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Moving Towards Organizational Agility: Are We Improving in the Right Direction?

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Moving towards Organizational Agility: Are We Improving in the Right Direction?

Abstract: Agility is one of the most vital competitive advantages of organizations in response to the constant changes of volatile markets. In this paper, a novel approach towards improving organizational agility is proposed. Initially, the key performance indicators (KPIs) of the organization being studied are identified and ranked using balanced scorecard (BSC) and technique for order of preference by similarity to ideal solution (TOPSIS). According to the ranking, the most important KPIs are selected as the organization's critical success factors (CSFs). To convert linguistics judgments into quantitative values a fuzzy logic-based framework is presented. At the end, two consecutive houses of quality (HOQs) are developed. By inserting the CSFs into the first house, the main agile attributes are discovered and used as the inputs of the second house. The outcome of the second house is identifying the main agile enablers that best satisfy the agile attributes and consequently move the organization towards becoming agile.

Keywords: organizational agility; balanced scorecard (BSC); fuzzy QFD; fuzzy TOPSIS; house of quality (HOQ).

1. Introduction

Agility is known as one of the most important characteristics of organizations in standing against market turbulences. The concept was first introduced by the researchers of Iacocca institute of Lehigh University (USA) in the early 1990s and received considerable attention since then (Yusuf et al. 1999; Bottani 2009; Sherehiy et al. 2007). Agility is defined as the "ability of organizations in quick and effective response to unexpected variations in market demands" (Brown and Bessant 2003; Sharifi and Zhang 2001). Such a response is aimed at satisfying different customer needs pertaining to product specification, price, quality, quantity, and delivery (Prince and Kay 2003).

Following to its introduction, agility was basically considered as a concept in the area of manufacturing; however, the scope has recently expanded to the whole supply chain. That is because an organization can't be *agile* per se, while rest of supply chain operates on a normal speed (Christopher 2000; Van Hoek et al. 2001; Ren et al. 2001). Organizational agility is tightly bound to the notions of adaptability and flexibility and all the three notions sometimes are interchangeably used to indicate the endeavors made by an organization for dealing with dynamic and unpredictable changes of market. In fact, adaptability and flexibility constitute two main characteristics which are vital for the evolution of organizations towards achieving agility. The highest level of development is reflected in form of organizational agility which comprises both concepts of adaptability and flexibility (Sherehiy et al. 2007).

Different studies have been conducted investigating the effects of specific factors on organizational agility. Some examples of these factors include information technology (Lu and Ramamurthy 2011), human resource, products (Vinodh et al. 2010), and leadership style (Oliveira et al. 2012). An extensive review of previous studies on enterprise and organizational agility can be found in (Sherehiy et al. 2007). However, little empirical research exists, in spite of the intense need, focusing on the essence of organizational and enterprise agility to provide methodologies and procedures for improving agility in organizations. The aim of present study is to offer a practical methodology for organizations to estimate their current level of agility, identify their weaknesses and strengths, and devote their effort to improve the critical areas of agility which might have been neglected.

Agile organizations are characterized by both *attributes* and *enablers* (Bottani 2009; Lin et al. 2006; Bottani 2010). Agile attributes –also referred to as capabilities– allow organizations to swiftly and efficiently cope with customers' dynamic demands and intense global competition. These attributes have been widely studied in the literature by different scholars (Ren et al. 2003; Bottani 2010). Sharifi and Zhang (1999) were among the pioneers who proposed a comprehensive classification of the agile attributes. They have divided these attributes into four main categories, namely responsiveness, competency, flexibility, and quickness each of which comprises several items. Their classification is shown in Table 1.

Table 1 A Classification of Agile Attributes

Agile Attributes (Capabilities)	**Items**
Responsiveness	• Sensing, perceiving and anticipating changes • Immediate reaction to changes by effecting them into system • Recovery from change
Competency	• Strategic vision • Appropriate technology (hard and soft) • Sufficient technological ability • Product/services quality • Cost effectiveness • High rate of new products introduction • Change management • Knowledgeable, competent, an empowered people • Operations efficiency and effectiveness (leanness) • Cooperation internal and external • Integration
Flexibility	• Product volume flexibility • Product model/configuration flexibility • Organization and organizational issues flexibility • People flexibility
Quickness	• Quick new products time to market • Products and services delivery quickness and timeliness • Fast operation time

(Sharifi and Zhang 1999)

A more extensive classification of agile attributes was proposed by Yusuf et al. (1999). They have totally delineated 32 agile attributes in their study which are categorized under 10 main decision domains. The agile attributes and their relevant decision domains are depicted in Table 2. According to that, the authors presented a framework which includes the pathway and obstacles in achieving the attributes. The framework also considers the metrics that are required to measure the process of agility.

Table 2 List of Agile Attributes and Taxonomy in Decision Domains

Decision Domain	**Related Agile Attributes**
Integration	• Concurrent execution of activities • Enterprise Integration • Information accessible to employee
Competence	• Multi-venturing capabilities • Developed business practice difficult to copy
Team building	• Empowered individuals working in teams • Cross functional teams • Teams across company borders • Decentralized decision making
Technology	• Technology awareness • Leadership in the use of current technology • Skill and knowledge enhancing technologies • Flexible production technology
Quality	• Quality over product life • Products with substantial value-addition • First-time right design • Short development cycle times
Change	• Continuous improvement • Culture of change
Partnership	• Rapid partnership formation • Strategic relationship with customers • Close relationship with suppliers • Trust-based relationship with customers/suppliers
Market	• New product introduction • Customer-driven innovations • Customer satisfaction • Response to changing market requirements
Education	• Learning organization • Multi-skilled and flexible people • Workforce skill upgrade • Continuous training and development
Welfare	• Employees satisfaction

(Yusuf et al. 1999)

Agile enablers –also referred to as providers– are the operational tools to gain the agile attributes. Gunasekaran (1998) was the first scholar who has identified and discussed the agile enablers. According to his study the agile enablers fall into seven distinctive groups, namely virtual enterprise formation tools/metrics, physically distributed teams and manufacturing, rapid partnership formation tools/metrics, concurrent engineering, integrated product/production/business information system, rapid prototyping tools, and electronic commerce. This taxonomy was derived from several previous studies related to agility [(Cho et al. 1996; Gehani 1995; Burgess 1994)].

Having identified the agile attributes and enablers, a practical model is necessary towards achieving organizational agility. One of the first integrated frameworks to achieve agility is offered by Gunasekaran (1998), which illustrates how the main capabilities of agile manufacturing, such as co-operation, value-based pricing strategies, investments in people and information, and organizational changes should be supported and integrated with appropriate agile enablers to develop an adaptable organization. Zhang and Sharifi (2000) and Sharifi et al. (2001) developed a 3-step approach to implement agility in manufacturing organizations, which binds agility *drivers* (i.e., changes or pressures from the business environment that lead companies to embrace the agility paradigm) to four essential agile attributes, namely responsiveness, competency, flexibility, and speed. They have also linked the agile attributes to a set of agile enablers. The authors investigated the presented links and proposed a network model for methodology quantification.

One of the milestone studies that proposes a methodology to attain organizational agility is conducted by Bottani (2009). The Author has developed a model that connects agile attributes to agile enablers using quality function deployment (QFD) technique and fuzzy logic. The model is applied on a numerical example from the literature to illustrate its application. In this paper, we expand her work by embedding balanced scorecard (BSC) to the model. BSC identifies and evaluates the gaps between the current and desirable levels of the organizational agility. Proper identification of gaps can lead to more insightful understanding of organization weaknesses as to where attention should be drawn while moving towards agility.

Several scholars have successfully bound BSC and multi-criteria decision making (MCDM) methods in different fields such as selection of optimal management systems (Tsai and Chou 2009), performance evaluation of university education centers (Wu et al. 2011), performance measurement of manufacturing firms (Yüksel and Dağdeviren 2010), performance measurement of IT (Lee et al. 2008), selection of enterprise resource planning (ERP) system for the textile manufacturing (Cebeci, 2009), and measuring knowledge management performance (M. Y. Chen et al. 2009). However, our survey of literature shows that no other work could be found that combines BSC and MCDM methods for improving organizational agility.

The methodology presented in this paper contributes to the previous literature in two ways. Firstly, this is the first study of its kind that genuinely combines BSC and fuzzy TOPSIS with QFD and offers a novel approach towards improving organizational agility. By this, the impact of agile attributes on critical success factors as well as of agile enablers on agile attributes can be directly evaluated and measured. Secondly, it mitigates the risk of adopting irrelevant agile enablers that are not in agreement with real organization requirements by applying BSC to the context. The rest of the paper is organized as following. Next section introduces the methods used in the proposed approach and provides reasons on the necessity of applying these methods to this study. Section 3 explains the proposed methodology. Finally, section 4 concludes the paper, discusses research limitations and implications, and provides suggestions for future research.

2. Materials and Methods

2.1. BSC

BSC was coined in 1992 as a performance measurement tool (Kaplan and Norton 1992). Following to the first introduction, its application and design has promoted from a mere measurement tool to a foundation for strategic management system which helps managers to adopt new business strategies in response to market opportunities and customers' taste (Lee et al. 2008). BSC is one of the best known performance management tools and has been adopted and embraced warmly by plenty of well known companies in the past decade (Papalexandris et al. 2005). BSC measures both financial and non-financial metrics by deploying four performance perspectives: financial, customer, internal processes, and learning and growth (Lee et al. 2008). The organization's mission, vision, and strategy are translated into these perspectives to clearly define what sort of skills and knowledge the staffs need (*learning and growth*) to create the required competencies and capabilities through *internal processes* that bring the right value to the *customer* and eventually lead to higher *financial* revenue (Fig. 1) (Kaplan and Norton 1996).

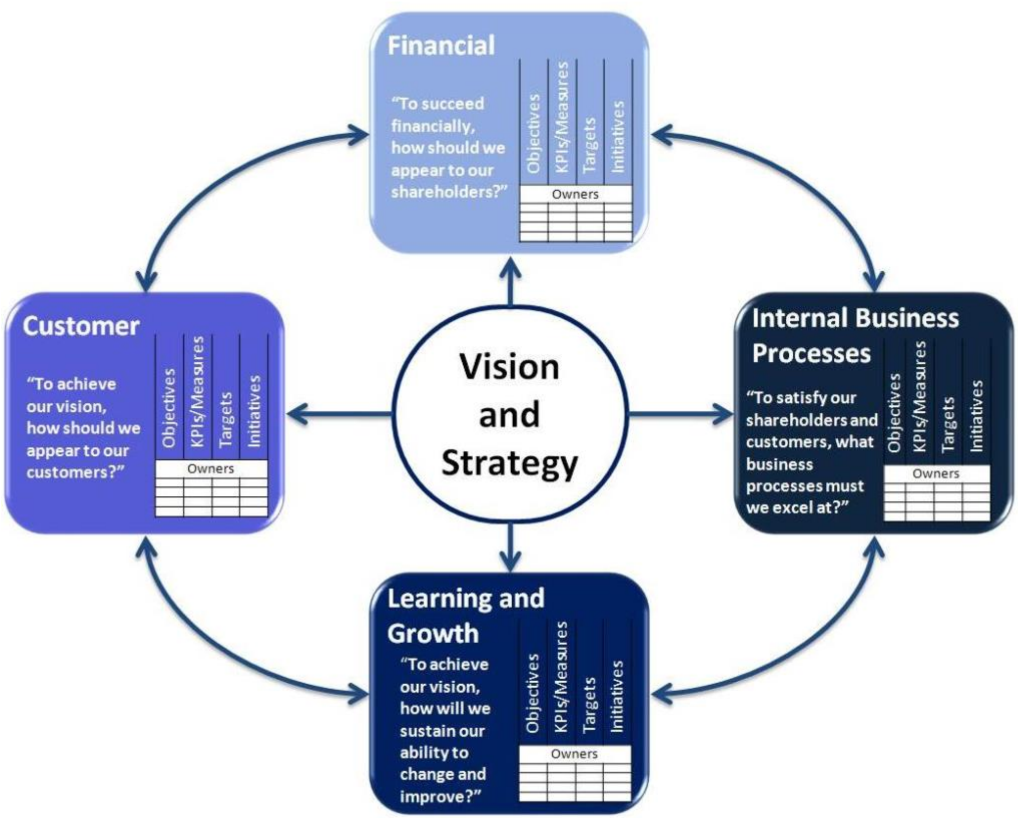

Fig. 1 The Structure of BSC
(Kaplan and Norton 1996)

It is important to comprehend the reason that BSC fits into the scheme of this research. Most of companies competing in dynamic and constantly changing environments aim at seizing larger market shares with respect to their competitors and design their strategies in line with achieving their goal. Based on the strategies, short term objectives and operational and administrative activities at all levels of organizational hierarchy are developed. Likewise, the ultimate goal of organizational agility is to achieve a higher market share in a competitive environment. Therefore, utilizing BSC to identify the gaps in the current organizational processes, and improving them based on QFD technique will not only enhance the speed of achieving organizational strategies, but also improve the level of organizational agility. In this essence, BSC is a viable tool that seeks mutual goals as the ones of companies striving in competitive markets.

2.2. Fuzzy Logic Combined with TOPSIS and QFD

In order to deal with ambiguities and inaccuracies oriented in the nature different problems fuzzy logic was introduced by Zadeh (1965). It has been found quite useful when vague and ill-defined subjects are to be discussed and decided. Since agility indicators are often defined vaguely and imprecisely, application of fuzzy logic is advocated for the assessment of agility (Lin et al. 2006). Fuzzy logic is based on fuzzy sets which contain objects with no clear boundary between the members and non-members. The degree of membership is defined using the numbers in the range [0,1] (Bevilacqua et al. 2006). Fuzzy logic can effectively cope with other quantitative methods such as TOPSIS and QFD. Applying fuzzy logic combined with such methods can ensure that the preferences and ideas are coherently considered even if different meanings are conceived from a single issue by decision makers. Moreover, it is a viable tool to translate linguistic judgments into numerical values.

TOPSIS is a MCDM method which was originally developed by Hwang and Yoon in 1981 (Hwang and Yoon 1981). The method is founded on the idea that the selected alternative should be located at the closest geometric distance from the positive ideal solution and at the farthest geometric distance from the negative ideal solution. Suppose a decision making problem with m alternatives and n criteria. The ratings of each alternative with respect to the criteria is presented in a decision matrix shown by $D[x_{ij}]_{m\times n}$. A brief description of TOPSIS steps is as follows (Dymova et al. 2013).

- Calculate the normalized decision matrix.

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, \quad i = 1,2,\dots,m; \quad j = 1,2,\dots,n. \qquad (1)$$

- Calculate the weighted normalized decision matrix.

$$v_{ij} = w_j n_{ij}, \quad i = 1,2,\dots,m; \quad j = 1,2,\dots,n.$$

where w_j is weight for the jth criteria satisfying $\sum_{j=1}^{n} w_j = 1$. (2)

- Determine the positive and negative ideal solutions.

$$A^{+} = \{v_1^{+}, \ldots, v_n^{+}\} = \{\max_i v_{ij}, \quad j = 1,2,\ldots,n\}, \qquad (3)$$

$$A^{-} = \{v_1^{-}, \ldots, v_n^{-}\} = \{\min_i v_{ij}, \quad j = 1,2,\ldots,n\}, \qquad (4)$$

- Calculate the distance of alternatives from the positive and negative solutions according to Euclidean distances.

$$S_i^{+} = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^{+})^2}, \quad i = 1,2,\ldots,m. \qquad (5)$$

$$S_i^{-} = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^{-})^2}, \quad i = 1,2,\ldots,m. \qquad (6)$$

- Calculate the relative closeness to the ideal alternatives.

$$RC_i = \frac{S_i^{-}}{S_i^{+} + S_i^{-}}, \qquad i = 1,2,\ldots,m. \qquad (7)$$

- Rank the alternatives according to their relative closeness to the ideal alternatives.

QFD is a strategic tool that helps the companies to characterize products and services from customers' point of view (Celik et al. 2009). The basic idea behind QFD is concentrating on customer needs and translating them into technical attributes. Although it was originally designed for improving the quality in product development, the application has been extended successfully beyond the initial goals (Celik et al. 2009). QFD consists of four main phases: product planning, part deployment, process planning, and production planning. The first phase, also known as HOQ, is the most widely used phase aiming at planning the customer requirements and transforming them into measurable characteristics (Dursun and Karsak 2013). It considers performance characteristics (or "what to do") and engineering characteristics (or "how to do it") as well as the relationships among these characteristics by developing matrices (Bevilacqua et al. 2006). Seven general steps for building a HOQ are as follows (Heizer and Render 2011).

- Identify customer *wants*. (What do prospective customers want in this product?)
- Identify *how* the good or service will satisfy customer wants. (What are the specific product characteristics, features or attributes?)
- Relate customer *wants* to product *hows* by building a relationship matrix.
- Identify relationships between the organization's *hows*. (How do our *hows* tie together?)
- Develop importance rating using *customer's* importance rating and weights for the relationships within the matrix. Then, calculate *your* importance rating.

- Evaluate competing products or services based on the market research. (How well do competing products meet customer wants?)
- Determine the desirable technical attributes, your performance, and the competitor's performance against these attributes.

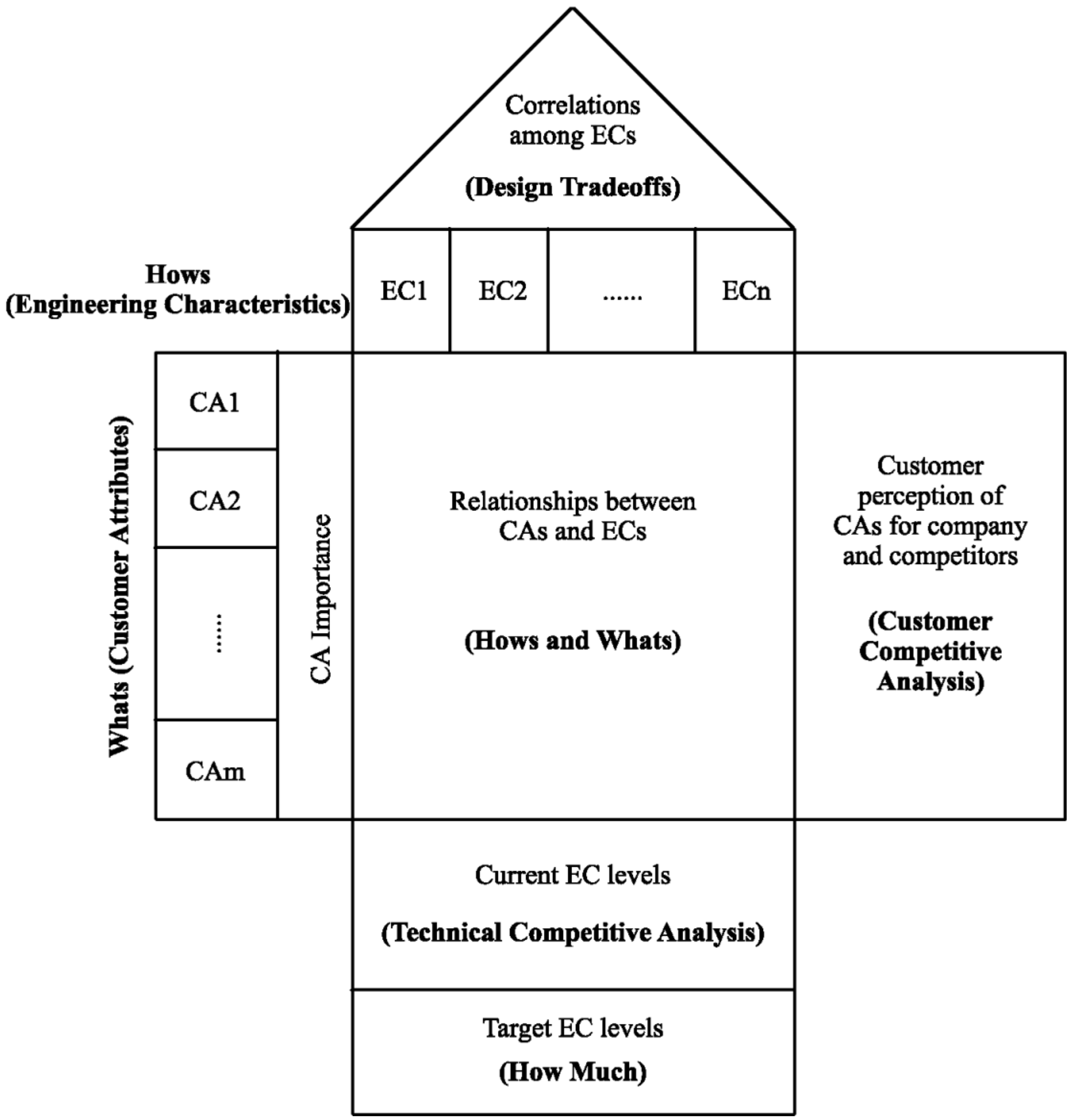

Fig. 2 The Structure of a HOQ

It should be noted that not all the HOQs share similar structure. They can be modified according to the requirements and the application. The HOQs used in our proposed approach (presented in subsection 3.3.) is simplified to fit the needs for improving agility. Fig. 2 represents the common structure of a HOQ.

In order to tackle some problems during the implementation of QFD such as uncertainties and incomplete understanding of the relationships between ‘‘hows’’ and between ‘‘hows’’ and ‘‘whats’’ or dealing with several parameters which seem difficult to express quantitatively, fuzzy QFD can be used (Bottani and Rizzi 2006). The application of fuzzy QFD have received considerable attention and made substantial progress in the past decades (Bevilacqua et al. 2006). Examples of the applications are shipping investment process (Celik et al. 2009), supplier selection (Bevilacqua et al. 2006), new product design (L. H. Chen and Ko 2009), part deployment, process planning, and production planning (Liu 2009), flexible manufacturing systems (Y. Chen et al. 2006), and logistic service management (Bottani and Rizzi 2006).

3. The Proposed Approach

In this section, an approach based on BSC, fuzzy TOPSIS, and fuzzy QFD concepts is presented for improving the organizational agility. The approach can be split into three major stages: identifying the key performance indicators (KPIs), ranking the KPIs, and selecting the appropriate agile enablers. These stages together with the tool used at each stage can be seen in Fig. 3. Most studies that offer methodologies for agility enhancement stress the need for measuring agility as one of the initial steps. Various agility measurement methods have been proposed by different scholars [see (Zhang and Sharifi 2000);(Ren et al. 2000);(Lin et al. 2006);(Vinodh et al. 2010)]. In this research, agility is measured based on practical practices underlying the proposed stages: The scores obtained from prioritizing the key performance indicators (KPIs) (subsection 3.2.) indicate the gap which exists between the current and desirable agility level. The higher a KPI is ranked, the larger its gap is, and consequently, the greater the need it has to become agile. Hence, the ranking precisely measures the gap based on subtraction of desirable and current agility level for each KPI. Moreover, when a KPI with higher score is inserted into the HOQ (subsection 3.3.), more priority is assigned to fill the gap pertaining to that KPI. This, in turn, causes stronger agile enablers to be chosen for improving the agility in the organization under consideration. Consequently, by deploying these conceptual methods embedded throughout the methodology agility is examined in an accurate and practical way. The relations among BSC, TOPSIS, and HOQs are schematically represented in Fig. 4 to provide an overview on the flow of the proposed approach and interconnection among the tools used. The remainder of this chapter provides a detailed discussion on the stages of the approach.

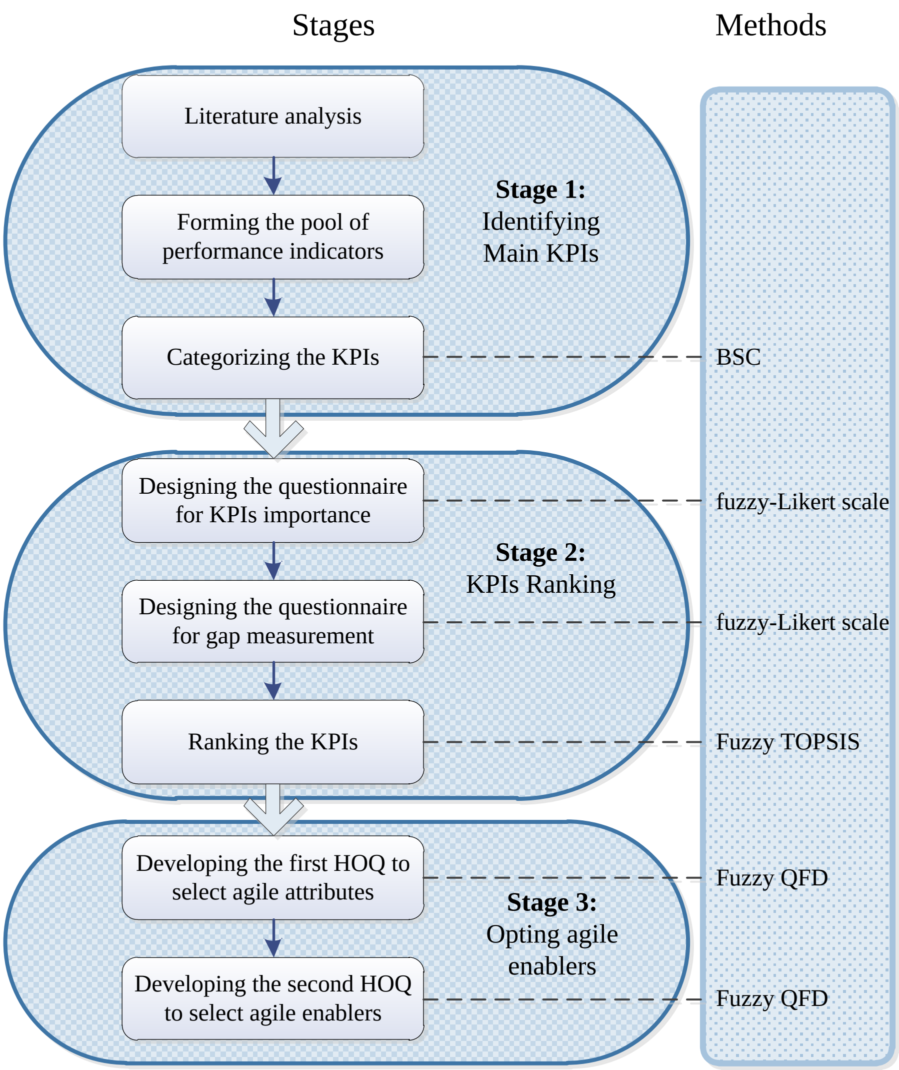

Fig. 3 The Stages of the Proposed Approach

3.1. Identifying Main KPIs

In the first stage of the proposed approach, a *pool of performance indicators* is developed by a comprehensive study of KPIs extracted from the literature. Exploring the literature is one of the most beneficial and widely used approaches to find relevant KPIs for any industry (Ahmad et al. 2012). In the extraction of these KPIs we have taken two main issues into consideration. First, the KPIs should be in line with the agility concept and address the requirements of the company in turbulent or competitive markets. Second, they should be selected with respect to the four BSC perspectives. To this end, the literature has been analyzed to find the most appropriate KPIs which are introduced in the next subsection.

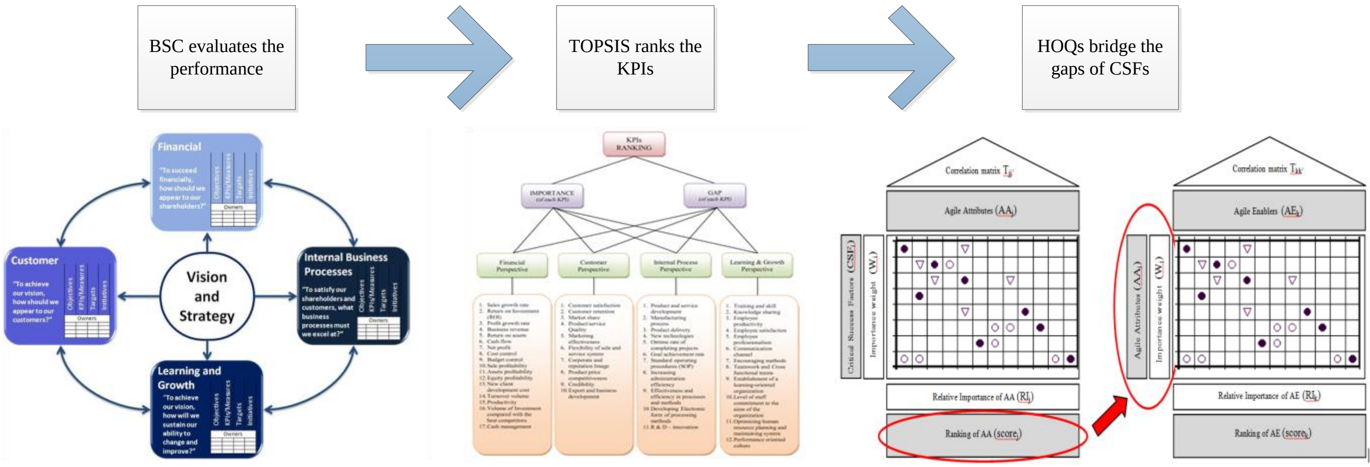

Fig. 4 The Relationships among BSC, TOPSIS, and HOQ in the Proposed Approach

In order to apply the proposed approach, each company should scrutinize its own MVV[1] and strategic objectives. This is necessary because they should be aligned with the pool of performance indicators to select the best matches for the studied company. Hence, the pool of performance indicators should be updated according to the requirements of the company prior to any other action. To this end, we recommend surveying the studies which has been conducted previously relevant to the same industry as the one of the company. Taking benchmarks from the successful enterprises and competitors is also helpful for forming the pool of performance indicators. In some cases, the right indicators cannot be found from the literature or the competitors and organizations need to *define* the performance indicator according to their individual organizational needs. Making comprehensive studies to identify performance indicators, although consumes time and staffing resources, provides a stronger foundation for the rest of agility improvement program as it will lead to finding more appropriate and matching indicators which consequently provides a wider spectrum of opportunities for improving the agility.

3.2. KPIs Ranking

In order to rank the KPIs, the ideas of company experts should be collected. The people referred to as *experts* may vary from company to company. Generally, the employees that run or supervise the organizational activities related to any of BSC perspectives can be cited. Managers at top, middle, and operational levels of organizational hierarchy and board of directors are among the instances of such people. In order to collect the ideas, two questionnaires need to be developed. The first questionnaire containing the selected performance indicators is designed and the priority of each indicator is scaled using the fuzzy Likert scale. The aim of this questionnaire is determining the *importance* of each indicator. It is sent to the company's experts to be answered. Based on the responses received, the second questionnaire is developed to determine the *gap* between the present and desirable performance levels. There again, the experts are asked to specify the gap for each indicator using a fuzzy Likert scale.

[1] mission, vision, and values

After each employee responds to a questionnaire, an appropriate weight is assigned to his or her ideas by chief executive officer (CEO). The CEO determines the weight according to several criteria such as skill, experience, and the relevance of employee's responsibility to each BSC perspective. For instance, an employee working in the sales unit receives higher weight for the customer perspective while the ideas of a staff working in human resource management unit is more important with respect to learning and growth perspective. In the design of both questionnaires, an empty field is considered for CEO score. When the employees fill out the questionnaires and return them to CEO, he or she assigns a proper score (e.g. on the scale of 1-10) to each employee for each BSC perspective. When inserting the ideas into the TOPSIS model, these scores are considered as the weights of respondents in the calculations.

Prioritizing the KPIs is dependent on not only the relative importance of each indicator (the first questionnaire) but also on the magnitude of the gap (the second questionnaire). That is because the KPIs with small gaps which are critically important (or vice versa) can be prioritized appropriately. To this end, MCDM tools can be of great assistance to rank the KPIs while taking into account both the gap and the importance. In this study, the fuzzy TOPSIS technique is deployed for ranking the extracted KPIs. Fuzzy TOPSIS applies to the KPIs all together regardless of the BSC perspectives under which they are classified. The hierarchy of KPIs ranking problem is shown in Fig. 5.

The results of the ranking offer a sorted list of all KPIs from which the most important ones should be selected. Note that KPIs are not ranked under their corresponding BSC perspective but considered all together. This is essential to avoid biased ranking results as a company may work quite well with respect to a specific perspective. Hence, if the ranking considers each perspective separately, redundant KPIs (e.g. the KPIs of well working perspective) will be selected as the important KPIs to be improved.

The next step is selecting the most important KPIs from the ranking. In this study, we have chosen the first quartile of ranked KPIs which filling their gap can lead to considerable improvement in agility. These KPIs are referred to as critical success factors (CSFs) hereafter. Certainly, it is not practical to work on all the KPIs especially if the number of KPIs is large. However, determining the portion of KPIs to be chosen as CSFs highly depends on different factors such as the managerial decisions, the budget and time to be spent on the agility improvement program, and the degree of agility improvement desired. Whilst the managers in an organization striving under market pressure might choose to proceed with a large number of KPIs to obtain the highest degree of agility, a semi-governmental organization in a low-competitive environment may pick a few of its KPIs as the CSFs. When the CSFs are identified, they should be restored to the BSC perspective they belonged. The number of CSFs existing in each BSC perspective can show how well the organization performs regarding that perspective.

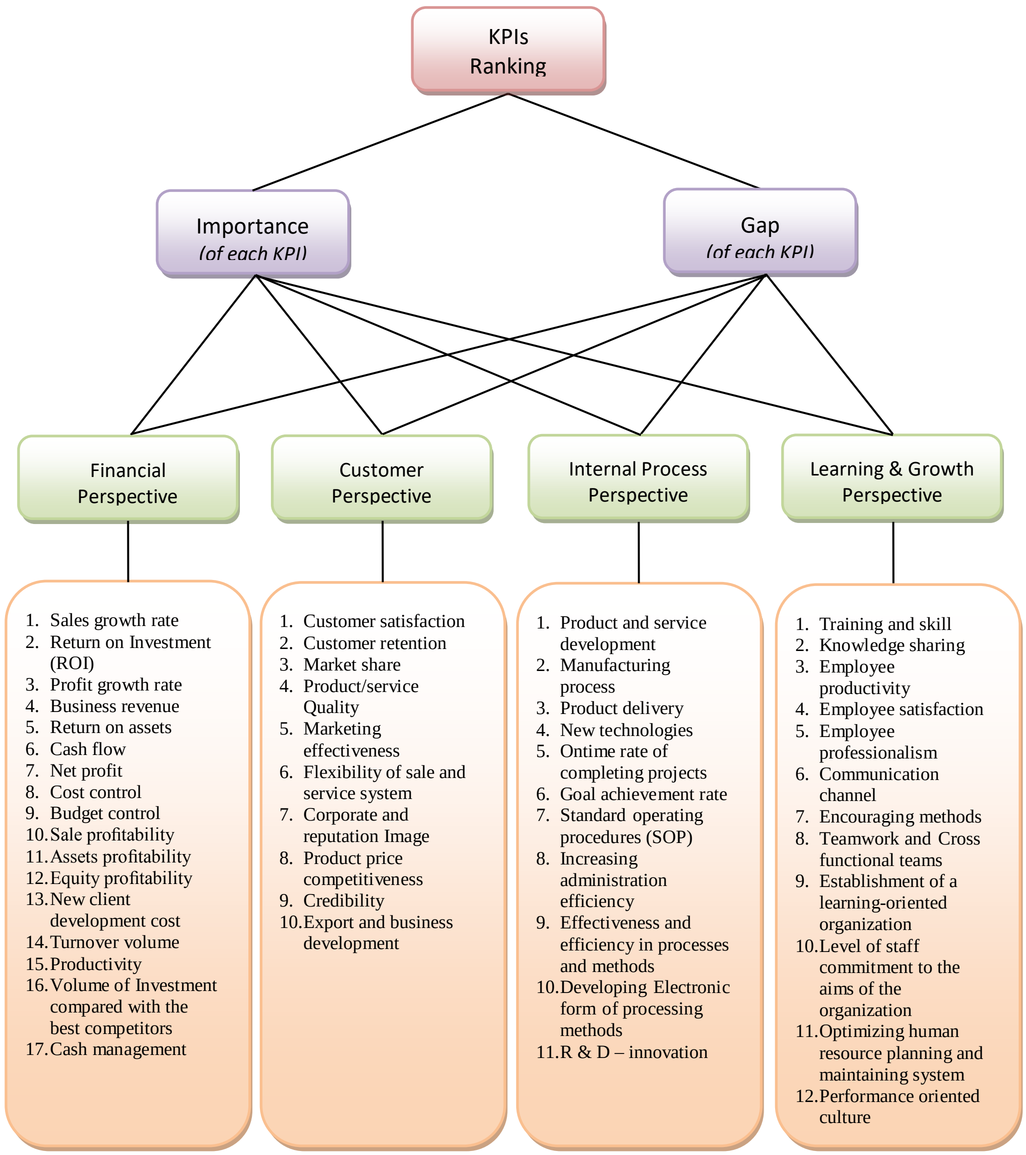

Fig. 5 The Hierarchical Structure of KPIs Ranking Problem

3.3. Opting Agile Enablers

This stage exploits fuzzy QFD, and particularly HOQ, for enhancing the organizational agility. The proposed approach requires construction of two houses of quality. The methodological approach is illustrated in Fig. 6. For the first HOQ, the CSFs are what we are seeking for or “whats”. Agile attributes show the way of achieving CSFs; they are “hows”. As the result of the first house, the attributes that play the major role in enhancing agility are identified. Consequently, these attributes are inserted into the second HOQ as “whats” while the “hows” are agile enablers that best satisfy the determined agile attributes. The outcome of the second house is identification of the agile enablers that achieve the required attributes.

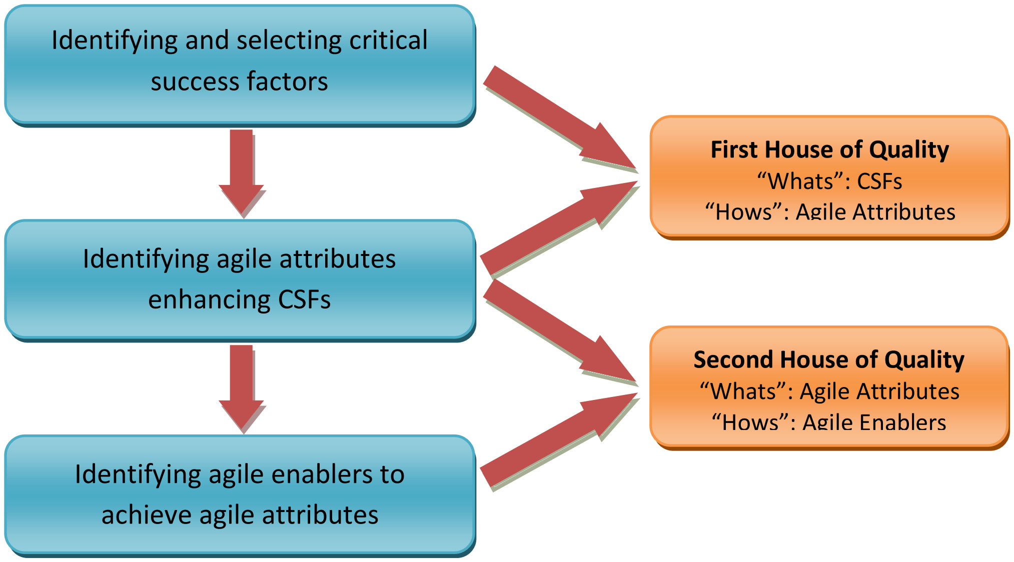

Fig. 6 Methodological Approach to Opt the Appropriate Agile Enablers

The structure of the first and the second houses of quality are shown in Fig. 7. Developing the first and the second HOQ is briefly discussed here. A more descriptive explanation on construction of HOQs can be found in Bottani (2009).

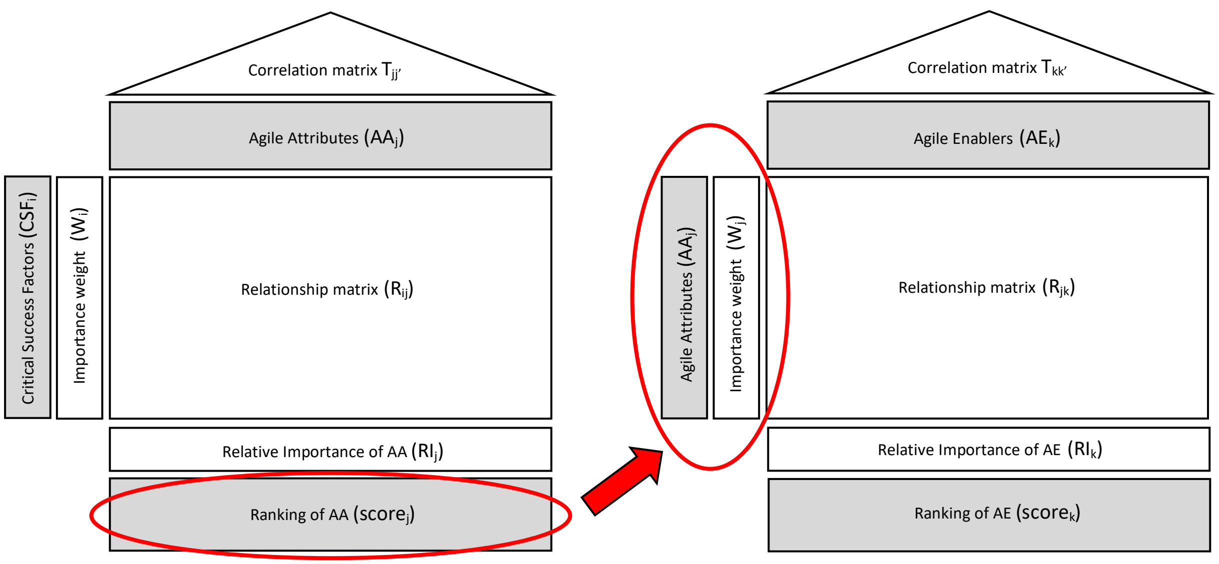

Fig. 7 Structure of the First and Second House of Quality

Derived from Bottani (2009)

3.3.1. The First HOQ

The aim of the first HOQ is specifying agile attributes that improve the organization's competitiveness based on the number of CSFs. Agile attributes are denoted by AA_j *(j=1,2,..,m)* and CSFs are shown by CSF_i *(i=1,2,…,n)*. Since the assessment of relationships and correlations within both HOQs require human judgments, fuzzy logic can be employed to translate verbal judgments into quantitative values for computational purpose. Thus, the importance weights of CSFs, denoted by W_i, is expressed by fuzzy triangular numbers which are derived from the results of KPIs ranking in the previous stage.

The relationship matrix of the first HOQ is shown by R_{ij} $(i=1,2,\ldots,n\ ;\ j=1,2,\ldots,m)$. Here, the entry (i, j) shows how the j-th agile attribute measures against the i-th CSF. The graphic symbols used in conventional QFD can be transformed into fuzzy scales which are presented in Table 3.

Table 3 Relationships, Graphic Symbols and Corresponding Fuzzy Numbers

Degree of relationship	Graphic symbol	Fuzzy number
Strong (S)	●	(0.7; 1; 1)
Medium (M)	○	(0.3, 0.5, 0.7)
Weak (W)	▲	(0; 0; 0.3)

(Bottani and Rizzi 2006)

Having assessed the relationships between agile attributes and CSFs, the relative importance of the j-th agile attribute, shown by RI_j, can be calculated according to the equation (8) (Guh et al. 2008).

$$RI_j = \sum_{i=1}^{n} W_i \times R_{ij} \qquad j = 1,2,\ldots,m. \tag{8}$$

Next step in developing the HOQ is defining the roof correlations, shown by $T_{jj'}$ $(jj'=1,2\ldots m;\ j\neq j')$, which states the correlation between the j-th and the j'-th agile attributes. Here again, the traditional QFD roof correlations are transformed into fuzzy triangular numbers and shown in Table 4.

Table 4 Correlations, Graphic Symbols and Corresponding Fuzzy Numbers

Degree of correlation	Graphic symbol	Fuzzy number
Strong Positive (SP)	●	(0.3; 0.5; 0.7)
Positive (P)	○	(0, 0.3, 0.5)
Negative (N)	□	(-0.5; -0.3; 0)
Strong Negative (SN)	■	(-0.7; -0.5, -0.3)

(Bottani 2009)

The score of the j-th agile attribute of roof, shown by $score_j$, is computed as shown in equation (9) (Tang et al. 2002).

$$score_j = RI_j + \sum_{j' \neq j} T_{jj'} \times RI_{j'} \qquad j = 1,2,\dots,m. \tag{9}$$

where RI_j can be gained from equation (8). Since all the elements involving in the equation (9) are fuzzy numbers, the resulting score of agile attributes is a fuzzy number as well. However, in order to rank the agile attributes the numbers should be de-fuzzified. The crisp value of fuzzy triangular number $a(l, m, u)$ can be obtained using equation (10) (Yager 1981).

$$crisp\ value = \frac{l + 2m + u}{4} \tag{10}$$

Developing the first HOQ ends up with sorting the agile attributes according to their crisp value. Agile attributes with higher scores have a more considerable influence on the CSFs and should be improved to gain competitive advantage.

3.3.2. The Second HOQ

The purpose of the second HOQ is finding the agile enablers by which the agile attributes found in the first HOQ are satisfied. To this end, agile attributes are inserted into the second HOQ as "whats" whilst the agile enablers, denoted by AE_k $(k=1,2,\dots,p)$, are listed as "hows". The procedure of developing the second HOQ is similar to the first HOQ shown in previous subsection. The relative importance of the k-th agile enabler is shown by RI_k and can be calculated according to equation (11).

$$RI_k = \sum_{j=1}^{m} W_j \times R_{jk} \qquad k = 1,2,\dots,p. \tag{11}$$

where R_{jk} is the assessment of relationship between agile enablers and agile attributes, and $T_{kk'}$ denotes the correlations between "hows" on the roof of the HOQ.

Similarly, the score of the k-th agile enabler, shown by $score_k$, is computed as shown in equation (12). Here again, the scores should be de-fuzzified for the ranking of agile enablers. Equation (10) can be used again to obtain crisp values of fuzzy numbers.

$$score_k = RI_k + \sum_{k' \neq k} T_{kk'} \times RI_{k'} \qquad k = 1,2,\dots,p. \tag{12}$$

Agile enablers with higher position in the ranking should be chosen by the studied company. Such agile enablers improve corresponding agile attributes and consequently promote the organizational agility.

4. Conclusion

This study proposes an innovative approach for improving organizational agility by means of BSC, QFD, and HOQ in particular. The inputs of the approach are CSFs which are gathered from the related literature, categorized under BSC perspectives, and then ranked using fuzzy TOPSIS technique. The outputs are a set of agile enablers that should be deployed by the organization to achieve agility and gain competitive advantage in constantly changing markets. Two successive houses of quality are developed to provide a meaningful connection among the CSFs, agile attributes, and agile enablers. Thus, the organization exploits the right agile enablers according to its CSFs. This significantly reduces the risk of selecting agile enablers that are heterogeneous with the organization needs.

Since the paper offers a holistic methodology in the area of organizational agility, it can be applicable to any organization, regardless of its size or type, which intends to move towards agility or is forced to become agile due to market pressures. Though, the research limitations and implications are quite noteworthy prior to the application of methodology. First, as the concept of organizational and enterprise agility expands to new areas, the pool of performance indicators may become obsolete and need to be updated by surveying the most recent literature. Second, the KPIs proposed in this study may not be comprehensive and large enough to be useful for all the organizations. Every organization should either identify its KPIs from the existing ones in the literature or define appropriate KPIs according to its requirements. Such a thorough investigation often demands spending time, effort, and money to be successful. The KPIs introduced in this study can be used as a milestone. Third, there is no rule of thumb for selecting CSFs out of KPIs. It is a quite subjective issue that depends on the desired level of organizational resources to be spent and the willingness of managers on how deep they want to engage with the context of agility.

We have proposed an approach to achieve and improve *agility*. Yet, that may not be the only goal to be sought through the approach. *Leanness* and, more recently, *leagileness* are other concepts which are closely tied to the agility (Agarwal et al. 2006). In the similar way as proposed in this paper, the attributes and enablers of these paradigms can be extracted from the literature [refer to (Narasimhan et al. 2006) for lean attributes and enablers]. Hence, future studies can focus on improving the leanness or leagileness of organizations. Another vein of research can examine the application of other MCDM techniques such as analytic hierarchy process (AHP) or analytic network process (ANP) on the proposed approach and compares the results with the ones of this study.

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Key Questions Reflecting Wider Reverberations

1. How can you achieve agility based on the strategic objectives of your organization?
2. How can critical success factors of your organization be identified?
3. How can you recognize agile attributes that best satisfy the critical success factors of your organization?
4. How can you identify relevant agile enablers to enhance the recognized agile attributes?

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