Identify and evaluate factors affecting non-oil exports using FGDM

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Abstract: Economic development is one of the main objectives of every society in the world and economic growth is fundamental to economic development. Nowadays, the international trade policy is deemed as a key strategy in most countries, in such a manner that the process moves forward with a speed more than production growth of the goods and services rendered in developed countries. Non-oil export growth is one of the effective factors in the development of the country's economy. The aim of this study is to evaluating the effective factors on non-oil exports, using fuzzy multi criteria decision making. We contribute non-oil exports literature by identify and evaluate seven critical factors. The findings show that foreign direct investment, technology and quality of products are the most important factors that have significant impact on non-oil exports.

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1. Introduction

Economic development is one of the main objectives of every society in the world and economic growth is fundamental to economic development. There are many contributors to economic growth. Export is considered as one of the very important contributors among them.

Although there is no overall consensus that support the export led economic growth, there are some economists such as Kavoussi (1984), Ram (1985), and Salvatore and Hatcher (1991) that argue export benefit economic growth.

Nowadays, the international trade policy is deemed as a key strategy in most countries, in such a manner that the process moves forward with a speed more than production growth of the goods and services rendered in developed countries. Hence, one of the effective elements in line with the advancement of export development policies is the production of competitive products at the foreign markets.

Within the framework of trading strategies, reducing amount of imports and putting emphasis on the increase of domestic products and also in line with alternative policies for the imports which necessitate the admission of the supportive and tariff policies, and also the exports development policies as a supplementary strategy which seeks for elimination of trading obstacles and limitations, both of these two strategies are used for foreign exchange earnings which causes the improvement of international transactions and facilitates; one of the important economic objectives.

Non-oil export growth is one of the effective factors in the development of the country's economy. For example in developing countries, export of the agricultural products has been considered in order to supply the foreign currency as required for sectors of industry and consumption of the society (Naderi, 1992).

Non-oil goods are goods produced in rural production cooperatives, including agricultural products and crafts that can be exported abroad. Because the Iranian economy is among the oil-reliant economies, this reliance on oil revenue has gone so far that many economists consider it as the main cause of inflation and liquidity growth.

Non-oil exports are the rural production cooperatives' important performances which is effective to reduce the dependence on oil. After the first, second, and third development plans, the country has not completely achieved the anticipated objectives concerning the non-oil exports and they still have a little share of earnings than oil exports. Seriously revising production process in order to improve export's chain has become inevitable (Tavassoli, 2005). The aim of this research is to identify effective factor that have the most impact on non-oil export growth. For this reason we use fuzzy AHP to evaluate the weight of these factors.

The organization of this paper is as follows. Section 2 discusses the literature review. In Section 3, we explain the process of the research, fuzzy Delphi and fuzzy AHP methods. Section 4 is data analysis and the paper ends with concluding remarks in section 5.

2. Literature review

According to Mehrizi (2000), the factors that make our failure in international markets are: clear information about the market of exported goods, having no attention on advantage of country in export, attention to quality standards, defining goals and coordination.

Farokhian et. al., (2010), presented the effective factors on increasing the export from the standpoints ofthe Iranian exporters under a model. They found that four main factors influenced exports which were: Individual factor (education, experience, export knowledge, public communications), economical factor (export markets, governmental subsidies, export pricing, export marketing), environmental factor (rules and regulations, culture, technology, informal communications, political factor) and product marginal factor (design and packaging, quality of products, guarantee and after-sell services, distribution canals, products' brands).

In 2001 Zargarzade designed marketing strategies for agricultural products exporters. According to his research long term interest of export merchants is affected by proper selection of exportable goods and target markets regarding variety of factors and the choosing of goods and target markets should take place by considering these factors.

according to Aghdaie and Zardeini (2012), Lack of attention to world economic situation and having no proper marketing plan are the causes of Persian carpet retardation but the thing which has made the most damage to Persian handmade carpet and puts its Export in Danger is its Identity in Foreign Markets which is hidden versus take carpets of competitors, for example, sometimes it happens when a buyer goes to a carpet shop in his or her country for buying a Persian handmade carpet, The seller inadvertently or intentionally introduced some carpet which are not really Persian carpet and have only Persian design and woven by Iran's competing countries such as Pakistan and India

In 2011, 448 large Brazilian companies had been considered to identify effective factors on export. The results showed that the external environment, firm characteristics and firm strategy have important effect on export (Carneiro et. al., 2011).
Samimi and Peikani (2002), in their study mentioned internal and external effective factors and non-oil export development obstacles, optimize production weakness, export organization weakness and … as non-oil export problems through a forecasting study pattern.

Ghazizade in 2003 has studied the effect of four variables including target market environment, national and internal environment of the company and mixed marketing elements.

Darvishkhani in 2004 has studied the role of packing, mixed marketing elements and hygienic and nutritious standards and proved their positive effects on increasing local and global selling from producer's perspective.

On the other hand there are a number of ways through which Trade flows and foreign direct investment (FDI) can be linked. Goldberg and Klein, (1998) asserted that FDI may encourage export promotion, import substitution, or greater trade in intermediate inputs which often exist between parent and affiliate producers.

The orientation of most investments by multinational firms is towards exports and this may most likely serve as a catalyst for the integration of the FDI host economy to a global production network in sectors in which it may formerly have had no industrial experience (OECD, 1998). Rodriguez Clare (1996); Calderón, Mortimore and Peres (1996) argue that the very nature of the activities of multinational enterprises in Mexico could encourage the expansion of its industrial exports.

These studies clearly indicate that FDI could be associated with export trade in goods, and the host country may enjoy an FDI led export growth. Goldberg and Klein (1998, 1999) do not find evidence to support a significant link between FDI and aggregate exports in Latin America. According to them, the trade-promoting effects of FDI appear to be weak or insignificant with regard to Latin American trade with the United States and Japan. Their results also failed to find a systematic linkage between sectorial trade and FDI in Latin America. So according to literature these factors are extracted (see table 1).

Table 1; factor affecting the non-oil exports

Row	Factors	Row	Factors
1	Education	10	Culture
2	Experience	11	Informal communications
3	Governmental subsidies	12	Technology
4	Public communications	13	Design and packaging
5	Exports' markets	14	Quality of products
6	Foreign direct investment	15	Guarantee and after-sell services
7	Export pricing	16	Distribution canals
8	Export marketing	17	Products' brands
9	Rules and regulations	18	export knowledge

2.1. Fuzzy logic

Fuzzy set theory first was introduced by Zadeh (1965) to map linguistic variables to numerical variables within decision making processes. Then the definition of fuzzy sets were manipulated to develop Fuzzy Multi-Factors Decision Making (FMCDM) methodology by Bellman and Zadeh (1970) to resolve the lack of precision in assigning importance weights of factors and the ratings of alternatives against evaluation factors.

A fuzzy set is characterized by a membership function, which assigns to each element a grade of membership within the interval $[0,1]$, indicating to what degree that element is a member of the set (Bevilacqua, Ciarapica, & Giacchetta, 2006). As a result, in fuzzy logic general linguistic terms such as ''bad'', ''good'' or ''fair'' could be used to capture specifically defined numerical intervals.

A tilde ''~'' will be placed above a symbol if the symbol represents a fuzzy set. A triangular fuzzy number (TFN) $\tilde{M}$ is shown in Fig. 1. A TFN is denoted simply as (l,m,u). The parameters l, m and u denote the smallest possible value, the most promising value and the largest possible value that describe a fuzzy event (Kahraman, Cebeci, & Ruan, 2004). When l = m = u, it is a non-fuzzy number by convention (Chan & Kumar, 2007).

Each TFN has linear representations on its left and right side such that its membership function can be defined as (Kahraman, Cebeci, & Ruan, 2004);

$$m_{\tilde{M}} = \begin{cases} 0, x < l \\ (x-l)/(m-l), l \le x \le m \\ (u-x)/(u-m), m \le x \le u \\ 0, x > u \end{cases} \quad (1)$$

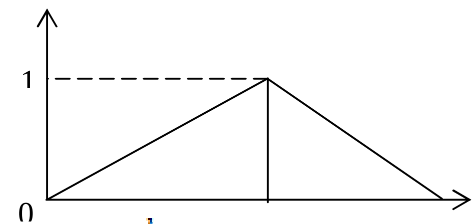

Fig 1: A triangular fuzzy number, $\tilde{M}$ (Kahraman, Cebeci, & Ruan, 2004)

$\otimes$: multiply fuzzy numbers, e.g. assuming two triangular fuzzy numbers

$$\tilde{A} = (a_1, b_1, c_1), \tilde{B} = (a_2, b_2, c_2)$$

$$\tilde{A} \otimes \tilde{B} = (a_1 \times a_2, b_1 \times b_2, c_1 \times c_2) \quad (2)$$

$\oslash$: divide fuzzy numbers, e.g.: assuming two triangular fuzzy numbers

$$\tilde{A} = (a_1, b_1, c_1), \tilde{B} = (a_2, b_2, c_2)$$

$$\tilde{A} / \tilde{B} = (a_1 / a_2, b_1 / b_2, c_1 / c_2) \quad (3)$$

3. Methodology

This study proposes a process integrating fuzzy Delphi and fuzzy AHP methods to engage the challenge of factors selection and evaluation. Our experts are ten people of Industry, Mines and Trade organization with over 8 years of experience in this organization. Firstly we define factors that are extracted from literature. Then the fuzzy Delphi method effectively gathers information toward developing critical factors. In this problem, the relative importance of different decision factors involves a high degree of subjective judgment and individual preferences. The linguistic assessment of human feelings and judgments are vague and it is not reasonable to represent them in terms of precise numbers. It feels more confident to give interval judgments. Therefore triangular fuzzy numbers were used in this problem to decide the priority of one decision factors over another. The triangular fuzzy numbers were determined from reviewing literature (Kahraman, C.; Cebeci, U.; Ulukan, Z., 2003). In order to evaluate the weights of factors that were obtained by fuzzy Delphi method, fuzzy AHP was used.

3.1. Fuzzy Delphi method:

Murry et al. (1985) proposed the concept of integrating the traditional Delphi Method and the fuzzy theory to improve the vagueness of the Delphi Method. Membership degree is used to establish the membership function of each participant. Ishikawa et al. (1993) further introduced the fuzzy theory into the Delphi Method and developed max–min and fuzzy integration algorithms to predict the prevalence of computers in the future. In this study we used Fuzzy Delphi Method was proposed by Ishikawa et al. (1993), and it was derived from the traditional Delphi technique and fuzzy set theory.

Noorderhaben (1995) indicated that applying the Fuzzy Delphi Method to group decision can solve the fuzziness of common understanding of expert opinions. In this study we use eleven experts to extract the critical factors of Industry, Mines and Trade organization.

The FDM steps are as follows:

1) Collect opinions of decision group: Find the evaluation score of each alternate factor's significance given by each expert by using linguistic variables in questionnaires.
2) Set up triangular fuzzy numbers: Calculate the evaluation value of triangular fuzzy number of each alternate factor given by experts, find out the significance triangular fuzzy number of the alternate factor. This study used the geometric mean model of mean general model proposed by Klir and Yuan (1995) for FDM to find out the common understanding of group decision.

The computing formula is illustrated as follows:

Assuming the evaluation value of the significance of No. j element given by No. i expert of n experts is $\tilde{W} = (a_{ij}, b_{ij}, c_{ij}), \quad i = 1,2,\ldots,n, \quad j = 1,2,\ldots,m$.

Then the fuzzy weighting $\tilde{W}$ of No j Element is $\tilde{W}_{ij} = (a_{ij}, b_{ij}, c_{ij}), \; j = 1,2,\ldots,m$.

Among which $a_j = \min\{a_{ij}\}, b_j = \frac{1}{n}\sum_{i=1}^{n} b_{ij}$, $c_j = \max\{c_{ij}\}$. (4)

3) Defuzzification : Use simple center of gravity method to defuzzify the fuzzy weight $\tilde{W}_{ij}$ of each alternate element to definite value Sj, the followings are obtained:

$$S_j = \frac{a_j + 4b_j + c_j}{6}, \qquad j = 1,2,\ldots,m$$

(5)

4) Screen evaluation indexes: Finally proper factors can be screened out from numerous factors by setting the threshold a. The principle of screening is as follows:

If $Sj \geq a$, then No. j factor is the evaluation index.

If $Sj < a$, then delete No. j factor.

Table 2; Linguistic variables for importance of each factor

Absolutely appropriate	(9,10,10)
Appropriate	(7,9,10)
Slightly appropriate	(5,7,9)
Neutral	(3,5,7)
Slightly inappropriate	(1,3,5)
Inappropriate	(0,1,3)
Absolutely inappropriate	(0,0,1)

For the threshold value r, the 80/20 rule was adopted with r set as 0.8. This indicated that among the factors for selection, ''20% of the factors account for an 80% degree of importance of all the factors''. The selection factors were:

If MA $\geqq$ r =0.8, this appraisal indicator is accepted.

If MA $<$ r = 0.8, this appraisal indicator is rejected.

3.2. Fuzzy Analytic Hierarchy Process

Laarhoven and Pedrycz (1983) proposed the Fuzzy Analytic Hierarchy Process in 1983, which was an application of the combination of Analytic Hierarchy Process (AHP) and Fuzzy Theory. The linguistic scale of traditional AHP method could express the fuzzy uncertainty when a decision maker is making a decision. Therefore, FAHP converts the opinions of experts from previous definite values to fuzzy numbers and membership functions, presents triangular fuzzy numbers in paired comparison of matrices to develop FAHP, thus the opinions of experts approach human thinking model, so as to achieve more reasonable evaluation factors.

Laarhoven and Pedrycz (1983) proposed the FAHP, which is to show that many concepts in the real world have fuzziness. Therefore, the opinions of decision makers are converted from previous definite values to fuzzy numbers and membership numbers in FAHP, so as to present in FAHP matrix.

Table 3; Linguistic variables for weight of each factor

Extremely strong	(9,9,9)
Intermediate	(7,8,9)
Very strong	(6,7,8)
Intermediate	(5,6,7)
Strong	(4,5,6)
Intermediate	(3,4,5)
Moderately strong	(2,3,4)
Intermediate	(1,2,3)
Equally strong	(1,1,1)

The steps of this study based on FAHP method are as follows:

1) Determine problems: Determine the current decision problems to be solved, so as to ensure future analyses correct; this study discussed the ‘‘evaluation factors for verification of supplier selection factors”.
2) Set up hierarchy architecture: Determine the evaluation factors having indexes to be the factors layer of FAHP, for the selection of evaluation factors, relevant factors and feasible schemes can be found out through reading literatures. This study screened the important factors conforming to target problems through FDM investigating experts’ opinions, to set up the hierarchy architecture.
3) Construct pairwise comparison matrices among all the elements/factors in the dimensions of the hierarchy system. Assign linguistic terms to the pairwise comparisons by asking which is the more important of each two dimensions, as following matrix $\tilde{A}$:

$$\tilde{A} = \begin{pmatrix} 1 & \tilde{a}_{21} & \Lambda\,. & \tilde{a}_{21} \\ \tilde{a}_{21} & 1 & \Lambda & \tilde{a}_{21} \\ & & & \\ \tilde{a}_{21} & \tilde{a}_{21} & \Lambda & 1 \end{pmatrix} = \begin{pmatrix} 1 & \tilde{a}_{21} & \Lambda\,. & \tilde{a}_{21} \\ \frac{1}{\tilde{a}_{21}} & 1 & \Lambda & \tilde{a}_{21} \\ & & & \\ \frac{1}{\tilde{a}_{21}} & \frac{1}{\tilde{a}_{21}} & \Lambda & 1 \end{pmatrix}$$

$$\text{Where } \tilde{a}_{ij} \begin{cases} \tilde{9}^{-1},\tilde{8}^{-1},\tilde{7}^{-1},\tilde{6}^{-1},\tilde{5}^{-1},\tilde{4}^{-1},\tilde{3}^{-1},\tilde{2}^{-1},\tilde{1}^{-1},\tilde{1},\tilde{2},\tilde{3},\tilde{4},\tilde{5},\tilde{6},\tilde{7},\tilde{8},\tilde{9} & i \neq j \\ \tilde{1} & i = j \end{cases}$$

4) To use geometric mean technique to define the fuzzy geometric mean and fuzzy weights of each factor by Hsieh et al. (2004).

$$\tilde{r}_i = \left(\tilde{a}_{i1} \otimes \tilde{a}_{i2} \otimes .... \otimes \tilde{a}_{in}\right)^{\frac{1}{n}} \quad (6)$$

$$\tilde{w}_i = \tilde{r}_i \otimes \left(\tilde{r}_1 \oplus \tilde{r}_2 \oplus .... \oplus \tilde{r}_n\right)^{-1} \quad (7)$$

Where a_{ij} is fuzzy comparison value of dimension i to factor j , thus, $\tilde{r}_i$ is a geometric mean of fuzzy comparison value of factor i to each factor, $\tilde{w}_i$ is the fuzzy weight of the ith factor, can be indicated by a TFN, $\tilde{w}_i = \left(lw_i, mw_i, uw_i\right)$.

The lw_i , mw_i and uw_i stand for the lower, middle, and upper values of the fuzzy weight of the ith dimension.

4. Data analysis

Stage one: reviewing relevant literature of non-oil export and proposing important factors: 18 factors for non-oil export based on relevant literature are proposed.

Stage two: Screen important factors by fuzzy Delphi Method: First a DM interview table is setup and second interview was done with ten experts from Industry, Mines and Trade organization.

Seven factors were extracted from this stage (see table 8).

Table 4; the extracted factors by FDM

Row	**Factor**
1	F1: Governmental subsidies
2	F2: Foreign direct investment
3	F3:Rules and regulations
4	F4:Technology
5	F5:Quality of products
6	F6: Distribution canals
7	F7: Export knowledge

Stage three: The weights of evaluation factors

We adopt fuzzy AHP method to evaluate the weights of different factors affecting non-oil export. Following the construction of fuzzy AHP model, it is extremely important that experts fill the judgment matrix.

According to the committee with ten representatives about the relative important of factors, the pairwise comparison matrices of factors will be obtained. We apply the fuzzy numbers defined in Table 4. We transfer the linguistic scales to the corresponding fuzzy numbers. Computing the elements of synthetic pairwise comparison matrix by using the geometric mean method suggested by Buckley (1985) that is:

$$\tilde{a}_{12} = (\tilde{a}_{ij}^{1} \otimes \tilde{a}_{ij}^{2} \otimes \ldots \otimes \tilde{a}_{ij}^{10})^{\frac{1}{10}}$$

For example

$$\tilde{a}_{12} = ((0.167, 0.2, 0.25) \otimes (0.125, 0.143, 0.167) \otimes (0.25, 0.33, 0.5) \otimes (4, 5, 6) \otimes (0.33, 0.5, 1) \otimes$$

$$(0.167, 0.2, 0.25) \otimes (0.167, 0.2, 0.25) \otimes (0.25, 0.33, 0.5) \otimes (1, 2, 3) \otimes (0.25, 0.33, 0.5))^{\frac{1}{10}} = (0.32, 0.43, 0.6)$$

It can be obtained the other matrix elements by the same computational procedure, therefore, the synthetic pairwise comparison matrices of the five representatives will be constructed as follows matrix **A**:

Table 5; Fuzzy comparison matrix for the relative importance of factors

	F1			F2			F3			F4			F5			F6			F7		
F1	1	1	1	0.32	0.43	0.60	1.05	1.35	1.78	0.47	0.62	0.81	0.56	0.73	1.03	2.73	3.55	4.43	2.08	2.79	3.60
F2	1.67	2.33	3.10	1	1	1	2.42	3.31	4.14	1.08	1.42	1.81	1.24	1.66	2.26	4.02	4.89	5.95	3.27	4.05	4.89
F3	0.56	0.74	0.96	0.25	0.31	0.43	1	1	1	0.35	0.43	0.56	0.48	0.62	0.82	2.17	2.67	3.19	1.18	1.59	2.11
F4	1.23	1.61	2.12	0.55	0.70	0.93	1.79	2.31	2.84	1	1	1	0.99	1.34	1.80	3.73	4.59	5.64	2.51	3.36	4.25
F5	0.97	1.37	1.77	0.44	0.60	0.81	1.22	1.61	2.07	0.56	0.75	1.01	1	1	1	3.57	4.33	5.16	2.22	3.03	3.90
F6	0.23	0.28	0.37	0.17	0.20	0.25	0.31	0.37	0.46	0.18	0.22	0.27	0.19	0.23	0.28	1	1	1	0.4	0.5	0.68
F7	0.28	0.36	0.48	0.20	0.25	0.31	0.44	0.60	0.81	0.23	0.29	0.38	0.26	0.33	0.45	1.47	1.99	2.52	1	1	1

To calculate the fuzzy weights of factors, the computational procedures are displayed as following parts:

$$\tilde{r}_1 = (\tilde{a}_{11}\otimes\tilde{a}_{12}\otimes\tilde{a}_{13}\otimes\tilde{a}_{14}\otimes\tilde{a}_{15}\otimes\tilde{a}_{16}\otimes\tilde{a}_{17})^{\frac{1}{7}}$$

$$\tilde{r}_1 = \big((1,1,1)\otimes(0.32,0.43,0.6)\otimes(1.05,1.35,1.78)\otimes(0.47,0.62,0.81)$$
$$\otimes\,(0.56,0.73,1.03)\otimes(2.73,3.55,4.43)\otimes(2.08,2.79,3.6)\big)^{\frac{1}{7}} = (0.908,1.145,1.462)$$

Table 6; The fuzzy comparison value of each factor among other factors

$\tilde{r}_i$	lr_i	mr_i	ur_i
$\tilde{r}_1$	0.909	1.145	1.462
$\tilde{r}_2$	1.838	2.319	2.851
$\tilde{r}_3$	0.670	0.826	1.035
$\tilde{r}_4$	1.413	1.768	2.189
$\tilde{r}_5$	1.126	1.443	1.796
$\tilde{r}_6$	0.287	0.342	0.416
$\tilde{r}_7$	0.417	0.518	0.655

For the weight of each factor, they can be done as follows:

$$\tilde{W}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \tilde{r}_3 \oplus \tilde{r}_4 \oplus \tilde{r}_5 \oplus \tilde{r}_6 \oplus \tilde{r}_7)^{-1}$$
$$\tilde{W}_1 = \tilde{r}_1 \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \tilde{r}_3 \oplus \tilde{r}_4 \oplus \tilde{r}_5 \oplus \tilde{r}_6 \oplus \tilde{r}_7)^{-1}$$
$$\tilde{W}_1 = (0.908, 1.145, 1.462) \otimes (1/(1.462 + 2.851 + 1.034 + 2.189 + 1.796 + 0.415 + 0.655),$$
$$1/(1.145 + 2.319 + 0.826 + 1.767 + 1.443 + 0.341 + 0.518),$$
$$= 1/(0.908 + 1.837 + 0.669 + 1.413 + 1.125 + 0.287 + 0.416) = (0.087, 0.137, 0.219)$$

We also can calculate the remaining $\tilde{W}_j$, there are:

Table 7; the weights and rank of factors

$\tilde{W}_j$	**a**	**b**	**c**	**Rank**	**Factor**
$\tilde{W}_1$	0.087	0.137	0.220	4	governmental subsidies
$\tilde{W}_2$	0.177	0.277	0.428	1	Foreign direct investment
$\tilde{W}_3$	0.064	0.099	0.155	5	Rules and regulations
$\tilde{W}_4$	0.136	0.211	0.329	2	Technology
$\tilde{W}_5$	0.108	0.173	0.270	3	Quality of products
$\tilde{W}_6$	0.028	0.041	0.062	7	distribution canals
$\tilde{W}_7$	0.040	0.062	0.098	6	export knowledge

5. Conclusion

The role of exports in economic performance of developing countries has become one of the more intensively studied topics in recent years. The major impetus for most studies on this relationship is the export-led economic growth which interestingly represents a dominant explanation in this context. The performance of non-oil export sector, as pointed out earlier, has however been relatively impressive in recent times.

We developed non-oil export literature by extracting and evaluating critical factors that affecting non-oil export. By this work seven factors were extracted that are; governmental subsidies, foreign direct investment, rules and regulations, technology, quality of products, distribution canals and export knowledge. As it is consider in table X foreign direct investment, technology and quality of products are the most important factor that have significant impact on non-oil export. Furthermore list of factors that have impact on non-oil export were extracted from non-oil export literature.

This study used MADM method for the first time in order to extract and evaluate factors affecting non-oil export. In general, selection problems as well as any human decision making are vague and uncertain, and so fuzzy set theory helps to convert DM preferences and experiences into meaningful results by applying linguistic values to measure each factor. In this paper, a multi-criteria group decision making model has been used based on fuzzy set theory to efficiently deal with the ambiguity of the decision making problems in practical cases to evaluate the factors.

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