Measuring IT service quality in the context of team-level service climate and GSD project outcome relationship

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Abstract: The offshore/on-site teams’ service quality is one of the most significant aspects of improving the productivity and quality of global software development (GSD) projects. The main aim of this paper is to determine the service quality dimension that imperatively includes (i) service behaviors (ii) service providers and (iii) service product to evaluate the offshore/on-site team-level service quality in GSD projects. In this paper, our aim is to address one such determinant of IT service quality in the software service outsourcing context – service behaviors (service climate). The operational procedure of this paper is as follows: (i) the weights of offshore/on-site teams’ service climate attributes with respect to IT service quality criteria are described in linguistic scales with triangular fuzzy numbers; (ii) FMCDM approach is used to determine the degree of importance with respective service quality criteria and is combined into genetic-algorithm (GA) based approach; (iii) twenty-five comprehensive service quality criteria and service climate measurement framework for GSD projects via systematic literature review are taken into account and to extend our earlier work; (iv) this empirical study is tested with 100 offshore/on-site experts in India to analyze IT service quality criteria in the context of offshore/on-site team-level service climate and GSD project outcome relationship. The managerial implications and conclusions are presented.

Key words: Global software development, Offshore/on-site teams, Service quality, Fuzzy multi-criteria decision-making, Genetic algorithm, Linguistic variables, Triangular fuzzy numbers.

INTRODUCTION

In today’s world, Indian software companies have expanded their business operations across national and geographical boundaries. GSD is primarily an outsourcing technique in which the on-site teams worked in the client location, understand and audit the client requirements whereas offshore teams, operating from India, executes the requirement based on the inputs provided by the on-site teams. Offshore/on-site teams’ service quality has created a significant impact on the development and servicing of the software in a distributed environment. According to the literature reviews, IT service quality in the context of software development outsourcing has been explicitly addressed from client and vendor perspective. In addition, past research (e.g. Babakus et al., 1992; Cronin et al., 1992) have addressed the factors that have significant impact on service employees’ behavior with regard to deliver the service quality. Based on this context, this study explored the IT service quality criteria on this basis to evaluate the service climate of offshore/on-site teams in the software service outsourcing context.

The objective of this study using FMCDM approach combined with a genetic - algorithm (GA) based learning approach suggested by (Yi-Chung Hu et al., 2011; Yi-Chung Hu., 2009) is adopted to determine the degree of importance of IT service quality criteria with respect to service climate of offshore/on-site teams. The purpose of using GA-based learning approach is to automatically find the connection weights of a given hierarchical structure (see Fig.1) by minimizing the root-mean-square error between the actual and desired outputs of each pattern(Yi-Chung Hu et al., 2011; Yi-Chung Hu., 2009). The FMCDM approach having a hierarchical structure consists of three decision levels: objective, aspects and attributes.

As depicted in Fig.1, the hierarchical structure is employed to reveal the IT service quality through the lens of offshore/on-site teams’ service climate and GSD project outcome relationship. Our study reveals the IT service quality criteria was categorized into six major aspects and twenty-five service climate attributes are summarized in Table 2 and Table 3. Furthermore, this twenty-five service climate attributes are classified under three IT service climate dimensions (see Fig.1 and Table 6) to determine the relationship between offshore/on-site teams’ service climate and GSD project outcome in the context of IT service quality.
Fig. 1: The hierarchical decision network for evaluating IT service quality in the context of offshore/on-site teams' service climate and GSD project outcome relationship

**Literature Review:**

In this section, we summarize the literature in the following areas to underpin our study: IT service quality and service climate of offshore/on-site teams.

### 2.1. IT Service Quality And Service Climate:

Service quality is defined as the level of service delivered by Information System (IS) service providers to business users in terms of reliability, responsiveness, assurance, and empathy (Gorla et al., 2010). In addition, (e.g. Parasuraman et al., 1985) defined service quality as “the global evaluation or attitude of the overall excellence of services”. Earlier studies (e.g. Gorla et al., 2010; DeLone et al., 2003; Pitt, 1995) emphasized that IT service quality has significant impact on the organizational performance along with information quality and system quality. Furthermore, (e.g. Parasuraman et al., 1985) classified the service quality determinants into ten key categories: reliability, responsiveness, competence, access, courtesy, communication, creditability, security, understanding and tangibles. Subsequently, many studies (Gorla et al., 2010; Kettinger et al., 2005; Jiang et al., 2002) have been widely used under four dimensions (i.e., reliability, responsiveness, assurance, and empathy) to evaluate the quality of service in IT departments. The present study is based on these reviews wherein the IT service quality is measured into six indicators: responsiveness, competence, reliability, creditability, understanding and tangibility.

Service climate refers to IT professionals’ shared perceptions of the practices and behaviors in their workplace that support the provision of IT service to business customers (Jia Ronnie et al., 2008). In addition, (Schneider B. et al., 1993) describes that service climate refers to the employee behavior which is influenced by the policies, practices, procedures, and routines facilitate the excellence of services that has been outlined by the organization to achieve goals or other organizational imperatives. Moreover, the earlier studies (e.g. Jia Ronnie et al., 2008; Schneider et al., 1993) conducted an extensive review to construct various service climate dimensions: managerial practices (deliver quality of service), customer orientation, customer feedback, global service climate (measure overall perceptions), service leadership (goal setting, work planning, and coordination), service vision, client feedback and client communication, and have investigated that these aspects are likely to be relevant in the IT service context. Based on these dimensions, the present study formulated the construct to measure the offshore/on-site teams’ service climate with respect to IT service quality criteria via three IT service climate dimensions: managerial practices, global service climate and service leadership. Moreover, (Ronnie Jia et al., 2013) reported that IT service climate aspects have been key predictors to create a major impact on IT service quality. Subsequently, many studies (e.g. De Jong et al., 2005; Liao et al., 2007;
Salanova et al., 2005) are presented as quality measures for investigating the relationship between service climate and service outcome. Based on this context, our current study investigated offshore/on-site team service climate has been a key predictor of IT service quality with respect to GSD project outcome/success in the software service outsourcing context.

**Fuzzy multi-criteria decision making (FMCDM) approach:**

The fuzzy multi-criteria decision-making approach is a powerful tool for decision makers that has been widely used for selecting, evaluating and ranking problems according to their weights of a finite set of criteria (usually conflicting criteria) (Arun Kumar Sangaiah et al., 2013). Many studies (e.g. Yi-Chung Hu et al., 2011; Arun Kumar Sangaiah et al., 2013; Tsung-Han Chang et al., 2009; Yi-Chung Hu et al., 2009) have adopted a FMCDM approach to handle problems consisting of more than one attribute in ambiguous conditions. Likewise, this study examines offshore/on-site teams’ service climate with respect to IT service quality criteria and evaluated on the basis of FMCDM problem. This study aims to use FMCDM approach to determine the degree of importance with respective service quality criteria to evaluate service behavior (i.e., service climate) of offshore/on-site teams’ towards the GSD project outcome/success. FMCDM having a hierarchical structure (see fig. 1) is commonly used as a model to a decision problem. The hierarchical decision network is the skeleton used to measure the IT service quality through the lens of offshore/on-site teams’ service climate attributes and project outcome relationship.

**3.1. Fuzzy Set Theory:**

This study follows on certain definitions and notations of fuzzy set theory from (e.g. Zadeh., 1965; Arun Kumar Sangaiah et al., 2013). The characteristics and membership degree function with corresponding triangular fuzzy number \( \mu_A(x) = (l, m, u) \) are denoted in Eq. (2) and Fig. 2.

**Definition:**

For any fuzzy set, (let’s say) \( A \), the function \( \mu_A \) represents the membership function for which \( \mu_A(x) \) indicates the degree of membership that \( x \), of the universal set \( X \), belongs to set \( A \) and is, usually, expressed as a number between 0 and 1 that is,

\[
\mu_A(x): X \rightarrow [0,1]
\]

\[
\mu_A(x) = \begin{cases} 
0 & \text{if } x \leq l \\
\frac{x-l}{m-l} & \text{if } l \leq x \leq m \\
\frac{u-x}{u-m} & \text{if } m \leq x \leq u \\
0 & \text{if } x \geq u 
\end{cases}
\]

Here \( (l, m, u) \) denotes the \( x \) coordinates of the three vertices of \( \mu_A(x) \) in a fuzzy set \( A \) (\( l \): lower boundary and \( u \): upper boundary where membership degree is zero, \( m \): the centre where membership degree is 1).

As depicted in Fig. 2, the linguistic scales can be represented by fuzzy numbers, since the triangular fuzzy numbers (TFN) are generally used.

**3.2. Fuzzy Linguistic variables:**

The previous researchers (Yi-Chung Hu et al., 2011; Göb et al., 2007) reported that the traditional Likert scales has been widely used in many studies in particular for evaluating the service quality via questionnaires. However, traditional Likert scales cannot deal with cognitive uncertainty arising from human thinking and perception process (Yi-Chung Hu et al., 2011).
In addition, many studies have stated that the uncertainty and subjective vagueness of human thoughts can be dealt with fuzzy theory (e.g., Zadeh, 1965) as a result; linguistic scale suggested a practical means of relating such situations. Subsequently, our earlier work (e.g., Arun Kumar Sangaiah et al., 2013) used fuzzy linguistic variables to deal with the cognitive uncertainty and subjective vagueness within the decision-making process. The present study, we employed the five linguistic scales to measure the importance weights of offshore/on-site teams’ service climate attributes with respective IT service quality criteria and their equivalent triangular fuzzy numbers (TFN) are listed in Table 1.

### Table 1: Linguistic scale for importance weights of IT service quality criteria in the context of offshore/on-site teams’ service climate

<table>
<thead>
<tr>
<th>Fuzzy Linguistic scale</th>
<th>Corresponding TFN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree (SA)</td>
<td>(0.75, 1.0, 1.0)</td>
</tr>
<tr>
<td>Agree (A)</td>
<td>(0.5, 0.75, 1.0)</td>
</tr>
<tr>
<td>Neither agree nor disagree (N)</td>
<td>(0.25, 0.5, 0.75)</td>
</tr>
<tr>
<td>Disagree (D)</td>
<td>(0.0, 0.25, 0.5)</td>
</tr>
<tr>
<td>Strongly disagree (SD)</td>
<td>(0.0, 0.0, 0.25)</td>
</tr>
</tbody>
</table>

3.3. Computing IT Service Quality Criteria Of Offshore/On-Site Teams:

This study follows a certain computational procedure, problem design and genetic algorithm based learning approach from (Yi-Chung Hu et al., 2011; Yi-Chung Hu et al., 2009)

1. Construct a decision matrix $\bar{A}$ for the degree of importance of IT service quality aspect with respect to IT service climate attributes ($D_j$, $j = 1,2,3, \ldots, n$). The respondents ($R^i$, $i = 1,2,3, \ldots m$) were asked to provide their subjective judgments about the importance weights of each aspects and attribute by using linguistic scales (as listed in Table 1) The decision matrix $\bar{A}$ is as follows

$$
\begin{bmatrix}
D_1 & R^2 & R^3 & \ldots & R^m \\
\bar{a}_{11} & \bar{a}_{12} & \bar{a}_{13} & \ldots & \bar{a}_{1m} \\
\bar{a}_{21} & \bar{a}_{22} & \bar{a}_{23} & \ldots & \bar{a}_{2m} \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
D_n & \bar{a}_{n1} & \bar{a}_{n2} & \bar{a}_{n3} & \ldots & \bar{a}_{nm}
\end{bmatrix}
$$

In this decision matrix where $m$ denotes the number of evaluations and $n$ is the number of evaluation factors. Let $\left(La_j^i, Ma_j^i, Ua_j^i\right)$ denote $\bar{a}_{ij}$ where $0 \leq La_j^i \leq Ma_j^i \leq Ua_j^i \leq 100$ represents the fuzzy performance value assessed by $i^{th}$ respondents for $j^{th}$ evaluation factor.

2. The subjective judgments of each respondent differ from others based on their experience and knowledge, this study employs linguistic scale values with corresponding triangular fuzzy number to incorporate the fuzzy performance values of $m$ respondents to match the perceptions of individuals. In fig.1, $\mathcal{C}_j(1 \leq j \leq s)$ is the aspect node and $o$ denotes fuzzy performance values of $j^{th}$ aspect and objective respectively.

$$
\mathcal{C}_j = \left(\sum_{i=1}^{n} W_{ij}^{(a)} La_j^i + \sum_{i=1}^{n} W_{ij}^{(a)} Ma_j^i + \sum_{i=1}^{n} W_{ij}^{(a)} Ua_j^i\right)
$$

Here $\left(La_j^i, Ma_j^i, Ua_j^i\right)$ denotes the normalized fuzzy number, $W_{ij}^{(a)}$ is degree of importance of $a_j^i$ with respect to the $j^{th}$ evaluation factor denoted by $(1 \leq j \leq s)$ and
Here $W_{ij}^{(a)}$ is the local weight of $a_i^j$ under $c_j$. Let $c_j = (LC_j^1MC_j^1UC_j^1)$ denote the synthesized fuzzy performance value (i.e., $o$) can be obtained via $c_j$ as follows:

$$o = \sum_{j=1}^{n} W_j^{(o)} c_j$$

$$= \left( \sum_{i=1}^{n} W_i^{(o)} LC_j^1 \sum_{i=1}^{n} W_i^{(o)} MC_j^1 \sum_{i=1}^{n} W_i^{(o)} UC_j^1 \right)$$

Here $W_j^{(o)}$ denoted the weights of aspects $c_j$ with respect to objective, and

$$\sum_{i=1}^{n} W_i^{(o)} = 1$$

The global weight of $a_i^j$ denoted by $W_i^g$ for the objective is calculated as

$$W_i^g = \frac{W_j^{(o)} W_{ij}^{(a)}}{\sum_{j=1}^{s} W_j^{(o)} \sum_{i=1}^{n} W_{ij}^{(a)}}$$

Then, the sum of the global weights of all service climate attributes is equal to 1

$$\sum_{i=1}^{n} W_i^g = 1$$

(3) Now we will compute the system performance, where ‘$O$’ will be converted to non-fuzzy value using defuzzification to convert a fuzzy number to crisp value. Defuzzification is a method to locate best non-fuzzy performance value. Where $(O_u, O_m, O_l)$ denote values for objective. Center of area method (Kuncheva., 2000) have been used for converting objective ‘$O$’ to corresponding BNP value, $BNP_o$:

$$BNP_o = \frac{(O_u - O_l) + (O_m - O_l)}{3} + O_l$$

Our hierarchical structure shown in fig.1 is similar to the feed-forward neural network, which is commonly used for input-output mapping problem. The feed-forward neural network consists of three layers that is input, hidden and output layers. In this study, the layer consisting aspects of IT service quality criteria with respect to service climate is represented via the hidden layer. Here $W_{ij}^{(a)}$ is the connection weight in the link between the $i^{th}$ input (i.e., $c_i$) and $j^{th}$ hidden (i.e., $a_j^i$) neurons, $W_j^{(o)}$ is the connection weights in the link between the $j^{th}$ hidden and the output neurons.

### Genetic-Algorithm Based Learning Approach:

This section briefly describes the genetic-algorithm-based approach for determining average degree of importance of IT service quality, IT service climate aspects and offshore/on-site teams’ service climate attributes. The section 4.1 describes the data for training the hierarchical decision network. The problem formation and genetic operations are discussed in section 4.2 and section 4.3. Finally, genetic algorithm based learning approach for finding the global weights of the hierarchical network is presented.

#### 4.1. Data Description:

In the implementation, the subjective judgment about importance weights of each aspect and attributes are assessed by $n^{th}$ respondents. In this study, we employ fuzzy input-output pattern to find $W_{ij}^{(a)}$ and $W_j^{(o)}$. The questionnaire data from $n^{th}$ respondents can be reorganized as follows:-
Here $r_{ij}$ and $d_i$ denotes the fuzzy performance values of $x_j$ and the equivalent overall evaluation is denoted by $d_i$. Here $r_{ij}$ is a fuzzy number and is relative to the computable performance value $r^{(i)}(1 \leq i \leq n)$

$$r_{xj} = r_{ij}$$

Let $d_i$ is the desired output for the $i^{th}$ input-output pattern. Our data sets are employed to train the given hierarchical network. Then, the average degree of importance, global weights of respective aspects and attributes are obtained.

4.2. Problem Design:

Let $P$ indicates a set of parameters including values of $W_{ij}^{(a)}$ and $W_{ij}^{(o)}$ for the given hierarchical decision network. The problem of determining $W_{ij}^{(a)}$ and $W_{ij}^{(o)}$ can be formulated by single-objective optimization problem (Hu., 2008) as

1) To minimize the root mean square error can be defined as

Minimize $e(P)$ \hspace{1cm} (12)

Here $e(P)$ is the root-mean-square error obtained by $P$. Assume that $o_i$ is the fuzzy number (actual output) with respect to an $n$-dimensional non-fuzzy input vector ($g_{i1} g_{i2} g_{i3} \ldots g_{in}$) for the given network. Without loss of generality $e(P)$ can be defined as

$$e(P) = \frac{\sum_{i=1}^{m} (BNP_{a_i} - BNP_{o_i})^2}{m}$$ \hspace{1cm} (13)

where $BNP_{a_i}$ and $BNP_{o_i}$ denote the defuzzified values of $d_i$ and $o_i$.

2) The single-objective genetic algorithm which is the general purpose optimization technique can be applied to this by calculating the fitness function (Yi-Chung Hu et al., 2009) as

$$F(P) = \frac{1}{1+e(P)}$$ \hspace{1cm} (14)

Where $F(P)$ is fitness value of $P$. The fitness value of set of connection weights is updated at each generation for the GA. Therefore, the aim of genetic algorithm is to find a set of parameters $P$ by minimizing the root-mean-square error (Yi-Chung Hu et al., 2011).

4.3. Genetic Operations:

Let $N_p$ and $N_s$ represent the over-all population and the total number of generations, respectively. Each factor is coded as a binary string. We have assigned binary numbers 1 and 0, on the basis of the population we have obtained from min-max normalization. The fitness values of each chromosome in the over-all population are obtained and then selection, crossover and mutation genetic operations are performed as suggested by (e.g. Yi-Chung Hu et al., 2011; Man et al., 1999; Osyczka., 2002). Through these series of genetic operation we can obtain the new $N_p$ strings in the next population, where $N_p$ has been taken as 100.

For generating new strings for next generation, roulette wheel selection approach has been used. First we randomly select two strings from the population. Then two point cross-over is performed on two selected chromosomes. The process is repeated till we reach the stopping condition $N_s$. Here, stopping conditions $N_s$ have been taken as 500. The stopping condition is assigned for sufficient evolution of the genetic algorithm. With these series of crossover and mutation operations we get new children. The crossover and mutation are
performed once we assign a probability for them. Pmut is the probability of mutation which is taken as 0.01. The lower value of mutation probability has been taken into account as lower value does not allow to generate excessive deviation. Pcross is the crossover probability which is taken as 0.90. The larger value of crossover probability allows the exploration of more solution space. When we perform crossover we get two new children. Then when we finally reach stopping condition we perform mutation. With mutation we invert one bit in the given string of newly generated chromosomes.

**Algorithm Implementation:**

Algorithm: A hierarchical network for decision problem.
- Population size: Np
- Total Generations: Ns
- Crossover Rate: Pcross
- Mutation Rate: Pmut
- No. of elite chromosomes: Ne

**Output:** Degree of importance of all attributes.

**Method:**

**Step 1:** Initialization
Generate Np binary strings for initial generation.

**Step 2:** Calculate fitness values
Calculate the fitness value for each string in the current population.

**Step 3:** Termination test
The overall number of generations are performed as the stopping condition. If stopping condition is not satisfactory then continue with Step 4. That is, the genetic operations are repeated again to generate new strings in the next population.

**Step 4:** Select two chromosomes which have highest fitness value.

**Step 5:** Perform crossover
Generate random value of x. If x<Pcross perform crossover and evaluate the fitness value of the new offspring. If the fitness value is not obtained for better chromosomes go to Step 7.

**Step 6:** Perform mutation
If x<Pcross is true. Generate random number y. If y<Pmut is true then perform mutation. If the values obtained from mutation process are not for the better chromosomes go to Step 7. That is add value y to first gene of the offspring and normalize them otherwise iterate.

**Step 7:** Otherwise two worst chromosomes are replaced by best chromosomes.

**Step 8:** Iterate the above algorithm till stopping condition Ns.

**Empirical Study:**

Huge number of companies using information system offshore is not fulfilled with the substantial outcome (Markus Westner et al., 2010). For this motivation, our earlier studies (e.g. Arun Kumar et al., 2012; Arun Kumar et al., 2013) emphasized that service provider companies should focus offshore/on-site teams’ partnership quality factors to have significant impact on GSD project outcome. To extend our earlier work, this study covers twenty-five attributes to evaluate the IT teams (offshore/on-site) service quality through lens of service climate measurement framework for the outcome of GSD projects. To evaluate the offshore/on-site teams’ service climate with respect to IT service quality criteria, this study identifies the people (offshore/on-site project experts) who are involved in GSD projects and formed the committee comprises three groups: Executive committee (comprising project board, project manager), solution development teams (comprising user team leader, application team leader, technical team leader) and solution delivery teams (comprising process specialist, solution architect, technical writer). In this empirical study, we utilize survey research methods based on the data collected from 338 software professionals to assess offshore/on-site team-level service climate. Thus, this study tested with 100 offshore/on-site experts belonging to the above mentioned groups in India to reveal the relationship between IT service quality criteria in the context of offshore/on-site teams’ service climate and GSD project outcome.

5.1. **Determinants for evaluating of Offshore/On-site teams Service Quality:**

In the service climate literature, the number of studies has investigated various types’ of strategic climates: climate for knowledge sharing (Kankanhalli et al., 2005), ethical climate of IT professionals (Iacovou et al., 2009), and communication climate in outsourced projects (Rai et al., 2009) in the context of IT service. Moreover, earlier studies (Jia Ronnie et al., 2008; Susskind et al., 2003) have demonstrated co-worker support is important in the IT context. Thus, co-worker support is absolutely necessary to build a favorable IT service climate. In the present study, co-worker support refers to work-related assistance between offshore/on-site team members within the IT units. Subsequently, our earlier work (e.g. Arun Kumar Sangaiah et al., 2013; Arun
Kumar et al., 2012; Arun Kumar et al., 2013) has investigated offshore/on-site teams’ on-going relationship towards a GSD project outcome on the basis of following dimensions: knowledge sharing, trust, team commitment, and knowledge transfer. In addition, in this study we seek to evaluate the IT service quality through the lens of IT service climate delivered by offshore/on-site teams. Therefore, consistent with earlier studies on IT service quality and IT service climate, we classify an item from the six dimensions (shown in Table 2) that are most related to the IT service sectors. As a result twenty-five instrument items are used to measure the gaps between IT service climate and GSD project outcome perceptions on six dimensions of IT service quality - responsiveness, competence, credibility, understanding and tangibility (shown in Table 3). The service climate attributes are determined via extensive investigations with various professionals, including the executive committee, solution development team and solution delivery team. Synthesizing literature reviews from (Parasuraman et al., 1985; Jia Ronnie et al., 2008; Schneider et al., 1993; Ronnie Jia et al., 2013; Arun Kumar Sangaiah et al., 2013; Arun Kumar et al., 2012; Arun Kumar et al., 2013; Tsung-Han Chang et al., 2009; Pitt et al.,1995; Campion et al., 1993; Oldham et al., 1996; Schneider et al., 1998) the views from the offshore/on-site development teams are employed to obtain the twenty-five IT service climate attributes which is vividly shown in Table 3. 

To ensure the internal consistency of our decision hierarchy Cronbach’s alpha was computed in order to validate the reliability of the constructs. The greater the value of Cronbach’s alpha, the more reliable the questionnaire. Commonly, the acceptable level of Cronbach’s alpha is higher than 0.7. Moreover, Cronbach’s alpha values (shown in table 4) of our constructs exceeds 0.7, which shows that all our constructs have adequate levels of internal consistency.

| Table 2: Criteria for evaluating IT service quality in the context of offshore/on-site teams’ service climate. |
|---------------------------------|-------------------------------------------------------------|
| Criteria                        | Definition                                                        |
| Responsiveness                  | Willingness or readiness of team members’ interaction in order to provide service. |
| Competence                      | Possession of the required technical and functional knowledge and skills with respect to perform service. |
| Reliability                     | Involves consistency of performance and dependability of team members. |
| Credibility                     | Involves trustworthiness and believability nature of people.     |
| Understanding                   | Involves understanding client’s specific requirements             |
| Tangibility                     | Technology availability in order to provide the service           |

| Table 3: IT Service quality criteria with respective service climate attributes |
|---------------------------------|--------------------------------------------------------------------------|
| Aspect                          | Attribute                                                                 |
| Responsiveness (C1)             | Participation and support to solve issues (C11), persistent, conscientious responsiveness information (C12), mutual coordination among team members (C13), understanding the project requirements (C14), participation and communication relationship (C15) [10,11,18,28,29] |
| Competence (C2)                 | Clear objective to initiate the project in a GSD environment (C21), knowledge incentive towards client business process and project outcome (C22), build up a pilot knowledge between teams (C23), capacity to absorb technical and business knowledge (C24), brainstorming actions for organizations (C25) |
| Reliability (C3)                | feeling of togetherness or closeness among team members(C31), cooperation towards project outcome(C32), arduous relationship among team members(C33), participation in helping each other(C34) |
| Credibility(C4)                 | trust relationship among teams(C41), team members understanding their roles in GSD project(C42), faith and interest of employees(C43), flexibility and beneficial decisions among teams(C44) |
| Understanding (C5)              | project functionality towards client’s business process(C51), understand the process with respect to the implementation(C52), mutual understanding towards the process(C53), understanding the goals, task and responsibilities over the client’s business process(C54) |
| Tangibility (C6)                | Participation, acceptance and learning incentive of innovative technology (C61), explicit and standard communication pattern in the GSD environment (C62), learning, and sharing the work materials of employees (C63) |

To ensure the internal consistency of our decision hierarchy Cronbach’s alpha was computed in order to validate the reliability of the constructs. The greater the value of Cronbach’s alpha, the more reliable the questionnaire. Commonly, the acceptable level of Cronbach’s alpha is higher than 0.7. Moreover, Cronbach’s alpha values (shown in table 4) of our constructs exceeds 0.7, which shows that all our constructs have adequate levels of internal consistency.
Table 4: Cronbach’s alpha values of IT Service quality criteria with respective service climate attributes

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>0.737</td>
</tr>
<tr>
<td>Competence</td>
<td>0.794</td>
</tr>
<tr>
<td>Reliability</td>
<td>0.870</td>
</tr>
<tr>
<td>Creditability</td>
<td>0.837</td>
</tr>
<tr>
<td>Understanding</td>
<td>0.910</td>
</tr>
<tr>
<td>Tangibility</td>
<td>0.935</td>
</tr>
</tbody>
</table>

5.2. Analyzing Degree Of Importance:

The respondents were asked to give their subjective judgments about the importance weights of each aspect with respect to its attribute by using 5-point linguistic scales which include strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. The respondents’ linguistic scales with equivalent triangular fuzzy numbers are listed in Table 1. Meanwhile it is not possible to find critical criteria to evaluate IT service quality before making the evaluation by the IT respondents. As a result, this study employs two data sets 100 fuzzy input-output patterns and 50-100 fuzzy input-output patterns corresponding to each evaluation have been aggregated. Consequently this study adopts genetic algorithm based learning approach which is used to determine the degrees of importance of respective aspects and attributes according to the data sets. The average degree of importance of IT service quality criteria, service climate dimension with respect to offshore/on-site teams’ service climate attributes are shown in Table 5 and Table 6.

Table 5: The average degree of importance of IT service quality aspects with respect to service climate attributes

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>C11(0.169),C12(0.155),C13(0.153),C14(0.300),C15(0.223)</td>
</tr>
<tr>
<td>Competence</td>
<td>C21(0.184),C22(0.209),C23(0.215),C24(0.190),C25(0.212)</td>
</tr>
<tr>
<td>Reliability</td>
<td>C31(0.174),C32(0.243),C33(0.220),C34(0.363)</td>
</tr>
<tr>
<td>Creditability</td>
<td>C41(0.124),C42(0.273),C43(0.226),C44(0.274)</td>
</tr>
<tr>
<td>Understanding</td>
<td>C51(0.515),C52(0.060),C53(0.050),C54(0.375)</td>
</tr>
<tr>
<td>Tangibility</td>
<td>C61(0.498),C62(0.073),C63(0.429)</td>
</tr>
</tbody>
</table>

Table 6: The average degree of importance of IT service climate dimensions with respect to service climate attributes

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial Practices</td>
<td>C11(0.163),C12(0.150),C14(0.289),C15(0.215),C24(0.158),C52(0.025)</td>
</tr>
<tr>
<td>Service Leadership</td>
<td>C13(0.087),C21(0.099),C22(0.098),C23(0.105),C31(0.087),C32(0.121),C34(0.181),C51(0.127),C53(0.012),C54(0.092)</td>
</tr>
<tr>
<td>Global service climate</td>
<td>C25(0.118),C33(0.125),C41(0.062),C42(0.188),C43(0.062),C44(0.189),C61(0.128),C62(0.019),C63(0.110)</td>
</tr>
</tbody>
</table>

Our study reveals the average degree of importance of IT service quality criteria was categorized into six major aspects and 25 service climate attributes are summarized in Table 2. Furthermore, this 25 service climate attributes are classified under three IT service climate dimensions to determine the relationship between offshore/on-site teams’ service climate and GSD project outcome in the context of IT service quality. Similarly, our results show that more concerned IT service quality aspects are tangibility (C6), reliability (C3), understanding (C5) and creditability (C4) with respect to offshore/on-site teams’ service climate attributes (shown in Table 5). Subsequently, the average degree of importance (shown in Table 6) of IT service climate dimensions such as managerial practices, service leadership aspects are more concerned IT service climate dimensions with respect to offshore/on-site service climate attributes. These results clearly indicate that offshore/on-site team service climate attributes should have significant impact on IT service quality and GSD project outcome relationship. The degree of importance of service climate attributes can be compared to each other by calculating the global weights of respective attributes. The results are shown in Table 7 and Table 8.

Table 7: Average global weights of IT service quality with respect to offshore/on-site teams’ service climate attributes

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>C11(0.009),C12(0.008),C13(0.008),C14(0.016),C15(0.012)</td>
</tr>
<tr>
<td>Competence</td>
<td>C21(0.013),C22(0.014),C23(0.015),C24(0.013),C25(0.014)</td>
</tr>
<tr>
<td>Reliability</td>
<td>C31(0.031),C32(0.043),C33(0.039),C34(0.064)</td>
</tr>
<tr>
<td>Creditability</td>
<td>C41(0.016),C42(0.050),C43(0.016),C44(0.051)</td>
</tr>
<tr>
<td>Understanding</td>
<td>C51(0.080),C52(0.009),C53(0.008),C54(0.058)</td>
</tr>
<tr>
<td>Tangibility</td>
<td>C61(0.206),C62(0.030),C63(0.178)</td>
</tr>
</tbody>
</table>

Discussion And Conclusion:

Measuring IT service quality, IT service climate are mentioned as objectives for motivating GSD project outcome relationship, thus evaluating offshore/on-site teams’ service climate attributes through IT service quality criteria and IT service climate dimensions. This study suggests a framework with the combination of
FMCDM and GA based approach for evaluating the IT service quality in the context of offshore/on-site team level service climate and GSD project outcome relationship. Our findings show that offshore/on-site teams’ service climate attributes have a significant effect on IT service quality from the perspective of GSD projects. Our earlier studies (Arun Kumar et al., 2012) used the traditional Likert scale for evaluating the offshore/on-site team partnership quality. The Likert scale cannot deal with cognitive uncertainty arising from human thinking and perception process (Cronin et al., 1992; Yi-Chung Hu et al., 2011). Therefore, this study employs fuzzy numbers to deal the uncertainty and subjective vagueness within the decision-making process. The average degree of importance of IT service quality, service climate aspects and service climate attributes are presented in Table 5 and Table 6. The global contribution to the IT service quality, service climate aspects towards the objective has been expressed through calculation of global weights of individual service climate attributes (shown in Table 7 and Table 8).

Table 8: Average global weights of IT service climate with respect to offshore/on-site teams’ service climate attributes

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial Practices(0.549)</td>
<td>C11(0.089), C12(0.082), C14(0.159), C15(0.118), C24(0.087), C52(0.014)</td>
</tr>
<tr>
<td>Service Leadership(0.430)</td>
<td>C13(0.039), C21(0.040), C22(0.044), C23(0.047), C31(0.039), C32(0.055), C34(0.081), C51(0.057), C53(0.006), C54(0.041)</td>
</tr>
<tr>
<td>Global service climate(0.021)</td>
<td>C25(0.030), C33(0.030), C41(0.008), C42(0.050), C43(0.010), C44(0.050), C61(0.037), C62(0.005), C63(0.032)</td>
</tr>
</tbody>
</table>

Our results show that understanding the project requirements (C14), participation and communication relationship (C13), participation and support to solve issues (C11), capacity to absorb technical and business knowledge (C24), these factors are more concerned under managerial practices IT service climate dimension in order to deliver quality of service with respect to IT service quality criteria. Likewise, participating in helping each other (C34), cooperation towards project outcome (C23), project functionality towards client’s business process (C51), build up a pilot knowledge between teams (C25) are the attributes that have greater values in order to set goals, work planning and coordination activities with respect to GSD project service leadership dimension.

In addition, the average global weights of IT service quality criteria with respect to service climate attributes such as C61, C63, and C51 values are above 0.1 (shown in Fig. 3.) specifies that offshore/on-site team service climate attributes reveal key determinant in the context of IT service quality and GSD project outcome relationship. Similarly, our results (see Fig. 3) shows that average global weights of IT service climate dimension with respect to offshore/on-site teams’ service climate attributes such as C11, C12, C14, C15, C24, C32, C34, C42, C44, and C52 values exceed 0.05 (see Fig. 3) that indicates that offshore/on-site teams’ service climate attributes have significant impact towards IT service quality. The relative importance of IT service quality, service climate aspects with respective offshore/on-site teams’ service climate attributes are determined by the proposed FMCDM with GA approach. Thus, our study emphasizes that offshore/on-site teams’ service climate attributes should have a significant effect on IT service quality in order to achieve outcome/success of the GSD project from the service providers’ perspective.

![Fig. 3: Average Global Weights IT service quality and Service climate Aspects](image)
REFERENCES


