Evaluation, Prioritization and Selection Capabilities Agility of the Organization by Using Quantitative Models Fuzzy Decision

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Abstract

There are different ways of prioritizing and choosing agility capabilities of organization, most of which are considered as one part of compensatory multi-criteria decision making methods. Using data envelopment analysis method, fuzzy TOPSIS, a new approach was developed for prioritization of agility capabilities based on environmental needs of the organization. Present investigation was carried out at tow frequent stages. At first, agility drivers of the organization were identified and then at second stage, the agility capabilities were prioritized based on their efficiency and their effects on overcoming drivers explored from first step. At first stage agility drivers of the organization were ranked and key drivers were selected using fuzzy TOPSIS technic and deficits planning approach and based on three criteria of accountability, effect on organizational activities and intensity of change. At second stage, agility capabilities explored from the study were tested using fuzzy data envelopment analysis technic.
Key words: Fuzzy TOPSIS, fuzzy data envelopment analysis (FDEA) and agility capabilities

Introduction

Manufacturing organizations have confronted unprecedented and rapid changes in technology, competition and customer need during recent two decades. Such changes, have led the organizations to new challenges, ignoring them can threaten success and survival of the organizations, considerably. Most organizations have started identification and understanding of their distinguished competencies and they have adapted different tools and acts to improve their competitiveness. Adaptation of such acts is based on emerge of a new manufacturing paradigm known as agile production. Agile production is resulted by changes in the environment[17] and it is a logic model which can be adapted to environmental changes rapidly, meeting needs of informed, expecting and aware customers[30]. Most studies in the field of agility have achieved theoretical models of agility, but regarding implementation method and development of operational models, less studies have been conducted[5]. The introduced quantitative methods for prioritization of capabilities are generally of compensatory type such as total weight or weighted average and hence they are not efficient in some cases. The aim of present article is to use data envelopment analysis technic as a method for evaluating and selecting agility abilities needed in the organization. Moreover its aim is to investigate and use organization's needed capabilities to respond drivers based on agility drivers. Hence first, change factors and agility drivers explored from agility studies were ranked and key drivers were selected using fuzzy TOPSIS technic and considered criteria. Then agility capabilities were prioritized and evaluated using appropriate model of data envelopment analysis and based on their effects and relationship with key drivers of agility. In this investigation, importance coefficient of criteria was included in data envelopment analysis model by weight control. The proposed method was tested in a private part maker industry. The overall framework of the study was based on fuzzy logic. The reason for this is appropriate converting of individual's verbal judgments to numerical values. Following sections of the paper have been organized as follows:

One of the pieces of industry

Chapter two proceeds on theoretical framework and review of related literature, chapter 3 discusses technics used in the study, chapter 4 explains methodology of the study, chapter 5 proceeds on implementation of technics and their results and chapter 6 discusses conclusion of the study.

Theoretical Framework and Review of Related Literature:

1. The Concept of Organizational Agility:

Organizational agility is resulted by agile manufacturing and agile manufacturing is a concept which has been generalized during recent years, being adapted as a successful strategy by manufacturers who prepare themselves for

considerable improved performance. The objective of these manufacturers is to be considered as leading factor at national and international level (in a competitive market where customers' needs are changing frequently) [21]. According to Sharifi and Jang's definition (2000), agility is capability of the organization in feeling, comprehending and predicting changes occurred at business environment. Generally the concept of agility involves two basic parts [14]:
1-Responding to the changes (which are unexpected or unpredicted) in an appropriate method at appropriate time
2-using changes and making them as opportunities
Hence, an agile organization is an organization with wide view to new disciplines of business world, with a hand full of capabilities to cope with turbulences and confusions and using advantageous aspects of changing condition [21].

2. Agility Drivers:

The business environment as a turbulence, uncertainty and change factor impose much pressure on business activities of the organization. These changes and imposed pressures of business environment act as driving force, advancing the organization toward taking agility strategy. These factors which are agility drivers, force the organization to find a way to keep their competitive advantage [19].

3. Agility Capabilities:

Agile organizations and corporations are concern about changes, uncertainty and no prediction at business environment. These organizations need some distinguished capabilities to cope with their changes, uncertainty and unpredictability at their working environment. Agility capabilities have been studied widely in previous studies. Kidd (1995) believes that agility can be achieved by integration of organizational procedures, knowledgeable and skilled work force and developed technology[10]. Sharif and Jang (2001) proposed a network model as in figure (1) to select agility capabilities and empowerment which connect agility drivers to agility empowerment in a way that agility capabilities act as an intermediary factor between them. Enablers are factors which facilitate achieving capabilities in the organization including human resource management, information technology and knowledge management. Hence determination of importance of such capabilities are important in tow aspects of: choosing appropriate capabilities for better responding to environmental changing conditions and helping to choose appropriate capabilities to achieve abilities. According to the model, importance coefficient of capabilities is function of change intensity, drivers' pressure and the relationship between drivers and capabilities.

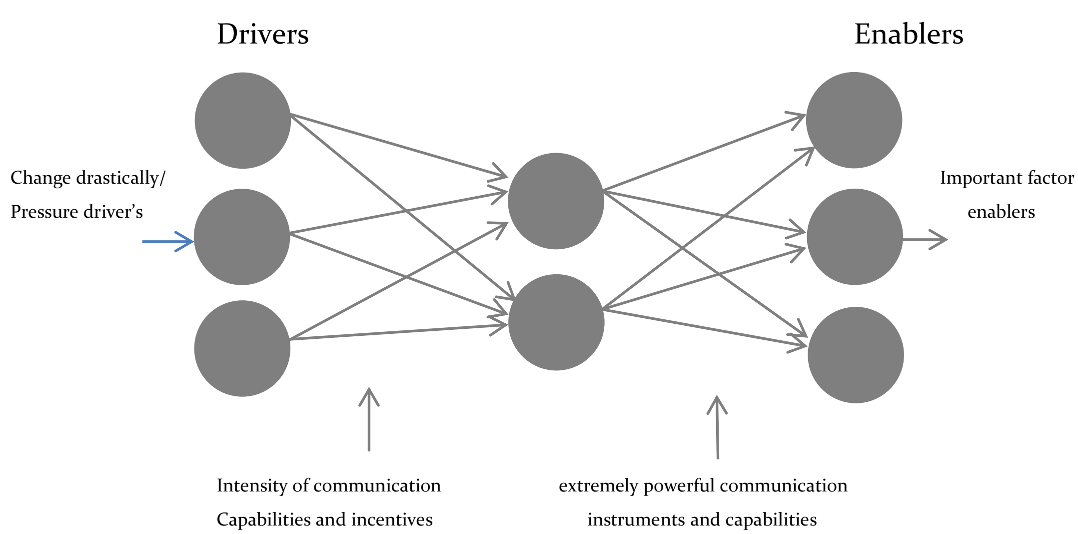


Figure (1): Select agility capabilities the network model(Sharifi and Jang,2001)

Sharifi and Jang also proposed a quantitative method for estimating importance coefficient of capabilities where the importance coefficient of capabilities are calculated based on their relationship with drivers and using simple method of total weight in a way that change intensity or pressure of every driving factor is considered as the driver's weight. Based on this method, the importance coefficient of capabilities is estimated by relation (1):

$$C_j = \sum_{i=1}^{n} D_i R_{ij}, \qquad j = 1,2,\dots,m \qquad (1)$$

Where n shows number of drivers, m is number of capabilities, C_J is importance coefficient of J^{th} capability, D_i is change level or pressure factor of I^{th} change and R_{ij} is effect of J^{th} capability in i^{th} change field. In a similar method Tsang et.al

(2011) developed and used fuzzy weighted average to determine level of competence of agility capabilities in the organization which can be estimated as relation (2) :

$$\widetilde{C_j} = \frac{\sum_{i=1}^{n} \widetilde{w}_i \widetilde{R}_{ij}}{\sum_{i}^{n} \widetilde{W_i}} \quad , \qquad j = 1, \dots, m \qquad (2)$$

Where $\widetilde{W_i}$, $\widetilde{R_{ij}}$ are fuzzy values which show change intensity of ith and effect of jth capability on driver I, respectively. Moreover n shows number of drivers and m is number of studied capabilities. As it can be seen first, agility drivers of the organization and change intensity or pressure of these factors should be determined to identify importance coefficient of capabilities needed in the organization and then we should proceed on investigation of the relationship between capabilities and drivers. In this investigation, considering multiple criteria, importance coefficient for ranking the drivers and investigation of the key factors were obtained which are replaced with change intensity of the factors in previously mentioned relations. First, a general list of agility drivers were prepared to investigate agility drivers of the organization, then its influential factors were evaluated by experts of the organization. Hence, through reviewing related literature, the existing classifications in the field of driver factors of change were investigated along with criteria used in different studies for evaluation of such factors and Sharifi and Jung's(2001) classification was selected as basis of the work[30]. Then through semi-organized interviews with elites of studied industry, driver factors of change which are especially for organizational environment were added to the classification [13]. Then three criteria were selected which were in accordance with type of considered driver (according to previous studies) in order to evaluate the factors[3]. Final list of drivers and influential criteria in drivers' evaluation process can be seen in tables 1 and 2.

Table (1): initial selected drivers

aspects	indexes	Reference
Change in the market	Failure in the market and development of new specific markets	Sharifi and Jung(2001), Tsang et.al (2011)
	Decreased life of manufactured products	Goldman et.al (1995), Sharifi and Jung (2001), Tsang et.al (2011)
Change in competition criteria	Emerge of new competitors	Industry elite's comment
	Increased competition to take market share	Sharifi and Jung(2007), Tsang et al. (2011)
	Increase of costs pressure	Sharifi and Jung(2001), Tsang et al. (2011)
	Increase of innovation rate in the products	Sharifi and Jung(2001), Tsang et al. (2011)
Change in customers' need	Increase of customers' expectation from quality	Sharifi and Jung(2001), Adliyeh and Yusef(2003)
	Reduce of orders delivery time	Sharifi and Jung(2001), Adliyeh and Yusef(2003)
	Customization of the products	Sharifi and Jung(2001), Adliyeh and Yusef(2003)
Technological changes	Presenting new hardware equipment	Sharifi and Jung(2001),
	Introducing new software and production method	Sharifi and Jung(2001),
	Introducing new consumed materials and components	Industry elite's comment
Change in political-social factors	Environmental pressures	Sharifi and Jung(2001),
	Changing needs and expectations of the government	Industry elite's comment

Table (2): influential criteria in evaluation of drivers

row	Criteria	Reference
1	intensity and level of change/pressure	Sharifi and et.al (2000, 2001), Tsang et al. (2011)
2	Effect of change factor on company's activities	Tsang et.al (2011)
3	Difficulty in responding changes and accordance with it	Hilgerzberg et.al (2006)

At second step, the classification of capabilities introduced by Jafarnejad(2007)[19] which was a combination of Sharifi and Jung's(2001)[30] view and Yusef et.al (1999)[17] was selected as basis of the study and then the factors were investigated in the form of interview for indexes in accordance with real conditions of the studied industry and achieving more realistic results in the studies and finally 32 factors were considered as studied capabilities which were in accordance with industrial conditions, use of which was possible at work place of the industry. These capabilities can be seen in table (3):

Table (3): selected agility capabilities for evaluation

row	Agility capabilities
1	Having multi-skill, deserved and empowered personnel
2	High quality products and services
3	Efficiency of costs
4	Designing and manufacturing products at shortest possible time
5	Operations efficiency and effectiveness(purity)
6	Unity and integration of sections of organization
7	Agility in delivery
8	Activity of empowered staff in the form of work teams
9	Flexibility in pattern and size of manufactured products
10	Leadership in using modern technologies
11	Continuous improvement and changes
12	Appropriate designing at first time

After determining evaluated agility capabilities, using data envelopment analysis , we proceeded on evaluation and prioritization of agility capabilities based on their relationship with key drivers. The research procedure schema can be seen in figure (2).

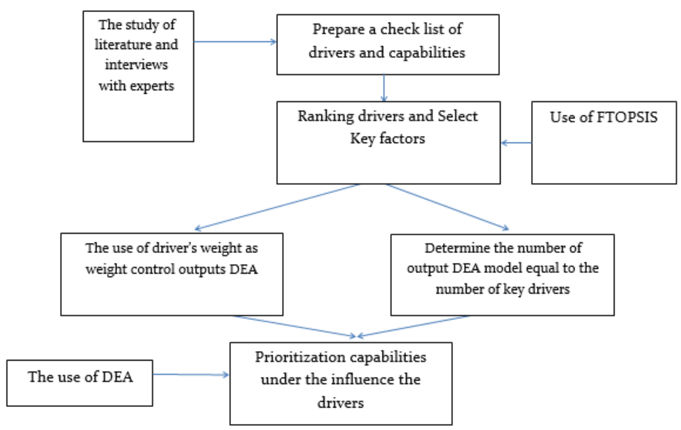


Figure (2): The project

Use of FTOPSIS and Fuzzy DEA technics for evaluation and selection of agility capabilities:

1. Fuzzy TOPSIS technic:

TOPSIS is one of multi-criteria decision making methods which ranks m items based on n criteria [2]. The base of the method is item selection which has least distance from ideal positive answer and has most distance from negative ideal response. In this investigation we used TOPSIS method developed by Chen (2000) with fuzzy data. In this method using alpha cuts and with the aid of principle of development the index of relative similarity (CCi) is estimated as distance value (Chen 2000). It is worth mentioning that due to limited amount of presented issues in the paper, it was not possible to discuss the method and we only rely on mentioning references.

2.Use of fuzzy DEA technic to evaluate agility capabilities:

Data envelopment analysis is a method used to determine relative efficiency of a group with similar decision maker units which use several input to produce several output. Traditional models of data envelopment analysis require accurate and definite data as model input and output; most of such data are not available at real world. Hence we tried mostly in this model to use fuzzy data. In this investigation, the model developed by Wang and Chin (2011) was used which will be explained later.Verbal variables and fuzzy values used in this investigation for evaluations can be seen in table 4.

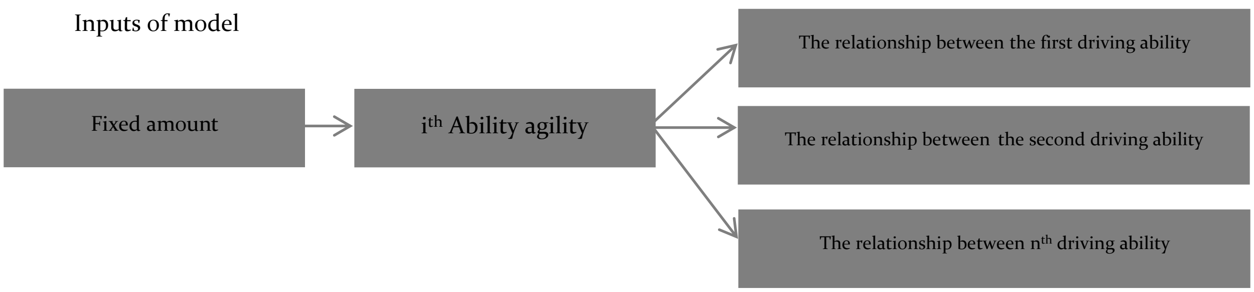
Table (4): verbal variables and fuzzy values (Chen and Huang 2006)

Verbal variables	Triangle Fuzzy numbers
Extremely low	(0,0,1)
Low	(0,1,3)
Relatively low	(1,3,5)
Normal	(3,5,7)
Relatively high	(5,7,9)
High	(9,7,10)
Extremely high	(9,10,10)

The aim of present investigation is to use fuzzy DEA technic to prioritize organization's needed capabilities. Although the technic was developed to evaluate efficiency of decision making units, considering initial requirements of the technic, it can be also used as an instrument for prioritizing agility capabilities. In this investigation instead of evaluating organizations efficiency, capabilities efficiency was evaluated in terms of their effects on improvement of organizations' agility. Hence considering similar input and output indexes for these units (capabilities) , the use of this technic is justifiable for evaluation of capabilities.

3. Explaining model inputs and outputs:

According to methods developed by Sharifi and Jung (2001) and Tsang (2011), importance coefficient of each capability is a function of capabilities' relationship with drivers and intensity of change and drivers pressure. In this investigation number of output variables equal number of agility drivers and their values equal the relationship of every capability with drivers and importance coefficient of drivers as outputs weight related to each driver was implemented as weight control on outputs. The used values were obtained by survey of elites in the field. Since decision maker units have a concept distinguished from manufacturing systems, without input, it is possible to consider a fixed value for all units. Moreover the use of output-based model for evaluation of capabilities was recognized appropriate and the output to scale model of variable was used due to unclear output to scale. Units with the same value of input which had more output, have higher efficiency being at top of selection priority. The proposed model can be displayed as fig(3).



Fig(3): The proposed model of DEA

Explaining DEA technic used in the study:

In this investigation we used Wang and Chin (2011)[16] to evaluate and rank agility capabilities. In this model, in an impetus environment tow values of optimistic (θ^{best}) efficiency and pessimistic efficiency (θ^{worst}) were considered for objective function and then geometrical mean of tow values were used as a criteria for ranking and determining most efficient unit. If triangle fuzzy numbers are defined as $A=(a^L, a^m, a^u)$ then the BCC model of output multiple axis will be as relation (1) to estimate optimistic efficiency:

$$\min \theta_p^{best} = \sum_{i=1}^{m} \left(v_i^L x^{L_{ip}} + 2v_i^M x^{M_{ip}} + v_i^U x^{U_{ip}} \right) + \left(v^{L_0} + v^{M_0} + v^{U_0} \right)$$

$$st: \sum_{r=1}^{s} \left(u^{L_r} y^{L_{rp}} + 2u^{M_r} y^{M_{rp}} + u^{U_r} y^{U_{rp}} \right) = 1$$

$$\sum_{i=1}^{m} \left(v^{L_i} x^{L_{ij}} + 2v^{M_i} x^{M_{ij}} + v^{U_i} x^{U_{ij}} \right) - \sum_{r=1}^{s} \left(u^{L_r} y^{L_{rj}} + 2u^{M_r} y^{M_{rj}} + u^{U_r} y^{U_{rj}} \right) + \left(v^{L_0} + v^{M_0} + v^{U_0} \right) \geq 1 \quad , j = 1, 2, \dots, n \qquad (1)$$

$$v^{U_i} \geq v^{M_i} \geq v^{L_i} \geq 0 \quad i = 1, 2, \dots, m$$

$$u^{U_r} \geq u^{M_r} \geq u^{L_r} \geq 0 \quad r = 1, 2, \dots, s$$

$$v^{U_0} \geq v^{M_0} \geq v^{L_0}$$

And to calculate the cynical performance of equation (2) is used**:**

$$\max \ \theta_p^{worst} = \sum_{i=1}^{m} \left(v_i^L x^{L_{ip}} + 2v_i^M x^{M_{ip}} + v_i^U x^{U_{ip}} \right) + \left(v^{L_0} + v^{M_0} + v^{U_0} \right)$$

$$st: \sum_{r=1}^{s} \left(u^{L_r} y^{L_{rp}} + 2u^{M_r} y^{M_{rp}} + u^{U_r} y^{U_{rp}} \right) = 1$$

$$\sum_{i=1}^{m} \left(v^{L_i} x^{L_{ij}} + 2v^{M_i} x^{M_{ij}} + v^{U_i} x^{U_{ij}} \right) - \sum_{r=1}^{s} \left(u^{L_r} y^{L_{rj}} + 2u^{M_r} y^{M_{rj}} + u^{U_r} y^{U_{rj}} \right) + \left(v^{L_0} + v^{M_0} + v^{U_0} \right) \leq 0 \quad , j = 1, 2, \dots, n \qquad (2)$$

$$v^{U_i} \geq v^{M_i} \geq v^{L_i} \geq 0 \quad i = 1, 2, \dots, m$$

$$u^{U_r} \geq u^{M_r} \geq u^{L_r} \geq 0 \quad r = 1, 2, \dots, s$$

$v^{U_0} \geq v^{M_0} \geq v^{L_0}$

So that $\widetilde{u_r}=(u^{L_r}, u^{M_r}, u^{U_r})$ **and** $\widetilde{v_i}=(v^{L_i}, v^{M_i}, v^{U_i})$ are The triangular fuzzy weights for the triangular fuzzy input $\widetilde{x_{ij}}=(x^{L_{ij}}, x^{M_{ij}}, x^{U_{ij}})$ and triangular fuzzy output $\widetilde{y_{rj}}=(y^{L_{rj}}, y^{M_{rj}}, y^{U_{rj}})$ and Variable $\widetilde{v_0}=(v^{L_0}, v^{M_0}, v^{U_0})$ Mark is a free variable**.** Index rating to determine the effective unit according to this model Is equal to Geometric mean's of θ_p^{best} **and** θ_p^{worst} **that** equation (3) computed as**:**

$$\theta_p^{Geometric} = \sqrt{\theta_p^{best} \times \theta_p^{worst}} \qquad (3)$$

In this model, if $\theta^{best} = 1$ The unit effective, and if $\theta^{worst} = 1$ The unit is ineffective. By calculating the geometric mean, In fact, the analysis used double(DFA).Therefore Method of $\theta_p^{Geometric}$ is the base of the ranking DMU's **.**

Research Methodology

The research method used in this investigation is applied in terms of objective and since it uses library and field studies, it can be considered as survey descriptive investigation, also. Data collection process of the study involves two frequent stages. First, for identification of studied industrial agility drivers , the available classification were determined for agility drivers through library studies, then through semi-organized interviewing with elites of industry and implementation of their views, first questioner was obtained which was the main data collection instrument. The elite team of present study involves a group with 6 members of managers and supervisors of the studied industry working at least for 10 years in the field. At second stage, to identify capabilities needed by the industry, second questioner was designed through library studies and interviewing industry elites and also results obtained from step 1. The designed questioners were Likrates' 7 level questioners in terms of scale. First questioner included 45 questions and second questioner involved 48 questions.

Results and Findings of Implementation of Technics

1. Results of Implementation of Fuzzy TOPSIS Technic for Ranking Drivers (Step 1):

In this section we will only present criteria's weights and final results of ranking driver factors due to more volume of calculations and impossibility of presenting them in the article and for preventing content volume. The weight of criteria can be seen in table 5 using Lio and Gong's method (2005)[21] obtained from combination of industry elites' views and fuzzy entropy technic [23].

Table (5): Fuzzy weight of criteria

row	Criteria	Fuzzy weights
1	Change intensity/pressure	(0.5715, 0.66, 0.6952)
2	Level of effects on activities	(0.4418, 0.5046, 0.5372)
3	Difficulty in responding	(0.2419, 0.2876, 0.3216)

Solving the problem of deficits planning needed for developed fuzzy TOPSIS technic (Chen 2000) upper and lower bound of similar index are obtained in ratio of α=0.5 equaling to (0.733, 0.932). To prevent increase of content in the paper the values obtained from model solution for 4 prior drivers are seen in table 6 and values in ratio of all drivers, indexes and $(CC_i)^*_{ALC}$ can be seen in table 7:

Table (6): key drivers of agility and index values of CC_i in ratio of α-cuts

Drivers	Government's changing needs and expectations		Increased expects of customers from products' quality		Reduce of delivery time		Products determination and customization	
Values of α	$[(cc)_\alpha^L, (cc)_\alpha^U]$		$[(cc)_\alpha^L, (cc)_\alpha^U]$		$[(cc)_\alpha^L, (cc)_\alpha^U]$		$[(cc)_\alpha^L, (cc)_\alpha^U]$	
0	[0.676	0.993]	[0.641	0.971]	[0.637	0.967]	[0.550	**0.895]**
0.1	[0.696	0.981]	[0.660	0.959]	[0.656	0.956]	[0.569	**0.880]**
0.2	[0.715	0.969]	[0.679	0.946]	[0.675	0.943]	[0.588	**0.865]**
0.3	[0.734	0.957]	[0.698	0.932]	[0.695	0.929]	[0.607	**0.850]**
0.4	[0.754	0.944]	[0.717	0.918]	[0.714	0.929]	[0.626	**0.834]**
0.5	[0.773	0.932]	[0.737	0.904]	[0.733	0.901]	[0.645	**0.819]**
0.6	[0.739	0.919]	[0.756	0.890]	[0.752	0.886]	[0.665	**0.803]**
0.7	[0.812	0.907]	[0.775	0.875]	[0.771	0.872]	[0.684	**0.788]**
0.8	[0.831	0.895]	[0.794	0.861]	[0.790	0.857]	[0.703	**0.772]**
0.9	[0.850	0.882]	[0.813	0.846]	[0.808	0.842]	[0.721	**0.756]**
1	[0.870	0.870]	[0.831	0.831]	[0.827	0.827]	[0.740	**0.740]**

Table (7): final values of average levels of cut and drivers order

order	$(CC_i)^*_{ALC}$	Items
1	0.852	Government's expectations and needs
2	0.819	Reduced time of order delivering
3	0.817	increased expectations of customers from products quality
4	0.689	Demand for completely customized and personal products
5	0.635	Development of professional markets
6	0.605	Emerge of new competitors
7	0.587	Introducing new software and production methods
8	0.581	Presenting new complexes and consumed materials
9	0.555	Reduced time of manufactured products life
10	0.537	Introducing new and efficient hardware
11	0.531	Innovation in products
12	0.464	intensity of competition to obtain a share in the market
13	0.444	Costs pressure
14	0.355	Environmental pressures

After obtaining value of index $(CC_i)^*_{ALC}$ and drivers, based on importance coefficient of total amount and industry elites' view, they were divided into 3 priorities of lower, average and higher in terms of priority in attention and factors with higher importance were selected as key drivers of next stage. This group involves 4 key drivers which can be seen along with their importance coefficient (index of fuzzy relative closeness) in table 8. With the aid of alpha cut values and separation principle (table 7) the index of interval relative closeness was changed to triangle fuzzy numbers.

Table (8): the key agility drivers

row	Drivers	Fuzzy weights
1	Government's changing needs and expectations	(0.676, 0.870, 0.993)
2	Increase of customers' quality expectations	(0.641, 0.831, 0.971)
3	Reduced time order delivery	(0.637, 0.827, 0.967)
4	Product's personalization and customization	(0.550, 0.740, 0.895)

2. Determination of output variables of DEA model and Their Values (Step 2):

According to key variables determined in section 4-1, we can proceed on determining model output .The outputs of each decision making unit (capabilities) can be considered as the capability's relationship with drivers. Hence the outputs of DEA model can be shown in table (9):

Table (9): outputs of DEA model

row	Model outputs
1	The relationship between capability and product quality (output 1)
2	The relationship between capability and reduced time of order delivery (Output 2
3	The relationship between capability and increased flexibility of production system (output3)
4	The relationship between capability and increased power of manufacturing ordered products (Output 4)

To obtain output values of each unit, second questioner was developed based on results of step 1 with 48 questions and then they were provided to industry managers and supervisors. After collecting views obtained from second questioner, the values of output variables of DEA model was obtained for each capability through averaging triangle fuzzy numbers. The input value was considered as definitive 1 for all units. Doing so, a model with 12 capabilities (DMU), 1 definite input and 4 fuzzy outputs were obtained. Input and output values of DMUs can be seen in table 10. For intervening importance coefficient of criteria in the model DEA obtained from TOPSIS technic, we used weight control method in DEA. To do so, the bigness of fuzzy numbers showing outputs weight compared to each other should be defined in a limit. Doing so, the bigness of relationship is applied on all elements of fuzzy numbers. Using this method we can add some limitations to control output weight in the main model. The limits applied on relations (1) and (2) can be seen in table 11. After adding limits, the above mentioned linear models can be solved in EXCEL and LINGO software easily by SOLVER. In this model EXCEL software was used for modeling and problem solving (Esmailiyan, 2009).

Table (10): DEA model inputs and outputs

DMU	Input	Output s											
	Input	Output 1			Output 2			Output 3			**Output 4**		
1	1	0.483	0.683	0.823	0.616	0.804	0.947	0.657	0.835	0.956	0.654	0.848	**0.975**
2	1	0.476	0.656	0.789	0.641	0.727	0.865	0.786	0.940	1.000	0.490	0.671	**0.786**
3	1	0.084	0.221	0.405	0.331	0.502	0.694	0.355	0.431	0.653	0.481	0.580	**0.658**
4	1	0.580	0.672	0.756	0.694	0.833	0.937	0.157	0.315	0.512	0.679	0.864	**0.934**
5	1	0.490	0.581	0.633	0.665	0.849	0.971	0.694	0.778	0.931	0.399	0.605	**0.704**
6	1	0.357	0.557	0.757	0.739	0.906	0.988	0.605	0.795	0.946	0.580	0.770	**0.905**
7	1	0.533	0.733	0.917	0.777	0.878	0.996	0.487	0.563	0.612	0.712	0.887	**0.995**
8	1	0.540	0.728	0.884	0.747	0.910	0.996	0.778	0.919	0.980	0.737	0.897	**0.984**
9	1	0.810	0.955	1.000	0.633	0.816	0.939	0.560	0.742	0.883	0.720	0.885	**0.975**
10	1	0.544	0.728	0.883	0.755	0.922	1.000	0.754	0.915	0.992	0.720	0.897	**1.000**
11	1	0.353	0.553	0.737	0.473	0.576	0.776	0.641	0.827	0.948	0.325	0.523	**0.720**
12	1	0.084	0.221	0.405	0.739	0.910	1.000	0.657	0.835	0.956	0.481	0.683	**0.864**

Table(11): converting method of fuzzy numbers to control limits of outputs weight in DEA

Determinant limits of bigness of elements of each fuzzy number	**Determinant limits of bigness of fuzzy numbers compared to each other**
$u^{U_1} \geq 1.1414\, u^{M_1}$	
$u^{M_1} \geq 1.2862\, u^{L_1}$	
$u^{U_2} \geq 1.1678\, u^{M_2}$	$u^{L_1} \geq 1.0550\, u^{L_2}$
$u^{M_2} \geq 1.2974\, u^{L_2}$	$u^{L_2} \geq 1.0058\, u^{L_3}$
$u^{U_3} \geq 1.2980\, u^{M_3}$	$u^{L_3} \geq 1.1585 u^{L_4}$
$u^{M_3} \geq 1.1694\, u^{L_3}$	
$u^{U_4} \geq 1.2980\, u^{M_4}$	
$u^{M_4} \geq 1.3469\, u^{L_4}$	

Results of DEA model Solution

Replacing values of table (11) in relations (1) and (2) and considering limits of table (11) the efficiency values are obtained as table (12). According to results obtained from DEA model, leadership and excellence in modern technologies are the most important capabilities (rank 1) and effectiveness in costs was the least important capability (rank 12).

Comparing developed model with previous methods of capabilities prioritization

In our proposed technic we used multi-criteria decision making technic for prioritizing drivers which considers several criteria in evaluation process at the same time. This is while most of previous studies used mainly scoring method, considering just one criterion for evaluation. Moreover previous studies used compensatory methods such as total simple weight or fuzzy weighted average for ranking agility capabilities [30,13]. The exact results weren't obtained in these studies due to compensatory features in a way that it is possible that strength of a capability in ratio of a less important criterion can compensate its weakness in ratio of an important criterion. Use of proposed method causes strong capabilities in all criteria to be known and considered as more important and prior capabilities.

Table (12): calculating geometrical average of efficiency for decision making units (capabilities)

DMU	θ^{best}	θ^{worst}	$\theta_p^{Geometric}$	Relative efficiency	rank
Having multi skilled, deserved and empowered staffs	1.0253	0.7328	0.8668	1.154	**4**
Higher quality of products and services	1.000	0.8571	0.9258	1.080	**6**
Effectiveness of cost	1.4412	1.000	1.2005	0.833	**12**
Designing and manufacturing the products at shortest possible time	1.0504	1.000	1.0249	0.976	**10**
Effectiveness and efficiency of operations (purity)	1.0294	0.9624	0.9953	1.005	**8**
Unity and integration of sections of organization	1.0124	0.7463	0.8692	1.150	**5**
Quick delivery of the orders	1.000	0.8905	0.9437	1.060	**7**
Activity of empowered individuals in the form working teams	1.000	0.6967	0.8347	1.198	**2**
Flexibility in pattern and size of manufactured products	1.000	0.7395	0.8599	1.163	**3**
Leadership and excellence in using modern technologies	1.000	0.6939	0.8330	1.200	**1**
Continuous change and improvement	1.0553	1.000	1.0273	0.973	**11**
Accurate designing of the product at first time	1.000	1.000	1.000	1.000	**9**

Conclusion

In this investigation, a method was developed for evaluation and ranking of agility capabilities needed in the organization with the aim of helping managers to choose agility capabilities needed in the organization where fuzzy TOPSIS technics and data envelopment analysis were used to investigate drivers and capabilities. Results of present investigation can be used in selecting process of agility empowerment needed in the organization. This results in balance between capabilities needed in the organization and selecting agility empowerments (which are considered as achievement tools of capabilities). Most previous studies used just one criteria for identification of agility drivers, this is while the proposed method used multi-criteria decision making technic for prioritizing drivers which can consider several criteria at the same time in the process of evaluation. This is one advantage of the proposed method. Other advantage of the proposed method is use of DEA technic in ranking agility capabilities and it is due to eliminating compensatory feature of multi-criteria decision making technics. To solve the weak points of the study it is suggested that, researchers in future studies consider uncertainty in environmental conditions and scenery planning in the process of choosing agility activities and choose and rank agility capabilities by stable and sustainable planning approach.

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