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Fuzzy Evaluation to Reach the Required Agility at Manufacturing Organizations

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ABSTRACT

Change is one of the major organization features in competitive area. Organizations deal with changes in different angels such as change in customer demand, technological innovations and unstable environment. In order to adapt with turbulent and volatile market they make an attempt for change priorities, strategic vision and their traditional models .therefore, in the last few decades the manufacturing has become changed to new paradigm called agility. The agility as a 21stcentury paradigm is an organization ability to exploit opportunities based on the occurred change. There is well document research in association with this winner strategy, agility evaluation and make organizations agile. However, there is no evidence that weather an organization gets to an agile state is a vital and inevitable activity in global economic system or not? In this paper details of the approach and a framework of fuzzy agility evaluation will be asserted. An example is also used to illustrate the approach developed.

KEY WORDS: Agility, Fuzzy logic, Agility need level, Fuzzy agility index.

1. Introduction

1.1. What is agility

In the last decade the manufacturing industry has experienced notable and pervasive changes that stem from business environments and threat manufacturing success as well as their survival.The shadow of change (anticipated or unexpected) have been seen in diverse customer requirements, competitors strategies, technological innovations and particularly in market demands. Therefore the penetration of concepts of change into management studies and researches [1] are inevitable. In this situation, companies have a strategic vision to manage these changing and unpredictable business environments, besides survival turbulent and volatile markets, enabling them to exploit begetting opportunities thereupon maintaining the competitive advantage. Many authors termed this ability in a continuously and unpredicted changing business environment as an agility.

There are several definitions of agility in literature review which each of them introduces as one or more aspect of agility. Some researchers defined agility as an ability to cope with uncertainty and unexpected changes and challenges in business environment besides effectively respond to given advantages and convert threat to opportunities [1-3]. Agility as a 21st century paradigm has

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many enthusiasts [4]. In today's economy, it is considered as a winning strategy for organizations that yearns to become a national or international leaders [5]. Dove (1991) express agility concepts as an organization's ability to survive and develop in an unpredictable and constantly changing business environment. According to him, agility represents management's capability for effective applying of knowledge. Therefore the organizations have an ability of prosperity in unexpected environments. He proposed agility concepts in four dimensions of cost, time, quality and scope [6] so that agility can be achieved with balance between these four [7]. Yusuf et al. (1994) believe that agility is a successful recognition of competitive fundamentals (speed, flexibility, innovation, quality) via integration of resources and optimization of activities in a knowledge-rich environment in order to achieve products and services for customer in a changing market [4, 8]. Goldman et al. (1995) argue that agility is a comprehensive and complete response to changes which occur in leadership systems in competitive first class economies. In this regard, they categorize the most important aspects of agility in four groups of " enriching the customer", "co-operation", "organizing to master change and uncertainty" and "leveraging the impact of people and information" [9]. Kid (2000) defines agility a being able to adapt organization elements quickly and proactively with unexpected changes [10].

In general, it can be seen that a lot of researches has been done about agility, despite their differences in details, all unanimously introduce agile organization as a dynamic, location-oriented, flexible and growth-oriented organization which is focused on identification of business environment changes and speed in order to give appropriate response to them[2, 3].

1.2. Achieve and measure agility

It can be found that several articles which have concentrated on the methods and models to implement and evaluate agility. Requires a proper measuring system to determine organization agility was discussed by Gunasekaran (1991), subsequently, the author proposed the first conceptual framework to achieve agility. However the suggested model because of its conceptual nature does not provide an accurate tool to achieve agility [11].

One of the best known models is Sharifi & Zhang model which consists of three main parts, agility drivers, namely capabilities and providers. According to them, agility capabilities are classified into four groups of responsiveness, speed, competency and flexibility. They developed a methodology to achieve agility based on their model [1]. Yusuf et al. (1991) on the basis of their theoretical studies and field researches, suggest a set of 32 capabilities in four dimensions of core competency, virtual organization, knowledge – driven organization and capability for reconfiguration [4].it seems that in fact these capabilities are agility aspects and determine overall behaviour of organization. Dove (1994) provides one of the earliest papers on assessment organization agility by measuring change proficiency metrics such as cost, time, quality and scope. Subsequently , they were classified into smaller components [12]. Ganguly et al. (2009) provide a set of important metrics such as market share, responsiveness, cost effectiveness to evaluate organization agility [7].

Most articles in literature review have focused on the extraction the agility index (AI) like evaluation of AI by Kumar &Motwani (1995) to determine organization efficiency in competitive [13], using speech-art theory in measurement model for virtual organization by Goranson (1999) [14]. Van Hoek et al. (2001) studies based on scored card and Goldman et al. (1999) factors measure agility index [15] . Integration agility method established by Yusuf et al. (2001), youssuf (1993) which measure agility level as follow [12, 16]:

$(\text{Agility}_{\text{index}})_i = \sum A_{ij}$

Yang and Li (2002), a fuzzy agility index (FAI) has been defined. Agility capabilities were classified into three grades: (1) MC enterprise organization management agility (2) MC company products design agility (3) MC company processing manufacture agility. Each of these grades has layers and every layer has many sub_layers. FAI that represents overall organizations agility is obtained by aggregating AC_{ijk} and W_{ijk} which respectively, represent the fuzzy performance ratings and fuzzy importance weight of agility element capability. FAI calculation equation is as [17] :

$$(Agility_{index})_i = \sum_{i=1}^{W} R_i * W_i$$

$$\sum_{i=1}^{N} W_i = 1$$

In addition Lin et al. (2006) developed a conceptual model to determine the level of agility in MC company by applying fuzzy logic approach [5] .Tseng and Lin (2011) suggested a practical tool by using relationship matrix in quality function deployment (QFD) method and fuzzy logic. This method established a logically interaction between the drivers, capabilities and providers to determine fuzzy agility index(FAI) [18]. But all of these techniques were applied to determine current agility level.

1.3. Fuzzy logic in evaluation agility

Fuzzy logic is widely used in managerial decisions. Human resources have an important role in the manufacturing companies since their perceptions and understanding of agility is linguistic, thus, it makes agility ambiguous in nature. Due to ambiguous and ill-defined definitions of agility in literature review, the linguistic variables are very useful in dealing with imprecise situation as well as estimating it [16, 19]. Fuzzy logic is a powerful tool to compensate inabilities of classical numbers (crisp) to measure agility effectively. So using fuzzy arithmetic is necessary to cope with the vague phenomena such as agility evaluation and using linguistic terms in fuzzy logic in assessing agility indicators could help researchers to evaluate them with human familiar language in order to obtain an accurate result [20]. Furthermore, fuzzy logic can help authors to identify the principle obstacles to implement and improve agility in manufacturing companies.

This paper aims to assist managers to measure agility need level (ANL) in manufacturing companies by seeking the suitable method to determine need level to be agile based on agility drivers. Agility drivers are known as the source of environmental pressure and therefore, they vary from one company to another. Consequently, the ways that companies respond to changes are different, so they need different levels of agility. Thus it is necessary for manufacturing companies' managers to be aware of their company's needed level of agility as an unavoidable necessity to gap analysis in order to recover and improve their current agility level. However the outcome of literature review shows that there are a few researches which concerns about companies' needs level to be agile. This essay addresses the question of how agile the company needs to be and subsequently has develops the agility need level (ANL) evaluation method as well as recognition drivers which are critical in determining how greatly a company should be agile.

3-MATERIALS AND METHODS

Uncertainty the major causes of failure in manufacturing industry are turbulence and uncertainty in businss environment [5]. As mentioned in literature, agility contains two main factors: responding to change and exploiting changes to gain advantages. However they have mentioned that

the concept of change is different in different business environments. Consequently, organizations should respond to changes in different manners and approaches , which is defined as agility need level [1]. However there are a few researches focused on approaches to evaluate how greatly the organization needs to be agile. Sharifi and Zhang in their study present a scoring model to determine agility need level (ANL) that include a series of environmental and also internal factors that make circumstance turbulence and severe which is called in their conceptual model agility drivers. They used drivers to assess ANL because they argued that the agility need level (ANL) is a direct function of different factors such as the competitive environment, the turbulence of the organizational environment and the organization characteristics Each factor scored in five levels and finally the average score of the total items is taken [1].

In this study, Sharifi and Zhang scoring model is integrated with fuzzy evaluating approach which is represented by Lin et al (2006) to measuring the agility level of MC product manufacturing.

According to relevant literature, the fuzzy agility need level (FANL) evaluation framework, as shown in fig1, is carried out in two main steps: the first step is identifying the drivers which are changes in the business environment. Generally we could classify drivers in several ways. Here we listed them as a Sharifi and Zhang proposed categorization in table 1. The second step is to assess FAI based on performance ratings and importance weight of agility drivers and adapt FAI with an appropriate agility need level (ANL). To obtain FAI and reach to ANL the linguistic variables which are a powerful tool to deal with ill-defined or complex situation was used. The values of these variables are words or sentences or artificial languages. Based on T-Seng and Lin (2011) studies in using the approximate fuzzy set theory reasoning [18], triangular fuzzy numbers corresponding to applied linguistic variables were used.

3.1. FAI measurement:

In order to FAI measurement, the information about performance ratings and importance weight for all factors were integrated using the following formula:

$$FAI = \sum_{j=1}^{n}(W_j \otimes R_j)/\sum_{j=1}^{n} W_j$$

(1)

Where R_j and W_j are respectively an average of fuzzy performance ratings and fuzzy importance weight, which are calculated as bellow:

$$R_j = (a_j, b_j, c_j) = (R_{j1} \oplus R_{j2} \oplus \ldots \oplus R_{jm})/m$$

(2)

$$W_j = (x_j, y_j, z_j) = (W_{j1} \oplus W_{j2} \oplus \ldots \oplus W_{jm})/m$$

(3)

m denotes the number of respondents.

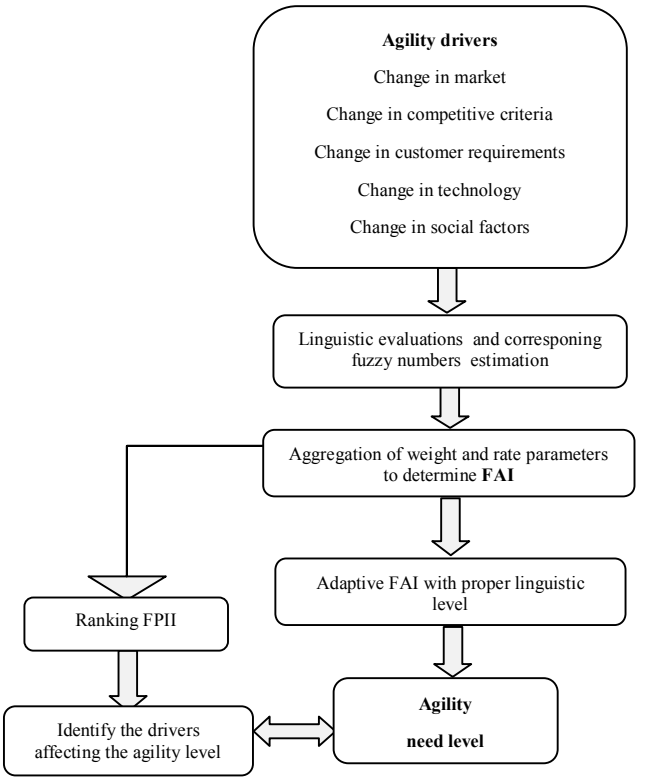

Fig 1: Agility need level evaluation framework

Table1: Change categorization

Change element	Change scope
Various group of customer National and international changes Increasing rate of change in product model Shortening product life cycles Highly variable market	Change in market
Increasing pressure to reduce costs Rising competition in world markets Reduce time to market for new products Competitors accountability to changes Increasing rate of innovation and creativity	Change in competitive criteria
Need to individual products and services Timeliness of delivery and shorter time to market Increasing expectations of quality Sudden changes in the quantity and specifications of orders	Change in customer requirements
Introduction of efficient, fast and affordable production equipments Introduction of new software technologies and their procedures Arrival of information technologies in new technologies	Change in technology
Environmental pressures Legal and political pressures Cultural issues Labor and worker's organization expectations Change in social commitment	Change in social factor

3.2. Agility need level (ANL):

To find the needed level of agility, FAI was matched with a proper linguistic level in a natural language expression set of ANL whose membership function is the same or closest to FAI [5]. There are several methods for adapting FAI membership function with ANL such as Euclidean distance, Successive approximation, Piecewise decomposition. In this study Euclidean distance was applied due to the intuition understanding by human[18]. Euclidean distance (D) from FAI membership function to membership functions corresponding to ANL' linguistic terms were calculated as:

$$d(FAI, XL_i) = \left\{\sum_{x \in p}(U_{FAI}(x) - U_{XL_i}(x))^2\right\}^{1/2}$$

(4)

Where $p = \{x_0, x_1, \dots, x_m\} \subset [0,10]$. To simplify, let $p = \{0,0.5,1,1.5,2,2.5,\dots,9.5,10\}$

The natural language expression set of ANL= and corresponding membership functions are listed as table 2.

Table 2: Company needed agility levels

	Linguistic terms	Fuzzy number
S	Non agile	(0,0.1,0.2)
LA	Low agile	(0.1,0.2,0.3)
SA	Slightly agile	(0.2,0.3,0.4)
FA	Fairly agile	(0.3,0.4,0.5)
A	Agile	(0.4,0.5,0.6)
HA	Highly agile	(0.5,0.6,0.7)
VA	Very agile	(0.6,0.7,0.8)
EA	Extremely agile	(0.7,0.8,0.9)
DA	Definitely agile	(0.8,0.9,1)

3.3. Fuzzy performance-importance index (FPII):

Lin et al (2006) in order to analyze and identify obstacles for improving agility level proposed Fuzzy performance-importance index (FPII) which aggregate the performance ratings and importance weight as follow:

$$FPII_i = R_i \otimes W'_{ijk}$$

(5)

$$W'_{ijk} = (1,1,1) \ominus W_{ijk}$$

(6)

FPII represents the effect of each contribution factors on the level of agility. Decreasing in FPII of each factor means reduction in the degree of contribution for that factor [5]. However, in this essay it could mean that the lower FPII for each factor has less effect in increasing the ANL. So FPII

as an indicator, in order to determine environmental drivers which effect on ANL in manufacturing organization was calculated.

After FPII determination, in order to establish a ranking, it must be converted to crisp number .among available numerous methods, Chen and Hwang's left-and-right fuzzy ranking method was selected. Because it preserves the ranking order and also considers the absolute location of each fuzzy number [18]. The fuzzy maximizing and minimizing sets, in this ranking method are defined as the following:

$$\mu_{max}(x) = \begin{cases} x, & 0 \leq x \leq 1 \\ 0, & otherwisw \end{cases} \tag{7}$$

$$\mu_{min}(x) = \begin{cases} 1 - x, & 0 \leq x \leq 1 \\ 0, & otherwisw \end{cases} \tag{8}$$

The right and left score can be obtained as:

$$\mu_L(x) = \sup\ [\ \mu_{min}(x) \wedge \mu_x(x)\ ] \tag{9}$$

$$\mu_R(x) = \sup\ [\ \mu_{max}(x) \wedge \mu_x(x)\ ] \tag{10}$$

Finally the total score can be calculated as:

$$\mu_T(x) = \frac{[\mu_R(x) + 1 - \mu_L(x)]}{2} \tag{11}$$

4. Practical case study:

In this section, the numerical example to clarify and validate the methodology, in Baspar Saze Company (manufacturer of automotive and industrial rubber products) was implemented to answer how agile B.S.Co. needs to be. The propose framework to evaluate the fuzzy agility need level (FANL) includes the following steps:

Step1- Identifying and listing the agility drivers as presented in the table 3 as well as determining proper linguistic scale.

As mentioned earlier The ANL is the result of unexpected changes, turbulent and competitive environment and company characteristics. Consequently, the appropriate questionnaire based on company survey was prepared with the aim of measuring driver performance and importance by using linguistic terms. Respondents were asked to answer all questions (about organization drivers) following 7 points Likert scale in two main parts, performance ratings and importance weigh.

Due to the different perceptions of people and with regard to previous studies [5, 17, 18], the linguistic scale{Extremely low (EL), very low (VL), Low (L), Fair (F), High (H), Very high (VH), Extremely high (EH)} are selected to measure the importance weight of drivers. Moreover the linguistic scale{Stable (S), Very poor (VP), Poor (P), Fair (F), high (H), very high (VH), Turbulent (T)} are selected to assess the performance ratings of drivers

Step2- Approximate the above linguistic scale by fuzzy numbers. For this purpose, triangular fuzzy number was applied in present study because they can be easily specified. The linguistic scale and their corresponding membership function are shown in table 4.

Table3: Agility drivers for measuring agility index

Indicator	Driver	Indicator	Driver
D1	Changes in market trends	**D10**	Competitors quick respond to changes in market
D2	Changes in the process of market specialization	**D11**	Changes in requirement and tastes of customers
D3	Fluctuations in market prices	**D12**	Increasing customer quality expectations
D4	Pressure for price cuts	**D13**	Customer expectations for product delivery time
D5	Changes of product models in market	**D14**	Arrival and introduce of new technologies
D6	Changes in order volume of products in the market	**D15**	Environmental standards
D7	Increasing rate of innovation and creativity in company	**D16**	Government policies in support of labour and workers unions
D8	Direct competitors in local markets	**D17**	The emergence of economic events
D9	Direct competitors in global markets	**D18**	Changes in political, economical, etc issues

Table 4: linguistic variables and corresponding fuzzy numbers

Performance rate		**Importance weight**	
Fuzzy numbers	**Terms**	**Fuzzy numbers**	**Terms**
(0,0.5,1.5)	Stable(S)	(0,0.05,0.15)	**Extremely low(EL)**
(1,2,3)	Very poor (VP)	(0.1,0.2,0.3)	**Very low(VL)**
(2,3.5,5)	Poor(P)	(0.2,0.35,0.5)	**Low(L)**
(3,5,7)	Fair(F)	(0.3,0.5,0.7)	**Fair(F)**
(5,6.5,8)	High(H)	(0.5,0.65,0.8)	**High(H)**
(7,8,9)	Very high(VH)	(0.7,0.8,0.9)	**Very high(VH)**
(8.5,9.5,10)	Turbulent(T)	(0.85,0.95,1)	**Extremely high(EH)**

Step3- Aggregation of fuzzy performance ratings and fuzzy importance weights to achieve FAI .in this step the average fuzzy performance ratings and fuzzy importance weights, as evaluated by experts, were calculated by using Eq. (2) and Eq. (3). The average results of fuzzy performance ratings and fuzzy importance weights are listed in table 5. Then FAI was computed via the formula in Eq. (1)

The obtained FAI for B.S.Co. is: FAI = (4.21, 5.53,6.85).

Step4- Determinate the agility need level (ANL) for B.S.Co. For this purpose, FAI was adapted with an appropriate All. In this case the linguistic ANL set ={Definitely agile (DA), Extremely agile (EA), Very agile (VA), Highly agile (HA), Agile (A), Fairly agile (FA), Slightly agile (SA), Low agile (LA), Non agile (NA)} was specified with corresponding membership functions as shown later in table 2. Euclidean distance (D) from FAI to each ANL set members based on Eq. (4) was calculated.

D(FAI,DA) = 1.82934 D(FAI,EA) =1.82934 D(FAI,VA) =1.75537

D(FAI,HA) =0.9034 D(FAI,A) = 0.97598 D(FAI,FA) =1.76827

D(FAI,SA) = 1.82934 D(FAI,LA) = 1.82934 D(FAI,NA) = 1.82934

Drivers	Important weight						Performance rate					
	E1	E5	E4	E3	E2	AVE(W)	E1	E5	E4	E3	E2	AVE(R)
D1	F	C	P	F	C	(2.00,3.50,5.00)	FL	FH	M	M	FH	(0.36,0.53,0.70)
D2	G	P	F	G	F	(3.60,5.30,7.00)	FH	L	FH	FH	FH	(0.42,0.56,0.70)
D3	M	C	M	F	C	(4.40,5.60,6.60)	FH	VL	VL	L	VL	(0.12,0.20,0.31)
D4	M	G	G	G	G	(5.70,7.10,8.40)	H	VH	H	H	FH	(0.69,0.80,0.90)
D5	Q	C	F	G	C	(2.00,3.20,4.50)	VL	FL	H	H	FL	(0.36,0.47,0.59)
D6	VG	P	C	G	P	(3.40,4.70,6.00)	H	M	FH	H	M	(0.50,0.65,0.80)
D7	VG	VG	G	VG	VG	(6.60,7.70,8.80)	H	H	H	H	H	(0.70,0.80,0.90)
D8	Q	F	C	P	VG	(2.60,3.80,5.10)	VL	H	FL	M	M	(0.30,0.44,0.59)
D9	Q	Q	C	P	Q	(0.60,1.40,2.50)	VL	VL	L	M	VL	(0.08,0.17,0.29)
D10	F	P	P	F	P	(2.40,4.10,5.80)	H	FL	L	FL	H	(0.48,0.59,0.70)
D11	P	G	G	F	G	(4.00,5.60,7.20)	FL	FH	FH	M	FH	(0.40,0.56,0.72)
D12	M	F	VG	G	F	(5.30,6.80,8.20)	H	H	H	FH	H	(0.66,0.77,0.88)
D13	P	F	VG	G	F	(4.00,5.60,7.20)	FL	M	FH	FH	M	(0.36,0.53,0.70)
D14	VG	P	VG	F	P	(4.20,5.60,7.00)	H	FL	FH	FH	FL	(0.49,0.65,0.80)
D15	C	F	P	G	F	(2.80,4.40,6.00)	L	M	H	H	M	(0.44,0.59,0.74)
D16	G	F	P	P	P	(2.80,4.40,6.00)	FH	FH	M	H	FL	(0.50,0.65,0.80)
D17	M	G	VG	VG	G	(6.50,7.70,8.80)	VH	FH	FH	FH	FH	(0.57,0.71,0.84)
D18	VG	G	G	VG	G	(5.40,6.80,8.20)	H	FH	FH	FH	FH	(0.54,0.68,0.82)

Table5: Average results of fuzzy performance ratings and fuzzy importance weight

Significantly, by matching FAI with linguistic terms with minimum D, it was found that B.S.Co. needs to have "Highly agile" (HA) level as shown in fig. 2.

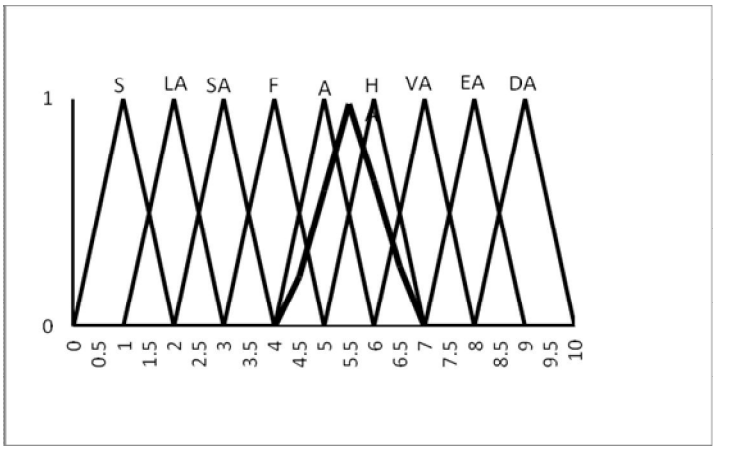

Fig 2. Linguistic levels to adapting FAI

Step5 - Analysis the participating drivers in determining ANL by introducing a fuzzy performance-importance index (FPII). As mentioned earlier, a higher FPII for a driver is very effective in determining importance, severity and urgency of need to be agile in manufacturing organization. FPII was calculated following Eq. (5). In order to diagnose the sequence of fuzzy

numbers, they should be converted to crisp number. Here the left-and-right fuzzy ranking proposed by Chen &Hwang was applied, followed by Eq. (7) – (11).

The computed and ranked FPIIs are listed in table 6.

Table 6: Drivers FPIIs and their ranking

Drivers	(1,1,1)-Wj	Rj	FPII	Rank
D1	(0.64,0.47,0.30)	(2,3.5,5)	(1.28,1.6450,1.50)	0.9897
D2	(0.58,0.44,0.30)	(3.6,5.3,7)	(2.0880,2.3320,2.1)	1.0924
D3	(0.88,0.80,0.69)	(4.4,5.6,6.6)	(3.8720,4.48,4.5540)	1.2731
D4	(0.31,0.20,0.10)	(5.7,7.1,8.4)	(1.7670,1.42,0.84)	0.8707
D5	(0.64,0.53,0.41)	(2,3.2,4.5)	(1.28,1.6960,1.8450)	0.9942
D6	(0.50,0.35,0.20)	(3.4,4.7,6)	(1.7000,1.6450,1.2000)	0.9512
D7	(0.30,0.20,0.10)	6.6,7.7,8.8)	(1.9800,1.5400,0.8800)	0.9020
D8	(0.70,0.56,0.41)	(2.6,3.8,5.1)	(1.8200,2.1280,2.0910)	1.0598
D9	(0.92,0.83,0.71)	(0.6,1.4,2.5)	(0.5520,1.1620,1.750)	0.9035
D10	(0.52,0.41,0.30)	(2.4,4.1,5.8)	(1.2480,1.6810,1.7400)	0.9982
D11	(0.60,0.44,0.28)	(4,5.6,7.2)	(2.4000,2.4640,2.0160)	1.1051
D12	(0.34,0.23,0.12)	(5.3,6.8,8.2)	(1.8020,1.5640,0.9840)	0.9212
D13	(0.64,0.47,0.30)	(4,5.6,7.2)	(2.5600,2.6320,2.1600)	1.1279
D14	(0.51,0.35,0.20)	(4.2,5.6,7)	(2.1420,1.9600,1.4000)	1.0119
D15	(0.56,0.41,0.26)	(2.8,4.4,6)	(1.5680,1.8040,1.5600)	1.0083
D16	(0.50,0.35,0.20)	(2.8,4.4,6)	(1.4000,1.5400,1.2000)	0.9436
D17	(0.43,0.29,0.16)	(6.5,7.7,8.8)	(2.7950,2.2330,1.4080)	1.0502
D18	(0.46,0.32,0.18)	(5.4,6.8,8.2)	(2.4840,2.1760,1.4760)	1.0498

5. DISCUSSION AND CONCLUSION

This essay has been addresses the question of how agile the company needs to be and subsequently has developed the agility need level (ANL) evaluation method.

Moreover, agility in nature is associated with complexity and ambiguity; therefore conventional evaluations are inappropriate and incompetent. However fuzzy logic is a very powerful tool to compensate this limitation and deal with vague and complex situations. Therefore the fuzzy agility index (FAI) was defined based on linguistic variables and fuzzy arithmetic to assess ANL.

To prove and validate the agility need level (ANL) evaluation method; the proposed framework has been implemented in Baspar Sazeh Company. A questionnaire was designed based on company survey and eighteen drivers were identified and emailed to respondents, which consist of senior and middle level managers. Based on the collected data, the calculated FAI for B.S.Co. was (4.21, 5.53, 6.85). After adapting FAI to ANL set membership function by using Euclidean distance method, the ANL specified “Highly agile”. In the last part of methodology, according to ranking drivers, it can be seen that D3 driver has a highest rate among other; it means that price volatility in B.S.Co. business market has the most significant effect on the importance and necessity to become highly agile. Furthermore, changes in factors like customer demand in delivery time and time to market, customer requirement and also market specialization are the major affecting factors for B.S.Co in determining high level of agility. However factors like competitors in global market has a minimum impact on ANL. Perhaps it is because of the economic sanctions and the closed economic policy.

The main advantages of the proposed methodology can be summarized as follows:

- The FAI is a useful tool for managers to assess company situation and perform gap analysis

- The method ability is reorganization the most important drivers which are determining the level of agility required
- This method contains an appropriate algorithm which is matched with manufacturing situation. In other words the method by focusing on linguistic variables and fuzzy arithmetic capable evaluate agility need level in different manufacturing companies.

From the work developed, the author suggests evaluation ANL by adaptive neuro fuzzy inference system (ANFIS) for future researches.

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