

# Assessment of Start-Up Agility Using Multi-grade Fuzzy and Importance Performance Analysis



Edrion Chacko and M. Suresh 

**Abstract** The aim of these papers is to report a study that has been carried out for assessing agility of start-up using multi-grade fuzzy approach and classifying the attributes based on Importance Performance Analysis (IPA). Agility refers to the ability of an organisation to positively adapt to the changing business environment. An agility assessment model was developed using multi-grade fuzzy. The model was applied to the data gathered from a start-up to identify its agility index. The study revealed that the start-up is agile but still there are still scopes for improvement. The areas for improvement were analysed through IPA model. The proposed framework helps for growing start-up companies to evaluate their agility index and focus on the weaker attributes to improve the agility level in their practice.

**Keywords** Agile · Agility assessment · Agility in start-ups · Multi-grade fuzzy · Importance performance analysis

## 1 Introduction

Advancement in information and technologies have resulted in the blooming of large number of start-ups in various sector in recent years. It has become a recent phenomenon where people shift from job seekers to job creators. Ground-breaking innovations caused start-ups coming up in higher rates in every part of the world. Various government bodies have been taking up actions to drive up the start-up ecosystem.

According to a recent report by IBM Institute for Business Value and Oxford Economics, 90% of start-ups in India fail within five years [1]. The number of

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start-ups that are coming up and the number of start-ups that fail are highly correlated. Amidst of various supporting schemes provided to support start-ups both in terms of finance and resources, they fail to meet success. There are multiple reasons contributing to the failure of start-ups which limelight to the question of start-up agility. Agility is the ability of an organisation to positively respond to the changes in business environment. Unceasingly updating technologies and innovations call for start-ups to adopt agile practices. In order to survive in this dynamic business environment, it is high time for start-ups to embrace agility.

## 2 Literature Review

Muduli et al. [2] proposed employee involvement can improve organisational performance. Sherehiy and Karwowski [3] explained autonomy as an important predictor of workforce agility. The study explained if management is responsive then the employees are more likely to be adaptive and flexible. Sherehiy et al. [4] proposed workforce agility as an important characteristic of agility that can be applied to all aspects of enterprise. The paper explains adaptability, flexibility and agility as the concepts needed for organisations to respond to changes. Nguyen-Duc et al. [5] suggested strategy, personnel, artifact and resources as tactics that will enable start-ups to achieve agility in its early stage. Patil and Suresh [6] explains innovation as the tool to react to business changes and rebound easily. The study also proposes collaboration within employees can help in exchanging expertise and thus faster execution. Shinwon et al. [7] proposed employees should be trained on new technologies and skillsets and put them into action. Olugbola [8] highlighted training has a positive influence on developing entrepreneurial ability and motivation. Patten et al. [9] suggests that anticipation, agility and adaptability can improve the capability of organisations to support agile enterprise. It is the primary step towards agile, anticipating what might happen in future and preparing accordingly to respond to the opportunities and challenges.

Lin et al. [10] used fuzzy logic approach to develop a framework to measure agility index. The study presented unprecedented application of fuzzy logic by illustrating a rational structure to review the imprecise phenomena in agility evaluation. Vinodh and Devadasan [11] used fuzzy logic to develop agility index measurement model. The paper discussed the obstacles for attaining agility in manufacturing organisation based on a twenty-criteria model comprehended with fuzzy logic. The study identified agility index that helped to identify the gaps and propose scopes for improvement. Nallusamy et al. [12] used multi-grade fuzzy approach to measure environmental sustainability. The study proposed a model to measure environmental sustainability index and identify prospect for improvement. Vimal et al. [13] proposed fuzzy logic to assess the sustainability of process orientation in organisations. The model calculated process sustainability index and observed the obstacles to achieve sustainability improvement.

Based on the literature review it was figured out that no research was reported on assessment of start-up agility using multi-grade fuzzy logic and Important Performance Analysis (IPA) model. In this context, this research study has been initiated.

### 3 Conceptual Model for Assessing Start-Up Agility

The conceptual model for assessing agility of Start-ups is shown in Table 1. This conceptual model was derived based on three aspects of start-up agility namely Organisation [14], Technology [15] and Strategy [11]. The model consists of three levels. The first level is the enabler, second level shows the criteria and the third level includes the respective attributes. As a sample, the enabler organisation has two criteria namely management and flexibility. The criteria management has three attributes namely flat organisational structure, employee involvement and autonomy and responding to changes in business.

**Table 1** Conceptual model for assessing start-up agility

Enablers	Criteria	Attributes
Organisation ( $I_1$ )	Management ( $I_{11}$ )	Flat organisational structure ( $I_{111}$ )
		Employee involvement and autonomy ( $I_{112}$ )
		Responding to changes in business ( $I_{113}$ )
	Flexibility ( $I_{12}$ )	Multi-skilled employee ( $I_{121}$ )
		Positively adapt to changes ( $I_{122}$ )
Technology ( $I_2$ )	Innovation ( $I_{21}$ )	Using latest technologies ( $I_{211}$ )
		Efficient methodology ( $I_{212}$ )
	Artifacts ( $I_{22}$ )	Developing new product or model ( $I_{221}$ )
		Upgrading existing systems ( $I_{222}$ )
Strategy ( $I_3$ )	Training ( $I_{31}$ )	Cross learning in organisation ( $I_{311}$ )
		Training new skill set and technologies ( $I_{312}$ )
	Collaboration ( $I_{32}$ )	Team working ( $I_{321}$ )
		Collaborating outside organisation ( $I_{322}$ )
	Anticipation ( $I_{33}$ )	Tracking changes in business ( $I_{331}$ )
		Forecasting opportunities and challenges ( $I_{332}$ )

## 4 Research Methodology

Literature review on agility assessment was initiated to identify the relevant criteria based on which the conceptual model was developed. The weightage for calculating the start-up agility based on the developed conceptual model is done through expert opinion. After which a suitable start-up was identified for conducting the case study. The proprietors and employees of the start-up were interviewed to assess the agility in that start-up. Based on the rating assessment and weightages by expert's agility is measured followed by IPA analysis and discerning attributes for improvement to achieve agility.

## 5 Case Study

### 5.1 About Case Company

The study is carried out in one case start-up from India (hereafter referred to as ABC start-up). ABC start-up is an IT consulting and services firm specialising in online digital marketing, corporate branding, interior branding, social media promotions and search engine optimisation. The company aims to achieve enviable loyal customers in its focus segments.

### 5.2 Assessment of Agility Using Fuzzy Logic

The agility of a start-up is denoted by  $I$ . It is the product of mean weightage of the expert opinions represented by  $W$  and the overall rating factor  $R$ . The equation for agility is given by  $I = W * R$ . Since the calculation of agility factor includes fuzzy determination the assessment is categorised into five grades,  $I = (10, 8, 6, 4, 2)$  where the range 8–10 represents that the start-up is 'extremely agile', 6–8 represents 'agile', 4–6 represents 'moderately agile', 2–4 represents 'non-agile' and 0–2 represents 'extremely non-agile'. Five experts contributed to the discussion meeting for weightage of agile enablers, criteria and attributes for IT-based start-ups. Five experts from case company participated in the evaluation for agility assessment. The mean normalised weightage of the experts' opinions and the attributes rating is shown in Table 2.

#### 5.2.1 Primary Assessment Calculation

The calculation applied for the criteria 'Management' is as shown as follows. The weightage related to the criteria 'Management'  $W_{11} = (0.34, 0.31, 0.35)$ . Rating

**Table 2** Single-factor rating and weightage by experts

$I_i$	$I_{ij}$	$I_{ijk}$	$R_1$	$R_2$	$R_3$	$R_4$	$R_5$	$W_{ij}$	$W_i$	$W$
$I_1$	$I_{11}$	$I_{111}$	7	9	9	8	8	0.34	0.56	0.32
		$I_{112}$	6	6	6	5	6	0.31		
		$I_{113}$	7	8	8	9	8	0.35		
	$I_{12}$	$I_{121}$	8	9	8	8	9	0.45	0.44	
		$I_{122}$	8	9	9	6	7	0.55		
$I_2$	$I_{21}$	$I_{211}$	8	9	7	8	9	0.43	0.49	0.34
		$I_{212}$	8	7	7	6	7	0.57		
	$I_{22}$	$I_{221}$	6	6	6	7	6	0.52	0.51	
		$I_{222}$	7	8	8	7	8	0.48		
$I_3$	$I_{31}$	$I_{311}$	8	9	10	7	10	0.56	0.33	0.35
		$I_{312}$	6	6	6	7	7	0.44		
	$I_{32}$	$I_{321}$	9	9	10	9	10	0.57	0.32	
		$I_{322}$	8	8	9	7	9	0.43		
	$I_{33}$	$I_{331}$	8	7	7	9	8	0.49	0.35	
		$I_{332}$	7	7	8	7	8	0.51		

vector related to the criteria ‘Management’ is given by

$$R_{11} = \begin{bmatrix} 7 & 9 & 9 & 8 & 8 \\ 6 & 6 & 6 & 5 & 6 \\ 7 & 8 & 8 & 9 & 8 \end{bmatrix}$$

Index for the criteria ‘Management’ is calculated as [16]

$$I_{11} = W_{11} * R_{11}$$

$$I_{11} = (6.69, 7.71, 7.71, 7.42, 7.38)$$

Similarly, using the same concept, the index for the other agile criteria is also computed.

$$I_{12} = (8, 9, 8.55, 6.89, 7.89)$$

$$I_{21} = (8, 7.85, 7, 6.85, 7.85)$$

$$I_{22} = (6.48, 6.96, 6.96, 7, 6.96)$$

$$I_{31} = (7.123, 7.7, 8.25, 7, 8.69)$$

$$I_{32} = (8.57, 8.57, 9.57, 8.13, 9.57)$$

$$I_{33} = (7.49, 7, 7.50, 7.99, 8)$$

### 5.2.2 Secondary Assessment Calculation

The calculation applied for the enabler 'Organisation' is as shown as follows. The weightage related to the enabler 'Organisation'  $W_1 = (0.56, 0.44)$ . Rating vector related to the criteria 'Management' is given by

$$R_1 = \begin{bmatrix} 6.69 & 7.71 & 7.71 & 7.42 & 7.38 \\ 8 & 9 & 8.55 & 6.89 & 7.89 \end{bmatrix}$$

Index for the criteria 'Management' is calculated as [17]

$$I_1 = W_1 * R_1$$

$$I_1 = (7.26, 8.28, 8.08, 7.19, 7.60)$$

Similarly using the same concept, the index for the other agile enablers are also computed.

$$I_2 = (7.22, 7.40, 6.98, 6.93, 7.40)$$

$$I_3 = (7.72, 7.73, 8.41, 7.71, 8.73)$$

### 5.2.3 Tertiary Assessment Calculation

The calculation applied for finding the value of agile index of ABC is as follows. Overall weight  $W = (0.32, 0.34, 0.35)$ . Overall rating vector is given by  $R$

$$R = \begin{bmatrix} 7.26 & 8.28 & 8.08 & 7.19 & 7.60 \\ 7.22 & 7.40 & 6.98 & 6.93 & 7.40 \\ 7.72 & 7.73 & 8.41 & 7.71 & 8.73 \end{bmatrix}$$

Agility index  $I = W * R$

$$I = (7.41, 7.79, 7.82, 7.28, 7.92)$$

$$I = (7.41 + 7.79 + 7.82 + 7.28 + 7.92)/5$$

$$I = 7.6$$

### 5.3 Classification of Agile Attributes Using IPA

IPA model is used to measure the agility of start-ups. IPA relates the mean weightage of the expert opinion to the rating assessment of start-up. IPA model is graphically represented in a framework distinguished by four zones [18]. The four zones and the inference of IPA is described in Table 3. The zones of the IPA framework correspond to the average of the mean weightage of expert opinion and the average of the mean assessment rating [19].

## 6 Results and Discussions

Based on the assessment of agility, agility index for the start-up ABC was computed to be 7.6. It comes in scale 6–8 which indicates that the start-up ABC is agile. Scale 8–10 is the range of extremely agile. This conveys that ABC has not achieved high level of agility and still there are scopes for improvements.

Improvement Performance Analysis (IPA) was done to identify the obstacles achieving high level of agility. The IPA model mentioned in Fig. 1 presented the attributes that need to be focused. Developing new products or models, use of efficient methodologies, forecasting opportunities and challenges in business environment and tracking changes in the business are the areas to be concentrated for improvement. Performance of ABC in these attributes is fairly low and requires action to be taken. Responding to changes in business, cross learning in organisation and team working are the areas which are perceived to be important where

**Table 3** Zones and inference of IPA model

Zones	Inference
Zone 1 focus area	This is the area of highest priority. Experts assessed the attributes in this area as highly important ones. But the performance of the company is low in this region. This indicates that the improvement actions should be more focused on the attributes present in this region
Zone 2 preserve area	Attributes in this zone are also assessed as highly important ones by the experts. In this region, the Start-up is also doing a fairly good job. This supports the company to maintain its performance in these attributes
Zone 3 low-priority area	This zone is analysed as the area of lower weightage by the experts. Even though the performance of Start-up's is low in this region, it does not disturb the company's overall performance. Less priority is needed on the attributes present in this zone
Zone 4 unmerited area	The performance of Start-up on the attributes in this zone is high, but these attributes are assessed as of lower importance by experts. Start-ups should focus less on this area. Managers should rethink about the resource allocation and prioritise the attributes in this region

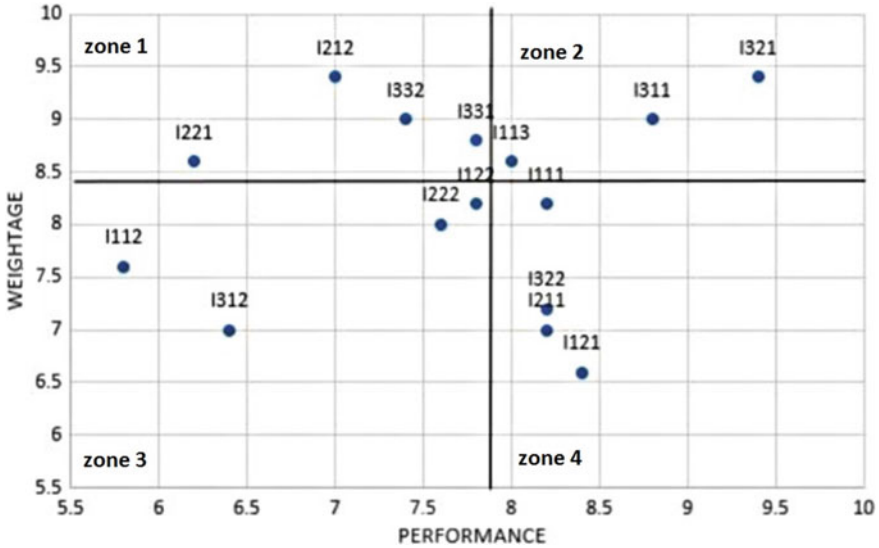


Fig. 1 IPA for startup agility assessment

ABC keeps a quality work. Employee involvement and autonomy, training new skills and technologies, upgrading existing systems and positively adapting to changes are some areas where the performance of the start-up ABC is low, but it is identified as a region of lower importance. This indicates that the low performance in these attributes won't have much effect on company's overall performance. Flat organisational structure, collaboration with outside organisation, using latest technologies and upholding multi-skilled employees are the areas where the performance of the company is higher than needed. Manager's may reconsider about resource allocation on the attributes in this region and may focus more on other attributes that need improvement.

### 6.1 Improvement Proposal for the Weaker Attributes

1. Developing new product or model: In this age of agility, driven by technology and innovation new service or product development has become the lifelines of any start-up. So, it is important to identify the needs of the targeted customer segment and cater to the product or service depending on the customer demand. The new product or should be able to deliver value to customers and able to make customer delight.
2. Efficient methodologies: Use of efficient methodologies are vital for the success of start-ups. Efficiency is important to save both time and money as well as for proper use of resources. This can be achieved through focusing more on the areas



where the performance of company is low by matching the proper skill sets to meet these tasks and keeping the goals of the start-up focused and clear.

3. Forecasting opportunities and challenges: It is important for the success of start-ups to forecast the challenges and opportunities as the pace of change in technology and innovation takes place at a higher rate. This can be done through keeping note of the updating technologies, understanding the changing preferences of the customer segment and analysing the economic conditions.
4. Tracking changes in business: Business is a dynamic environment that is directly affected by external as well as internal environmental conditions. However, the internal factors are under the control of managers, the external factors are beyond their control. So, to sustain in the competitive circumstance managers should keep track of the surrounding changes and adapt accordingly.

## 7 Managerial Implications

The methodology for assessing agility index proposed in this study enables the start-ups to measure its agility level. Apart from calculating agility index, the study helps the managers to identify obstacles for agility improvement and the areas to be concentrated. The managers can use this model to prioritise the attributes to achieve agility in their organisation. This research is a useful resource for industry persons as it constitutes the inputs from industry experts. In this context modern managers can focus their start-up's to be successful in ensuring agile practices by using this methodology.

## 8 Conclusion

The prime focus of this research is to assess the agility level of start-ups. Agility refers to the ability of a firm to positively adapt to the dynamic business environment. This study proposes a model to measure the agility index of start-ups. The model was developed using multi-grade fuzzy approach that incorporated the opinions of the industry experts. The paper discusses the case study of a start-up whose agility index is measured using the developed conceptual model. IPA is used to find the obstacles for the agility enhancement of start-up. On improvement of the weaker attributes start-up can improve its agility level to attain competitive advantage. The model can be further developed by incorporating enablers that are not addressed in this study. The case study has been carried out in a single start-up that is into IT consulting and services. Further study can be extended to various start-ups in different segments to make the conceptual model more generic and validated.

**Compliance with Ethical Standards Conflict of Interest** The authors declare that there is no conflict of interest in publishing this paper. The authors states the clarification of the anonymization of the data collection or for questionnaires (if any).

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