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# Evaluating Lean Service Principles in Restaurants: A Data-Driven Approach with Fuzzy Logic

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ABSTRACT

Customers' perceptions of a restaurant and their overall satisfaction level can be significantly improved by investing in and improving its physical environment. Applying Lean Service Principles in restaurants enables the identification of areas for enhancement and proposes solutions to achieve exceptional outcomes efficiently, using minimal time and resources. Restaurant management needs more information about customers' preferences to overcome existing weaknesses. The research aims to improve a restaurant's service quality using fuzzy logic by examining the data attributes provided within a service quality leanness assessment. Ten physical environment data attributes were collected from data attributes within a leanness assessment of quality service for use in this study. Recognizing the weaker attributes would assist restaurant management in improving the physical environment of their restaurant so that they could capture more customers in the future and positively impact loyal customers. The result shows three attributes with the lowest ranking scores: the visually appealing dining area, the restaurant's décor typical of its image and price range and the easily readable menu. The study revealed that parking lots with visually appealing features and well-functioning parking management systems obtained a maximum score. In response, the restaurant must take the appropriate actions to improve them. Based on the findings of this study, evaluating a restaurant's physical attributes may enhance customer happiness. The restaurant management would only be able to resolve the current challenges faced by their company with access to the findings of this survey, as they would need an in-depth knowledge of their consumers' preferences.

## 1. INTRODUCTION

Customer service, as well as constant quality development are top priorities in the restaurant business. Customers are exploring new tastes, enjoying a relaxing environment, and making exciting moments because of changes lifestyle (Balasubramanian & Suresh, 2022). Customers choose to enjoy a meal at a restaurant not only because of nutrient requirements, but instead to structure special moments, to be with someone and get away from the stress and the habit of living (Tuzunkan & Albayrak, 2016). To stand out in a competitive marketplace, restaurant owners should gain customers' interest and support. Food type

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and quality, as well as the restaurant's public identity, environment, and vibe, are important factors in customers' restaurant decisions (Lee et al., 2022).

However, the physical surroundings of a restaurant will be the first thing customers notice when they walk in, and it is an important factor for them (Tuzunkan & Albayrak, 2016). A restaurant's physical environment could enhance a restaurant's reputation, restructure customers' perspectives, and directly impact customer satisfaction (Jang & Lee, 2020). According to Hanaysha (2016), all tangible and intangible components, inside and outside the restaurant, have been included in the physical environment, including temperature, lighting, scent, noise, environment, and music. The writer also mentioned that a well-kept physical environment could help a restaurant retain current customers while also attracting new ones. Furthermore, ambient factors such as noise, smell, taste, and touch, as well as design features such as restaurant decoration and setup, can significantly impact customer behaviour (Jang & Lee, 2020).

The restaurants' management teams must put money into interior designs, including interior decoration, floor cleanliness and other equipment, since these expenditures are the most crucial investments to win over customers. Customers will more likely return to a restaurant with a well-maintained physical environment (Hanaysha, 2016). The physical environment not only retains the restaurant's current customers, but also serves as an important aspect of attracting new customers. Many consumers value a pleasant and unique restaurant surrounding above the meal and service. Consumers demand something more than food; they would like a unique dining experience dissimilar from what they already have at home (Canny, 2013).

The lean assessment can identify areas where a restaurant can improve and provides a sequence and method for doing so to achieve the best results in the shortest amount of time with the fewest resources. In addition, Leanness can be used as a decision-making tool to determine the current state of lean adoption, its effects on the business's performance, and the extent of upcoming changes. As an outcome, the assessment emphasizes progress, increases management focus, and fosters a desire for high marks throughout the business (Mathew Alexander & Saleeshya, 2022).

This study aims to examine the characteristics of the physical setting at a restaurant and its impact on customer satisfaction to attract a more extensive client base. This study ascertains how physical factors impact customers' decision-making while choosing eateries. In addition, this study examines the variables that influence customers' decision-making process in selecting restaurants for dining. This investigation addresses a critical knowledge gap: understanding customer preferences is crucial for restaurant management to identify and fix existing shortcomings. Tuzunkan and Albayrak (2016) emphasized the importance of identifying the specific characteristics of a restaurant's physical environment that are more desirable than others. The physical environment can enhance or suppress consumers' emotions, influencing their satisfaction and subsequent behaviours. Neglecting client feedback is a grave error that business management has committed. The potential outcomes of this could have irrevocable consequences in some instances, such as financial loss and harm to one's reputation (Tuzunkan & Albayrak, 2016).

In contrast to conventional logic, which operates on unambiguous facts and falsehoods, fuzzy logic is a mathematical framework that handles subjective or imperfect data. It allows for complex concept representations by assigning membership degrees to categories. Fuzzy logic can address the inherent subjectivity and individual interpretations associated with capturing consumer impressions of service components such as "friendly," "efficient," or "clean." To obtain more precise feedback regarding the friendliness of the staff, it is recommended to employ a scale that ranges from "not friendly at all" to "somewhat friendly" to "very friendly." By assigning membership functions, such as a value of 0 for "not friendly" and 1 for "very friendly," respondents can provide measurable comments. Through fuzzy logic, this study aims to improve restaurant service quality. An examination of the data attributes of the physical components that contribute to the service quality of the restaurant is proposed as a means of accomplishing this goal as part of an evaluation of the restaurant's leanness.

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## 2. LITERATURE REVIEW

### 2.1 Fuzzy Sets

The foundation of classical set theory lies in the notion of a "set," which indicates an entity that an individual either belongs to or does not belong to. By this theory, a distinct boundary defines whether an entity is a member or a nonmember of a well-defined "set" of entities. The difference between the two is sharp, crisp, and unambiguous. Alternatively stated when the inquiry arises, "Does this entity belong to that set?" There are two possible responses: "yes" or "no." This holds true under both random and predictable conditions.

In probability and statistics, the question is about the probability of an entity belonging to a specific set. Despite a 90% chance, the entity is either a member or not a member of the set. The probability of accurately predicting an item belonging to a set is 90%. However, this does not imply that it has 90% membership and 10% non-membership (Chen & Pham., 2000). More precisely, within the framework of classical set theory, it is impermissible for an element to exist in two sets concurrently. Consequently, the classical set theory must be revised to describe and address many real-world problems, such as involving elements that possess only partial membership in each set. Conversely, fuzzy set theory extends the concepts of classical set theory and allows for incomplete memberships.

### 2.2 Fuzzy Logic

The inventor of fuzzy logic is Lotfi Zadeh. He produced significant contributions to the field of fuzzy logic. Fuzzy logic is not a stand-alone knowledge system. Fuzzy logic can be applied in various ways to deal with ambiguous and uncertain situations (Alekhya et al., 2022). When specific information referred to as reluctance that has not been classified as favourable or unfavourable prevents doubts from being addressed, intuitionistic fuzzy logic can identify such uncertainty (Sharma et al., 2021).

Fuzzy logic is a knowledge-based modelling method that uses linguistic variables provided by human operators or professional knowledge as model variables instead of discrete numerical variables with progressive (fuzzy) limitations. It mimics the human mind by modelling an analytical decision-making process. This strategy addresses data imprecision using an understandable rule-based structure and inference approaches. It offers the capacity to deal organically with the vagueness of data (qualitative and linguistic data input). Employing IF-THEN rules, the fuzzy inference approach enables an integrative result drawn from imprecise inputs. As a result, fuzzy logic offers the ability to deal efficiently with data derived from qualitative instead of quantitative data, insufficient databases, or inaccurate information. This skill is based on the integration of slow changes in environmental factors, which enables a particular numerical (crisp) value to be assigned to more than one linguistic (fuzzy) component category at different levels (Ouellet et al., 2021).

### 2.3 Leanness Assessment

Leanness assessment, also known as lean quantification, can be interpreted as estimating the level of poor achievement qualitatively, quantitatively, or both. Leanness assessment metrics have some essential qualities that are measurable and consistent with the organization's strategic goals and customer values. It also additionally allows control and assessment of performance, provides valuable resources within the expertise of the modern-day situation, and assists in figuring out possibilities for improvement. Finally, it is updated and realistic. Repetitive assessment of leanness will become essential, as it might help assess the contribution of lean practices carried out by using the organization to enhance its operational and financial performance. Initially, leanness assessment was characterized by using ambiguity and multi-possibility, expressed in linguistic terms (Yap & Ng, 2018).

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Leanness efficiently reduces waste and various non-value-added operations to raise quality, boost output, and cut costs. It primarily focuses on fewer inputs and their expenses to generate higher production and the associated increase in customer satisfaction. Leanness is a term used to describe how becoming lean affects business goals (Tekez & Taşdeviren, 2016). Leanness assessments were required since they help determine the present status, monitor the overall effectiveness of the business, and identify weak spots (Kumar et al., 2019). In addition, customers' psychology is influenced by the layout accessibility, facility aesthetics, seating comfort, electronic equipment, hygiene, and social characteristics of a facility (Horng et al., 2013).

## 2.4 Previous Studies

Kilic et al. (2021) published research published a technique for systematically monitoring leanness from managerial and application viewpoints and highlighting improvement opportunities across businesses on their path. It evaluates leanness using a neutrosophic DEMATEL (The Decision-Making Trial and Evaluation Laboratory) based scoring structure and a large variety of lean criteria with a wholly prepared questionnaire. The approach can be used to evaluate the leanness of production systems, and then it can be used as a starting phase and a guideline for businesses that want to change into lean businesses. Mathew Alexander and Saleeshya (2022) suggest significantly comparing performance characteristics while selecting numerous solutions in lean production. The research focused on Multi-Criteria Decision Making (MCDM) tools. The five MCDM methods, AHP, ANP, TOPSIS, VIKOR, and Fuzzy Logic and their combinations (ensemble methods) are thoroughly analysed. The approach utilized demonstrates that MCDM is well suited to lean manufacturing. Most lean manufacturing operations rely on traditional approaches, with a clear preference for uncertainty principles, like fuzzy logic.

Lupo and Bellomo (2019) suggested measuring service quality in the restaurant surroundings concerning the University of Palermo's three significant restaurants. The research used a new multi-criteria decision-analysis (MCDA) approach that merged the DINESERV model with the hierarchical TOPSIS method (Technique for Order of Preference by Similarity to Ideal Solution). The DINESERV model is a tool for measuring service quality in restaurants. In more context, hierarchical TOPSIS is used to make comparisons of the quality of restaurant services based on the DINESERV theoretical framework of restaurant service quality. The results suggest that the technique is applicable and that using it enables the identification of both best practices and flaws in given services that need to be fixed.

## 2.5 Applications of Fuzzy Logic in Service Quality Assessment

Measuring and evaluating leanness in manufacturing, customer service, and other areas can be difficult due to subjective and qualitative factors. Traditional approaches frequently require assistance to capture these details effectively, resulting in limitations in their usefulness. One possible approach to overcoming this obstacle is fuzzy logic. Fuzzy logic allows us to put intangible, subjective criteria like "high quality" or "fast service" into a quantitative form by representing and processing imprecise information. This offers a more accurate and flexible approach to assessing leanness.

Vinodh and Balaji (2011) applied a fuzzy logic framework for leanness assessment in their study. Their framework utilises fuzzy sets to incorporate subjective factors, allowing for a more comprehensive evaluation. To facilitate this procedure, they developed a computer-aided decision support system called FLBLA-DSS (decision support system for fuzzy logic-based leanness assessment). FLBLA-DSS has many advantages over older approaches. Automating calculations and simplifying assessment improves objectivity and usability. Its capacity to handle subjective data makes leanness assessment more realistic. Vinodh and Balaji (2011) show that fuzzy logic can overcome the shortcomings of standard leanness assessment methods. FLBLA-DSS is a valuable instrument for assessing manufacturing leanness more accurately and efficiently.

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An additional investigation relating to the implementation of fuzzy logic in service quality evaluation is the multi-grade fuzzy (MGF) analysis, which Balasubramanian and Suresh (2022) employed to develop a procedure for assessing restaurant service quality. Their study aimed to determine the restaurant's current service quality level and identify areas for improvement. This study links the requirement for fuzzy logic with selecting service quality factors. The research results discovered that the restaurant's weaker factors are service workers who should indeed review the customer needs, comfy seats in the restaurant, clients' needs to be appreciated by the service workers, accurate pricing, receiving feedback from customers on the expertise, and maintaining speed and service quality throughout busy periods.

### 2.6 Conclusion

This literature research was conducted to investigate the concept of fuzzy logic and its potential application in evaluating the quality of service offered by restaurants, with the focus on the attributes of the physical environment in leanness assessment. Additionally, the findings of this study demonstrated that physical enablers influence consumers' selection of restaurants. This is accomplished by evaluating concepts from lean service in restaurants using a fuzzy logic method.

## 3. RESEARCH METHODOLOGY

This study implements fuzzy logic to improve restaurant service quality by analysing data attributes derived from a leanness assessment. This study utilised ten physical environment data attributes from a leanness assessment of quality services. Comprehending the influence that subjective consumer perceptions of the physical environment of a restaurant have on satisfaction and decision-making requires fuzzy logic. Below is a methodological step in the application of fuzzy logic:

(i) Applying Fuzzy Logic in the study: Identify the attributes (as specified in Table 1)

(ii) Define linguistic terms: Substitute the terms "good" or "bad" with more specific descriptors such as "very attractive," "somewhat appealing," and so on.

(iii) Generate membership functions: Allocate numerical values ranging from 0 to 1 to each linguistic phrase, indicating the membership level. For example, a value of 0.8 may be described as "highly attractive", whereas a value of 0.4 could be considered "moderately".

(iv) Collect consumer feedback: Customers are given a survey where they rate each attribute using linguistic terms.

(v) Transform feedback into fuzzy values.

(vi) Analyse results: Evaluate the fuzzy scores to determine the influence of perceived strengths and weaknesses on customer satisfaction and decision-making.

Within the context of a leanness assessment of service quality to customer happiness, this study focuses on the attributes of the physical environment of a restaurant. This study uses the criteria for the restaurant's exterior and interior presented in the research article by Balasubramanian and Suresh (2022). The restaurant's exterior features include effective parking management systems and visually appealing parking lots. A restaurant's interior includes visually appealing building exteriors, a visually appealing dining area, clean, orderly, and appropriately attired staff, décor appropriate for the restaurant's image and price range, an easy-to-read menu, and a visually appealing menu, a pleasant dining area, and clean restrooms. Table 1 shows the attributes used in this study.

Table 1. Conceptual model for service quality assessment in restaurants

| Enabler | Criteria | Attributes |
|---|---|---|

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| | | |
|---|---|---|
| Tangible | Restaurant Exterior (*RE*) | Visually attractive parking area (*RE1*)<br>Efficient parking management systems (*RE2*) |
| | Restaurant Interior (*RI*) | Visually attractive building exteriors (*RI1*)<br>Visually attractive dining area (*RI2*)<br>Clean, neat, and appropriately dressed staff (*RI3*)<br>Restaurant's décor typical to its image and price range (*RI4*)<br>Easily readable menu (*RI5*)<br>Visually attractive menu (*RI6*)<br>Comfortable dining area (*RI7*)<br>Clean rest rooms (*RI8*) |

Source: Balasubramanian and Suresh (2022)

Table 2. Linguistic variables and fuzzy numbers for rating and weights

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

Source: Lin et al. (2006)

Linguistic terms are allocated to each attribute to quantify the leanness attribute's performance ratings and importance weights. The subsequent methodology was utilised to ascertain the principal obstacles to leanness attributes. The fuzzy numbers and linguistic variables used in the importance weights and performance rating are presented in Table 2 was used to determine the main obstacles to leanness attributes. The notations used to incorporate the fuzzy logic model are displayed in Table 3.

Table 3. Fuzzy logic assessment model notations

| **Indices** | **Abbreviations** |
|---|---|
| W | Importance weightage |
| R | Performance rating |
| FPII | Fuzzy Performance Importance Index |
| W' | Complement of importance weight |
| RE | Restaurant Exterior attributes |
| RI | Restaurant Interior attributes |

## 4. FINDING AND DISCUSSION

The performance ratings and significant weighting for each service quality criterion of the restaurant's leanness assessment are presented in Table 4. The respondents for the data collection were chosen based on the number of them coming to the selected restaurant. Customers (R1,..., R5) who had visited the

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restaurant for the first time were asked to score the performance rating of the restaurant's physical environment within the context of a leanness assessment of service quality. To give weightage to the physical environment features, another client (W1,..., W5) who has visited the restaurant multiple times will assist. The table was constructed using the questionnaire responses to make decisions. The questionnaire uses a strategy to answer selections based on linguistic variables.

Table 4. Importance weightages and performance ratings of attributes rated by decision-makers

| Attributes | Attributes weightage | | | | | Attributes rating | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | W1 | W2 | W3 | W4 | W5 | R1 | R2 | R3 | R4 | R5 |
| RE1 | M | M | VH | H | H | F | G | G | VG | F |
| RE2 | MH | M | VH | MH | H | G | G | G | VG | F |
| RI1 | VH | EH | EH | H | EH | VG | VG | E | VG | G |
| RI2 | VH | EH | EH | EH | EH | VG | VG | E | VG | G |
| RI3 | VH | H | EH | VH | EH | VG | VG | G | G | G |
| RI4 | VH | EH | EH | VH | EH | VG | VG | G | VG | G |
| RI5 | EH | EH | EH | EH | EH | VG | VG | VG | VG | G |
| RI6 | EH | MH | EH | EH | EH | G | VG | G | G | G |
| RI7 | VH | EH | EH | H | EH | VG | G | E | F | G |
| RI8 | H | EH | H | VH | VH | VG | G | E | G | G |

A median operation was performed to integrate the viewpoints of the experts, and the results of this procedure are provided in Table 5. A spectrum of fuzzy indices for each leanness trait is provided by the data that is shown in Table 2. Using Table 2, all the linguistic factors that are shown in Table 5 are converted into fuzzy numbers. Table 6 displays the fuzzy number representations of factors related to linguistic variables.

Table 5. Importance weightages and performance ratings of physical attributes

| Leanness attributes | W | R |
|---|---|---|
| RE1 | MH | G |
| RE2 | MH | G |
| RI1 | VH | VG |
| RI2 | EH | VG |
| RI3 | VH | G |
| RI4 | EH | VG |
| RI5 | EH | VG |
| RI6 | VH | G |
| RI7 | VH | G |
| RI8 | VH | VG |

Table 6. Linguistic terms approximated by fuzzy numbers

| Leanness attributes | W | R |
|---|---|---|
| RE1 | (0.3, 0.5, 0.7) | (5, 6.5, 8) |
| RE2 | (0.3, 0.5, 0.7) | (5, 6.5, 8) |
| RI1 | (0.7, 0.8, 0.9) | (7, 8, 9) |

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| | | |
|---|---|---|
| RI2 | (0.85, 0.95, 1.0) | (7, 8, 9) |
| RI3 | (0.7, 0.8, 0.9) | (5, 6.5, 8) |
| RI4 | (0.85, 0.95, 1.0) | (7, 8, 9) |
| RI5 | (0.85, 0.95, 1.0) | (7, 8, 9) |
| RI6 | (0.7, 0.8, 0.9) | (5, 6.5, 8) |
| RI7 | (0.7, 0.8, 0.9) | (5, 6.5, 8) |
| RI8 | (0.7, 0.8, 0.9) | (7, 8, 9) |

The Fuzzy Performance Importance Index (FPII) is used in this work to help identify and analyse obstacles. FPIIs are indicators that assess the relative importance of different factors or criteria in a fuzzy decision-making or evaluation process. The following demonstrates how to calculate the FPII by integrating performance ratings and necessary weights of data categories in a lean service quality assessment. FPII can be expressed using Eq. (1).

$$FPII = W' \times R \tag{1}$$

The value of W' shows the important weight complement of the attribute, while the value of R represents the performance rating of the attribute. The expression that is provided is given below:

$$W' = [(1, 1, 1) - W] \tag{2}$$

where W is the importance weight of the attribute for the given expression. An FPII contributes to the leanness of a restaurant to a greater extent than it would otherwise. A display of the FPII results and computations may be found in Table 7.

Table 7. Excerpt of fuzzy performance importance index (FPII)

| **Attributes** | **R** | **W'** | **FPII** |
|---|---|---|---|
| RE1 | (5, 6.5, 8) | (0.3, 0.5, 0.7) | (1.5, 3.25, 5.6) |
| RE2 | (5, 6.5, 8) | (0.3, 0.5, 0.7) | (1.5, 3.25, 5.6) |
| RI1 | (7, 8, 9) | (0.1, 0.2, 0.3) | (0.7, 1.6, 2.7) |
| RI2 | (7, 8, 9) | (0, 0.05, 0.15) | (0, 0.4, 1.35) |
| RI3 | (5, 6.5, 8) | (0.1, 0.2, 0.3) | (0.5, 1.3, 2.4) |
| RI4 | (7, 8, 9) | (0, 0.05, 0.15) | (0, 0.4, 1.35) |
| RI5 | (7, 8, 9) | (0, 0.05, 0.15) | (0, 0.4, 1.35) |
| RI6 | (5, 6.5, 8) | (0.1, 0.2, 0.3) | (0.5, 1.3, 2.4) |
| RI7 | (5, 6.5, 8) | (0.1, 0.2, 0.3) | (0.5, 1.3, 2.4) |
| RI8 | (7, 8, 9) | (0.1, 0.2, 0.3) | (0.7, 1.6, 2.7) |

The ranking of fuzzy numbers is determined using the centroid technique, which considers the membership function (a, b, c) where a, b, and c represent the lowest, middle, and upper values of triangle fuzzy numbers. To determine the rank, use Eq. (3).

$$\text{Ranking score} = \frac{a + 4b + c}{6} \tag{3}$$

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Table 8. Ranking score for leanness attributes

| Attributes | Ranking score |
|---|---|
| RE1 | 3.35 |
| RE2 | 3.35 |
| RI1 | 1.63 |
| RI2 | 0.49 |
| RI3 | 1.35 |
| RI4 | 0.49 |
| RI5 | 0.49 |
| RI6 | 1.35 |
| RI7 | 1.35 |
| RI8 | 1.63 |

The values of a, b, and c are derived from the information presented in Table 6. As previously stated, the rank is determined by using Eq. (3). For illustrative purposes, the ranking score for the initial attribute is computed. Similarly, the ranking score for other attributes are calculated and presented in Table 8.

$$\text{Ranking score} = \frac{1.5 + 4(3.25) + 5.6}{6} = 3.35$$

Based on the findings in Table 8, it was determined that three attributes, each with a ranking score of 0.49, are the least favourable. As a result, the restaurant must make the required efforts to improve these attributes. The following is a list of the three characteristics:

(i) A visually attractive eating space (RI2)

(ii) A restaurant's décor representative of its image and price range (RI4)

(iii) An easily accessible menu (RI5)

According to the ranking, the two features with the highest-ranking score, 3.35, were effective parking management systems (RE2) and visually attractive parking lots (RE1).

Due to the industry's intense competition, a visually appealing dining area (RI2) is one of the weak attributes. The restaurant may add unique and eye-catching dining places to attract customers and provide the best dining experience. The restaurant may also distinguish itself from its rivals by decorating consistently with its brand and pricing range (RI4). The restaurant may then develop a style that reflects its image and pricing range. This restaurant needs a simple-to-read menu (RI5) with excellent, gorgeous, and well-taken cuisine photos.

This work employs a mathematical modelling technique to develop an assessment system using fuzzy logic, likely by using existing data on service attributes and performance. This study differs from Fan-Yun Pai's research (Pai et al., 2018), which utilised a survey-based technique together with established frameworks such as the Kano model and IPA (Importance-Performance Analysis) to categorise service elements and evaluate customer input. In "Classifying Restaurant Service Quality Attributes by Using Kano Model and IPA Approach," Fan-Yun Pai finds chain restaurant service attributes. The study groups service quality indicators by consumer responses using the Kano model, while IPA evaluates service quality from the customer's perspective. The study evaluates chain restaurant

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services using both methods. Fan-Yun Pai's service qualities were classified based on their impact on customer pleasure to highlight improvement actions in the findings (Pai et al., 2018).

A system that is capable of evaluating the quality of services was developed as a consequence of the research that we conducted. The utilization of fuzzy logic, which is a more advanced method than the approaches that were employed in the past, was utilized in the development of this system.

## 5. CONCLUSION

This research demonstrates that evaluating a restaurant's physical qualities might help increase customer satisfaction. Without the findings of this study, restaurant managers would be unable to address their company's current challenges since they would not understand what their customers want. The primary purpose of this research is to improve the service quality given by a restaurant that employs fuzzy logic by analysing the data characteristics discovered in a leanness evaluation of service quality. Another research goal is to apply fuzzy logic to find data elements of the physical environment inside the leanness evaluation that may impact consumers' restaurant decisions.

To summarise, the restaurant sector prioritises offering outstanding customer service and continuous quality improvement. Success in the restaurant industry requires owners to engage with customers actively. Diners would gaze around the restaurant before ordering meals to understand the ambience. The décor of a restaurant may dramatically impact customers' perceptions, experiences, and overall happiness. The lean evaluation may help a restaurant discover areas for development while providing a strategy and sequence for attaining the most significant outcomes in the shortest period with the fewest resources.

Based on the study's findings, it is strongly advised that future research explores fuzzy logic to enhance restaurant services by analysing data attributes related to service quality. Other methods, such as Fuzzy Multi-Criteria Decision-Making (MCDM), Fuzzy Conjoint Analysis, and Fuzzy Analytic Hierarchy Process (AHP), should be considered for further investigation. In addition, future studies can utilise the fuzzy logic methodology to address a distinct problem, although one that is still related to customer services. In addition to the physical environment, various other lean service principles can be employed to assess a restaurant's performance, including Value Stream Mapping, Just-in-Time (JIT) Inventory, and the Kanban System.

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## 7. CONFLICT OF INTEREST STATEMENT

The authors acknowledge that the data for this study was collected from a single restaurant, and at the time of publication, all authors declared no competing interests.

## 8. AUTHORS' CONTRIBUTIONS

**Suzanawati Abu Hasan**, **Teoh Yeong Kin** and **Marini Mohd Thaib** devised the research concept and designed the technique. **Afiza Syazwani Mohd Razali** and **Diana Sirmayunie Mohd Nasir** collected

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and assessed the data, respectively. The results were analysed, and **Suzanawati Abu Hasan** wrote the manuscript. The final version was reviewed and authorised for submission by all authors.

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