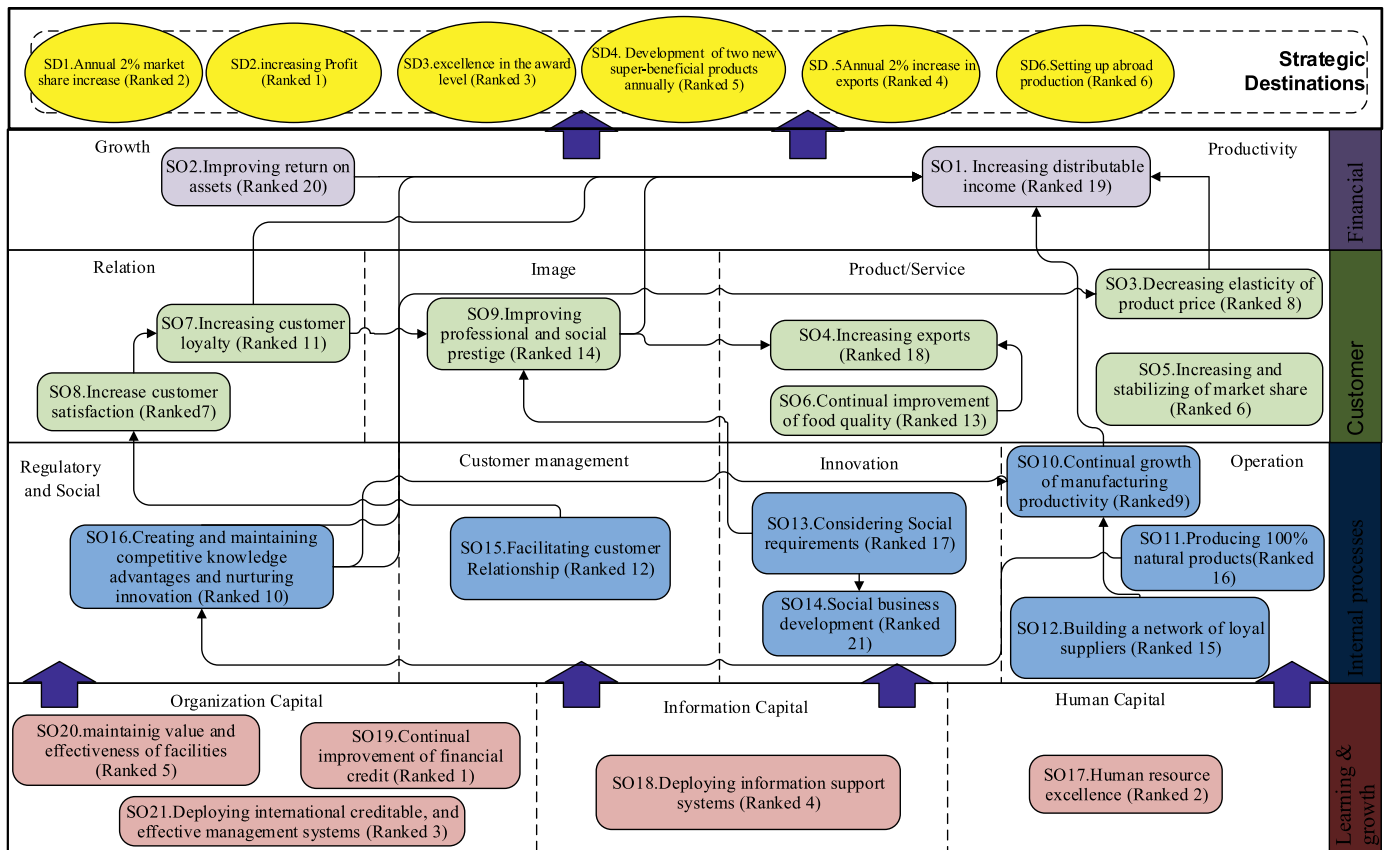


Fig. 5. Alpha Company's strategy map based on the objectives and destinations priority.

4.2.1. Finding the weights

Finding the weights, hence the importance degrees of the decision makers which are indicated in Table 6. The linguistic terms used for deriving the ratings of the decision makers and criteria are demonstrated in Table 7.

4.2.2. Construction of the aggregated intuitionistic fuzzy decision matrix depending on the decision makers' opinions

Decision matrix is a 21×6 matrix, in which 21 strategic objectives are defined as alternatives and 6 strategic destinations are defined as the criteria of decision-making problem.

To complete the decision matrix, the importance level of each strategic objectives for reaching each strategic destination was questioned. In other words, it was asked that: how much does each strategic objective help the organization reach each strategic destination. Table 8 shows the ratings obtained from the decision makers' opinions to 21 alternatives. Putting these opinions together, the aggregated intuitionistic fuzzy decision matrix is yielded (Table 9).

4.2.3. Determining the weights of the criteria

The weights derived from the FLLSM method are defuzzified using Eq. (10) and shown in Table 10.

4.2.4. Building the aggregated weighted intuitionistic fuzzy decision matrix

After the weights of the criteria and the rating of the alternatives are found, Eqs. (14) and (15) lead to the construction of the aggregated weighted intuitionistic fuzzy decision matrix as follows (Table 11).

4.2.5. Obtaining the intuitionistic fuzzy positive-ideal and negative-ideal solutions (Table 12)

Eqs. (17)–(21) yield the intuitionistic fuzzy positive-ideal and negative-ideal solutions as shown below.

4.2.6. Determining the similarity measures

Based on Eqs. (22) and (23), negative and positive similarity measures have been determined for each alternative according to Table 13.

4.2.7. Ranking the alternatives

Ultimately, Table 13 demonstrates the relative closeness coefficients for the twenty-one strategic objectives. The alternatives have been ranked in the descending order of the C_i 's thanks to Eq. (24).

4.3. Drawing the cause and effect relationships among the strategic objectives

The cause and effect relationships among the strategic objectives are obtained and the Alpha Company's strategy map is drawn. Strategic objectives are placed on the four aspects of the BSC model. In order to draw the organizational causal relationships, first, decision makers draw the relations between strategic objectives based on each strategic destination. The final map was then obtained from combination of six maps created in the previous step. According to these relationships as well as the importance degree of the destinations and objectives, the company's ultimate strategy map is drawn as Fig. 5.

5. Managerial implications

The prioritization obtained from step 6 can be used as a powerful tool by organizational managers, so that they could reach organizational goals faster and more efficiently. It is observed that the most helpful objectives in regard to organizational destinations, mostly lies in growth and learning perspective which in turn define organization's intangible assets and their role in strategy, and are divided into Human capital, information capital, and organizational capital categories. Alpha Company must improve its personnel, technology, and culture to reach the six destinations and put more focus on this perspective.

Table 14
Proposed strategic initiatives.

Row	Project title	Project type			Strategic objective
		QFIP	DIP	SI	
1	Investigating Organizational Culture of the Company		✓		Continual growth of manufacturing productivity
2	Investigating leadership style of the company		✓		Continual growth of manufacturing productivity
3	Establishing an Authorization System		✓		Continual growth of manufacturing productivity
4	Rearrangement of organizational structure			✓	Human resource excellence
5	Drawing a stakeholder map	✓			Continual improvement of food quality
6	Identifying different channels of communication with external stakeholders	✓			Continual improvement of food quality
7	Classifying leaders and identifying their channels of communication with employees	✓			Continual growth of manufacturing productivity
8	Formulation and implementation of succession system		✓		Human resource excellence
9	Developing a system for evaluating the personnel performance and its implementation		✓		Human resource excellence
10	Developing a Personnel training system			✓	Human resource excellence
11	Developing a job classification system		✓		Human resource excellence
12	(5S) Implementation of System		✓		Deploying internationally creditable, and effective management systems
13	Developing a system for evaluating performance and ranking suppliers and launching it		✓		Building a network of loyal suppliers
14	- Developing a system for interaction and collaboration with partners		✓		Continual improvement of financial credit
15	Investigating the establishment of internal audit of the company		✓		Continual improvement of financial credit
16	Implementation of the Environmental Standard (ISO 14001) and obtaining the relevant certificate		✓		Deploying internationally creditable, and effective management systems
17	Establishing an Energy Management Instruction and its implementation			✓	Maintaining value and effectiveness of facilities
18	Launching a fire alarm system			✓	Maintaining value and effectiveness of facilities
19	Implementation of the technology management system			✓	Deploying internationally creditable, and effective management systems
20	Implementing Knowledge Management			✓	Creating and maintaining competitive knowledge advantages and nurturing innovation
21	Implementation of the Quality Management Standard (ISO 9001: 2008) and obtaining the relevant certificate		✓		Deploying internationally creditable, and effective management systems
22	Implementing the Excellence Model in the company			✓	Deploying internationally creditable, and effective management systems
23	Launching a management dashboard system			✓	Deploying information support systems
24	Launching customer club			✓	Facilitating customer relationship
25	Developing R & D unit			✓	Producing 100% natural products
26	Performing charitable activities		✓		Improving professional and social prestige
27	Establishment of advertising campaigns		✓		Increasing customer satisfaction
28	CRM system development			✓	Increasing customer loyalty
29	Establishing offices in other countries of the region			✓	Increasing exports

There are three improvement project groups based on the strategic objectives. These groupings are in accordance with conduction cost and time of the project and include; strategic initiatives, development improvement project, and quick fix improvement project. The conduction time and cost of each group decreases, respectively. Table 14 shows the proposed improvement projects.

Based on the environmental condition of the organization and the level of accessible resources, allocation of funds by directors are enforced based on prioritization of strategic objectives. The Gantt chart of development projects are designed, performed and controlled based on the dedicated budget. Therefore, the strategic map is able to lead the organization with the least deviation from organizational destinations in times of resource constraints.

6. Conclusions

In this paper, a decision approach is provided to rank the existing strategic objectives of Alpha Company. The strategic objectives are considered as the alternatives, while strategic destinations play the role of the criteria here. The implementation stage of the proposed framework can be divided into two phases. The first phase is the strategic phase that includes the first three steps of the proposed framework, including development of the SWOT matrix, strategic positioning of the company and its generic strategy, formulation of the strategic destinations, and finally setting the strategic objectives based on the four aspects of the BSC model. The second phase consists of steps four to six, which begins with determining the importance of strategic destinations through fuzzy logarithmic least squares method. Then, in the fifth step, the strategic objectives are ranked

using a new intuition fuzzy similarity technique, and the second phase ends with drawing the strategy map in the sixth step. By specifying the more important objectives, which are those with the most effect on achieving the destinations of the organization strategy, more focus could be devoted to them. Thus, ranking the existing strategic objectives is one of the most critical steps in the implementation of strategy.

The proposed methodology may be implemented in all the organizations which intend to develop strategies. Utilizing the proposed comprehensive method may help us to carry out strategy development systematically, avoiding different strategy tools which cause confusion among strategists. The important limitations of this research are as follows: the researcher did not have complete control on factors influencing the managers' attitudes. Since strategic management is part of senior management, access to the senior managers to find their information and opinions was made available slowly and with difficulties. Moreover, a number of the senior managers did not have sufficient knowledge about strategic management subjects, which caused the researcher some problems. The use of other types of fuzzy numbers and their combination with the methods applied in this study can be considered as subjects in future studies. Another suggestion is to use dynamic simulation tool for modeling strategy maps optimally.

Conflict of interest

The authors have no conflict of interest.

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