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ORIGINAL RESEARCH

Assessing the Readiness Level of Healthcare for Implementing Agility Using Fuzzy Logic Approach

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Abstract *An agile strategy in healthcare would authorize organizations to provide efficient, customized and standard service on time at an optimized cost. To implement agility, the management of the healthcare organization needs to know the mechanisms and how to make the whole organization ready for change process. Thus, the current study assesses the readiness level of healthcare utilizing fuzzy logic approach to implement agility. The conceptual readiness model is framed with five enablers, twenty criteria and fifty-six attributes. The proposed model is applied in to a case hospital to assess the readiness level. The Fuzzy readiness for the implementation of agility index (FRAI) and fuzzy performance importance index (FPII) are computed to determine the readiness level of the case hospital and its weaker attributes in the implementation of agility. FRAI is computed as average ready with (3.00, 4.78, 6.56), and FPII identifies 15 weaker attributes from 56 attributes. It constructs the conceptual model which analyses the current readiness of healthcare and weaker attributes are denoted and required corrective actions should be carried by the management of healthcare organization to improve the readiness. The continuation of assessment readiness model over a period of time would help to improve the readiness level of healthcare for agile implementation.*

Keywords Agility · Assessment · Fuzzy logic · Healthcare · Hospital · Readiness

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Introduction

In the present scenario, healthcare experiences a driving and essential change in business, clinical and operating models including healthcare spending, public/private, innovation and demographic changes over the polices and programme to provide efficient service and care (Maruthappu et al. 2015; Sharma et al. 2018). Healthcare requires continuous and systematic improvement to remain cost-effective and to provide better care and high quality of service (Singh et al. 2014). The healthcare organizations need to maintain their standards with factors such as refined funding system, trained and skilled workforce, anticipated information for decisions and policies and a strong mechanism to save excellence in medicine and technologies (Martínez-García and Hernández-Lemus 2013). These aspects make a clearly unbalanced situation, which determines to make increasingly multifaceted and unpredictable with time (Basole and Rouse 2008; Tolf et al. 2015). Healthcare organizations need to find a new approach to improve the quality and respond quickly with lower cost and to increase the service and quality (Aronsson et al. 2011). The approach handles unpredictable changes as flexibility which is denoted as 'agility' (Ganguly et al. 2009; Acharya 2019).

Agility is an ability to react to new chances and issues by integrating meaningful new design features in a shorter period of time and in an extra promised manner (Amin and Horowitz 2008). Agility is fundamentally a holistic thought, primarily about adaptability, which can be accomplished during reconfiguration competence (Mishra et al. 2014). It has an essential competitive potential as it modifies a firm to satisfy its customer's necessities with enormous speed (Sieger et al. 2000; Drupsteen et al. 2016; Voss et al. 2016). It gains importance in service sector to

establish coordination and cooperation for determining enhancement in a patient's experience with high quality of service (Mandal 2018). It can be employed in the healthcare sector to increase organizational abilities by making with strategies such as formal and informal inter-organizational interactions by proper communication, denoted environment scanning, decentralized decision making, self-organizing principles, trust in employees, enhanced employee skill in independence, flexibility and creativity (Tolf et al. 2015; Vaishnavi et al. 2019).

The effective execution of agile system in healthcare is done by understanding the agile healthcare along with the change process and how it deviates from industry and manufacturing agile system (Sindhwani et al. 2019). The change process could be made effective by addressing the issues, leadership commitment, customer's involvement, team efforts to identify external factors and quick decision by leadership (Fuller et al. 2007). The change process is required to reflect on the agility with clarity, rapidity, high commitment and flexibility along with organizational strategies, organizational capability for learning with the ability to provide resource, funding, facilities, process and human resource (Worley and Lawler 2010). The initiation of change is accomplished effectively by formulating readiness at the beginning of change process (Self and Schraeder 2009). To implement agility successfully, the management needs to identify the organization's readiness level, agile philosophy and their capability to make the change effectively (Carew and Glynn 2017; Vaishnavi et al. 2019).

Readiness is a set of information about willingness or unwillingness to accept the change by employees in the healthcare organization. It is composed of beliefs, attitudes and purpose of change of target members concerning to the necessities and possibility of executing organizational change (Armenakis and Fredenberger 1997). The readiness is a basic factor, which serves to initiate change in the organization by making support and association from employees (Holt et al. 2007; Stevens 2013; Douglas et al. 2017). The recognition of readiness level of a healthcare organization would support to know the potential of an organization to implement change procedure effectively (Washington et al. 2018). The assessment of readiness would help to recognize the gap between the expectations about the change priority with the employees. If the gap is identified more, it will be necessary to take an action to overcome the resistance among employees, in addition to threats in the change initiatives (Holt et al. 2007).

Assessment of readiness level would help the organization to know the degree of motivation among employees for delivering and implementing change, to measure the ability within organization, to improve the organizational capabilities and to enrich the organization as a whole (Lehman et al. 2002). A few studies have emphasized on the assessment of agility in healthcare (Rust et al. 2013; Teoh and Chen 2013; Suresh and Patri 2017; Goodarzi et al. 2018; Mahmoudi and Abdi Talarposhti 2018; Ornelas-Vences et al. 2019). There is an absence of the assessment of readiness for employing agility in healthcare organization, which is the motivation for the current study. The present study applies fuzzy logic to formulate a conceptual model for assessing the readiness level for the implementation of agility in healthcare organization. Fuzzy logic is said to be a classical logical method, which aims at modeling correct modes of reasoning that play a significant role in the human capacity to make rational decisions in situations of ambiguity and distinctiveness (Zadeh 1988). It can acquire the linguistic data as input, analyse it and then convey the results back in linguistic terms using triangular fuzzy numbers (Vinodh and Vimal 2012; Suresh and Patri 2017). The following are the questions used for the research:

RQ1 How can the readiness level be measured for the implementation of agility in healthcare organization?

RQ2 What are the enablers, criteria and attributes that influence the readiness level of agility in healthcare?

RQ3 How are the weaker attributes addressed to enhance the readiness level of healthcare organization?

The above research questions are taken into account to identify the attributes that improve the readiness level for agile implementation. The current study adds to the existing literature of agility in two ways. First, key factors for agile readiness are defined from the agility literature and grouped into six enablers. Second, the conceptual model is developed to assess the readiness level of the case hospital for agility implementation.

The sequential order of the paper is as follows: Sect. 2—literature review on agility. Section 3—methodology and development of the conceptual model using fuzzy logic. Section 4—evaluation of a case hospital, Sect. 5—results and discussion with suggestions for improvements, Sect. 6—managerial implications, and Sect. 7—conclusion with future research.

Literature Review

Agility

Iacocca Institute of Lehigh University (Iacocca Institute Report 1991) first introduced agility as a main component of market competition which permits the organization to activate and reply continuously to the changing business

atmosphere (Abdelilah et al. 2018). Hooper et al. (2001) have defined agility as "the ability of an enterprise to develop and exploit its inter- and intra-organizational capabilities". Sherehiy et al. (2007) have described agility with responsiveness, flexibility, rapidity, cultural change, incorporation, high quality, customized product/service and enhanced core competencies. Agility is a capability, strategy and automation which focuses on team-based exploration for the chances to accomplish consumer requirement for innovation and potential solution with quick decision and investigation unexpected situation (Denning, 2017; Kacani and van Wunnik 2017).

An agile healthcare system is a mixture of flexibility and decision making which includes effective leadership to prove quality of care and delivery process with utilizing effective organizational structure and capability to change quickly to configure with quality (Worley 2012).

In healthcare, Pipe et al. (2012) have applied agility to analyse workplace stress and resilience level of employees, which contributes to form interference in healthcare organization. Guimaraes and de Carvalho (2012) have applied both lean and agility in hospital to understand "leagile" which is a key for current requirement strategy of market to meet the service unpredictability, uncertainty and complexity and hyper active competition to enhance the organizational goals. Burwitz et al. (2012) have utilized agility in the treatment process and adopted it for a pathway model to mix the complete process and enhance quality of care for long run and patient satisfaction. Teoh and Chen (2012) have focused on an agile Hospital Information System (HIS) execution with the strategic utilization of various Information Technology (IT) governance models to encourage the organizational competencies to prepare hospitals for change. Nazari et al. (2013) have identified the obstacles related to the agility as awareness about the system, proper training, cultural resistance, lack of reporting, lack of current market software and infrastructure problems for HIS. Košinár and Štrba (2013) have utilized agility to develop a model with the machine learning for the HIS development with alignment and modification on the software process with the knowledge gathered with the company. Ghodrati and Zargarzadeh (2013) have dealt with the organizational agility assigned to the employee's mental health of hospital for the strategic readiness for dealing with the crises.

Similarly, Converso et al. (2015) have adopted agility to improve a simulation model for the emergency department for the arrangement of resources, enhance the performance to diminish the time essential to achieve the critical tasks, drop the overcrowding of the process, enhance service efficiency by decreasing the number of stretches and also decreasing the capacity of bed. Shirey (2015) has highlighted strategic agility as the essential leadership ability and proposed a method for the change management strategies for a healthcare system. Teoh and Cai (2015) have combined agility and innovation capability to enhance the quality of healthcare services. The process model is established to innovate strategy and integrate responsiveness and resources for better medical process. Tolf et al. (2015) have recognized five important organizational capabilities that are needed for the hospital to become agile which includes transparent cooperation throughout the organization, understanding the market and customers, leadership support to motivate employees, flexible resource and human capacity for effective delivery of service. Patri and Suresh (2017) have developed the conceptual model to analyse the agile performance of healthcare organization. Glassman and Withall (2018) have utilized learning agility to identify the leadership ability on the capacity for development, performance improvement and forecast success in leadership style for nursing. Chakraborty et al. (2019) have noted as that agility is utilized to adopt the Internet of Things (IoT) for the caring and prominent accomplishment for the improved flexible patient care delivery. Rungsrisawat and Jermsittiparsert (2019) have used agility and health supply chain performance to enhance the human capital of the healthcare sector, which is a significant mediating role. The agility indicates the improved human capital of healthcare with the increased supply chain performance.

Assessment of Agility

An assessment model for agility is developed by the Lin et al. (2006a, b) in manufacturing, and further it is utilized by various researchers in supply chain, tested with different manufacturing sector, twenty, thirty and forty level criteria to enrich the model and benchmarking (Lin et al. 2006a, b; Jain et al. 2008; Vinodh et al. 2010; Dahmardeh and Pourshahabi 2011; Shahrabi, 2011; Tseng and Lin, 2011; Vinodh and Devadasan, 2011; Vinodh and Vimal, 2012; Vinodh et al. 2012; Aravindraj and Vinodh 2014; Lotfi and Houshmand 2014; Vinodh and Aravindraj 2015; Khorasani 2018). The assessment of agility is done in different aspects which include business type process, supply chain, internal operational measure, performance and specific projects (Yauch 2011).

Yauch (2011) has made a quantitative study to develop a metric for agility performance that measures agility as a performance result holding both organizational achievement and environmental turbulence, which is indeed applied to manufacturing organizations of all types. Mishra et al. (2014) have extended an agility model using fuzzy logic to analyse a particular organization's hierarchy and how it reflects in decision making attitudes as overall performance of agility in an organization. Vinodh and

Aravindraj (2015) have benchmarked the assessment approaches of agility in a manufacturing organization using fuzzy logic and multi-grade fuzzy approach. Narayanan et al. (2015) have applied contingency theory and Transaction Cost Economics (TCE) to well understand the linkage between collaboration, trust and agility performance in a buyer-supplier relationship. Azevedo et al. (2016) have developed an assessment model for Lean, Agile, Resilient and Green (LARG) index as a benchmarking instrument to evaluate the leanness, agility, resilience and greenness of the automotive companies representing Supply Chain (SC). Potdar et al. (2017) have utilized fuzzy (DEMATEL) to assess the barriers of agile manufacturing and applied it in Indian automobile manufacturing company.

In healthcare, slowly attention is paid on the implementation and assessment of agility in manufacturing and software development. Teoh and Chen (2013) have adopted agile organization and IT governance to assess the case hospital with the strategic process model empirically. Further, the model suggests that agile healthcare IT is achieved with the IT governance strategies and it approves decision making with resources strategically for dynamic environment. Rust et al. (2013) have adopted agile practices as guidelines in the hospital to enrich the performance of the system to meet the new challenges in supply chain management and to provide knowledge to the healthcare managers and policy makers of the hospital. Suresh and Patri (2017) have attempted to execute the agility of a healthcare organization by assessing the agility of a university dispensary by using fuzzy logic approach. Mahmoudi and Abdi Talarposhti (2018) have assessed the performance of organizational agility in a hospital using a descriptive analytical study. As a result, health policy makers are recommended to plan customer satisfaction, timely utilization of facilities, elimination of weak points, cost reduction, encouragement and punishment system for staff, and staff empowerment. Likewise, Goodarzi et al. (2018) have tried to correlate the organizational agility with the performance of Human Resource (HR) of Tehran emergency centre where HR is the major vital tool in the agility of an organization and is reflected to be the most valuable benefit of any organization. Ornelas-Vences et al. (2019) have utilized agility assessment to develop a model to sense the leg quantification with the case of Parkinson's disease patients. The model is accomplished to capture all information irrespective of the mission speed and reduce the integral uncertainty of the examiner with at least one expert.

Research Methodology

Fuzzy Logic Approach

Fuzzy logic is a system of interpretation and computation in which the objects of reasoning and computation are classes with unsharp (fuzzy) borders (Zadeh 2015). It specifies an adequate way of handling with problems related to imprecise and unclear phenomena. It would not make any assumption about independence, exhaustiveness, and exclusiveness and can tolerate a blurred boundary in definitions (Lin and Chen 2004). Fuzzy concepts enable evaluators to use linguistic terms to measure indicators in natural language expressions, and each linguistic term can be connected with a membership function.

Fuzzy logic approach in the present study is acquired from Lin et al. (2006a, b); Narayanamurthy et al. (2018); Sreedharan et al. (2019) to evaluate the readiness for the implementation of agility in a hospital. The fuzzy readiness assessment framework for agile implementation in the hospital is given in Fig. 1, and it consists of three phases. The first phase is the identification of enablers, criteria and attributes from literature review. The second phase is the selection of an appropriate hospital for testing agile readiness. The last phase is the continuous assessment of readiness and making the hospital ready to accept the implementation of agility successfully.

For assessing agile readiness, six enablers such as management responsibility, workforce, organizational, strategy, technology and environmental agility are identified. Then 20 criteria along with 56 attributes are identified. These attributes are evaluated and rated by experts like doctors and managers from different hospitals in India. Then, the questionnaire is given and responses are recorded from the six employees of a particular hospital. To calculate the fuzzy logic model, the notations given in Table 1 are utilized.

Fuzzy logic has been used to improve the performance of manufacturing sector by evaluating the leanness, agility, Lean Six Sigma (LSS), sustainability and leagility (Tseng and Lin 2011; Vinodh 2011; Vinodh and Vimal 2012; Vinodh and Aravindraj 2013; Sreedharan et al. 2019). Likewise, in healthcare, leanness and agility are evaluated to improve the performance, but no study has analysed readiness for the implementation of agility using fuzzy logic (Suresh and Patri, 2017; Narayanamurthy et al. 2018; Narayanamurthy and Gurumurthy,2018). Fuzzy tools deliver a simplified and scientific route for the progress, analysis and testing of models quantitatively compared to other approaches in a relatively lesser duration. As a result, fuzzy tools are simple to work with and to adapt (Sreedharan et al. 2019). The readiness for the implementation of

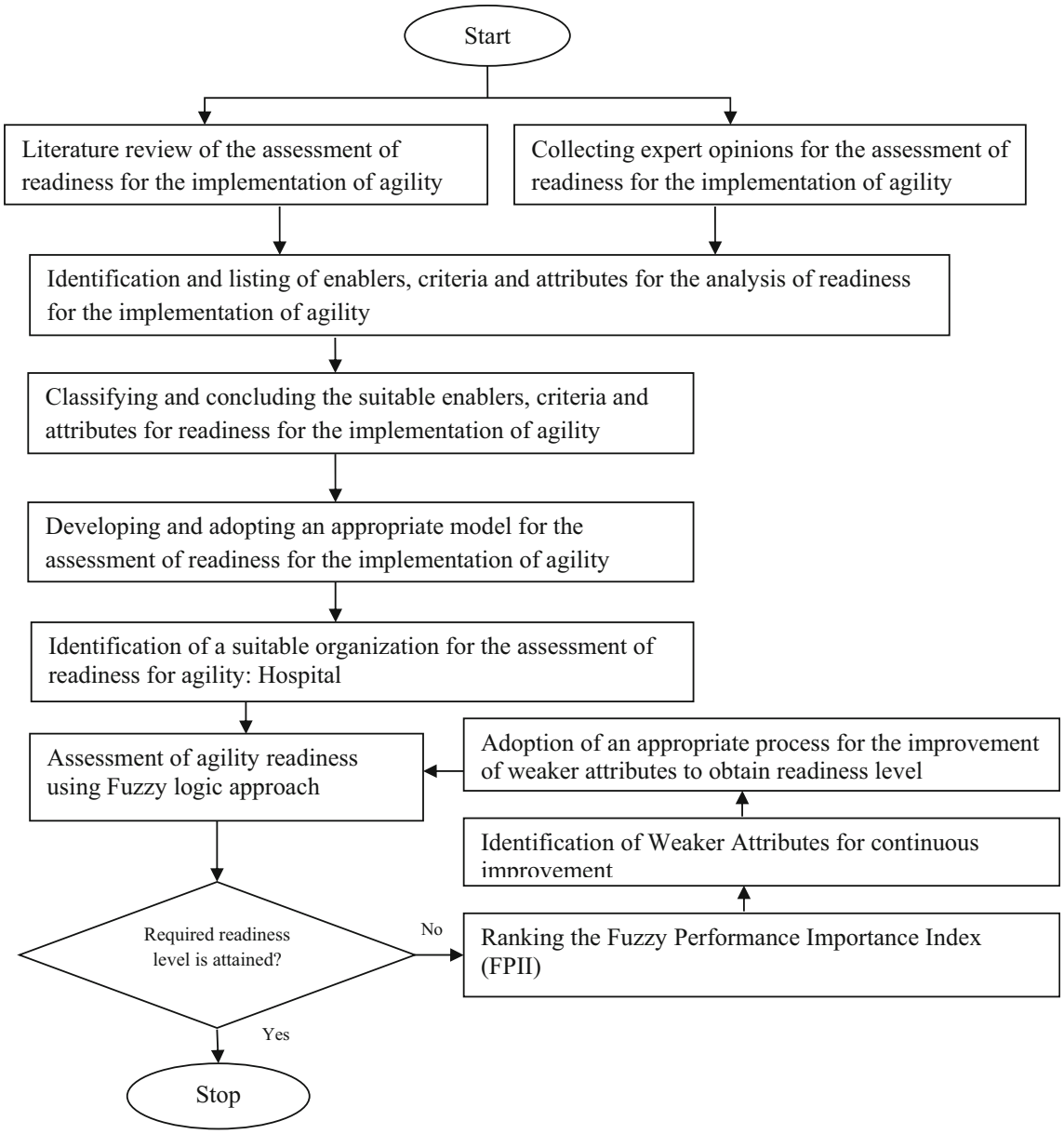

Fig. 1 Framework for the assessment of readiness for the implementation of agility in a hospital

agility in healthcare has been assessed by experts using importance weights of readiness with linguistic variables. Fuzzy logic will consider linguistic data as input, analyse and further express the results back in linguistic terms. Triangular fuzzy number is used in the present study to get approximate linguistic variables (Vinodh and Vimal 2012; Rajak and Vinodh 2015; Suresh and Patri 2017). Using the fuzzy logic approach, two levels of calculations are done and FRAI is calculated. Euclidean distance method has been used; the readiness level of the hospital is obtained by matching the FRAI in the natural expression with linguistic terms. FPII is calculated to identify the weaker attributes, and suggestions are made to improve the readiness level of the hospital for effective implementation of agility.

Sampling Design and Data Collection

The present study utilizes scheduled interviews with questionnaire to collect data for importance weightage and performance rating for the assessment analysis. Initially, an interview is conducted with various experts from hospitals after the review of literature to formulate the conceptual model with enablers, criteria and attributes. Then the importance weightage is collected from different hospital experts who are well knowledgeable and decision makers

Table 1 Notations used for fuzzy logic readiness assessment model for the implementation of agility

Indices	Abbreviations
P_i	Fuzzy importance weight for readiness for the implementation of agility of *i*th enabler
P_{ij}	Fuzzy importance weight for readiness for the implementation of agility of *j*th criterion in *i*th enabler
P_{ijk}	Fuzzy importance weight for readiness for the implementation of agility of *k*th attribute of *j*th criterion in *i*th enabler
Q_i	Fuzzy importance rating for readiness for the implementation of agility of *i*th enabler
Q_{ij}	Fuzzy importance rating for readiness for the implementation of agility of *j*th criterion in *i*th enabler
Q_{ijk}	Fuzzy importance rating for readiness for the implementation of agility of *k*th attribute of *j*th criterion in *i*th enabler
RA_i	Readiness for the implementation of agility measure of *i*th enabler
RA_{ij}	Readiness for the implementation of agility measure of *j*th criterion in *i*th enabler
RA_{ijk}	Readiness for the implementation of agility measure of *k*th attribute of *j*th criterion in *i*th enabler
$FRAI$	Fuzzy readiness for the implementation of agility index
RAL_i	Fuzzy number of natural language expression set of readiness level for the implementation of agility
$fFRAI_i(x)$	Triangular fuzzy number of $FRAI_i$
$fRAL_i(x)$	Triangular fuzzy number of RAL_i

of their premises and they have successfully running a well-established hospital for the last 10 years. Totally, five experts include doctors, general managers and nurse supervisor from different hospitals from India. Those five experts provide for the importance weightage for enablers, criteria and attributes.

After collecting importance weightage, the final survey is conducted with six caregivers to collect the performance rating from a single-case hospital. Among the caregivers 2 are doctors, 1 is a nurse supervisor, 1 is an admin manager, 1 is a senior laboratory technician, and 1 is a head of pharmacy at the case hospital. The caregivers are well experienced and good decision makers in the administration of the hospital for the past 10 years. First, the readiness for agility implementation is discussed with the experts and they are requested to provide final survey on the performance rating for the attributes.

Conceptual Model

A conceptual model for the evaluation of readiness for the implementation of agility in the hospital has been developed from the evaluation of different models including leanness assessment, agility assessment, lean readiness and LSS in healthcare and manufacturing (Suresh and Patri 2017; Narayanamurthy et al. 2018; Narayanamurthy and Gurumurthy 2018; Sreedharan et al. 2019). It is developed to evaluate the readiness level of a hospital. It consists of three levels. The first level consists of six enablers, second level consists of twenty criteria and third level consists of fifty six attributes.

Table 2 depicts the detailed description of the enablers, criteria and their attributes (Zain et al. 2005; Lin et al. (2006a, b); van Oosterhout et al. 2006; Misra et al. 2009; Vinodh et al. 2012;Ghodrati and Zargarzadeh 2013; Aravindraj and Vinodh 2014; Avazpour et al. 2014; Dubey et al. 2015; Vinodh and Aravindraj, 2015; Dubey and Gunasekaran, 2016; Appelbaum et al. 2017;Suresh and Patri,2017) identified in the healthcare context of readiness for the implementation of agility in the hospital. Table 12 depicts the detailed explanation of each attribute for the implementation of agility in the hospital.

A stepwise description of fuzzy logic is given as follows:

Step 1 Selection of enablers, criteria and attributes for assessing the readiness level for implementation of agility

The appropriate attributes related to each criterion are identified from the literature review and expert opinions from five different hospitals in India. The identified criteria related to assessing readiness level would classify the enablers as management responsibility, organizational, environmental, technical, workforce and strategy perspective. Agility can be applied in healthcare sector to enhance the organizational capabilities by enabling with strategies such as formal and informal organizational relationships (Tolf et al. 2015). An agile organization integrates organizational processes and individuals using advanced technologies in order to attain high-quality products and services, thereby accomplishing customer needs (Shahrabi 2012). To implement agility successfully in healthcare organization, it is necessary to know the readiness level of agile implementation before starting the change process. So, the readiness assessment model for the implementation of agility is developed by considering employees,

Table 2 Readiness for the implementation of agility index for the evaluation of the hospital

Agility enablers	Agility criteria	Agility attributes	References
Management Responsibility Agility	Multiple task and decision making	Multiple tasking	Suresh and Patri (2017)
		Transparent and quick decision	Zain et al. (2005)
	Organizational leadership	Good relationship with caregivers	Suresh and Patri (2017)
		Management involvement	Lin et al. (2006a, b)
		Delegation of authority	Aravindraj and Vinodh (2014)
Organizational Agility	Information sharing	Frequent interval of meeting	Dubey et al. (2015)
		Sharing information with stakeholders	Aravindraj and Vinodh (2014)
	Transparency in communication	Building trust with caregivers	Dubey and Gunasekaran (2016)
		Current situation of organization	Dubey et al. (2015)
		Positive towards change	Dubey and Gunasekaran (2016)
	Organizational change	Policy and procedure change	Ghodrati and Zargarzadeh (2013)
		New organizational structure	Ghodrati and Zargarzadeh (2013)
		Change in infrastructure	Ghodrati and Zargarzadeh (2013)
	Adapting to new culture	Speed of adoption	Dubey and Gunasekaran (2016)
		Work sharing culture	Suresh and Patri (2017)
	Resource availability	Availability of facilities	Appelbaum et al. (2017)
		Financial resources	Appelbaum et al. (2017)
		Facility required	Appelbaum et al. (2017)
Workforce Agility	Training and development	Need for training	Vinodh et al. (2012)
		Frequent training for caregivers	Patri and Suresh (2017)
		Continuous learning	Misra et al. (2009)
	Performance reward	Assess performance periodically	Dubey and Gunasekaran (2016)
		Sufficient salary and bonus	Suresh and Patri (2017)
	Team building	Cross-functional teams	Misra et al. (2009)
		Individual level in teams	Avazpour et al. (2014)
		Team across company boarders	Lin et al. (2006a)
	Cooperation and collaboration	Cooperation among caregivers	Misra et al. (2009)
		Collaborative activity	Suresh and Patri (2017)
		Work facilitation	Suresh and Patri (2017)
Strategy agility	Strategic commitment	Continuous strategic change	Appelbaum et al. (2017)
		Flexible automation	Vinodh et al. (2012)
		Competitive advantage	Appelbaum et al. (2017)
	Suggestion implementation	Caregiver's suggestion	Patri and Suresh (2017)
		Customer opinions	Patri and Suresh (2017)
		Technical experts' suggestion	Expert opinion
	Cost effectiveness	Future resource evaluation	Vinodh et al. (2012)
		Fixed price for service	Vinodh et al. (2012)
		Fund allocation by category	Expert opinion

Table 2 continued

Agility enablers	Agility criteria	Agility attributes	References
Technology agility	Technology cycle	Technology awareness	Lin et al. (2006a)
		Skill and knowledge of enhancing technology	Lin et al. (2006a)
		Upgradation of technology	Vinodh et al. (2012)
	Innovativeness	Innovation in service design	Vinodh et al. (2012)
		Creativity	Aravindraj and Vinodh (2014)
		New idea to service	Vinodh and Aravindraj (2015)
	Flexible service design	Design improvement	Aravindraj and Vinodh (2014)
		New service development	Aravindraj and Vinodh (2014)
		Flexible service time	Aravindraj and Vinodh (2014)
Environmental Agility	Environmental scanning	Legal and political scanning	vanOosterhout et al. (2006)
		Economical scanning	van Oosterhout et al. (2006)
		Adopting to recent scenario	van Oosterhout et al. (2006)
	Need for ultimate customer	Customer expectation	Vinodh et al. (2012)
		Change in taste and preference	Vinodh and Aravindraj (2015)
		Customer relationship management	Vinodh et al. (2012)
	Limited of service	Service variety	Aravindraj and Vinodh (2014)
		Fast service delivery	Lin et al. (2006)
		Seasonal demand variation	Vinodh and Aravindraj (2015)

organization, external environment, strategy, technology and management perspective as a whole.

Step 2 Determination of the linguistic scale

Linguistic terms are used to access performance rating and importance weights to evaluate readiness for the implementation of agility based on attributes, criteria and enablers. They are selected from natural language expressions to provide more information than numerical grades for many situations (Lin and Chen 2004; Sreedharan et al. 2019). The linguistic scale used by Lin et al. (2006a, b), Rajak and Vinodh (2015) has been used in the current research. To assess the performance rating of readiness for the implementation of agility, the linguistic variables used are excellent (E), very good (VG), good (G), fair (F), poor (P), very poor (VP) and worst (W). Likewise, to assess the weights of importance for readiness for the implementation of the agility, the linguistic variables used are: very high (VH), high (H), fairly high (FH), medium (M), fairly low (FL), low (L) and very Low (VL). These linguistic ratings are expressed by triangular fuzzy numbers. Triangular fuzzy numbers are used in assessment due to the abstraction and impreciseness associated with predictable assessment of societal performance. They are utilized widely in performance assessment studies (Lin et al. 2006a, b; Vinodh and Devadasan 2011).

Step 3 Measurement of performance ratings and importance weighting from experts

The next step is the collection of importance weights and performance rating of enablers, criteria and attributes for evaluating readiness for the implementation of agility. A questionnaire is distributed to five experts including doctors, decision makers and managers of a hospital who develop the new strategy and policy for the betterment of service. The performance rating is collected only for attributes because the analysis uses aggregated performance rating to criteria and criteria rating to enabler rating (Suresh and Patri 2017). For performance rating, the point scale is (0–10) of the linguistic variables and for importance weights, the point scale is (0–1) of the linguistic variables (Sreedharan et al. 2019). The experts' responses include rating and weights obtained for evaluating readiness for the implementation of agility. The following equation is used to calculate average operation method by using the responses from the experts (Wang et al. 2012; Suresh and Patri, 2017; Narayanamurthy and Gurumurthy 2018).

Formula of average operational method

$$= (a_1 b_1 c_1) +, \ldots, + (a_n b_n c_n)$$
$$= [(a_1 +, \ldots, + a_n)/n, (b_1 +, \ldots, + b_n)/n, (c_1 +, \ldots, + c_n)/n]$$

Table 3 Linguistic terms and appropriate fuzzy numbers for rating and weights for readiness for the implementation of agility in the hospital

Performance rating		Importance weighting	
Linguistic variable	Fuzzy number	Linguistic variable	Linguistic variable
Worst (W)	(0,0.5,1.5)	Very Low (VL)	(0,0.05,0.15)
Very poor (VP)	(1,2,3)	Low (L)	(0.1,0.2,0.3)
Poor (P)	(2,3.5,5)	Fairly low (FL)	(0.2,0.35,0.5)
Fair (F)	(3,5,7)	Medium (M)	(0.3,0.5,0.7)
Good (G)	(5,6.5,8)	Fairly high (FH)	(0.5,0.65,0.8)
Very good (VG)	(7,8,9)	High (H)	(0.7,0.8,0.9)
Excellent (E)	(8.5,9.5,10)	Very High (VH)	(0.85,0.95,1.0)

Step 4 Conversion of linguistic terms into appropriate fuzzy numbers

Triangular numbers are widely applied owing to their simplified methodology in attaining results (Lin et al. 2006a, b). In addition, subtraction and multiplication operations are easy to perform on fuzzy numbers. Chen and Hwang (1992) and Lin et al. (2006a, b) have described triangular fuzzy numbers as a special case of fuzzy numbers and defined a fuzzy number (a,b,c) whose membership functions ($f_A(X)$) are as shown in the following equation:

$$f_A(x) = \begin{cases} (x-a)/(b-a), & a \le x \le b, \\ (x-c)/(c-b), & b \le x \le c, \\ 0, & \text{otherwise.} \end{cases}$$

If $a = b = c$, then the triangular fuzzy number is reduced to a real number. Lin et al. (2006a, b), Vinodh and Vimal (2012), Vinodh and Aravindraj, (2013) and Sreedharan et al. (2019) have developed a fuzzy set number corresponding to each linguistic term for the evaluation of leanness, agility, leagility and Lean Six Sigma (LSS), and these are used to evaluate readiness for the implementation of agility as shown in Table 3.

Step 5 Aggregating fuzzy rating with fuzzy weights

The aggregate performance rating of the attributes is customized into criteria rating, and the criteria rating is customized into enabler rating and shown in Eqs. (1) and (2), respectively (Lin et al. 2006a, b; Suresh and Patri 2017).

$$Q_{ij} = \frac{\sum_{K=1}^{K} (P_{ijk} \otimes Q_{ijk})}{\sum_{k=1}^{k} P_{ijk}} \quad (1)$$

$$Q_i = \frac{\sum_{j=1}^{j} (P_{ij} \otimes Q_{ij})}{\sum_{j=1}^{j} P_{ij}} \quad (2)$$

Once the criteria rating is obtained, the next step is to compute the FRAI by Eq. (3).

$$\text{FRAI} = \frac{\sum_{i=1}^{i} (P_i \otimes Q_i)}{\sum_{i=1}^{i} P_i} \quad (3)$$

Step 6 Match the FRAI with an appropriate level

The FRAI calculated is compared with the general linguistic term using Euclidean distance method. Euclidean distance method is conceived of as the most spontaneous method for humans to calculate perceived closeness (Lin et al. 2006a, b; Vinodh and Vimal 2012; Vinodh and Aravindraj 2013). In this method, five linguistic terms known as natural language expressions are adopted from Narayanamurthy et al. (2018) which include not ready (NR), low ready (LR), average ready (AR), close to ready (CR) and ready (R). Table 4 represents readiness for the implementation of agility and its corresponding fuzzy interval. The Euclidean distance is calculated by using Eq. (4).

$$D(\text{FRAI}, \text{RAL}_i) = \sqrt{\sum (f\text{FRAI}(x) - f\text{RAL}_i(x))^2} \quad (4)$$

Step 7 To identify weaker attributes, FPII is calculated

To identify weaker attributes of readiness for implementing agility by using FPII, the performance rating and importance weights of each attribute are combined. After computation, FPII helps the manager to focus on the attributes that have low value and they address those attributes to improve the readiness level for the implementation of agility in the hospital. The computation of FPII consists of two steps: first is the calculation of as given in Eq. (5).

$$\text{FPII}_{ijk} = U_{ijk} \otimes Q_{ijk} \quad (5)$$

Where $U_{ijk} = (1,1,1) - P_{ijk}$

Next step is the prediction of ranking score for each attribute by employing centroid method where a, b and c

are the lower, middle and upper numbers of the triangular fuzzy number, respectively, as shown in Eq. (6) (Vinodh and Vimal 2012; Sreedharan et al. 2019).

$$\text{Rank score} = \frac{a + 4b + c}{6} \tag{6}$$

After obtaining ranks for all attributes, the management should take corrective actions to overcome the issues and to make the organization ready for the implementation of agility.

Case Study

The assessment of readiness model for the implementation of agility is done in a hospital which is 44 years old, located in India. The selected hospital is with a capacity of 41 beds, and it is now functioning with a team of well-qualified and professionally skilled medical staff with long years of experience in their respective fields. The quality of nursing care is maintained by adequate trained nurses and Para medical staff. The hospital works on round the clock and offers services including casualty, Intensive Care Unit (ICU), ambulance service, operation theatre, diagnostic centre, health checkup schemes, skin treatment, gastroenterology, neurological conditions, diabetes management, general paediatrics and gynaecology. A team of doctors on board, including specialists, are equipped with the knowledge and experience of handling various types of medial issues.

The hospital faces an issue of competitive advantage due to the increase in competition, changes in the requirements of customers, continual change process, uncertainty and increase in the standard of quality. All the above issues are handled by applying agility in the hospital. The enablers of agile organization would imply refined environmental scanning, decentralized decision making, informal and formal interrelationship by networking and trust among employees' skill to take decisions and innovation (Tolf et al. 2015). To implement agility in hospital, management needs to formulate before initiating the change process, for which the current study would assist the management of the hospital to know the readiness level on agility. Data have been collected from six experts including 2 doctors, 1 head of nursing, 1 senior laboratory technician, 1 head of pharmacy and 1 admin manager. The experts provide data for performance rating of attributes. The survey is conducted with five experts from different hospitals to get the importance weights for enablers, criteria and attributes.

The responses of importance weights for enabler and criteria are shown in Tables 5 and 6, respectively. For assessing the readiness level, the response for performance rating and importance weights of attributes is given in Table 7.

Primary Computation of FRAI

The fuzzy interval values are assigned by linguistic values using Table 4 to importance weights and performance rating. The aggregated importance weights and performance rating are calculated based on the formula of average operational method.

$$\begin{aligned}&\text{Average fuzzy weight}\\ &= [(0.85, 0.95, 1.0) + (0.7, 0.8, 0.9) + (0.7, 0.8, 0.9)\\ &\quad + (0.7, 0.8, 0.9) + (0.7, 0.8, 0.9)]/5\\ &= (0.73,\ 0.83,\ 0.92)\end{aligned}$$

$$\begin{aligned}&\text{Average fuzzy rating}\\ &= [(2, 3.5, 5) + (1, 2, 3) + (3, 5, 7)\\ &\quad + (2, 3.5, 5) + (2, 3.5, 5) + (3, 5, 7)]/6\\ &= (2.17, 3.75, 5.33)\end{aligned}$$

The next step is the calculation of fuzzy index rating for criteria (Q_{ij}) by using Eq. (1). For example, the criteria rating of multiple task and decision making Q_{11} (RA_{11}) are computed as given below.

$$\text{FRAI} = \frac{\begin{bmatrix} ((2.44, 4.16, 5.88) \otimes (0.79, 0.89, 0.96)) \oplus ((3.11, 4.91, 6.72) \otimes (0.69, 0.8, 0.9)) \oplus \\ ((3.11, 4.93, 6.76) \otimes (0.66, 0.77, 0.88)) \oplus ((3.11, 4.88, 6.66) \otimes (0.76, 0.86, 0.94)) \oplus \\ ((3.01, 4.79, 6.57) \otimes (0.66, 0.77, 0.88)) \oplus ((3.31, 5.06, 6.82) \otimes (0.62, 0.74, 0.86)) \end{bmatrix}}{\begin{bmatrix} (0.79, 0.89, 0.96)) \oplus (0.69, 0.8, 0.9) \oplus (0.66, 0.77, 0.88) \oplus \\ (0.76, 0.86, 0.94) \oplus (0.66, 0.77, 0.88) \oplus (0.62, 0.74, 0.86) \end{bmatrix}}$$

$$Q_{11}\,(\mathrm{RA}_{11}) = \frac{\left[\begin{array}{l}((2.17, 3.75, 5.33) \otimes (0.73, 0.83, 0.92)) \oplus \\ \quad ((2.50, 4.25, 6.00) \otimes (0.54, 0.68, 0.82))\end{array}\right]}{(0.73, 0.83, 0.92) \oplus (0.54, 0.68, 0.82)}$$

Q_{11} (RA_{11}) = (2.31, 3.98, 5.65).

The same equation is applied to calculate the performance rating of criteria and shown in Table 8. The fuzzy index of the enabler $\mathrm{RA_i}$ is calculated by utilizing Eq. (2). For example, the management responsibility agility enabler $\mathrm{RA_1}$ is calculated as

$$Q_1(RA_1) = \frac{\left[\begin{array}{l}((2.31, 3.98, 5.65) \otimes (0.58, 0.71, 0.84)) \oplus \\ \quad ((2.56, 4.34, 6.11) \otimes (0.61, 0.74, 0.86))\end{array}\right]}{(0.58, 0.71, 0.84) \oplus (0.61, 0.74, 0.86)}$$

Q_1 (RA_1) = (2.44, 4.16, 5.88)

The same equation is applied to calculate the performance rating of enabler and shown in Table 9. The FRAI is calculated using Eq. (3) as

$$\mathrm{FRAI} = (3.00, 4.78, 6.56)$$

Euclidean Distance Method

After obtaining, FRAI is converted back into linguistic term. In this method, the five linguistic terms used are known as readiness label which is given in Table 4 and for each readiness label, Euclidean distance (D) is calculated by using Eq. (4) as shown below.

$$D\,(\mathrm{FRAI},\ R) = \left[(3.00-7)^2+(4.78-8.5)^2+(6.56-10)^2\right]^{1/2} = 6.46$$

$$D\,(\mathrm{FRAI},\ \mathrm{CR}) = \left[(3.00-5.5)^2+(4.78-7)^2+(6.56-8.5)^2\right]^{1/2} = 3.87$$

$$D\,(\mathrm{FRAI},\ \mathrm{AR}) = \left[(3.00-3.5)^2+(4.78-5)^2+(6.56-6.5)^2\right]^{1/2} = 0.55$$

$$D\,(\mathrm{FRAI},\ \mathrm{LR}) = \left[(3.00-1.5)^2+(4.78-3)^2+(6.56-4.5)^2\right]^{1/2} = 3.10$$

$$D\,(\mathrm{FRAI},\ \mathrm{NR}) = \left[(3.00-0)^2+(4.78-1.5)^2+(6.56-3)^2\right]^{1/2} = 5.69$$

Thus, the linguistic label is matched with minimum D value and the readiness for the implementation of agility index of the hospital is known as "average ready". The pictorial representation of readiness label for the implementation of agility is given in Fig. 2.

Fuzzy Performance Importance Index (FPII)

Weaker attributes are identified by computing FPII which consists of two steps. The first step is the calculation of FPII done by using Eq. (5), and the second step is the development of ranking score for each attribute by using Eq. (6). The sample calculation of "Multiple tasking (RA_{111})" is shown below.

$$W_{111} = (1, 1, 1) - (0.73, 0.83, 0.92) = (0.27, 0.17, 0.08)$$

$$\mathrm{FPII}_{111} = (2.17, 3.75, 5.33) \times (0.27, 0.17, 0.08) = (0.59, 0.64, 0.43)$$

$$\text{Ranking score of } (RA_{111}) = \frac{(0.59 + 4(0.64) + 0.43)}{6} = 0.59$$

Further, the ranking score has been obtained for all the attributes and given in Table 10. The management threshold is fixed with the Pareto principle (20%) to acquire weaker attributes (Narayanamurthy et al. 2018). The management of the case hospital is consulted to fix the threshold level for the improvement of readiness level of

Table 4 Readiness factor for the implementation of agility and fuzzy intervals

Natural language expression set of readiness for the implementation of agility label	Fuzzy intervals
Ready (R)	(7, 8.5, 10)
Close to ready (CR)	(5.5, 7, 8.5)
Average ready (AR)	(3.5, 5, 6.5)
Low ready (LR)	(1.5, 3, 4.5)
Not ready (NR)	(0, 1.5, 3)

Table 5 Importance weights of readiness for the implementation of agility of enabler

RA_i	P_i				
	E1	E2	E3	E4	E5
RA_1	H	VH	H	VH	VH
RA_2	VH	FH	H	H	H
RA_3	H	H	FH	H	H
RA_4	VH	H	VH	H	H
RA_5	H	H	H	FH	H
RA_6	H	H	FH	FH	H

the hospital. In the present study, the management fixes the threshold as 1 and identifies weaker attributes less than 1 with the Pareto principle. There are 15 attributes which have lower performance that come below 1 (26%) out of 56 attributes.

Results and Discussion

Agility in hospital has the competence to survive and expand its competitive environment continuously and to respond to the unpredictable situation of market (Teoh and Cai 2015). It handles the uncertainty in healthcare which includes changes in demographic, public expectation, general technical innovation, socioeconomic status, work-related, supplier, municipality, social care and clients (Tolf et al. 2015). Agile implementation in a hospital is complex due to continual change, for which readiness level would help the manager for efficient implementation of agility. The analysis of readiness level is incorporated with the framework developed of conceptual model which is given in Table 2. The assessment of readiness level for the implementation of agile in the hospital is done, which divides into two elementary analyses. First, the current study computes FRAI from the selected hospital is "average ready". Second, FPII is calculated to identify fifteen weaker attributes and the management needs to pay attention to make the hospital ready for accepting agile in its system. The weaker attributes have low performance and also less than the value of FPII value based on Pareto principle (20%) which is discussed with management.

The weaker attributes are multiple tasking, good relationship with caregivers, management involvement, delegation of authority, positivity towards change, financial resources, customers' opinions, technical expert suggestions, innovation in service design, creativity, new idea to service, customer expectation, change in taste and preference, customer relationship management and service variety. General strategies to overcome the resistance for change include the continual management support for caregivers, proper training on the updated technology, continuous improvement process to increase quality, informal and formal relationship with caregivers, sharing of knowledge by caregivers with other employees and encouraging caregivers on taking responsibility.

The management also needs to develop and encourage a good relationship with its stakeholders including caregivers, customers, suppliers and other allied partnership from external environment. The good inter-relationship can be created by a proper communication with all the employees and capability to show them to be transparent with all caregivers. The customer requirement should be treated as central for the entire change process and should build trust with customers for long-term which would help to keep the hospital competitive. The management needs to develop and encourage nourishing the skill of employees

Table 6 Importance weights of readiness for the implementation of agility of criteria

RA_i	P_{ij}					RA_i	P_{ij}				
	E_1	E_2	E_3	E_4	E_5		E_1	E_2	E_3	E_4	E_5
RA_{11}	H	H	FH	FH	FH	RA_{34}	VH	H	H	H	FH
RA_{12}	VH	H	FH	FH	FH	RA_{41}	H	FH	FH	FH	FH
RA_{21}	H	H	FH	FH	FH	RA_{42}	FH	H	H	H	H
RA_{22}	VH	H	VH	H	VH	RA_{43}	FH	H	H	H	H
RA_{23}	H	H	H	H	H	RA_{51}	M	FH	M	FH	FH
RA_{24}	H	H	H	H	H	RA_{52}	VH	H	H	H	H
RA_{25}	FH	FH	FH	H	H	RA_{53}	H	H	FH	FH	H
RA_{31}	H	H	H	H	H	RA_{61}	VH	VH	H	H	H
RA_{32}	VH	H	H	H	FH	RA_{62}	H	VH	H	H	H
RA_{33}	VH	H	VH	H	H	RA_{63}	M	L	VL	M	VL

Table 7 Importance weights and performance rating of readiness for the implementation of agility of attributes

RA_{ijk}	P_{ijk}					Q_{ijk}					
	E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5	E_6
RA_{111}	VH	H	H	H	H	P	VP	F	P	P	F
RA_{112}	H	FH	FH	FH	FH	F	P	P	F	F	P
RA_{121}	H	VH	H	H	H	F	F	F	F	P	P
RA_{122}	VH	VH	H	FH	FH	F	P	P	P	F	F
RA_{123}	H	H	FH	H	H	F	P	F	F	P	P
RA_{211}	H	VH	M	M	M	F	F	P	P	F	F
RA_{212}	M	FL	M	M	H	P	P	F	F	F	F
RA_{221}	H	H	FH	FH	FH	F	F	F	G	F	G
RA_{222}	H	H	M	M	M	F	F	P	F	F	F
RA_{223}	H	H	H	H	H	F	F	P	P	F	P
RA_{231}	FH	VH	H	FH	FH	F	G	F	F	P	G
RA_{232}	M	VH	FH	FH	H	F	F	F	P	F	F
RA_{233}	FH	FH	FH	FH	FH	F	F	P	P	F	F
RA_{241}	M	L	M	M	M	F	F	P	F	G	F
RA_{242}	H	H	FH	FH	FH	F	F	F	G	G	G
RA_{251}	H	H	H	FH	H	F	F	P	F	F	G
RA_{252}	H	H	H	H	H	F	P	P	F	G	F
RA_{253}	H	M	M	M	M	F	F	F	P	G	F
RA_{311}	H	M	H	M	M	F	P	P	F	G	F
RA_{312}	FH	FH	FH	FH	FH	F	F	G	G	F	F
RA_{313}	H	FH	FH	FH	FH	F	F	F	G	F	F
RA_{321}	FH	VH	H	FH	FH	P	F	F	P	P	F
RA_{322}	FH	H	M	M	M	F	F	F	P	G	F
RA_{331}	H	M	M	M	FH	F	P	P	F	F	P
RA_{332}	H	M	M	M	FH	G	F	F	F	G	F
RA_{333}	FH	M	FH	FH	FH	F	F	P	F	F	P
RA_{341}	H	H	H	FH	H	F	G	G	F	F	P
RA_{342}	H	H	H	FH	FH	F	F	F	G	F	F
RA_{343}	H	H	FH	FH	FH	F	F	F	F	F	G
RA_{411}	H	H	FH	FH	H	F	F	F	G	F	G
RA_{412}	FH	VH	FH	FH	FH	F	G	G	G	F	F
RA_{413}	H	M	M	H	H	F	P	P	F	F	F
RA_{421}	FH	M	M	M	FH	G	F	F	F	P	F
RA_{422}	FH	VH	VH	VH	VH	G	G	F	F	F	G
RA_{423}	H	H	H	H	H	F	F	P	P	P	P
RA_{431}	FH	H	FH	FH	H	F	F	P	P	P	F
RA_{432}	FH	M	M	M	M	F	F	P	P	F	F
RA_{433}	FH	H	FH	FH	FH	F	F	F	P	G	F
RA_{511}	FH	H	H	H	H	F	F	G	G	F	F
RA_{512}	FH	VH	FH	FH	FH	F	G	F	F	F	G
RA_{513}	H	VH	FH	FH	FH	F	P	P	F	F	G
RA_{521}	H	H	H	H	M	F	F	P	P	P	P
RA_{522}	FH	VH	VH	H	H	G	F	P	P	F	F
RA_{523}	FH	H	H	VH	VH	F	F	F	P	P	G
RA_{531}	FH	H	FH	FH	FH	P	P	P	F	F	P
RA_{532}	H	M	H	M	H	P	F	P	F	F	F
RA_{533}	FH	H	FH	M	FH	F	G	G	F	F	G

Table 7 continued

RA_{ijk}	P_{ijk}					Q_{ijk}					
	E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5	E_6
RA_{611}	M	H	H	H	FH	F	F	P	F	F	G
RA_{612}	M	VH	H	VH	VH	F	G	P	F	G	P
RA_{613}	FH	H	FH	FH	FH	F	G	G	F	F	G
RA_{621}	H	VH	VH	VH	VH	F	G	F	G	F	P
RA_{622}	FH	VH	VH	VH	VH	F	F	F	F	P	P
RA_{623}	VH	VH	VH	VH	VH	F	G	F	G	P	F
RA_{631}	H	H	H	H	H	G	P	P	P	P	F
RA_{632}	FH	H	FH	FH	FH	F	G	F	F	P	F
RA_{633}	M	H	M	M	M	F	G	F	G	G	F

for changing environment. The caregivers are the backbone, and importance is given to their values and responsibility. New teams are identified, and the responsibility with flexibility is shared to take decisions to increase the trust among employees to accept change. Further, the utilization of the available resource is an essential element of achieving agility in hospital. The readiness level analysis is done to know the required resource to accomplish agility in hospital and carefully distribute resources to all the departments. The readiness can be created in the hospital by reaching the caregivers about the current requirements of hospital from customers, external environment and availability of resources. The suggestions for the enhancement of readiness level are gained from the experts and discussed with the management of the case hospital for further clarity. The detailed and multiple descriptions of suggestions for weaker attributes are given in Table 11.

Practical Implications

The preset study develops a readiness assessment model with the enablers, criteria and attributes. The model is communicated with the managers, and the approval is obtained to assess the hospital on readiness for agility implementation. Then the questionnaire is circulated among the managers to collect the ratings which are converted into linguistic terms. Then the linguistic variables use fuzzy set number to calculate FRAI and FPII to know the current readiness level of hospital for agility implementation. The weaker attributes are identified, and the management needs to take necessary actions to improve the readiness level of the hospital. The new strategies are framed and executed to improve readiness in the hospital. Further, the model is tested once again to know the hospital's readiness level for agility implementation. The continuous improvements in performance, quick decisions, developing a new service design, regular monitoring of external environment, encouraging employees to learn new skills and enhancing the customer satisfaction would make a hospital agile.

Managerial Implications

The readiness assessment model developed would be simple, comfortable and easily assessable by the management of the hospital. The adoption of the model can bring insights for the management into the obstacles to overcome the resistance. Fuzzy logic that uses the triangular can provide the truth level of the hospital whether it is ready or not to accept the agility in their premises. The results of the assessment model are strong enough for the management to understand issues and implement the strategy to overcome the resistance. The model represents the overall readiness level and helps to identify weaker areas that require special attention with detailed explanation for improvement. The model identifies the both external and internal issues separately to improve the readiness level. The external factors regulations, competitors advantage and customer needs are monitored regularly for the betterment of the hospital. In organization level size, location, employee requirement and workforce enrichment to improve readiness level. A special focus is required on both the internal and the

Table 8 Fuzzy index of readiness for the implementation of agility of criteria rating

Agility criteria for readiness	Agility Attributes for Readiness	Fuzzy performance average rating (Q_{ijk})	Attributes of importance average weight (P_{ijk})	Criteria rating
RA_{11}	RA_{111}	(2.17, 3.75, 5.33)	(0.73, 0.83, 0.92)	(2.31, 3.98, 5.65)
	RA_{112}	(2.50, 4.25, 6.00)	(0.54, 0.68, 0.82)	
RA_{12}	RA_{121}	(2.67, 4.50, 6.33)	(0.73, 0.83, 0.92)	(2.56, 4.34, 6.11)
	RA_{122}	(2.50, 4.25, 6.00)	(0.68, 0.8, 0.9)	
	RA_{123}	(2.50, 4.25, 6.00)	(0.66, 0.77, 0.88)	
RA_{21}	RA_{211}	(2.67, 4.50, 6.33)	(0.49, 0.65, 0.8)	(2.67, 4.50, 6.33)
	RA_{212}	(2.67, 4.50, 6.33)	(0.36, 0.53, 0.7)	
RA_{22}	RA_{221}	(3.67, 5.50, 7.33)	(0.58, 0.71, 0.84)	(2.98, 4.81, 6.65)
	RA_{222}	(2.83, 4.75, 6.67)	(0.46, 0.62, 0.78)	
	RA_{223}	(2.50, 4.25, 6.00)	(0.7, 0.8, 0.9)	
RA_{23}	RA_{231}	(3.50, 5.25, 7.00)	(0.61, 0.74, 0.86)	(3.03, 4.85, 6.67)
	RA_{232}	(2.83, 4.75, 6.67)	(0.57, 0.71, 0.84)	
	RA_{233}	(2.67, 4.50, 6.33)	(0.5, 0.65, 0.8)	
RA_{24}	RA_{241}	(3.17, 5.00, 6.83)	(0.26, 0.44, 0.62)	(3.74, 5.46, 7.22)
	RA_{242}	(4.00, 5.75, 7.50)	(0.58, 0.71, 0.84)	
RA_{25}	RA_{251}	(3.17, 5.00, 6.83)	(0.66, 0.77, 0.88)	(3.10, 4.91, 6.71)
	RA_{252}	(3.00, 4.75, 6.50)	(0.7, 0.8, 0.9)	
	RA_{253}	(3.17, 5.00, 6.83)	(0.38, 0.56, 0.74)	
RA_{31}	RA_{311}	(3.00, 4.75, 6.50)	(0.46, 0.62, 0.78)	(3.34, 5.17, 7.01)
	RA_{312}	(3.67, 5.50, 7.33)	(0.5, 0.65, 0.8)	
	RA_{313}	(3.33, 5.25, 7.17)	(0.54, 0.68, 0.82)	
RA_{32}	RA_{321}	(2.50, 4.25, 6.00)	(0.61, 0.74, 0.86)	(2.77, 4.58, 6.39)
	RA_{322}	(3.17, 5.00, 6.83)	(0.42, 0.59, 0.76)	
RA_{33}	RA_{331}	(2.50, 4.25, 6.00)	(0.42, 0.59, 0.76)	(2.94, 4.75, 6.55)
	RA_{332}	(3.67, 5.50, 7.33)	(0.42, 0.59, 0.76)	
	RA_{333}	(2.67, 4.50, 6.33)	(0.46, 0.62, 0.78)	
RA_{34}	RA_{341}	(3.50, 5.25, 7.00)	(0.66, 0.77, 0.88)	(3.39, 5.25, 7.11)
	RA_{342}	(3.33, 5.25, 7.17)	(0.62, 0.74, 0.86)	
	RA_{343}	(3.33, 5.25, 7.17)	(0.58, 0.71, 0.84)	
RA_{41}	RA_{411}	(3.67, 5.50, 7.33)	(0.62, 0.74, 0.86)	(3.46, 5.26, 7.06)
	RA_{412}	(4.00, 5.75, 7.50)	(0.57, 0.71, 0.84)	
	RA_{413}	(2.67, 4.50, 6.33)	(0.54, 0.68, 0.82)	
RA_{42}	RA_{421}	(3.17, 5.00, 6.83)	(0.38, 0.56, 0.74)	(3.20, 4.94, 6.68)
	RA_{422}	(4.00, 5.75, 7.50)	(0.78, 0.89, 0.96)	
	RA_{423}	(2.33, 4.00, 5.67)	(0.7, 0.8, 0.9)	
RA_{43}	RA_{431}	(2.50, 4.25, 6.00)	(0.58, 0.71, 0.84)	(2.72, 4.50, 6.27)
	RA_{432}	(2.67, 4.50, 6.33)	(0.34, 0.53, 0.72)	
	RA_{433}	(3.00, 4.75, 6.50)	(0.54, 0.68, 0.82)	
RA_{51}	RA_{511}	(3.67, 5.50, 7.33)	(0.66, 0.77, 0.88)	(3.45, 5.25, 7.06)
	RA_{512}	(3.67, 5.50, 7.33)	(0.57, 0.71, 0.84)	
	RA_{513}	(3.00, 4.75, 6.50)	(0.61, 0.74, 0.86)	
RA_{52}	RA_{521}	(2.33, 4.00, 5.67)	(0.62, 0.74, 0.86)	(2.80, 4.52, 6.23)
	RA_{522}	(3.00, 4.75, 6.50)	(0.72, 0.83, 0.92)	
	RA_{523}	(3.00, 4.75, 6.50)	(0.72, 0.83, 0.92)	
RA_{53}	RA_{531}	(2.33, 4.00, 5.67)	(0.54, 0.68, 0.82)	(2.97, 4.74, 6.49)
	RA_{532}	(2.67, 4.50, 6.33)	(0.54, 0.68, 0.82)	
	RA_{533}	(4.00, 5.75, 7.50)	(0.5, 0.65, 0.8)	

Table 8 continued

Agility criteria for readiness	Agility Attributes for Readiness	Fuzzy performance average rating (Q_{ijk})	Attributes of importance average weight (P_{ijk})	Criteria rating
RA_{61}	RA_{611}	(3.17, 5.00, 6.83)	(0.58, 0.71, 0.84)	(3.48, 5.23, 6.99)
	RA_{612}	(3.33, 5.00, 6.67)	(0.71, 0.83, 0.92)	
	RA_{613}	(4.00, 5.75, 7.50)	(0.54, 0.68, 0.82)	
RA_{62}	RA_{621}	(3.50, 5.25, 7.00)	(0.82, 0.92, 0.98)	(3.23, 5.01, 6.78)
	RA_{622}	(2.67, 4.50, 6.33)	(0.78, 0.89, 0.96)	
	RA_{623}	(3.50, 5.25, 7.00)	(0.85, 0.95, 1)	
RA_{63}	RA_{631}	(2.67, 4.25, 5.83)	(0.7, 0.8, 0.9)	(3.15, 4.91, 6.67)
	RA_{632}	(3.17, 5.00, 6.83)	(0.54, 0.68, 0.82)	
	RA_{633}	(4.00, 5.75, 7.50)	(0.38, 0.56, 0.74)	

external factors for updating and making the organization ready to accept the changes. Further, model is continuously utilized by the practitioners and the experts, and it will help the hospital for the betterment for making the organization ready.

Conclusion

Agility is a quick attractive key and a crucial factor to all the organizations to survive in the uncertain and unstable market. The organization should continuously adopt the change according to the changing environment and need to respond quickly, flexibly and within the ability to meet customer demands (Ganguly et al. 2009). The implementation of agility in an organization requires a concern time, and it depends on various factors. The management and employees are required to be enthusiastic, accept the transformation of organization and develop a strategy to adopt agility (Devadasan et al. 2005). Agility is implemented with the attention of management by measuring the readiness level of a hospital. The current study helps to identify the readiness level of the hospital using fuzzy logic. Fuzzy logic approach is utilized mainly to overcome the difficulties like vagueness, uncertainty, and ambiguity (Vinodh and Vimal 2012).

The current study addresses the all three research questions. First, the framework for the assessment of readiness level is developed with the literature and the experts. Second, the model developed is tested with the case hospital and FRAI is computed and measured by Euclidean distance method and the hospital is found to be "average ready" for implementing agility. Third, FPII is computed to identify 15 attributes that were weaker from 56 attributes. The agile leader needs to discuss the strength and weakness, effective utilization of the potential of human resource, to set the goal to accomplish task and to develop a strategy to make hospital readiness. The organizational culture would encourage collaboration and cooperation among employees, innovation, creativity and transparency for making the organization agile (Sanatigar et al. 2017). The readiness level is increased in the hospital by integrating, implementing and practicing strategic workforce on planning workloads, healthcare size, location and process. The analysis of readiness level would help to increase flexibility and acceptance of agility among the employees of the hospital.

The current study addresses the issues related to resistance on the assessment model for readiness, but it has its own limitations. The generalizability of the study can be done by testing the model in different location and medium-sized hospitals in different regions because each hospital is unique in its nature and all the affecting factors are captured to be included in the model. The study can be extended in future by applying longitudinal study with a single hospital with different levels of healthcare organizations like dispensary, multi-specialty hospital, public and private medical institutes. Comparison and contrast would give further insights into the readiness level on a single hospital with long time and different hospital with a single time. Further, it can use correlation to rank the agility readiness attributes.

Table 9 Fuzzy index of readiness for the implementation of agility of enabler rating and FRAI

Readiness for agility enabler	Readiness for agility criteria	Criteria rating (Q_{ij})	Criteria weights (P_{ij})	Enabler rating (Q_i)	Enabler weights (P_i)	FRAI
RA_1	RA_{11}	(2.31, 3.98, 5.65)	(0.58, 0.71, 0.84)	(2.44, 4.16, 5.88)	(0.79, 0.89, 0.96)	(3.00, 4.78, 6.56)
	RA_{12}	(2.56, 4.34, 6.11)	(0.61, 0.74, 0.86)			
RA_2	RA_{21}	(2.67, 4.50, 6.33)	(0.58, 0.71, 0.84)	(3.11, 4.91, 6.72)	(0.69, 0.80, 0.90)	
	RA_{22}	(2.98, 4.81, 6.65)	(0.79, 0.89, 0.96)			
	RA_{23}	(3.03, 4.85, 6.67)	(0.70, 0.80, 0.90)			
	RA_{24}	(3.74, 5.46, 7.22)	(0.70, 0.80, 0.90)			
	RA_{25}	(3.10, 4.91, 6.71)	(0.58, 0.71, 0.84)			
RA_3	RA_{31}	(3.34, 5.17, 7.01)	(0.70, 0.80, 0.90)	(3.11, 4.93, 6.76)	(0.66, 0.77, 0.88)	
	RA_{32}	(2.77, 4.58, 6.39)	(0.69, 0.80, 0.90)			
	RA_{33}	(2.94, 4.75, 6.55)	(0.76, 0.86, 0.94)			
	RA_{34}	(3.39, 5.25, 7.11)	(0.69, 0.80, 0.90)			
RA_4	RA_{41}	(3.46, 5.26, 7.06)	(0.54, 0.68, 0.82)	(3.11, 4.89, 6.66)	(0.76, 0.86, 0.94)	
	RA_{42}	(3.20, 4.94, 6.68)	(0.66, 0.77, 0.88)			
	RA_{43}	(2.72, 4.50, 6.27)	(0.66, 0.77, 0.88)			
RA_5	RA_{51}	(3.45, 5.25, 7.06)	(0.42, 0.59, 0.760	(3.01, 4.79, 6.57)	(0.66, 0.77, 0.88)	
	RA_{52}	(2.80, 4.52, 6.23)	(0.73, 0.83, 0.92)			
	RA_{53}	(2.97, 4.74, 6.49)	(0.62, 0.74, 0.86)			
RA_6	RA_{61}	(3.48, 5.23, 6.99)	(0.76, 0.86, 0.94)	(3.31, 5.06, 6.82)	(0.62, 0.74, 0.86)	
	RA_{62}	(3.23, 5.01, 6.78)	(0.73, 0.83, 0.92)			
	RA_{63}	(3.15, 4.91, 6.67)	(0.48, 0.62, 0.74)			

Table 10 FPII of readiness for the implementation of Agility

Readiness for the implementation of agility attributes	Fuzzy performance average rating (Q_{ijk})	W_{ijk} = (1, 1, 1) − P_{ijk}	FPII	Ranking score
RA_{111}	(2.17, 3.75, 5.33)	(0.27, 0.17, 0.08)	(0.59, 0.64, 0.43)	0.59**
RA_{112}	(2.50, 4.25, 6.00)	(0.46, 0.32, 0.18)	(1.15, 1.36, 1.08)	1.28
RA_{121}	(2.67, 4.50, 6.33)	(0.27, 0.17, 0.08)	(0.72, 0.77, 0.51)	0.71**
RA_{122}	(2.50, 4.25, 6.00)	(0.32, 0.2, 0.1)	(0.80, 0.85, 0.60)	0.80**
RA_{123}	(2.50, 4.25, 6.00)	(0.34, 0.23, 0.12)	(0.85, 0.98, 0.72)	0.91**
RA_{211}	(2.67, 4.50, 6.33)	(0.51, 0.35, 0.2)	(1.36, 1.58, 1.27)	1.49
RA_{212}	(2.67, 4.50, 6.33)	(0.64, 0.47, 0.3)	(1.71, 2.12, 1.90)	2.01
RA_{221}	(3.67, 5.50, 7.33)	(0.42, 0.29, 0.16)	(1.54, 1.60, 1.17)	1.52
RA_{222}	(2.83, 4.75, 6.67)	(0.54, 0.38, 0.22)	(1.53, 1.81, 1.47)	1.70
RA_{223}	(2.50, 4.25, 6.00)	(0.3, 0.2, 0.1)	(0.75, 0.85, 0.60)	0.79**
RA_{231}	(3.50, 5.25, 7.00)	(0.39, 0.26, 0.14)	(1.37, 1.37, 0.98)	1.30
RA_{232}	(2.83, 4.75, 6.67)	(0.43, 0.29, 0.16)	(1.22, 1.38, 1.07)	1.30
RA_{233}	(2.67, 4.50, 6.33)	(0.5, 0.35, 0.2)	(1.33, 1.58, 1.27)	1.48
RA_{241}	(3.17, 5.00, 6.83)	(0.74, 0.56, 0.38)	(2.34, 2.80, 2.60)	2.69
RA_{242}	(4.00, 5.75, 7.50)	(0.42, 0.29, 0.16)	(1.68, 1.67, 1.20)	1.59
RA_{251}	(3.17, 5.00, 6.83)	(0.34, 0.23, 0.12)	(1.08, 1.15, 0.82)	1.08
RA_{252}	(3.00, 4.75, 6.50)	(0.3, 0.2, 0.1)	(0.90, 0.95, 0.65)	0.89**
RA_{253}	(3.17, 5.00, 6.83)	(0.62, 0.44, 0.26)	(1.96, 2.20, 1.78)	2.09
RA_{311}	(3.00, 4.75, 6.50)	(0.54, 0.38, 0.22	(1.62, 1.81, 1.43)	1.71
RA_{312}	(3.67, 5.50, 7.33)	(0.5, 0.35, 0.2)	(1.83, 1.93, 1.47)	1.83
RA_{313}	(3.33, 5.25, 7.17)	(0.46, 0.32, 0.18)	(1.53, 1.68, 1.29)	1.59
RA_{321}	(2.50, 4.25, 6.00)	(0.39, 0.26, 0.14)	(0.98, 1.11, 0.84)	1.04
RA_{322}	(3.17, 5.00, 6.83)	(0.58, 0.41, 0.24)	(1.84, 2.05, 1.64)	1.95
RA_{331}	(2.50, 4.25, 6.00)	(0.58, 0.41, 0.24)	(1.45, 1.74, 1.44)	1.64
RA_{332}	(3.67, 5.50, 7.33)	(0.58, 0.41, 0.24)	(2.13, 2.26, 1.76)	2.15
RA_{333}	(2.67, 4.50, 6.33)	(0.54, 0.38, 0.22)	(1.44, 1.71, 1.39)	1.61
RA_{341}	(3.50, 5.25, 7.00)	(0.34, 0.23, 0.12)	(1.19, 1.21, 0.84)	1.14

Table 10 continued

Readiness for the implementation of agility attributes	Fuzzy performance average rating (Q_{ijk})	W_{ijk} = (1, 1, 1) − P_{ijk}	FPII	Ranking score
RA_{342}	(3.33, 5.25, 7.17)	(0.38, 0.26, 0.14)	(1.27, 1.37, 1.00)	1.29
RA_{343}	(3.33, 5.25, 7.17)	(0.42, 0.29, 0.16)	(1.40, 1.52, 1.15)	1.44
RA_{411}	(3.67, 5.50, 7.33)	(0.38, 0.26, 0.14)	(1.39, 1.43, 1.03)	1.36
RA_{412}	(4.00, 5.75, 7.50)	(0.43, 0.29, 0.16)	(1.72, 1.67, 1.20)	1.60
RA_{413}	(2.67, 4.50, 6.33)	(0.46, 0.32, 0.18)	(1.23, 1.44, 1.14)	1.35
RA_{421}	(3.17, 5.00, 6.83)	(0.62, 0.44, 0.26)	(1.96, 2.20, 1.78)	2.09
RA_{422}	(4.00, 5.75, 7.50)	(0.22, 0.11, 0.04)	(0.88, 0.63, 0.30)	0.62**
RA_{423}	(2.33, 4.00, 5.67)	(0.3, 0.2, 0.1)	(0.70, 0.80, 0.57)	0.74**
RA_{431}	(2.50, 4.25, 6.00)	(0.42, 0.29, 0.16)	(1.05, 1.23, 0.96)	1.16
RA_{432}	(2.67, 4.50, 6.33)	(0.66, 0.47, 0.28)	(1.76, 2.12, 1.77)	2.00
RA_{433}	(3.00, 4.75, 6.50)	(0.46, 0.32, 0.18)	(1.38, 1.52, 1.17)	1.44
RA_{511}	(3.67, 5.50, 7.33)	(0.34, 0.23, 0.12)	(1.25, 1.27, 0.88)	1.20
RA_{512}	(3.67, 5.50, 7.33)	(0.43, 0.29, 0.16)	(1.58, 1.60, 1.17)	1.52
RA_{513}	(3.00, 4.75, 6.50)	(0.39, 0.26, 0.14)	(1.17, 1.24, 0.91)	1.17
RA_{521}	(2.33, 4.00, 5.67)	(0.38, 0.26, 0.14)	(0.89, 1.04, 0.79)	0.97**
RA_{522}	(3.00, 4.75, 6.50)	(0.28, 0.17, 0.08)	(0.84, 0.81, 0.52)	0.77**
RA_{523}	(3.00, 4.75, 6.50)	(0.28, 0.17, 0.08)	(0.84, 0.81, 0.52)	0.77**
RA_{531}	(2.33, 4.00, 5.67)	(0.46, 0.32, 0.18)	(1.07, 1.28, 1.02)	1.20
RA_{532}	(2.67, 4.50, 6.33)	(0.46, 0.32, 0.18)	(1.23, 1.44, 1.14)	1.35
RA_{533}	(4.00, 5.75, 7.50)	(0.5, 0.35, 0.2)	(2.00, 2.01, 1.50)	1.93
RA_{611}	(3.17, 5.00, 6.83)	(0.42, 0.29, 0.16)	(1.33, 1.45, 1.09)	1.37
RA_{612}	(3.33, 5.00, 6.67)	(0.29, 0.17, 0.08)	(0.97, 0.85, 0.53)	0.82
RA_{613}	(4.00, 5.75, 7.50)	(0.46, 0.32, 0.18)	(1.84, 1.84, 1.35)	1.76
RA_{621}	(3.50, 5.25, 7.00)	(0.18, 0.08, 0.02)	(0.63, 0.42, 0.14)	0.41**
RA_{622}	(2.67, 4.50, 6.33)	(0.22, 0.11, 0.04)	(0.59, 0.50, 0.25)	0.47**
RA_{623}	(3.50, 5.25, 7.00)	(0.15, 0.05, 0)	(0.53, 0.26, 0.00)	0.26**
RA_{631}	(2.67, 4.25, 5.83)	(0.3, 0.2, 0.1)	(0.80, 0.85, 0.58)	0.80**

Table 10 continued

Readiness for the implementation of agility attributes	Fuzzy performance average rating (Q_{ijk})	W_{ijk} = (1, 1, 1) − P_{ijk}	FPII	Ranking score
RA_{632}	(3.17, 5.00, 6.83)	(0.46, 0.32, 0.18)	(1.46, 1.60, 1.23)	1.51
RA_{633}	(4.00, 5.75, 7.50)	(0.62, 0.44, 0.26)	(2.48, 2.53, 1.95)	2.43

** Weaker attributes

Table 11 Suggestions for improvement for weaker attributes

Attributes	Explanation
Multiple tasking	Management needs to assign and clarify tasks to each employee who leads a team
	Flexible organizational climate is required to handle complex situations
	Managers and department heads are assigned the duties of change process with their daily routine
	Skilled employees are identified from each department and grouped them a team and utilized for change process
Good relationship with caregivers	Treat caregivers nicely
	Respect their emotions and values
	Engage them in decisions and get their opinions
	Create values for their effort and work performance
Management involvement	Authorize employees to take decisions on critical situations
	Provide employees the potential to accept new changes quickly
	Encourage lower level employees to take part in decisions
	Invite new ideas and opinions from employees
Delegation of authority	Proper selection of individuals for team
	Divide the authority and responsibility to all caregivers
	Sufficient training and support should be given by management
	Improve motivation and commitment among caregivers
Positive towards change	Explain the necessity on change and issues
	Discuss the commitment and involvement of management towards change
	Develop an efficient plan
	Motivate employees with benefits and privileges for their efforts
	Change the culture towards learning and sustainable growth
Financial resources	Allocate certain percentage of income for the development of the hospital
	Survey the entire hospital and make a list of requirements
	Allocate fund based on priority
	Get fund from outside on emergency situation and repay periodically for the development of the hospital
Customer opinions	Getting feedback would help to improve the service
	Get information about their requirements, preference and necessity of customers
	Customer retention is achieved
	Feedback would help to take better decisions by management
Technical expert suggestions	Get opinions on the equipment and machinery used in hospitals
	Update and change required machines in hospital
	Separate training programme can be arranged to know the current trends in services
	Sharing knowledge with other peers to improve skills together
Innovation in service design	Reduce the waiting time of patients on the process of test and reports
	Add more ambulance service in new locations
	Create new departments for home caring, delivery of medicine to customers' home and appointments for regular check up

Table 11 continued

Attributes	Explanation
Creativity	Assign a separate help assistance in all the floors to help the customers
	Separate entry for outpatient, emergency and in patient is necessary
	Create a app or software for the appointments
	Periodically call for health enquiry to maintain good relations with customers
	Provide door delivery on medicines
	Take blood test of patients before their time of appointment
New idea to service	Arrange the floors with the available service
	In ground floor, all the labs, scan, X-rays, pharmacy, billing and other allied services are to set for customers' convenience
	In first floor, all the outpatient sections of all the available service of hospital
	Next floor must have ICU and operation theatre and rooms
Customer expectation	Openness among customers to get their feedback
	Be transparent and honest with your customers
	Accomplish the requirement of customers
Change in taste and preference	Requirements of customers would change
	Identify the current requirements of customers
	Regular feedback and opinion would help to customer taste
	Follow up the implementation of opinions
Customer relationship management (CRM)	Know your customers
	Develop a service design which meets the needs of customers
	Friendly approach and openness with customers
	Treat all types of customers equally
	Appoint separate CRM managers to handle issues
Service variety	Extend the available services like bed, doctors, nurses and other technical caregivers
	Add aligned department of medical services like scan, lab expansion and pharmacy
	Expand the incentive care unit with the separation of each service

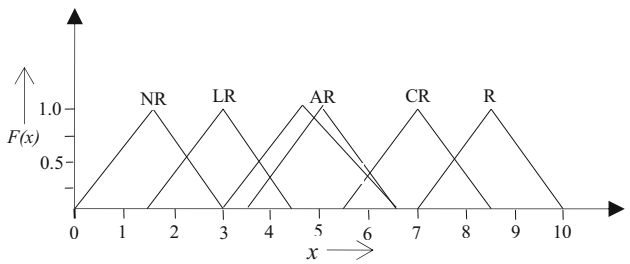

Fig. 2 Linguistic levels to match fuzzy readiness for the implementation of Agility index

Compliance with Ethical Standards

Conflict of interest The author declares that there is no conflict of interest in publishing this paper. The author states the clarification of the anonymization of the data collection or for questionnaires (if any).

Appendix

See Table 12.

Table 12 Detailed explanation of attributes with reference

S. no.	Attributes	Explanation	References
1	Multiple tasking	Management would work on multiple tasking to implement agility in the organization	Suresh and Patri (2017)
2	Transparent and quick decision	Management would take quick decisions, and it must be transparent to caregivers	Zain et al. (2005)
3	Good relationship with caregivers	Management needs to maintain good relationship with caregivers make to the change process smoother	Suresh and Patri (2017)
4	Management involvement	The involvement of management should be make all the employees know about the importance of agility in organization	Lin et al. (2006a, b)
5	Delegation of authority	Dividing work and responsibility among employees to carry out the work in better way	Aravindraj and Vinodh (2014)
6	Frequent interval of meeting	The frequent interval of meeting conducted to know about the happening in the organization	Dubey et al. (2015)
7	Sharing information with stakeholders	The management should share all information with their employees, suppliers and their customers about the changes	Aravindraj and Vinodh (2014)
8	Building trust with caregivers	The management must create a positive image and trust among its caregivers	Dubey and Gunasekaran (2016)
9	Current situation of organization	The management should say about the current situation of organization	Dubey et al. (2015)
10	Positive towards change	The management can create a positive atmosphere and comfort towards change	Dubey and Gunasekaran (2016)
11	Policy and procedure change	The new policy and procedure changes according to the requirement of readiness	Ghodrati and Zargarzadeh (2013)
12	New organizational structure	The structure of organization is essential to change according to the requirement of the organization	Ghodrati and Zargarzadeh (2013)
13	Change in infrastructure	The facility and infrastructure required are changed to implement agility in organization	Ghodrati and Zargarzadeh (2013)
14	Speed of adoption	The quick adoption of change is essential to survive in the current scenario	Dubey and Gunasekaran (2016)
15	Work sharing culture	The caregivers should follow sharing of their work with others. This helps to reduce the workload	Suresh and Patri (2017)
16	Availability of facilities	The facilities like fund, human and other facilities available are used properly for the implementation of agility	Appelbaum et al. (2017)
17	Financial resources	The liquid cash, loans and shares are should be available for the implementation process	Appelbaum et al. (2017)
18	Facility required	The facilities like space, equipment and amenities required to carry out the implementation of change process	Appelbaum et al. (2017)
19	Need for training	Training is essential because the organization will transform to new structure which would help to follow agility in organization	Vinodh et al. (2012)
20	Frequent training for caregivers	Frequent training is given to employees to gain knowledge to carry out the work	Patri and Suresh (2017)
21	Continuous learning	Continuous learning helps the caregivers to carry out the work in a better way	Misra et al. (2009),
22	Assess performance periodically	The performance of caregivers is assessed periodically to know if they required training to meet the actual performance	Dubey and Gunasekaran (2016)
23	Sufficient salary and bonus	The best salary package and bonus given to caregivers to retain them in their organization	Suresh and Patri (2017)
24	Cross-functional teams	The caregiver should work in teams and to have smooth functioning of work	Misra et al. (2009)

Table 12 continued

S. no.	Attributes	Explanation	References
25	Individual level in teams	The individual contribution to teams is measured to know the actual performance of team	Avazpour et al. (2014)
26	Team across company boarders	The caregivers work across the organization because it collaborates with suppliers and work tie-up with other countries	Lin et al. (2006a, b)
27	Cooperation among caregivers	Each individual caregiver works with others with good cooperation to maintain the quality of organization	Misra et al. (2009)
28	Collaborative activity	Combined work is carried out by caregivers	Suresh and Patri (2017)
29	Work facilitation	The facility required to carry out the work is provided to caregivers properly	Suresh and Patri (2017)
30	Continuous strategic change	The restructure strategy would happen according to the prediction of changes in market, legal change and so on	Appelbaum et al. (2017)
31	Flexible automation	The convenient automation of work is designed to make comfort for caregivers	Vinodh et al. (2012)
32	Competitive advantage	The organization would gain by providing best service than their competitors	Appelbaum et al. (2017)
33	Caregiver's suggestion	The employee suggestion should be considered by the management to improve the organization to next level	Patri and Suresh (2017)
34	Customer opinions	The customer's opinion is considered because they are important for the implementation of agility	Patri and Suresh (2017)
35	Technical experts' suggestion	The technical experts from outside would suggest to management to implement agility in a better way	Expert opinion
36	Future resource evaluation	The future resource requirement is predicted and fund is allocated for it	Vinodh et al. (2012)
37	Fixed price for service	The price for service is fixed based on facilities provided, but it must be in affordable level	Vinodh et al. (2012)
38	Fund allocation by category	The fund in organization is allocated in proposition for the requirement	Expert opinion
39	Technology awareness	The management should be aware of the recent technology update in market	Lin et al. (2006a, b)
40	Skill and knowledge of enhancing technology	The skills and knowledge to adopt technology are given through proper training to caregivers	Lin et al. (2006a, b)
41	Upgradation of technology	The upgradation of present technology would help caregivers to work in comfort zone	Vinodh et al. (2012)
42	Innovation in service design	The innovative ideas would provide service to customers in an efficient and effective way	Vinodh et al. (2012)
43	Creativity	Creative ideas are used by management to carry out the work in different and best way	Aravindraj and Vinodh (2014)
44	New idea to service	New ideas are discussed to provide service in a better way	Vinodh and Aravindraj (2015)
45	Design improvement	The slight modification in current design would improve the service is considered	Aravindraj and Vinodh (2014)
46	New service development	The new type of service is developed to satisfy the customer	Aravindraj and Vinodh (2014)
47	Flexible service time	The flexible time is followed for the service given to the customers	Aravindraj and Vinodh (2014)
48	Legal and political scanning	The continuous scanning of legal and political environment	van Oosterhout et al. (2006)
49	Economical scanning	The frequent scanning of economy helps the organization to follow accordingly	van Oosterhout et al. (2006)
50	Adopting to recent scenario	The organization must adopt according to the changing scenario in current environment	van Oosterhout et al. (2006)
51	Customer expectation	The need and want of customers are the most important criteria of agility implementation process	Vinodh et al. (2012)
52	Change in taste and preference	The taste and preference of customers change periodically, and they should be analysed by the management	Vinodh and Aravindraj (2015)

Table 12 continued

S. no.	Attributes	Explanation	References
53	Customer relationship management	The management should maintain good relationship with their customers	Vinodh et al. (2012)
54	Service variety	A variety of services are provided to the customers	Aravindraj and Vinodh (2014)
55	Fast service delivery	Quick service is provided to the patients by reducing waiting time	Lin et al. (2006a, b)
56	Seasonal demand variation	The seasonal disease would demand differently which is also considered	Vinodh and Aravindraj (2015)

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Key Questions

1. How can the readiness level be measured for the implementation of agility in healthcare organization?
2. What are the enablers, criteria and attributes that influence the readiness level of agility in healthcare?
3. How are the weaker attributes addressed to enhance the readiness level of healthcare organization?

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