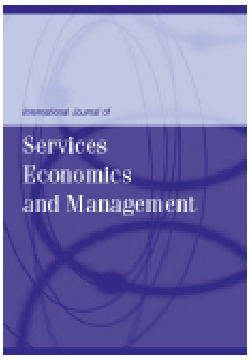


International Journal of Services, Economics and Management

ISSN online: 1753-0830 - ISSN print: 1753-0822
https://www.inderscience.com/ijsem

Requirements analysis of customer service recovery system in hospitality industry using fuzzy DEMATEL and ANP

Amir Mohammad Fakoor Saghih, Bahare Sabzevari Bidokhti

DOI: 10.1504/IJSEM.2022.10051711

Article History:

Received:	03 May 2021
Accepted:	11 February 2022
Published online:	16 March 2023

Requirements analysis of customer service recovery system in hospitality industry using fuzzy DEMATEL and ANP

Amir Mohammad Fakoor Saghih*

Department of Management,
Faculty of Economics and Administrative Sciences,
Ferdowsi University of Mashhad (FUM),
Mashhad, Iran
Email: amf@um.ac.ir
*Corresponding author

Bahare Sabzevari Bidokhti

Master of Business Management,
Hakim Nezami Institute of Higher Education of Quchan,
Quchan, Iran
Email: bahar.sbz92@gmail.com

Abstract: Companies can adopt reactive and proactive strategies for service recovery. This study aimed to identify the requirements of the customer service recovery system in the hospitality industry. Using fuzzy DEMATEL technique, the cause-effect relations between the requirements of the service recovery system were identified and then ranked using the fuzzy ANP (FANP) technique. A model was developed to represent the effective and affected requirements of the service recovery system in the hospitality industry. The senior management support and customer relationship management (CRM) were the most effective and affected requirements, respectively. The literature has traditionally focused more on the basic concepts and conceptual model of service recovery and not covered the requirements of creating a service recovery system. In this regard, this study helps to develop the service recovery theory by identifying the requirements for creating a service recovery system and prioritising them.

Keywords: service recovery; service failure; fuzzy DEMATEL; fuzzy analytic network process; FANP; hospitality industry.

Reference to this paper should be made as follows: Saghih, A.M.F. and Bidokhti, B.S. (2023) ‘Requirements analysis of customer service recovery system in hospitality industry using fuzzy DEMATEL and ANP’, *Int. J. Services, Economics and Management*, Vol. 14, No. 1, pp.108–132.

Biographical notes: Amir Mohammad Fakoor Saghih is an Associate Professor from the Department of Management at the Ferdowsi University of Mashhad. He has 20 years of experience in teaching and research. He has written several books related to his research work. His research interests include service operations management, operational research, HRM and optimisation. He has published more than 60 research papers and guided 50 dissertation works.

Bahare Sabzevari Bidokhti has a Master in Business Management. She graduated from Department of Management, Hakim Nezami Institute of Higher Education of Quchan, Iran.

1 Introduction

Potential errors in various manufacturing and service industries may lead to customer dissatisfaction. Organisations may lose their customers if errors are repeated or not resolved. Due to simultaneous service delivery and consumption in service industries, service providers play a key role in the customer perception of service quality and organisational performance leading to an increase in the risk of errors or service failures. Therefore, the staff should do their best to provide a positive experience for customers who encounter an organisation for the first time (Craighead et al., 1999). Human errors might be significantly reduced through necessary predictions and provision of appropriate conditions but cannot be completely eliminated. Despite many efforts made by organisations to provide premium services, it is practically unrealistic to provide defect-free services; thus, service failure often occurs. This turns the service recovery system into a necessary aspect of an organisation (Chaparro-Peláez et al., 2015).

Many researchers argue that service recovery is a forgotten aspect of service marketing that organisations need to further focus on (Anderson and Gerbing, 1988). The concept of service recovery implies the need for a systematic approach to dealing with customer dissatisfaction and complaints. Service recovery is a conscious and pre-planned process aiming to win back unsatisfied customers. An organisation should make efforts to predict service failures in order to plan systematically to respond to them. Accordingly, organisations are expected to develop their procedures, resources, staff, and other capabilities to deal with all types of service failure (Zemke and Bell, 1990). Service recovery has been identified as one of the key ingredients for achieving customer loyalty (Andreassen, 2001; Tax and Brown, 2000) and is thus important as an effective measure to maintain the customers (Stauss and Friege, 1999). Effective service recovery can also positively affect brand loyalty. If customers are satisfied with the company's responses, brand loyalty will be 33% in the face of a minor failure but it may increase to 44% in the face of a major failure. Moreover, 48% of customers who are satisfied with service recovery may recommend the brand to others. Although brand loyalty does not increase without effective decision-making, most efforts are heading in the wrong direction (Harrison-Walker, 2019). A BBC report, for example, shows how service failures led to boycott campaigns against companies such as Tesco and British Airways. Similarly, Npower, the UK, lost 300,000 customers in only one year due to billing errors and poor service recovery. By contrast, some companies, such as Southwest Airlines Co., that effectively managed service failures made large profits (Borah et al., 2020). Studies have also shown that a combination of failures and inefficient service recovery methods can increase an organisation's costs by 20–40% and reduce its revenue by 5–45% (Smith et al., 2010).

The first principle of service quality, 'to take the right action for the first time', can create value for customers. The provision of services with a desirable quality is a key success factor in service industries, especially in the hospitality industry. Service failure in the hospitality industry is very common due to a high level of interaction between guests and employees. Under such circumstances, organisational performance and problem-solving methods will affect customer satisfaction and loyalty in future (Vázquez-Casielles et al., 2017). Service failure in the hospitality industry can include: an unpleasant behaviour by a recipient, messy room, failure in the heating and cooling systems, and low food quality. Given the extent of processes and potential failures, it is essential to design a service recovery system in the hospitality industry. The first step in creating and implementing such a service recovery system is to identify its requirements (Chaparro-Peláez et al., 2015).

Effective service recovery requires an efficient service recovery system. The findings of Surachartkumtonkun et al. (2015) suggested a difference between the strategies offered by companies and customers' expected response, which resulted in customer dissatisfaction. For example, 76% of customers expect an apology, whereas only 32% of companies apologise in practice; 40–50% of customers ask for a kind of compensation, whereas only 10–20% of them are paid compensation; and 68% of customers want to make a complaint to be heard by a company, whereas only 37% of the complaints are addressed by companies. These findings reveal the poor performance of service companies in service recovery (Harrison-Walker, 2019).

A review of the literature shows that most studies have provided a conceptual model and tested hypotheses on the model variables in relation to service failure and recovery (Chang and Hsiao, 2008; Zehir and Narcıkara, 2016; Li and Fang, 2016; Jung and Seock, 2017). For instance, Harrison-Walker (2019) proposed a conceptual model to investigate the relationship of recovery strategies and customer forgiveness with recovery outcomes. In another study, Tronvoll and Edvardsson (2019) developed an experimental 5C model that identifies drivers for customer participation in the service recovery process and demonstrates how companies should involve customers and other stakeholders in the service recovery process. Salagrama et al. (2021) studied how customers evaluate an organisation's service recovery efforts based on the extent to which they are involved in the service recovery process. Honora et al. (2022) employed a conceptual model to examine the influence of service recovery transparency on customer forgiveness to retain customers in the context of service recovery via social media.

Another set of studies has employed the QFD method to investigate the relationship between causes of service failure and service recovery. For example, Wu et al. (2018) integrated QFD and ANP approaches to evaluate the optimal allocation of service recovery measures to the most important service failures identified in the hotel industry. Liu et al. (2016) identified and prioritised service failures by using the failure modes and effects analysis (FMEA). Lee et al. (2011) and Barbara and Pamela (2004) also employed the critical incident technique (CIT) and an author-made questionnaire to classify the causes of service failures and their relationship with service recovery. Another category of studies in this regard consists of those that used mathematical modelling to address issues related to service recovery. For example, in a study titled 'Optimizing service failure and damage control', Halbheer et al. (2018) showed how the determinants of service failures, i.e. cost, damage, and customer heterogeneity, affect optimal failure rates and prices. Their results also provided a deeper understanding of how an optimal failure control system can be designed. Zhang et al. (2016) addressed the integrated service recovery in the aviation industry using a mathematical model. They also proposed solutions to failures related to the aircrafts and passengers scheduling in order to reduce the recovery cost, operating costs, and delay- or cancelation-related costs.

As it can be seen, service recovery has become an interesting area of research in recent years. Most studies on this subject have developed a model of factors affecting service recovery and investigated the relationship between them. However, these models do not provide us with the requirements of a service recovery system. This study hence aims to address this research gap using a combination of fuzzy DEMATEL and fuzzy analytic network process (FANP) in order to propose a causal model for identifying the requirements of a service recovery system. Therefore, the study findings not only provide a basis for developing a service recovery theory, but they also help the hotel industry establish an efficient service recovery system to convert dissatisfied customers into loyal ones following a service failure. The establishment of a service recovery system requires the allocation of material and human resources. If such a system fails to recover customer satisfaction, it will be only a white elephant for the organisation. Therefore, the prerequisite for developing a successful service recovery system is to identify its requirements, which are mainly related to the internal factors of an organisation. Moreover, prioritising the requirements and focusing on the most important ones can help us establish a service recovery system by using limited organisational resources.

A question arises in this case: 'What are the requirements of the service recovery system, their cause-effect relationships, and their priority?' After the theoretical backgrounds are discussed, the literature is reviewed. The research methodology is then explained, and the research findings are analysed. Concluding remarks are finally presented.

2 Theoretical backgrounds

2.1 Service failure

Service failure is defined as a situation in which a customer is dissatisfied with a service (Fatma et al., 2016). Service failure refers to a negative customer experience of the organisation when the perceptions of the customer fall below their expectations in the delivery of service (Harrison, 2018). Ford et al. (2012) divided service failures into four categories called product service failures, customer demand response failures, failures caused by other customers, and failures caused by reactions and lack of staff reactions.

1 *Product service failure:* this category includes any failures in the provision of services (*e.g.*, cold food in restaurants and inaccessibility of hotel rooms), a set of services (*e.g.*, dirty and messy rooms), and service systems (*e.g.*, failures of the heating and cooling systems and irregular servicemen).

2 *Customer demand response failure:* this category refers to the inability to provide those services requested by customers. Special needs and customer preferences cannot be neglected. For instance, if a hotel guest asks for a sponge pillow, providing an inappropriate pillow out of her/his request can be very frustrating.

3 *Failures caused by other customers:* this category includes the accidental events or those out of the organisation's control. The tourism industry often faces destructive behaviours of other customers. Customers talk loudly, engage, or behave inappropriately near rooms of other guests. These are considered the examples of service failure. Another common example, especially in the hospitality industry, is

loud laughter in the hotel and different noises during the night when most guests are asleep (Koc et al., 2017).

4 *Failures caused by reactions and lack of staff reactions:* This category includes both intentional and unintentional behaviours such as aggression, negative attitudes, and the failure to provide bills timely. However, recent studies have shown that the staff should spend enough time and do their best to predict service failures before customer complaints (Nazifi et al., 2021).

The poor service performance imposes huge costs to companies, and most customers seek for another service provider following such experiences, whereas the costs for preserving existing customers are three or five times less than those related for attracting new customers (Li and Fang, 2016). Although studies show that in most cases, few customers complain, complaint is a common reaction of dissatisfied customers to service failures. In comparison with other probable customer reactions, complaint is the most desirable reaction from the service organisation's viewpoint. Service failure may lead to negative word-of-mouth (Grégoire and Mattila, 2021). Regardless of purchase behavioural changes, customers may talk with their friends and colleagues about service failures, discourage potential customers from selecting that organisation, and even encourage present customers to leave the organisation (Bruhn and Georgi, 2006). Therefore, organisations should design appropriate service recovery mechanisms to ensure customer satisfaction (Li and Fang, 2016).

2.2 Service recovery

Despite efforts made by different companies to achieve excellence, service failure is sometimes inevitable and may negatively impact on firm-customer relationships. In case of service failure, companies are recommended to recover their services to avoid more serious consequences in developing relationships with their customers. Service recovery is aimed at finding a solution to a problem (Cambra-Fierro et al., 2015). Since service failure is an integral part of today's business, service recovery is an issue that deserves great attention. A study conducted in the US in 2017 indicated that 56% of the households had experienced at least one negative experience with products and services over the last 12 months before the study, suggesting that 313 billion $ of revenue was at stake (Tronvoll and Edvardsson, 2019).

According to the literature, effective service recovery efforts may positively affect behaviours of complaining customers in future. The satisfaction levels of customers who experience service failures and subsequently observe significant recovery increases to the same level or even much further in comparison with the cases without any service failures. Therefore, efficient plans should be made to address the complaints of dissatisfied customers, and clear service recovery guidelines should be developed to moderate the negative effects of service failures (Li and Fang, 2016).

Service recovery can be defined as a strategy adopted by organisations to identify and correct existing service failures to preserve customer satisfaction and loyalty (El-Helaly et al., 2013). Accordingly, the service recovery performance is considered a strategic problem (Rod et al., 2008). Wilson (2002) defined service recovery as "measures taken by a service provider in response to existing failures in the delivered services". There are several reasons why the positive outcomes of service recovery can reduce the initial effects of a service failure:

1. effective service recovery makes customers believe that the service provider is fair (e.g. admits and compensates for the mistakes)
2. efforts made to recover a service eliminate all the negative consequences of a service failure
3. the service provider influences the customer to provide documents that the customer may use elsewhere for negative advertising (Mount, 2012).

Since the service recovery strategies can greatly affect the service provider's revenue, a service provider needs to establish and maintain good relationships with its existing customers (Ozuem et al., 2017). If customer dissatisfaction following a service failure is neglected, dissatisfied customers are more likely to go for competitors and engage in negative word-of-mouth advertising (Rosenmayer et al., 2018). Odoom et al. (2019) argue that a service provider's response to a service failure should include compensation, apology, and explanation.

3 Research methodology

This study addresses the requirements of the service recovery system in the hospitality industry. The population included all five-star hotels located in the north of Iran. The reasons behind selecting the five-star hotels were the large numbers of passengers and tourists from different countries and the higher risk of service failure. The decision team included 21 experts in the hospitality industry with a minimum working experience of 15 years as well as university professors. The decision team were fully familiar with the hospitality industry.

In this study, the literature was reviewed to extract the requirements of a service recovery system, and the decision team selected the most important one using a questionnaire. Then DEMATEL and fuzzy DEMATEL were employed to analyse the structure of requirements and determine the causal relationships between them, respectively. Finally, the requirements of a service recovery system were prioritised using FANP. The comments and views of the decision team were elicited to complete the survey matrix of pairwise comparisons and the intensity of direct relations in DEMATEL and ANP techniques. All calculations related to fuzzy DEMATEL and FANP were performed in Excel. Various steps of this study are discussed below in detail.

Step 1 Identifying the requirements of the service recovery system

A total of 27 requirements were identified by reviewing the literature for creating the service recovery system in the hospitality industry (Table 1). For this purpose, papers and books in accredited scientific databases were reviewed. Semi-structured interviews were conducted to match the identified factors with the case study (five-star hotels in the Northeastern Iran). A questionnaire with a 5-point Likert scale was first developed, and the decision team was asked to determine the significance of each factor according to the case study conditions. They were also asked to add new factors at the end of the questionnaire if they considered any factor. Data with an average score of below 3 were eliminated in SPSS. Table 1 presents the average scores for each factor.

Table 1 Identification of factors affecting the service recovery system

Factors	*Studies*	*Means*
Employees empowerment	Miller et al. (2000) and Bowen and Johnston (1999)	2.9
Employees training	Miller et al. (2000)	2.77
Collecting, analysing and interpreting data of failure	Johnston and Michel (2008) and Kumar and Kumar (2016)	3.29
Identification of various failure modes, proper management and necessary measures	Johnston and Michel (2008)	3.41
Focus on dealing with the mechanisms that generate errors and improve correction capabilities	Johnston and Michel (2008)	1.64
Senior management support	Bowen and Johnston (1999)	3.87
Organisational support	Bowen and Johnston (1999)	2.25
Practicing for the service recovery process	Bowen and Johnston (1999)	2.36
Strategies directed specifically toward combating learned	Bowen and Johnston (1999)	1.57
Involvement, understanding and awareness of employees	Akhavan and Jafari (2006) and Moffett et al. (2003)	2.13
Knowledge sharing	Tobin (2003), and Davenport and Probst (2002)	2.92
IT infrastructure	Wong (2005), and Egbu (2004)	2.14
good organisational communications and collaborations	Burger (2004), and Akhavan and Jafari (2006)	3.54
Integration of service recovery management with other systems	Egbu (2004)	1.93
The atmosphere of risk-taking in the organisation	Wong (2005)	2.15
Human resource management and motivation	Akhavan and Jafari (2006) and Egbu (2004)	2.17
Appointment of a senior service recovery manager	Leibowitz (1999)	1.34
Changing the culture of the organisation	Egbu (2004) and Tobin (2003), and Wong (2005)	3.79
Creating a service recovery process	Tobin (2003)	2.19
Customer relationship management	Kumar and Kumar (2016)	3.48
Choosing the right strategy for service recovery	Kumar and Kumar (2016)	1.22
Identifying nodes and fix them	Kumar and Kumar (2016)	2.45
Increasing managers' individual skills in service recovery	Koc (2017)	2.11
Developing guidelines for the service recovery process	Koc (2017)	1.69
Complaint management	Krishna et al. (2011)	2.17
Staff's job satisfaction	Robinson et al. (2011)	3.52
Self-efficacy	Robinson et al. (2011)	1.14
Adaptability and their effects on employee perceptions of service recovery effectiveness	Robinson et al. (2011)	2.22

Note: Extracted from the literature.

Step 2 Determining the cause-and-effect relationships of requirements through the fuzzy DEMATEL technique

The DEMATEL technique is a multi-criteria decision-making method for evaluating the causal relationships of research factors. Different steps of the fuzzy DEMATEL are discussed below (Yeh and Huang, 2014).

1 *Calculating the direct relation matrix (D)*

In this step, the respondents were asked to determine the effect of the criterion *i* on the criterion *j* through Table 2. The arithmetic mean of the opinions of all experts was calculated through equation (1).

$$\tilde{Z} = \frac{\tilde{x}^1 \oplus \tilde{x}^2 \oplus x^3 \oplus \cdots \oplus x^p}{p} \tag{1}$$

where p represents the number of experts, whereas $\tilde{x}^1$, $\tilde{x}^2$ and $\tilde{x}^p$ respectively show the pairwise comparison matrices for experts 1, 2, and n. Moreover, $\tilde{z}$ denotes a triangular fuzzy number defined as $\tilde{z}_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$.

Table 2 The five-point scale in the fuzzy DEMATEL technique

Linguistic terms	*Triangular fuzzy numbers (l, m, r)*
No influence (No):0	(0, 0, 0.25)
Very low influence (VL):1	(0, 0.25, 0.5)
Low influence (L):2	(0.25, 0.5, 0.75)
High influence (H):3	(0.5, 0.75, 1)
Very high influence (VH):4	(0.75, 1, 1)

Source: Yeh and Huang (2014)

2 *Normalising the direct relation matrix*

The mean matrix normalised by equation (2) is called the matrix *H*. The resultant matrix is normalised through equation (2) and equation (3):

$$\tilde{H}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left(\frac{l'_{ij}}{r}, \frac{m'_{ij}}{r}, \frac{u'_{ij}}{r}\right) = \left(l''_{ij}, m''_{ij}, u''_{ij}\right) \tag{2}$$

where r is calculated as follows:

$$r = \max_{1 \le i \le n}\left(\sum\nolimits_{j=1}^{n} u'_{ij}\right) \tag{3}$$

3 *Calculating the total relation matrix of criteria (T_c)*

After the above matrices are calculated, the total fuzzy relation matrix is obtained from equations (4)–(7).

$$T = \lim_{k \to +\infty}\left(\tilde{H}^1 \oplus \tilde{H}^2 \oplus \cdots \oplus \tilde{H}^k\right) \tag{4}$$

where each entry represents a fuzzy number, *i.e.*, $\tilde{t}_{ij} = (l_{ij}^t, m_{ij}^t, u_{ij}^t)$, calculated as follows:

$$\left[l_{ij}^t\right] = H_l \times \left(I - H_l\right)^{-1} \tag{5}$$

$$\left[m_{ij}^t\right] = H_m \times \left(I - H_m\right)^{-1} \tag{6}$$

$$\left[u_{ij}^t\right] = H_u \times \left(I - H_u\right)^{-1} \tag{7}$$

where I represents the unit matrix, whereas H_l, H_m and H_u are $n \times n$ matrices in which the entries are the lower, middle and upper numbers of the triangular fuzzy numbers in the matrix H, respectively.

4 *Calculating the effect intensity and direction*

The indices *ri* and *cj* are respectively calculated through equation (8) and equation (9). The index *ri* is the sum of entries in the row *i*, and the index *cj* represents the sum of entries in the column *j* of the total relation matrix (*T*). The intensity of effect and the effect direction obtained from *ri* and *cj* are required to plot and analyse diagrams. For any $i = j$:

$$\tilde{D} = \left(\tilde{D}_i\right)_{n\times 1} = \left[\sum_{j=1}^{n} \tilde{T}_{ij}\right]_{n\times 1} \tag{8}$$

$$\tilde{R} = \left(\tilde{R}_i\right)_{1\times n} = \left[\sum_{j=1}^{n} \tilde{T}_{ij}\right]_{1\times n} \tag{9}$$

where $\tilde{D}$ and $\tilde{R}$ respectively represent $n \times 1$ and $1 \times n$ matrices.

In the next step, the significance of indices $(\tilde{D}_i + \tilde{R}_i)$ and the relationship of criteria $(\tilde{D}_i - \tilde{R}_i)$ are determined. If $\tilde{D}_i - \tilde{R}_i > 0$, the criterion is effective; otherwise, if $\tilde{D}_i - \tilde{R}_i < 0$, the criterion is affected.

- *ri* + *dj* is the intensity of effect (a higher *ri* + *dj* for a factor means the higher interaction of that factor with other factors in the system).
- *ri* – *dj* is the effect direction (*ri* – *dj* > 0 and *ri* – *dj* < 0 respectively mean an effective criterion and an affected criterion).

Given the values calculated above, *ri* + *dj* and *ri* – *dj* for the criteria as well as $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$ obtained for dimensions are defuzzified through equation (10):

$$\text{defuzzy} = \frac{\left((u-l)+(m-l)\right)}{3} + l \tag{10}$$

5 *Plotting the network relation map*

The threshold value should be calculated to determine the network relation map (NRM). To calculate the threshold value of relations, the mean value of the defuzzified matrix T should be obtained. After the threshold intensity is determined, all values below the threshold are equated zero, *i.e.*, their causal relations are not considered.

6 *Buckley's geometric mean*

In this method, Buckley's geometric mean is employed to calculate the relative weights in the fuzzy pairwise comparisons (Hsieh et al., 2004). The steps are explained below.

Assume that $\tilde{P}_{ij}$ is a set of decision maker preferences regarding an index related to other indices. The pairwise comparisons matrix is formed as below.

Where n is the number of related elements in each row. The fuzzy weights of each index in the pair comparison matrix are obtained from the Buckley's geometric mean (Hsieh et al., 2004). The geometric mean of the value of fuzzy comparisons for the index i related to other indices is obtained from equation (11):

$$\tilde{r}_i = \left(\prod_{j=1}^{n} \tilde{P}_{ij} \right)^{1/n} \quad i = 1, 2, 3, \ldots, n \tag{11}$$

The fuzzy weight of the i^{th} index is then represented by a triangular fuzzy number [equation (12)].

$$w_i = r_i \otimes \left(r_1 \oplus r_2 \oplus \cdots \oplus r_m \right)^{-1} \tag{12}$$

After the fuzzy weights of factors are calculated, the weights are first defuzzified and then normalised [equation (13)].

$$w_{crisp} = \frac{l + 2m + u}{4} \tag{13}$$

To calculate the weights in the pairwise comparisons, verbal expressions and triangular fuzzy numbers from Table 3 were used.

Table 3 The verbal expressions and fuzzy numbers for weighting the criteria

Fuzzy number	*Linguistic*	*Scale of fuzzy number*
9	Perfect	(8, 9, 10)
8	Absolute	(7, 8, 9)
7	Very good	(6, 7, 8)
6	Fairly good	(5, 6, 7)
5	Good	(4, 5, 6)
4	Preferable	(3, 4, 5)
3	Not bad	(2, 3, 4)
2	Weak advantage	(1, 2, 3)
1	Equal	(1, 1, 1)

Source: Hsieh et al. (2004)

Step 3 Prioritising (ranking) the requirements of the service recovery system through the FANP technique

The ANP technique has extensively been used in recent years for making multi-purpose decisions and solving complex decision problems. The clusters represent the decision levels, whereas the straight lines or arcs show interactions of decision levels. The FANP steps are discussed below.

1 *Model development and network construction*

The problem should be clearly stated and separated into a rational system like a network. This network structure can be determined by decision makers in brainstorming sessions or through other methods (Büyüközkan and Öztürkcan, 2010).

2 *Matrix of pairwise comparisons and priority vectors*

Like the AHP technique, the pairwise comparisons in the ANP technique are obtained directly in the form of a matrix through judgements through paiwise comparisons including the relevant criteria. In the FANP technique, the relative significance of each pair of elements and that of decision maker preferences are shown by triangular fuzzy numbers. The fuzzy judgement matrix, A' is formed through pariwise comparisons [equation (14)] where $a'_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$ indicates the significance of compared indices (the significance of *i* relative to *j*) (Büyüközkan and Öztürkcan, 2010).

$$A' = \begin{pmatrix} a'_{11} & \cdots & a'_{1n} \\ \vdots & \ddots & \vdots \\ a'_{m1} & \cdots & a'_{mn} \end{pmatrix} \tag{14}$$

3 *Supermatrix formation*

A supermatrix is used in the ANP technique to demonstrate the interactions and interdependencies of decision levels and to determine the relative significance of criteria and prioritise problem alternatives. To complete different matrices in the supermatrix, the priority vectors for each pairwise comparison matrix should be calculated by the logarithm of least squares and Chang's developmental analysis [equation (15)] (Yüksel and Dağdeviren, 2010).

$$\boldsymbol{W} = \begin{array}{c c} & \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \\ e_{11}\cdots e_{1m_1} & e_{21}\cdots e_{2m_2} & & e_{n1}\cdots e_{nm_n} \end{array} \\ \begin{array}{c} C_1 \begin{array}{c} e_{11} \\ e_{12} \\ \vdots \\ e_{1m_1} \end{array} \\ C_2 \begin{array}{c} e_{21} \\ e_{22} \\ \vdots \\ e_{2m_2} \end{array} \\ \vdots \\ C_n \begin{array}{c} e_{n1} \\ e_{n2} \\ \vdots \\ e_{nm_n} \end{array} \end{array} & \begin{bmatrix} \boldsymbol{W}_{11} & \boldsymbol{W}_{12} & \cdots & \boldsymbol{W}_{1n} \\ \boldsymbol{W}_{21} & \boldsymbol{W}_{22} & \cdots & \boldsymbol{W}_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \boldsymbol{W}_{n1} & \boldsymbol{W}_{n2} & \cdots & \boldsymbol{W}_{nm} \end{bmatrix} \end{array} \tag{15}$$

A supermatrix is a segmented matrix in which each section shows the relationship of two nodes or decision levels in the whole decision problem where *C* and *e* represent the nodes and elements in the nodes, respectively. The vectors W in the matrix are the weighted vectors obtained from pairwise comparisons of elements in the nodes.

4 *Supermatrix solution*

To solve the supermatrix, each of the elements in a column is first divided by the sum of elements in that column to obtain a weighted/stochastic supermatrix. The limit supermatrix can be then calculated to obtain the final priorities of each alternative. It is sufficient to raise the stochasic supermatrix to the power of infinity (or a very large number). According to Saati, the final weight of elements is obtained from equation (16) through probable matrices and Markov chains:

$$W = \lim_{k \to \infty} W^{2k+1} \tag{16}$$

K belongs to the set of natural numbers and can be arbitrary increased to achieve convergence so that all elements in a row (or column) will be the equal.

4 Research findings

After the factors obtained from the literature were evaluated by experts, a total of seven factors were selected as the main requirements affecting the service recovery system. They were then coded in Table 4.

Table 4 The main factors affecting the service recovery system

Factor	*Cod*
Senior management support	C1
Changing the culture of the organisation	C2
Good organisational communications and collaborations	C3
Staff's job satisfaction	C4
Customer relationship management	C5
Identification of various failure modes, proper management and necessary measures	C6
Collecting, analysing and interpreting failure data	C7

4.1 Results of fuzzy DEMATEL technique for main criteria

4.1.1 Creating the direct relation matrix

In this section, the DEMATEL matrix was given to 21 experts to determine the effect of each criterion on other criteria based on a 0–4 scale in the fuzzy DEMATEL table. The opinions of respondents were then integrated through equation (1), the results of which are reported by Table 5.

Table 5 The direct relation matrix for the criteria

	C1	*C2*	*C3*	*C4*
C1	(0, 0, 0.25)	(0.51, 0.76, 0.99)	(0.442, 0.692, 0.933)	(0.385, 0.635, 0.885)
C2	(0.067, 0.288, 0.538)	(0, 0, 0.25)	(0.365, 0.615, 0.865)	(0.317, 0.567, 0.817)
C3	(0.077, 0.298, 0.548)	(0.288, 0.529, 0.779)	(0, 0, 0.25)	(0.394, 0.644, 0.885)
C4	(0.115, 0.317, 0.567)	(0.183, 0.433, 0.683)	(0.317, 0.567, 0.817)	(0, 0, 0.25)
C5	(0.048, 0.25, 0.5)	(0.308, 0.529, 0.779)	(0.288, 0.51, 0.76)	(0.26, 0.481, 0.731)
C6	(0.212.0.452, 0.702)	(0.25, 0.49, 0.74)	(0.317, 0.538, 0.788)	(0.115, 0.317, 0.567)
C7	(0.058, 0.221, 0.471)	(0.077, 0, 298, 0.548)	(0.163, 0.385, 0.635)	(0.077, 0, 288, 0.538)

	C5	*C6*	*C7*
C1	(0.337, 0.567, 0.817)	(0.317, 0.558, 0.808)	(0.221, 0.452, 0.702)
C2	(0.394, 0.635, 0.885)	(0.154, 0.394, 0.644)	(0.144, 0.365, 0.615)
C3	(0.375, 0.625, 0.875)	(0.317, 0.567, 0.817)	(0.279, 0.529, 0.779)
C4	(0.356, 0.606, 0.846)	(0.288, 0.519, 0.769)	(0.221, 0.462, 0.712)
C5	(0, 0, 0.25)	(0.356, 0.587, 0.827)	(0.298, 0.5, 0.74)
C6	(0.375, 0.615, 0.865)	(0, 0, 0.25)	(0.385, 0.625, 0.875)
C7	(0.048, 0.26, 0.51)	(0.154, 0.385, 0.635)	(0, 0, 0.25)

4.1.2 Normalising the direct relation matrix

The direct relation matrix in Table 5 is normalised through equation (2) and equation (3). For this purpose, the maximum value of the sum of rows for the upper limits of the direct relation matrix should be obtained. It was reported 2.25. All numbers in the direct relation matrix (Table 5) are then divided by 5.385. Table 6 reports the results.

Table 6 The normalised direct relation matrix

	C1	*C2*	*C3*	*C4*
C1	(0, 0, 0.046)	(0.095, 0.141, 0.184)	(0.082, 0.129, 0.173)	(0.071, 0.118, 0.164)
C2	(0.013, 0.054, 0.1)	(0, 0, 0.046)	(0.068, 0.114, 0.161)	(0.059, 0.105, 0.152)
C3	(0.014, 0.055, 0.102)	(0.054, 0.098, 0.145)	(0, 0, 0.046)	(0.073, 0.12, 0.164)
C4	(0.021, 0.059, 0.105)	(0.034, 0.08, 0.127)	(0.059, 0.105, 0.152)	(0, 0, 0.046)
C5	(0.009, 0.046, 0.093)	(0.057, 0.098, 0.145)	(0.054, 0.095, 0.141)	(0.048, 0.089, 0.136)
C6	(0.039, 0.084, 0.13)	(0.046, 0.091, 0.138)	(0.059, 0.1, 0.146)	(0.021, 0.059, 0.105)
C7	(0.011, 0.041, 0.088)	(0.014, 0.055, 0.102)	(0.03, 0.071, 0.118)	(0.014, 0.054, 0.1)

	C5	*C6*	*C7*
C1	(0.063, 0.105, 0.152)	(0.059, 0.104, 0.15)	(0.041, 0.084, 0.13)
C2	(0.073, 0.118, 0.164)	(0.029, 0.073, 0.12)	(0.027, 0.068, 0.114)
C3	(0.07, 0.116, 0.163)	(0.059, 0.105, 0.152)	(0.052, 0.098, 0.145)
C4	(0.066, 0.113, 0.157)	(0.054, 0.096, 0.143)	(0.041, 0.086, 0.132)
C5	(0, 0, 0.046)	(0.066, 0.109, 0.154)	(0.055, 0.093, 0.138)
C6	(0.07, 0.114, 0.161)	(0, 0, 0.046)	(0.071, 0.116, 0.163)
C7	(0.009, 0.048, 0.095)	(0.029, 0.071, 0.118)	(0, 0, 0.046)

4.1.3 Creating the total relation matrix (T)

The total relation matrix (*T*) is formed through equations (4)–(7). To calculate the total relation matrix, the identity matrix (I_{7*7}) is first constructed. The identity matrix is then subtracted from the normal matrix, and the resultant matrix is inversed. Finally, the normal matrix is multiplied by the inversed matrix as shown in Table 7.

Table 7 The total relation matrix for the criteria

	C1	*C2*	*C3*	*C4*
C1	(0, 0, 0.046)	(0.095, 0.141, 0.184)	(0.082, 0.129, 0.173)	(0.071, 0.118, 0.164)
C2	(0.013, 0.054, 0.1)	(0, 0, 0.046)	(0.068, 0.114, 0.161)	(0.059, 0.105, 0.152)
C3	(0.014, 0.55, 0.102)	(0.054, 0.098, 0.145)	(0, 0, 0.046)	(0.073, 0.12, 0.164)
C4	(0.021, 0.059, 0.105)	(0.034, 0.08, 0.127)	(0.059, 0.105, 0.152)	(0, 0, 0.046)
C5	(0.009, 0.046, 0.093)	(0.057, 0.098, 0.145)	(0.054, 0.095, 0.141)	(0.048, 0.089, 0.136)
C6	(0.039, 0.084, 0.13)	(0.046, 0.091, 0.138)	(0.059, 0.1, 0.146)	(0.021, 0.059, 0.105)
C7	(0.011, 0.041, 0, 088)	(0.014, 0.055, 0.102)	(0.03, 0.071, 0.118)	(0.014, 0.054, 0.1)

	C5	*C6*	*C7*
C1	(0.063, 0.105, 0.152)	(0.059, 0.104, 0.15)	(0.041, 0.084, 0.13)
C2	(0.073, 0.118, 0.164)	(0.029, 0.073, 0.12)	(0.027, 0.68, 0.114)
C3	(0.07, 0.116, 0.163)	(0.059, 0.105, 0.152)	(0.052, 0.098, 0.145)
C4	(0.066, 0.113, 0.157)	(0.054, 0.096, 0.143)	(0.041, 0.086, 0.132)
C5	(0, 0, 0.046)	(0.066, 0.109, 0.154	(0.055, 0.093, 0.138)
C6	(0.07, 0.114, 0.161)	(0, 0, 0.046)	(0.071, 0.116, 0.163)
C7	(0.009, 0.048, 0.095)	(0.029, 0.071, 0.118)	(0, 0,0.046)

4.1.4 Plotting and analysing the causal diagram

In this step, the sum of rows (D) and columns (R) of the total relation matrix (Table 7) is obtained, and D+R and D-R are then calculated. Equation (10) is employed to defuzzify the values. Table 8 reports the results.

Table 8 D and R for the criteria

	C1	*C2*	*C3*	*C4*
C1	(0, 0, 0.046)	(0.095, 0.141, 0.184)	(0.082, 0.129, 0.173)	(0.071, 0.118, 0.164)
C2	(0.013, 0.054, 0.1)	(0, 0, 0.046)	(0.068, 0.114, 0.161)	(0.059, 0.105, 0.152)
C3	(0.014, 0.055, 0.102)	(0.054, 0.098, 0.145)	(0, 0, 0.046)	(0.073, 0.12, 0.164)
C4	(0.021, 0.059, 0.105)	(0.034, 0.08, 0.127)	(0.059, 0.105, 0.152)	(0, 0, 0.046)
C5	(0.009, 0.046, 0.093)	(0.057, 0.098, 0.145)	(0.054, 0.095, 0.141)	(0.048, 0.089, 0.136)
C6	(0.093, 0.084, 0.13)	(0.046, 0.091, 0.138)	(0.059, 0.1, 0.146)	(0.021, 0.059, 0.105)
C7	(0.011, 0.041, 0.088)	(0.014, 0.055, 0.102)	(0.03, 0.071, 0.118)	(0.014, 0.054, 0.1)

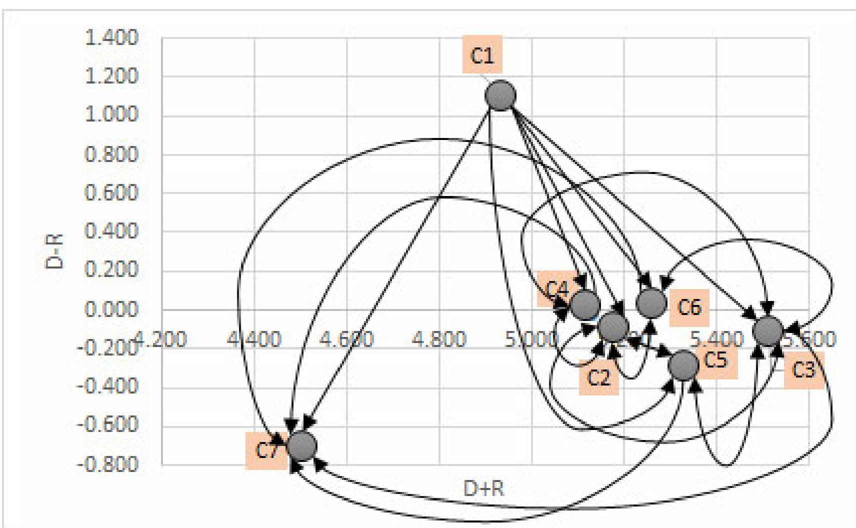
	C5	*C6*	*C7*
C1	(0.063, 0.105, 0.152)	(0.059, 0.104, 0.15)	(0.041, 0.084, 0.13)
C2	(0.073, 0.118, 0.164)	(0.029, 0.073, 0.12)	(0.027, 0.068, 0.114)
C3	(0.07, 0.116, 0.163)	(0.059, 0.105, 0.152)	(0.052, 0.098, 0.145)

Table 8 D and R for the criteria (continued)

	C5	*C6*	*C7*
C4	(0.066, 0.113, 0.157)	(0.054, 0.096, 0.143)	(0.041, 0.086, 0.132)
C5	(0, 0, 0.046)	(0.066, 0.109, 0.154)	(0.055, 0.093, 0.138)
C6	(0.07, 0.114, 0.161)	(0, 0, 0.046)	(0.071, 0.116, 0.163)
C7	(0.009, 0.048, 0.095)	(0.029, 0.071, 0.118)	(0, 0, 0.046)

The sum of elements in each row (Table 8) shows the effect of each factor on other factors in the system. Accordingly, the senior management support (C1) shows the highest effect on other factors. The sum of elements in the column (R) shows the effect of other factors on the intended factor. Accordingly, the CRM (C5) is further affected by other factors. The horizontal vector (D+R) shows how a factor is effective or affected in the system. In other words, a higher D+R indicates the higher interaction of a factor with other factors. Therefore, good organisational communication and collaboration (C3) have most interactions with other factors. The vertical vector (D-R) represents the intensity of effect of each factor. In general, a positive D-R refers to a cause variable, whereas a negative D-R denotes an effect variable. According to Figure 1, the criteria above and below the horizontal axis show the cause and effect criteria, respectively.

Figure 1 The cause diagram of criteria (see online version for colours)



4.1.5 Interrelations of criteria

To plot the significant relations, the fuzzy total relation matrix is defuzzified (Table 9), and the threshold limit (the arithmetic mean of entries) is determined. Each number above the threshold limit indicates a significant relationship between the criterion in the row *i* with that in the column *j*. A threshold value of 0.366 was obtained in this study. Accordingly, entries larger than 1.938 are marked by an asterisk (*) indicating a significant relationship shown in Figure 1.

Table 9 The defuzzified total relation matrix

	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*
C1	0.273	0.475*	0.487*	0.451*	0.472*	0.445*	0.424*
C2	0.274	0.31	0.419*	0.389*	0.426*	0.368*	0.36
C3	0.289	0.405*	0.348	0.418*	0.433*	0.413*	0.403*
C4	0.281	0.372*	0.412*	0.307	0.42*	0.389*	0.376*
C5	0.267	0.384*	0.4*	0.372*	0.328	0.395*	0.379*
C6	0.306	0.391*	0.418*	0.36	0.431*	0.322	0.41*
C7	0.216	0.281	0.309	0.277	0.291	0.296	0.24

4.2 Results of fuzzy ANP technique

To implement the FANP technique, Buckley's geometric mean is employed to obtain the weights in the pairwise comparisons. These weights are inserted in the original (initial) ANP supermatrix to calculate the weighted and limit supermatrices in order to obtain the final FANP weights (Mohanty et al., 2005). The DEMATEL total relation matrix is normalised by column (each entry is divided by the sum of entries in each column) and is then inserted in the ANP supermatrix as the interrelations of factors.

4.2.1 Results of Buckley's geometric mean

The pairwise comparison questionnaire was given to 21 experts. The inconsistency rate was calculated after the pairwise comparisons were drawn. An inconsistency rate of 0.1 obtained indicates the reasonable reliability of pairwise comparisons. The responses integrated by the geometric mean method are given below in the form of integrated pairwise comparisons.

4.2.2 Formation of pairwise comparisons

This section presents the pairwise comparisons of seven research criteria. The pairwise comparisons were performed based on a 1–9 fuzzy scale completed by 26 experts and then integrated by the geometric mean method (Table 10).

Table 10 Pairwise comparisons of criteria

	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*
C1	0.273	0.475*	0.487*	0.451*	0.472*	0.445*	0.424*
C2	0.274	0.31	0.419*	0.389*	0.426*	0.368*	0.36
C3	0.289	0.405*	0.348	0.418*	*0.443	0.413*	0.403*
C4	0.281	0.372*	0.412*	0.307	0.42*	0.389*	0.376*
C5	0.267	0.384*	0.4*	0.372*	0.328	0.395*	0.379*
C6	0.306	0.391*	0.418*	0.36	0.431*	0.322	0.41*
C7	0.216	0.281	0.309	0.277	0.291	0.296	0.24

Note: *Indicates a significant relationship shown in Figure 1.

4.2.3 Calculating fuzzy and normal weights

The geometric mean of the fuzzy numbers in each rows in Table 10 are calculated through equation (11) and equation (12). The geometric mean is then divided by the sum of geometric means to obtain the fuzzy weight. The fuzzy weights are then defuzzified through $\frac{l+2m+u}{4}$. To normalise each defuzzified weight, it is sufficient to divide that weight by the sum of defuzzified weights. For example, the calculations for the criterion C1 in Table 10 are as follows:

$$\begin{aligned}(\text{geometric mean})C1 &= \left[(1,1,1)\times(1.058,1.307,1.576)\times(1.248,1.703,2.124)\right.\\ &\left.\quad\times\cdots\times(0.522,0.682,0.92)\right]^{\frac{1}{7}}\\ &= (0.951,1.204,1.479)\end{aligned}$$

Similar calculations are performed for other rows. The results are presented in the second column of Table 11 for all rows. The sum of all these geometric means is then calculated (5.679, 7.111, 8.894). The fuzzy weight of each criterion is obtained by dividing the geometric mean of each row through the overall geometric mean. The fuzzy weight for the criterion C1 is as follows:

$$(\text{fuzzy weight})C1 = \frac{(0.951,1.204,1.479)}{(5.679,7.111,8.894)}) = (0.107,0.169,0.26)$$

Similar calculations are performed for all other criteria, and the fuzzy weights are presented in the third column of Table 11. Each fuzzy weight is then defuzzified as follows:

$$(\text{fuzzy weight})C1 = (0.107,0.169,0.26) \Rightarrow$$

$$(\text{defuzzified weight})C1 = \frac{0.107+2\times0.169+0.26}{4} = 0.177$$

Similar calculations are performed for all other criteria, and the results are presented in the fourth column of Table 11. Each fuzzy weight is then defuzzified as follows:

$$(\text{defuzzified weight})C1 = 0.177 \Rightarrow$$

$$(\text{Normal weights})C1 = \frac{0.177}{0.177+0.139+\cdots+0.113} = 0.168$$

Table 11 The fuzzy and defuzzified weights of main criteria

Factor	*Geometric means* $\left(\prod_{j=1}^{n}\tilde{P}_{ij}\right)^{\frac{1}{n}}$	$(\tilde{W})$ *fuzzy weight*	*Defuzzified weights*	*Normal weights*
C1	(0.951, 1.204, 1.479)	(0.107, 0.169, 0.26)	0.177	0.168
C2	(0.731, 0.942, 1.194)	(0.082, 0.132, 0.21)	0.139	0.133
C3	(0.818, 1.029, 1.307)	(0.092, 0.145, 0.23)	0.153	0.145
C4	(0.934, 1.155, 1.448)	(0.105, 0.162, 0.255)	0.171	0.163

Table 11 The fuzzy and defuzzified weights of main criteria (continued)

Factor	*Geometric means* $\left(\prod_{j=1}^{n} \tilde{P}_{ij}\right)^{\frac{1}{n}}$	$(\tilde{W})$ *fuzzy weight*	*Defuzzified weights*	*Normal weights*
C5	(0.984, 1.223, 1.515)	(0.111, 0.172, 0.267)	0.180	0.172
C6	(0.657, 0.799, 0.99)	(0.074, 0.112, 0.174)	0.118	0.112
C7	(0.604, 0.759, 0.961)	(0.068, 0.107, 0.169)	0.113	0.107
$\left(\prod_{j=1}^{n} \tilde{P}_{ij}\right)^{\frac{1}{n}}$	(5.679, 7.111, 8.894)			

4.2.4 Creating initial and weighted supermatrices

Table 12 shows the initial supermatrix. The weighted and initial supermatrices are the same, for the sum of each column in the initial supermatrix equals 1.

Table 12 The initial supermatrix

	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*Goal*
C1	0.143	0.181	0.174	0.175	0.168	0.169	0.164	0.168
C2	0.144	0.119	0.150	0.151	0.151	0.140	0.139	0.133
C3	0.152	0.155	0.125	0.162	0.158	0.157	0.156	0.145
C4	0.147	0.142	0.148	0.119	0.150	0.148	0.145	0.163
C5	0.140	0.147	0.143	0.145	0.117	0.150	0.146	0.172
C6	0.161	0.149	0.150	0.140	0.153	0.122	0.158	0.112
C7	0.113	0.107	0.111	0.107	0.104	0.113	0.093	0.107
Goal	0	0	0	0	0	0	0	0

4.2.5 Limit supermatrix

After the weighted supermatrix is created, the limit supermatrix should be constructed so that the weighted supermatrix is raised to a certain power to be convergent. The weighted supermatrix is converged at a power of 3. Table 13 reports the results on the limit supermatrix.

Table 13 The limit supermatrix

	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*Goal*
C1	0.1675	0.1675	0.1675	0.1675	0.1675	0.1675	0.1675	0.1675
C2	0.1421	0.1421	0.1421	0.1421	0.1421	0.1421	0.1421	0.1421
C3	0.1516	0.1516	0.1516	0.1516	0.1516	0.1516	0.1516	0.1516
C4	0.1428	0.1428	0.1428	0.1428	0.1428	0.1428	0.1428	0.1428
C5	0.1410	0.1410	0.1410	0.1410	0.1410	0.1410	0.1410	0.1410
C6	0.1475	0.1474	0.1475	0.1474	0.1475	0.1474	0.1475	0.1474
C7	0.1075	0.1075	0.1075	0.1075	0.1075	0.1075	0.1075	0.1075
Goal	0	0	0	0	0	0	0	0

4.2.6 Final weights of criteria

The research factors can be prioritised (ranked) through the weights obtained from the limit supermatrix, for the weights in this supermatrix are in fact the final weights of factors (Table 14). Accordingly, the senior management support, good organisational communication and collaboration, and identification of various failure modes, proper management and necessary measure (service recovery process) were ranked first with weights of 0.1675, 0.1516, and 0.1475, respectively.

Table 14 The final weights of factors

Rank	*Weight*	*Factor*	*Cod*
1	0.1675	Senior management support	C1
5	0.1421	Changing the culture of the organisation	C2
2	0.1516	Good organisational communications and collaborations	C3
4	0.1428	Staff's job satisfaction	C4
6	0.1410	Customer relationship management	C5
3	0.1475	Identification of various failure modes, proper management and necessary measures	C6
7	0.1075	Collecting, analysing and interpreting failure data	C7

5 Conclusions, discussion, and recommendations

The risk of service failure is inevitable due to the unique features of a service. The organisational response to service failure is the result of a conscious and coordinating organisational effort for predicting service failures causing development of procedures, policies, individuals and their capabilities by organisations to face service failures. This study aimed to propose a framework by using the fuzzy DEMATEL technique for implementing a service recovery system in the hospitality industry and determining the cause-and-effect relationships among model components. According to the results, 'the senior management support' and 'CRM' were the most affected factors. Considering time, human and financial resource limitations, organisations should identify the most important requirements of the service recovery system and give a higher priority to the development of such requirements. For this purpose, the FANP was used in this study. The key requirements of the service recovery system in the hospitality industry were 'senior management support', 'good organisational communication and collaborations', and 'identification of various failure modes, proper management and necessary measures'.

According to the results obtained from the fuzzy DEMTEL technique, the senior management support (C1) had the greatest effect on the other factors (Figure 1) indicating the high significance of senior management support in implementing the service recovery system in an organisation. Like any other systems, the implementation of the service recovery system needs the senior management support as the first step. Therefore, the strong senior management support improves the performance of other components of the service recovery system. For example, the senior management support plays a key role in collaborations and communication among various organisational units or in creating a proper organisational structure for developing a service recovery system. Senior managers can play a major role in promoting the culture of service recovery in organisations; introducing and appreciating the employees who perform well in service recovery can provide other employees with good role models in this regard. This process can gradually promote organisational grounds for the culture of service recovery.

According to the DEMATEL results, CRM (C5) is the most affected factor. This indicates to what extent the CRM is affected by other managerial and organisational communication and culture factors. There should be a proper CRM in such a way that proper communication with customers might be the first step in the service recovery process, *i.e.*, failure identification. If an organisation fails to communicate with its customers, customers may not complain and leave the organisation forever without obtaining good information on the cause of customer dissatisfaction. Thus, an organisation will be unable to identify service failures leading to the loss of huge amount of information that could be used for service recovery, customer satisfaction, and improved organisational performance. The needs of customers can be recognised through a proper CRM system. This system can be used in implementing the service recovery system to resolve performance failures of an organisation. Organisational culture is one of the factors affecting how employees of an organisation treat customers. Organisations need to focus on promoting the culture of customer orientation to promote customer-oriented behaviours. Promotion and communication of the positive outcomes of customer orientation and recall of organisational values can help organisations institutionalise the culture of customer orientation (Benedetto and Thompson, 2013). For successful customer orientation, organisations should ensure that their employees deeply believe in the importance of customer satisfaction in their survival. It is hence necessary to promote such a belief as an organisational value throughout all organisational subcultures (Williams, 2002).

In the model derived from the fuzzy DEMATEL technique, the most effective relationships were found among the senior management support (C1) and good organisational communication and collaborations (C3) (0.478) and also between the senior management support (C1) and cultural changes in the organisation (0.475). The senior management support in implementing the service recovery system makes various organisational sectors more cohesive for realising this system and facilitates organisational collaborations and communication as well as the formation of necessary organisational culture through teamwork. Consequently, the organisation will obtain more favourable results for creating a system in compliance with customer needs. Good organisational communication and collaborations (C3) was significantly related with the CRM (C5) in this model (0.443). If there are good relations and collaborations among individuals in an organisation (especially in the hospitality industry with direct relations with customers), information on failure formation, customer features, and existing strategies for service recovery will be shared. This in turn increases the likelihood of consistency between the selected strategy and personality and cultural traits of customers leading to customer satisfaction. Organisations should pay special attention to the cultural characteristics of customers in order to prevent service failures and adopt the most appropriate service recovery strategies. Depending on the cultural characteristics of customers, organisations can apply a variety of strategies, from a simple apology to financial compensation, to realise service recovery.

The relationship of staff's job satisfaction (C4) and good organisational communication and collaborations (C3) were also significant (0.412); when employees are satisfied with their jobs, their commitment to the organisation increases. In this case, they make more efforts to preserve organisational reputation by reducing service failures and recovering services. Both eventually lead to customer satisfaction. As discussed previously, in addition to the senior management support, job satisfaction also paves the way for good organisational communication and collaborations. Thus, another requirement for a proper service recovery system is formed.

5.1 Applied recommendations

According to the results, it seems that a successful service recovery system is established based on human factors (senior management support, organisational communication and collaborations). This can be related to the simultaneous delivery and consumption of services as well as the direct contact of service providers with customers. To achieve maximum cooperation of staff, hotels are recommended to design the service recovery systems through teamwork in the presence of representatives of different sectors. Moreover, holding regular training courses might be helpful for acquainting staff with the necessity of the service recovery system and up-to-date strategies in this area. Furthermore, incentives for top staff in reducing service failures and providing service recovery will help formation of a proper organisational culture through introducing successful patterns. Given the importance of CRM in the service recovery system, hotel managers are recommended to establish a customer relationship team and manage it directly. The use of novel methods such as electronic CRM could make the organisation more efficient in this regard.

5.2 Limitations and recommendations for future research

Different social, cultural, and economic conditions were not analysed due to limitations in the research area. The questionnaires were completed with regard to present conditions. Since only five-star hotels were studied, the model presented in this paper should cautiously be used for other hotels. Considering different expectation levels and service failures in hotels, it is recommended to propose models in the future studies based on hotel ratings and various types of customers (*e.g.*, foreign tourists and domestic guests). To prevent the excessive complexity of the causal model proposed in this study, the most important requirements of a service recovery system were used as the input of DEMATEL and less important ones were eliminated. Future studies are recommended to employ Interpretive Structural Modelling (ISM) to first classify the identified requirements into different (managerial, cultural, etc.) levels, then examine the relationship between them, and, finally, develop a model for the requirements of a service recovery system.

References

Akhavan, P. and Jafari, M. (2006) 'Critical issues for knowledge management implementation at a national level', *Vine*, Vol. 36, No. 1, pp.52–66.

Anderson, J.C. and Gerbing, D.W. (1988) 'Structural equation modelling in practice: a review and recommended two-step approach', *Psychological Bulletin*, Vol. 103, No. 93, pp.411–423.

Andreassen, T.W. (2001) 'From disgust to delight: do customers hold a grudge?', *Journal of Service Research*, Vol. 4, No. 1, pp.39–49.

Barbara, R.L. and Pamela M. (2004) 'Service failure and recovery: evidence from the hotel industry', *International Journal of Contemporary Hospitality Management*, Vol. 6, No. 1, pp.6–17.

Benedetto, R. and Thompson, K. (2013) 'Creating an optimal culture: the emergence of the entangled organization', *Employment Relation Today*, Vol. 39, No. 14, pp.13–19.

Borah, S.B., Prakhya, S. and Sharma, A. (2020) 'Leveraging service recovery strategies to reduce customer churn in an emerging market', *Journal of the Academy of Marketing Science*, Vol. 48, No. 5, pp.848–868.

Bowen, D.E. and Johnston, R. (1999) 'Internal service recovery: developing a new construct', *International Journal of Service Industry Management*, Vol. 10, No. 2, pp.118–131.

Bruhn, M. and Georgi, D. (2006) *Services Marketing: Managing the Service Value Chain*, Pearson Education, London, UK.

Burger, P. (2004) *Critical Success Factors for Knowledge Management in Government Enterprises: A Case Study of Success at the Department of Commerce*, SYSTALEX E-Gov Knowledge Management Exhibition Booth 214, USA.

Büyüközkan, G. and Öztürkcan, D. (2010) 'An integrated analytic approach for Six Sigma project selection', *Expert Systems with Applications*, Vol. 37, No. 8, pp.5835–5847.

Cambra-Fierro, J., Melero-Polo, I. and Sese, J. (2015) 'Does the nature of the relationship really matter? An analysis of the roles of loyalty and involvement in service recovery processes', *Service Business*, Vol. 9, No. 2, pp.297–320.

Chang, H. and Hsiao, H, (2008) 'Examining the causal relationship among service recovery, perceived justice, perceived risk and customer value in the hotel industry', *The Service Industries Journal*, Vol. 28, No. 4, pp.513–528.

Chaparro-Peláez, J., Hernández-García, Á. and Urueña-López, A. (2015) 'The role of emotions and trust in service recovery in business-to-consumer electronic commerce', *Journal of Theoretical and Applied Electronic Commerce Research*, Vol. 10, No. 2, pp.77–90.

Craighead, C.W., Karwan, K.R. and Miller, J.L. (1999) 'Empirically-derived profiles of service failure encounters: implications for service recovery', *Proceedings of the Thirtieth Annual Meeting of the Decision Sciences Institute. New Orleans: Decision Sciences Institute*, pp.1343–1345.

Davenport, T. and Probst, G. J. (2002) *Knowledge Management Case Book: Best Practices*, Publicis Corporate Publishing and John Wiley & Son, Hoboken, New Jersey, USA.

Egbu, C.O. (2004) 'Managing knowledge and intellectual capital for improved organizational innovations in the construction industry: an examination of critical success factors', *Engineering, Construction and Architectural Management*, Vol. 11, No. 5, pp.301–315.

El-Helaly, N., Ebeid, A. and El-Menbawey, A. (2013) 'The impact of customer knowledge management process on service recovery performance', *European Conference on Intellectual Capital*, Academic Conferences International Limited, April, p.506.

Fatma, M., Khan, I. and Rahman, Z. (2016) 'The effect of CSR on consumer behavioral responses after service failure and recovery', *European Business Review*, Vol. 28, No. 5, pp.583–599.

Ford, R.C., Sturman, M.C. and Heaton, C.P. (2012) *Managing Quality Service in Hospitality: How Organizations Achieve Excellence in the Guest Experience*, Delmar, Cengage Learning, Clifton Park, New York.

Grégoire, Y. and Mattila, A. S. (2021) 'Service failure and recovery at the crossroads: recommendations to revitalize the field and its influence', *Journal of Service Research*, Vol. 24, No. 3, pp.323–328.

Halbheer, D., Gärtner, D.L., Gerstner, E. and Koenigsberg, O. (2018) 'Optimizing service failure and damage control', *International Journal of Research in Marketing*, Vol. 35, No. 1, pp.100–115.

Harrison, J. (2018) 'An examination of the nature of service recovery within the airline industry and its impact on customer loyalty', *Journal of Promotional Communications*, Vol. 6, No. 2, pp.148–160.

Harrison-Walker, L.J. (2019) 'The critical role of customer forgiveness in successful service recovery', *Journal of Business Research*, Vol. 95, No. 1, pp.376–391.

Honora, A., Chih, W.H. and Wang, K.Y. (2022) 'Managing social media recovery: the important role of service recovery transparency in retaining customers', *Journal of Retailing and Consumer Services*, Vol. 64, No.102814, p.102814.

Hsieh, T.Y., Lu, S.T. and Tzeng, G.H. (2004) 'Fuzzy MCDM approach for planning and design tenders selection in public office buildings', *International Journal of Project Management*, Vol. 22, No. 7, pp.573–584.

Johnston, R. and Michel, S. (2008) 'Three outcomes of service recovery', *International Journal of Operations & Production Management*, Vol. 28, No. 1, pp.79–99.

Jung, N.Y. and Seock, Y. K. (2017) 'Effect of service recovery on customers' perceived justice, satisfaction, and word-of-mouth intentions on online shopping websites', *Journal of Retailing and Consumer Services*, Vol. 37, No. 1, pp.23–30.

Koc, E. (Ed.) (2017) *Service Failures and Recovery in Tourism and Hospitality: A Practical Manual*, CABI, Oxford, UK.

Koc, E., Ulukoy, M., Kilic, R., Yumusak, S. and Bahar, R. (2017) 'The influence of customer participation on service failure perceptions', *Total Quality Management & Business Excellence*, Vol. 28, No. 3, pp.390–404.

Krishna, A., Dangayach, G.S. and Jain, R. (2011) 'Service recovery: literature review and research issues', *Journal of Service Science Research*, Vol. 3, No. 1, p.71.

Kumar, M. and Kumar, N. (2016) 'Three dimentions of service recovery: examining relationship and impact', *Supply Chain Management: An International Journal*, Vol. 21, No. 2, pp.273–286.

Lee, M.J., Singh, N. and Chan, E.S. (2011) 'Service failures and recovery actions in the hotel industry: a text-mining approach', *Journal of Vacation Marketing*, Vol. 17, No. 3, pp.197–207.

Leibowitz, J. (1999) 'Key ingredients to the success of an organization's knowledge management strategy', *Knowledge and Process Management*, Vol. 6, No. 1, pp.37–40.

Li, C.Y. and Fang, Y.H. (2016) 'How online service recovery approaches bolster recovery performance? A multi-level perspective', *Service Business*, Vol. 10, No. 1, pp.179–200.

Liu, H.C., Chen, Y.Z., You, J.X. and Li, H. (2016) 'Risk evaluation in failure mode and effects analysis using fuzzy digraph and matrix approach', *Journal of Intelligent Manufacturing*, Vol. 27, No. 4, pp.805–816.

Miller, J.L., Craighead, C.W. and Karwan, K.R. (2000) 'Service recovery: a framework and empirical investigation', *Journal of Operations Management*, Vol. 18, No. 4, pp.387–400.

Moffett, S., McAdam, R. and Parkinson, S. (2003) 'An empirical analysis of knowledge management applications', *Journal of Knowledge Management*, Vol. 7, No. 3, pp.6–26.

Mohanty, R.P., Agarwal, R., Choudhury, A.K. and Tiwari, M.K. (2005) 'A fuzzy ANP-based approach to R&D project selection: a case study', *International Journal of Production Research*, Vol. 43, No. 24, pp.5199–5216.

Mount, D.J. (2012) 'Putting the dollar signs on quality: The benefits of service recovery in the hotel industry', *Journal of Quality Assurance in Hospitality & Tourism*, Vol. 13, No. 2, pp.152–163

Nazifi, A., Gelbrich, K., Grégoire, Y., Koch, S., El-Manstrly, D. and Wirtz, J. (2021) 'Proactive handling of flight overbooking: How to reduce negative eWOM and the costs of bumping customers', *Journal of Service Research*, Vol. 24, No. 2, pp.206–225.

Odoom, R., Agbemabiese, G.C. and Hinson, R. E. (2019) 'Service recovery satisfaction in offline and online experiences', *Marketing Intelligence & Planning*, Vol. 38, No. 1, pp.1–14.

Ozuem, W., Patel, A., Howell, K.E. and Lancaster, G. (2017) 'An exploration of consumers' response to online service recovery initiatives', *International Journal of Market Research*, Vol. 59, No. 1, pp.97–115.

Robinson Jr., L., Neeley, S.E. and Williamson, K. (2011) 'Implementing service recovery through customer relationship management: identifying the antecedents', *Journal of Services Marketing*, Vol. 25, No. 2, pp.90–100.

Rod, M., Ashill, N.J. and Carruthers, J. (2008) 'The relationship between job demand stressors, service recovery performance and job outcomes in a state-owned enterprise', *Journal of Retailing and Consumer Services*, Vol. 15, No. 1, pp.22–31.

Rosenmayer, A., McQuilken, L., Robertson, N. and Ogden, S. (2018) 'Omni-channel service failures and recoveries: refined typologies using Facebook complaints', *Journal of Services Marketing*, Vol. 32, No. 3, pp.269–285.

Salagrama, R., Prashar, S. and Sai Vijay, T. (2021) 'Do customers exhibit gratitude after service recovery? Understanding the moderating role of relationship type', *Service Business*, Vol. 15, No. 4, pp.757–779.

Smith, J.S., Fox, G.L. and Ramirez, E. (2010) 'An integrated perspective of service recovery: a sociotechnical systems approach', *Journal of Service Research*, Vol. 13, No. 4, pp.439–452.

Surachartkumtonkun, J., McColl-Kennedy, J.R. and Patterson, P.G. (2015) 'Unpacking customer rage elicitation: a dynamic model', *Journal of Service Research*, Vol. 18, No. 2, pp.177–192.

Stauss, B. and Friege, C. (1999) 'Regaining service customers: costs and benefits of regain management', *Journal of Service Research*, Vol. 1, No. 4, pp.347–361.

Tax, S.S. and Brown, S.W. (2000) 'Service recovery', in *Handbook of Services Marketing and Management*, Vol. 43, No. 2, pp.273–275.

Tobin, T. (2003) *Ten Principles for Knowledge Management Success*, Gartner Inc., Stamford, CT.

Tronvoll, B. and Edvardsson, B. (2019) 'Exploring customers' experiences of service co-recovery', *Service Science*, Vol. 11, No. 3, pp.189–200.

Vázquez-Casielles, R., Iglesias, V. and Varela-Neira, C. (2017) 'Co-creation and service recovery process communication: effects on satisfaction, repurchase intentions, and word of mouth', *Service Business*, Vol. 11, No. 2, pp.321–343.

Williams, S. (2002) 'Strategic planning and organizational values: links to alignment', *Human Resource Development International*, Vol. 5, No. 2, pp.217–233.

Wilson, T.D. (2002) 'The nonsense of knowledge management', *Information Research*, Vol. 8, No. 1, pp.8–1.

Wong, K.Y. (2005) 'Critical success factors for implementing knowledge management in small and medium enterprises', *Industrial Management & Data Systems*, Vol. 105, No. 3, pp.261–79.

Wu, W.Y., Qomariyah, A., Sa, N.T.T. and Liao, Y. (2018) 'The integration between service value and service recovery in the hospitality industry: an application of QFD and ANP', *International Journal of Hospitality Management*, Vol. 75, No. 8, pp.48–57.

Yeh, T.M. and Huang, Y.L. (2014) 'Factors in determining wind farm location: Integrating GQM, fuzzy DEMATEL, and ANP', *Renewable Energy*, Vol. 66, No. 6, pp.159–169.

Yüksel, İ. and Dağdeviren, M. (2010) 'Using the fuzzy analytic network process (ANP) for balanced scorecard (BSC): a case study for a manufacturing firm, *Expert Systems with Applications*, Vol. 37, No. 2, pp.1270–1278.

Zehir, C. and Narcıkara, E. (2016) 'E-service quality and e-recovery service quality: effects on value perceptions and loyalty intentions', *Procedia-Social and Behavioral Sciences*, Vol. 229, No. 13, pp.427–443.

Zemke, R. and Bell, C. (1990) 'Service recovery: doing it right the second time', *Training*, June, Vol. 27, No. 6, pp.42–8.

Zhang, D., Yu, C., Desai, J. and Lau, H.H. (2016) 'A math-heuristic algorithm for the integrated air service recovery', *Transportation Research Part B: Methodological*, Vol. 84, No. 2, pp.211–236.