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Providing a Hybrid Fuzzy Approach to Explain Managers' Mental Paradigms to Prioritize Employee Needs

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Abstract

Today, most manufacturing and service companies adopt a customer-oriented approach to take into account employee needs and expectations as a strategic principle for sustainability and success in a competitive market. Meanwhile, Sengeh argues that "many of the best ideas and strategies will not be realized due to the conflict between new ideas and managers' subjective model, rather than the management weakness". On the other hand, managers' decisions based on self-developed rules can suffer all kinds of biases. As Bierzman explains: "managers' mental heuristic rules lead to weak analysis of information, inappropriate weighting of the various data, and an investigation of few alternatives for decision-making, which can lead to systematic errors and common biases in the decision". Addressing the existing gap between managers' subjective perceptions of employees and employees' self-perceptions, the present study aims to present a new systematic approach with a combination of Delphi, Kano and AHP methods in an attempt to explain managers' mental paradigms in Abadan Oil Refinary Company as one of the elading ones in the Middle East. The statistical population of the study consists of 18 experienced managers (using snowball method) and 203 employees at Abadan's Oil Refinery (using the Cochran formula). The validity and reliability of the questionnaire were also confirmed using Kendall's Correlation Coefficient, Cronbach's Alpha coefficient, and Gogus and Butcher's Incompatibility Rate. First, needs were determined from the views of the experts using the Fuzzy Delphi method, and then, Kano's non-linear model and Alpha-cut (α-Cut) method were used to classify 21 components as basic, performance, and excitement needs. In the end, the needs have been ranked using the Fuzzy AHP method. The results indicated that the proposed method was effectively successful in reducing biases, vagueness, and possible inconsistencies in managers' decisions and judgments. Overall, the method presented insights on the significance of future strategic decisions to achieve sustainable competitive advantages and to increase employee satisfaction while categorizing the needs optimally as confirmed and welcomed by decision-making experts.

Keywords: Employee needs and expectations, Fuzzy Kano model, Fuzzy AHP, Managers' mental paradigms.

1 | Introduction

Today, successful and customer-oriented organizations view their employees as the main intra-organizational customers and strong tools to promote their macro-level management and organizational objectives, thus regulating their plans based on their employees' needs and preferences. Moreover, such organizations constantly seek to provide high-quality services to the customers [1]. Paying attention and giving importance to the needs and expectations of the customers will create in them a sense of attachment to the organization, causing them to not only feel satisfied with the organization but also to consider themselves as part of it [2]. In the past, considering the limited competition and advantages of supplying products and services, employees and external customers had low bargaining power as they were forced to comply with whatever the supplier made available. However, today, most companies and organizations, cognizant of their customers' and

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employees' knowledge, seek to diversify their needs and expectations. In the meantime, given the competitive business environment for achieving a bigger portion of the market, companies have been increasingly focusing on determining and understanding the needs and mental preferences of their customers and increasing their satisfaction levels [3].

Because in the past, there was a uni-dimensional view of customer satisfaction, the more the quality of services offered to employees as the internal customers of an organization, the more the satisfaction they expressed towards the products, and vice versa. However, lesser attention was paid to the fact that an increase in the quality of services does not necessarily result in increased satisfaction. Kano maintained that not all employees are equal. That said, the understanding and selection of loyal and committed employees will be the key to the survival and sustainability of the organizations in the world of business and competitive market. Therefore, organizations focus on employees and customers that will bring them the highest efficiency and profitability [4]. Also, a review of analyses provided by the Pareto law in the employee appraisal system suggests that 20% of the employees account for 80% of the corporate revenues, with the remaining number of the employees (i.e., 80%) only contributing to 20%. Thus, one would conclude that the understanding of the committed and loyal employees and attention to their expectations and preferences will be an undeniable necessity [5].

The present research was conducted in Abadan's Oil Refinery, the largest nationwide oil refinery, and one of the top five oil refineries in the world which compete both in the domestic and foreign markets. The authors began by investigating the employee needs and expectations in various sections of this strategic refinery, evaluating employee satisfaction, and conducting a field survey to conclude that no previous articles had addressed this major component. Revealing a major gap between managers' understanding of the employee needs and expectations and the expectations of the employees themselves after consulting and thinking together with elites and university professors in the fields of strategic management and future studies on this issue, they predict that if the problems are not fundamentally identified, they will lead to the neglect of the employees towards doing the assigned tasks and ultimately the failure of the strategies and the drawn macro goals and will lead to serious damage in the level of decisions and implementation of the organization's plans. So, the authors have conducted this research in a new and effective method. The reason for the selection of this subject and administration procedure is that despite some apparent privileges provided to the employees by the organization, the presence of conflicts of interest and dissatisfaction between employees of various manufacturing, service, operational and administrative sections would leave an undesirable effect on their working efficiency. Also, following consultation with academic experts in strategic management, and considering future studies, it is predicted that the conflicts and dissatisfactions, if not solved properly, would lead employees to be indifferent to the affairs entrusted, thus causing a failure of macro-level strategies and goals.

However, library studies and field surveys revealed that no basic work had been taken to deal with the root causes of the problems. Since attention to customer and employee satisfaction is a major concern in the world of business, and because the component of satisfaction is the key to the survival and sustainability of the organization in the world of the business market, there are still conflicts and dissatisfactions with the various sections of the organization, we consulted experts to present a fully novel methodology that combines highly applicable algorithms and uses fuzzy logic to provide a real image with the least error and maximum reliability of employee expectations so that experts and managers can provide a correct analysis of the employee needs and expectations to determine and prioritize them. This will certainly lead them to educate more valuable and loyal employees for the organization, and the organization can also use real, acceptable, and reliable data to achieve a greater share of the competitive market and to create a competitive advantage in the business environment. To meet this goal, the use of fuzzy logic and concepts of ranked sets were put on the agenda. The concurrent use of the fuzzy Delphi, Fuzzy Kano, together with the Alpha-cut method, Fuzzy AHP, and defuzzification of the results using the Gogus and Butcher method to determine the incompatibility

rates of the responses could lead to a reduction of the possible conflicts, consistencies in respondents' judgments' responses, reducing their uncertainties, which ultimately reduces mental ambiguities.

2 | Theoretical Foundations of the Research

2.1 | Delphi and Fuzzy Delphi Method

Delphi gathers views from experts to identify attributes and indicators of a specific subject through a set of regulated questionnaires of various iterations and using absentee written responses [6]. The classic Delphi method is based on experts' subjective paradigms and their preferential judgments, denoting the use of vague and inaccurately subjective words that cannot provide a real and rational image of the responses received. On the one hand, some responses may be removed due to the low convergence relative to other responses received; thus, we need a model which, beyond classical and conventional methodologies, can utilize the views of all experts, and take into account their preferential judgments in a way they are most compatible with the reality, thus managing to offer a real image of employees' demands and expectations. For this, the best method is the fuzzy Delphi method, which was developed by Kaufmann and Gupta [7], and later expanded by Ishikawa et al. [8] by using triangular fuzzy numbers. This is because this method uses fuzzy logic and fuzzy sets to challenge the experts' mental paradigm, and to considerably reduce their judgments and ambiguities, which are mostly based on mental heuristic rules, while the strategies outlined by the experts have the highest compatibility with rationale models [9].

2.2 | Kano's Model

In the 1980s, Kano [10] of the University of Rica collaborated with his colleagues to provide a two-dimensional model of quality. According to this model, the level of efficiency is noted on the horizontal axis, while the level of satisfaction is on the vertical axis [11]. Kano [10] maintained that attributes of a product or service were not equal for the customers, with each leaving a different impact on their satisfaction, because they have different needs and demands. Various models were used to classify employee needs on the assumption that the relationship between customer satisfaction and performance of quality attributes is symmetrical and linear, though this relationship follows a non-linear pattern in some other cases, with the effects of the performance of quality attributes not being the same on satisfaction or dissatisfaction of the employees or customers [12]. In his model, Kano used the relation between "satisfaction" and "efficiency" to classify the types of needs under such titles as "must-be/basic", "one-dimensional or expected", "attractive /motivational", "indifferent", and "reverse" [13].

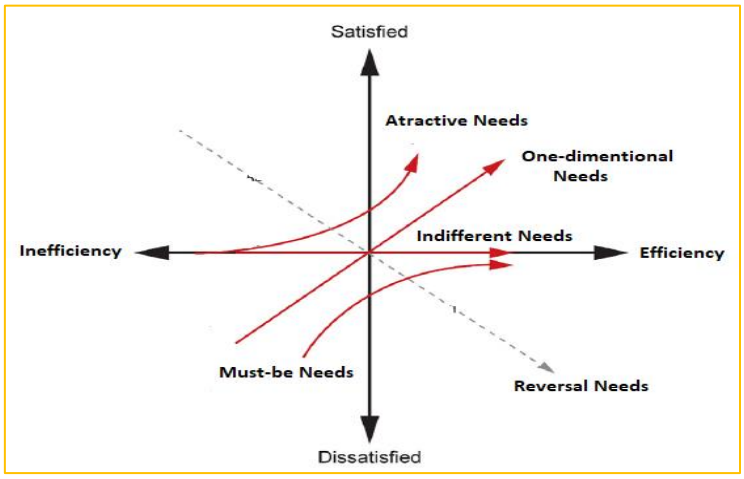

Fig. 1. Customer satisfaction diagram obtained using the Kano model [11].

2.2.1 | Must-be qualities

This category of needs is so fundamental that is not directly expressed by the customer. These needs express the minimum requirements, as their presence does not create a specific value for the customer, thus failing to increase their satisfaction. If these needs are not met, it leads to severe dissatisfaction, and this dissatisfaction is spread by word of mouth [13].

2.2.2 | One-dimensional qualities

This category of needs is clearly articulated by customers and employees. These needs are in a linear relationship with employee and customer satisfaction, meaning the more they are met, the greater the efficiency, thus increasing the level of satisfaction, and vice versa [13].

2.2.3 | Atractive and motivational needs

This category of needs has a considerable impact on increasing employee and customer satisfaction because they do not expect such attributes at all; however, the absence of these needs does not make employees and customers dissatisfied, because they do not know that the product or service, supposed to be offered, will have such abilities [13].

2.2.4 | Indifferent Needs

This category of needs and attributes is not important to customers and employees; in fact, they do not pay any attention to these attributes, and it doesn't make any difference to them whether they are or not. Therefore, the presence or absence of these needs and attributes does not cause satisfaction or dissatisfaction; however, the attention and focus of the organization's research and development team on these attributes and needs can prevent the loss of organizational resources and save the organization's costs [13].

It should be noted that the use of such methods as Delphi or Kano, each with its structural weaknesses, cannot alone provide conclusive, rational, and satisfactory results, as the separate use of each method would not be able to fully comply with the existing reality; for example, in the Delphi method, the identification stage is performed well, but the results obtained are first taken from uncertainties and ambiguities with the complicated subjective structure of the experts, and second, they are not useful for the classification of customer expectations. Or in the traditional Kano model, the use of an appraisal table does not sometimes provide a correct classification, failing to properly reveal the customer needs. This can also cause results that are less compatible with reality. For example, a need may be, in essence, motivational, but determined to be performance based on the traditional Kano model, causing the organization and management to make strategic mistakes when developing plans and they cannot meet the needs and expectations of customers by an improper understanding of them, which will leave undesirable impacts on the outcomes.

We believe that the new integrated method in this research, which is a combination of fuzzy Delphi, Fuzzy Kano, and Alpha-Cut, as well as the Fuzzy AHP method based on the Gogos and Butcher method while benefiting from the advantages of fuzzy sets and fuzzy logic (reduce ambiguities and ambiguities in the mental paradigms of managers, reducing cognitive limitations and perceptual errors and improving the decision-making process), has been able to determine the needs appropriately and classifies and compares the views of managers and employees separately. Meanwhile, the proposed method aims to provide more practical solutions to bridge the gap between experts' opinions and employees' expectations and provides results that are more compatible with the current situation and also it is attractive to the organization. Below is some research reviewed in this field:

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Ahadi and Pani [14] did a study entitled "identification of factors affecting the special value of a brand using fuzzy Delphi method". They identified and then ranked 13 factors affecting the special value of a service brand, concluding that the ranking will help the organization to create a strong brand of the products, increase the product price and seize more market share by appropriately prioritizing the factors affecting the brand value.

Habibzadeh et al. [15] did a study entitled "identification of intra-organizational factors affecting the technological learning using fuzzy Delphi method (case study: Foolad Mobarakeh Co.)". By studying managers and experts involved in technology development of the engineering unit of the industries, and evaluating the technologies of the Foolad Mobarakeh industries of Isfahan, they prioritized 5 factors out of 9 factors which were R & D activities empowerment, production empowerment, motivational systems, educational systems, and attraction capacity using fuzzy DEMATEL technique.

Rezaiyan et al. [16] did a study entitled "measuring the satisfaction of customers in online shops using data mining techniques and fuzzy Kano model (case study: Niazco website)". They combined the K-Means method as a major determining method and a fuzzy Kano model to classify the customers of the Niazco online shop, then evaluate and identify their needs and expectations. Following the investigation of customers in various clusters, it was determined that the third cluster customers were more important for the shop compared to others due to the higher number of repeated purchases from the site, and considering the sum of purchases from that site.

Sadeghi Moghaddam et al. [12] did a study entitled "presenting a fuzzy approach and a Kano model evaluation table for the quality attribute analysis". They aimed to provide a correct understanding of customer expectations to classify them using the Kano model. The outcome suggested that analyzing Kano's questionnaire using the fuzzy algorithm was more compatible with Kano's definition of the quality attribute.

Rahayu and Wulandari [17] did a study entitled "defining electronic portfolio for the issuance of competence certificate using fuzzy Delphi method". This study aimed to develop an electronic portfolio, especially one for the issuance of a competence certificate in a way it is easy to use and involves added value for the user. The result suggested that by using the fuzzy Delphi method, the elements and features in the electronic portfolio development process were well identified, and after the consensus of experts based on empirical studies, a list of factors that can be used to build an electronic portfolio model and Support for the certification process used has been specified.

Karam et al. [18] did a study entitled "analysis of barriers to implementing horizontal collaborative transportation using the combined fuzzy Delphi and AHP methods in Denmark". This research aimed to identify the barriers to the successful implementation of horizontal transportation collaboration as a promising strategy to strengthen sustainable transportation. The authors maintained that companies can integrate their consignments in fewer trucks, which could reduce costs incurred on the environment. Using the fuzzy Delphi method, 30 barriers were identified and were then prioritized in five classes using the AHP.

Baier and Rese [19] did a study entitled "how to increase satisfaction with a multi-channel purchase?" In this study, the researchers established a Kano Model-based gate-stage approach for new technologies. In this study, older and male customers, constituting 29% of the population, and female and younger customers, constituting 71% of the population, were compared, and their statements were classified based on the Kano model. On this basis, older and male customers were indifferent to all the developments made to the online shops, and a large part of the physical shop developments, evaluating some needs very negative (reverse), such as geo-fencing, while considering some other new technologies such as magic mirrors as appealing needs. However, the younger and female customers declared more appealing needs than their male counterparts.

Bui et al. [20] also did a study entitled "identification of barriers to solid waste sustainable management using fuzzy Delphi method", concluding that 44 basic barriers to sustainable solid waste management were identified which were categorized into four groups: technical problems, information sharing, and knowledge problems, human resources problems and financial and economic problems. In the end, the most important barriers to sustainable management of solid waste were determined to be hazardous domestic garbage, insufficient budget for research, local architecture, employees' incompetence, and absence of a standard process for the gathering and analysis of the data.

Wu et al. [21] did a study entitled "developed integrated performance-based on Kano, QFD, and FAST methods to design baby carriage". It was found that upon identifying the user needs and analyzing the needs using the Kano model categorization, the new integrated method was found to better and more effectively understand the user needs, as the use of an appropriate carriage model would help meet the user expectations and increase their satisfaction.

Tseng [22] did a study entitled "Categorization and determination of airport service attribute using the IPA-Kano model (case study: Taiwan's international airport". The attributes which increased and decreased travelers' satisfaction were identified and then classified using the Kano model.

Ebrahimi and Bridgelall [23] conducted a study entitled "a fuzzy Delphi hierarchical analysis model to rank the factors affecting public transportation selection (a case study)". It was found that using the fuzzy Delphi analysis, out of such attributes as service, safety, reliability, travel cost, convenience, information, and accessibility, the subway accounted for the highest number of passengers, followed by car, express bus, van, and public taxi, respectively.

Singh and Sarkar [24] did a study entitled "a framework based on fuzzy Delphi and DEMATEL method for the sustainable development of products (case study: Indian auto industry)". This research aimed to provide a mixed framework combining fuzzy Delphi methods and DEMATEL methods to identify various types of Canvas Design (EP) patterns and to determine the relationship between them to achieve sustainable products in the auto industry. It was found that the most important EPs for the sustainable development of the product were to use "alternative production techniques", "increase reliability" and "easiness of repair and maintenance".

Bigorra et al. [25] did a study entitled "classification of the Kano model using proposed attributes", concluding that because the classification of the product attributes extracted from textual data would seldom provide a clear distinction from the view of the Kano classification, the proposed method, i.e., classification using proposed attributes, could effectively provide data on customer insights to product designers.

Ma et al. [26] did a study entitled "use of the Kano model to create distinction in driving services offered by the future vehicles". Upon gathering the views and needs of 56 possible purchasers of four-door sedans, and categorizing them, they concluded that companies classify the future needs of the purchasers by using the Kano model to effectively reduce customer dissatisfaction, and increase their satisfaction based on product quality classification.

Chen et al. [27] did a study entitled "Kano's smart classification of product attributes using customer expectations". This study was based on artificial intelligence development, which was conducted by integrating several artificial intelligence methods and machine learning techniques on 12000 customers of coffee makers.

Suh et al. [28] conducted a study entitled "analysis of satisfaction from the cooperation between university and industry (a Korean sample)". It was found that the proposed model and guidelines in this way helped improve satisfaction with the university-industry cooperation.

Ocampo et al. [29] did a study entitled "sustainable ecotourism indicators using fuzzy Delphi method (case study: Philippines)". In this study, 59 indicators were considered for sustainable ecotourism; then, the fuzzy Delphi method was used to list 39 sustainable ecotourism indicators for the country. The proposed approach suggested that its easiness and accuracy provided more traceability, thus creating a more flexible condition for the decision-makers when allocating resources and policy-making to improve welfare.

Ilbahar and Cebi [30] did a study entitled "a novel fuzzy Kano approach to classifying parameters of designing e-commerce websites", concluding that 4 websites were comprehensively investigated using the newly proposed method and intended parameters. The findings revealed that e-commerce could greatly affect the use of customer purchase websites, as highly-capable websites received higher scores from the customers, thus regulating their strategies accordingly.

Wanga and Wang [31] did a study entitled "combining fuzzy AHP and fuzzy Kano model for the optimization of smart camera products: correct 0 and 1 programming (Bayesian method) perspective". They found that pricing policies and the mixed method could be used to maximally attract customers, and provide credible and reliable programs for the optimization of smart cameras in various sections".

Florez-Lopez and Ramon-Jeronimo [32] did a study entitled "management of customer logistics services under uncertainty using an integrated fuzzy Kano model". Findings revealed that the proposed classification based on the fuzzy Kano model could effectively manage logistical services to the customers, thus empowering the managers to better specify the conditions and develop strong competitive strategies for increased customer satisfaction.

Ebrahim Karbalaei et al. [33] did a study entitled "evaluate supply chain management using fuzzy hierarchical analysis process technique". While examining the effective factors in creating a suitable model for future investment planning, in order to evaluate and rank the effective factors on supply chain management in the pharmaceutical system, they used the fuzzy hierarchical analysis technique to identify and prioritize different factors and models. And finally, they presented the conceptual model of the research using the opinion of experts including four categories of main indicators and 16 sub-criteria. The final factors are: anagerial factors and employees, economic factors, organizational factors and cultural factors. The results showed that the economic factors with a weight of 0.266 are the most important according to the experts and have the first rank, followed by managerial factors and employees, organizational factors and cultural factors. Also, among the sub-criteria, the factors of adopting a business strategy in accordance with environmental goals with a weight of 0.0936, the first rank, designing a competitive business plan for the desired price and quality with a weight of 0.0878, the second rank, and modeling the commercial policies of leading countries 3rd place with a weight of 0.0846 gained.

Amiri and Setayeshi [34] did a study entitled "fuzzy analytic hierarchy process of neuromarketing evaluation criteria for sustainable products". The results showed that the criteria for evaluating neuromarketing, which based on FAHP are: accuracy, biasness, exploration of memory and emotion, information quality, usefulness, time saving, cost, respectively. Also, the alternatives of marketing for sustainable products affected by neuromarketing in order of priority are: advertising, product design and development, branding, consumer decision, pricing and distribution.

Rasi and Mohammadi Dolat-Abadi [35] did a study entitled "proposing a framework for identifying the competitive advantage of small and medium-sized manufacturing organizations under uncertainty conditions". This research ranks of the core competencies in small and medium-sized manufacturing organizations in conditions of fuzzy uncertainty using the group fuzzy TOPSIS method, which is a mathematical model. The findings revealed that the core competencies of customer services and advertising are considered as a "competitive advantage" in small and medium-sized manufacturing organizations.

Davoodi and Khatami [36] did a study entitled "assessing customer needs using hybrid technique including QFD and DEMATEL in fuzzy conditions (case study: service company RAZI industrial town: industrial town corporation Isfahan province)". Based on the results of the research, 64 needs were identified by the company that the need for drinking water was the first priority. Then, 8 services or technical requirements were identified by this company and the relations between the needs of the customers of Razi Industrial City Service Company were determined by the Quality House. Service priority was set.

Khalifa [37] did a study entitled "a signed distance for (γ,δ) interval-valued fuzzy numbers to solve multi objective assignment problems with fuzzy parameters". The findings showed that for the multi-objective assignment problem with fuzzy parameters (FMOASP), the fuzzy parameters are specified by fuzzy numbers (γ) with distance value instead of fuzzy numbers. Ranking specified intervals of interval-valued fuzzy numbers (a new approach, the optimal flow method), is proposed to obtain the ideal and set of all efficient fuzzy solutions for the problem.

Barati and Fanati Rashidi [38] did a study entitled "fuzzy AHP and fuzzy TOPSIS synergy for ranking the factor influencing employee turnover intention in the Iran hotel industry". The objective of this study is to construct a fuzzy AHP and fuzzy TOPSIS model to evaluate the dimensions of the hotel employee turnover intention model. The critical fuzzy AHP and fuzzy TOPSIS analysis results, the study shows that the most important dimensions of employee turnover intention in the hotel industry model are salary and benefits. Moreover, the results indicate that the least important dimensions are the Co-workers relationship, supervision, and career opportunities. The second group dimensions that impact employee turnover in the context of the COVID-19 epidemic are work itself, job stress perceived risk, and job insecurity.

Hoseini et al. [39] did a study entitled "identifying and ranking the factors affecting the transportation of products from a marketing perspective using the fuzzy analytic hierarchy process approach". Analytic hierarchical process was used to determine the importance and weight of the criteria and then Expert Choice software was used for ranking. The results of pairwise comparisons and weights are expressed in the following. Accordingly, among the 20 sub-criteria, the use of information technology is ranked first. After that, sustainable development and smart transportation ranked second and third, respectively.

3 | Research Methodology

The present research is applied in terms of goal, and cross-sectional in terms of time. To gather data, fuzzy Delphi and fuzzy Kano questionnaires were used. Data were gathered via field surveys. This research falls under exploratory research. Because this research uses library and field studies (use of questionnaires), the nature and manner of gathering data can be considered to be a descriptive survey. Many types of research have been done in similar fields using the fuzzy Delphi method and hierarchical analysis, etc. However, with regards to the identification of managers' mental paradigms to make a desirable decision with the least biases, no study has ever addressed the combined method we have proposed in this study. This research was performed in three separate phases, each involving different stages. In the first phase: using the fuzzy Delphi method, the needs and expectations of the employees of the production and service sectors of Abadan's Oil Refinery have been identified from the perspective of managers and experts. The statistical population consists of all managers and officials with a work experience of over 10 years, as samples were taken due to the higher number of these people, and lack of direct access to them. The sampling method was performed via the chained (snowball) sampling method, as the number of 18 managers and officials with over 10 years of work was selected. In the first step: the experts identified major components as the employee needs, and accordingly, a semi-structured questionnaire was designed. Then, using expert consensus, the final fuzzy Delphi questionnaire was designed, and 21 factors were selected as indicators of the needs and expectations of employees at various sectors of the Abadan's Oil Refinery from the perspective of experts. These factors were regarded as items of the fuzzy Delphi questionnaire. In the second step: a fuzzy Delphi questionnaire

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was prepared based on a five-degree Likert scale and given out among experts, each selecting a number from 1-5 to respond to the items. In the third step, to make decisions and eliminate the biases, defuzzification of responses was performed by using the center of area defuzzification method. As far as I know, there isn't any optimal defuzzification method to choose and it seems that it depends on the simplicity of calculations and an empirical principle. After that, because some experts offered new opinions, another round was taken as the second round and previous steps were iterated. In the fourth step, according to the knowledge, experience, and consensus of experts and the views of academic professors, 0.7 was selected as the threshold. Thus, components whose de-fuzzified values were greater than 0.7 in the second round were selected as the final research components. In the fifth step, since the de-fuzzified value difference between the first and second rounds tended to be zero, the second round was selected as the final round. In the second phase, the employees were polled and their demands were examined from their perspectives using the fuzzy Kano model and the fuzzy Kano questionnaire. In the first step, the questionnaire concerning Kano classification was designed in a dualistic way, with functional and dysfunctional questions for each item.[40], [41]. In the second step, by calculating the R matrix, derived from the multiplication of the functional transpose matrix (F^t) by functional matrix (D), quality attributes were classified based on the Kano evaluation table, and this process was repeated for all attributes and comments. In the third step, a table was prepared to calculate the membership of the qualitative attributes in the Kano model was calculated based on the opinions of the employees. For this purpose, and to provide a satisfactory result, the strong alpha cut method was used, so after the consensus of the experts, the value of 0.4 was determined as the threshold of the strong alpha cut, and the calculations were also conducted based on the alpha of 0.4. In other words, if the quality attribute was greater than 0.4, value 1, otherwise, 0 was assigned so that whenever the quality characteristic level is more than 0.4, the value of 1 and otherwise the value of zero was assigned, and finally based on the highest frequency of the quality characteristic (fuzzy mod value) as the majority in favor, the needs were classified from the employees' views into three categories such as "basic"-"functional"-"motivational". The statistical population consisted of 502 employees who, due to lack of access to all of them, the Cochran formula was used to select 152 ones as the representative sample size. However, due to the coronavirus pandemic, some of the employees were affected by this disease, and some others failed to attend the research, or respond to the questionnaires. Eventually, 109 questionnaires were collected and analyzed. In the last phase, the incompatibility rate of the responses was calculated through Gogus and Butcher method; for this, the fuzzy paired comparison matrix was first divided into two non-fuzzy matrices such as A^m matrix (middle values of respondents' comments that are presented as triangular fuzzy numbers) and A^g matrix (average upper and lower bounds of the respondents' views that are presented as triangular fuzzy numbers)and then, the weight vectors of both matrices were calculated. Then, the random Gogus and Butcher index was used to derive two incompatibility rates called CR^M and CR^C. Because both rates were less than 0.1, the compatibility rates of the respondents were confirmed. Eventually, the needs were ranked using the FAHP technique.

3.1 | Data Analysis; Research Stages of Administration

Step 1. Identification of employee needs with the fuzzy Delphi method.

As stated in the research methodology section, the employee needs and expectations were identified in six steps using the Delphi questionnaire and based on a five-degree Likert scale and each question was answered in the form of triangular fuzzy numbers by experts. Then all the answers were aggregated using the geometric mean. After that, the center of area formula was used to calculate the de_fuzzing value for each item. However, in the first round, two of the questions were removed as their final de_fuzzing values were much lower than the threshold. thus, they were absent in the second-round questionnaire. Also, considering that a new component was added by one of the experts in the first round, it was added in the second-round questionnaire and lastly, the second round was selected as the final Delphi round while the de-fuzzified value difference of the first and second rounds tended to zero. so the components which managed to gain a de-fuzzified value greater than the threshold in the second round were selected as the final research components. Results have been shown in *Table 1*.

Table 1. Determining the final components of the research as employee needs with the fuzzy Delphi method.

Row	Final Components of the Research	Defuzzied Value (D)	Threshold	Result (D>0.7)
1	Learning, training and development index	0.745	0.7	Pass
2	Physical condition index in proportion to the working environment	0.771	0.7	Pass
3	Attention to physical and psychological health	0.779	0.7	Pass
4	Good relation between managers and employees	0.834	0.7	Pass
5	Creation of opportunity for creativity	0.906	0.7	Pass
6	Occupational diversity and avoiding monotonousness	0.917	0.7	Pass
7	Health and treatment needs	0.845	0.7	Pass
8	Justice and fairness	0.728	0.7	Pass
9	Appreciation	0.789	0.7	Pass
10	Modern software and hardware equipment	0.735	0.7	Pass
11	Recreational and entertainment services	0.769	0.7	Pass
12	Occupational security	0.754	0.7	Pass
13	Duties matching with skills	0.917	0.7	Pass
14	Sports and medical reservation system	0.745	0.7	Pass
15	Participation in decision-making	0.855	0.7	Pass
16	Desirable performance evaluation system	0.745	0.7	Pass
17	Efficiency rewards	0.885	0.7	Pass
18	protecting human dignity	0.906	0.7	Pass
19	Reinterment bonuses and salaries	0.835	0.7	Pass
20	Low-interest loans and credits	0.768	0.7	Pass
21	Housing credits for employees	0.779	0.7	Pass

Step 2. Classification of employee needs and expectations using the fuzzy Kano model.

First, the needs described by experts were listed in a fuzzy Kano questionnaire, which was distributed among the employees. Also, the employees were required to express the answers in percentages. Here, for each component, two questions were asked, functional (how do you feel if that component is present) and dysfunctional (how do you feel if that component is absent) and then, all the results were summarized in a table, and then to ensure a satisfactory and desirable result, the α-cut method was used to determine the type of quality component and its degree of belonging to Kano classes (*Table 2*).

Table 2. Evaluation table for classifying quality attributes using the Kano questionnaire.

		Dys-Functional				
Employee Needs		**Satisfied**	**It Must be That Way**	**It is Indifferent**	**I can Live with It**	**Dissatisfied**
Functional	Satisfied	O	A	A	A	Q
	It must be that way.	M	I	I	I	R
	It is indifferent to me.	M	I	I	I	R
	I can live with it.	M	I	I	I	R
	Dissatisfied	Q	R	R	R	R

*O= One-dimentional, M= Must-be, I=Indifferent, R=Reverse, A=Atractive, Q= Questionable

The following is the calculation and classification table of one of the features as an example (*Table 3*):

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Table 3. The calculations table for feature_1.

		Satisfied	It Must be That Way	It is Indifferent	I can Live with It	Dissatisfied	
Employee_1	Feature _1						
	Functional	0.2	0.8	0	0	0	
	Dys-functional	0	0	0	0.1	0.9	
		0	0	0	0.02	0.18	
		0	0	0	0.08	0.72	
		0	0	0	0	0	
		0	0	0	0	0	
		0	0	0	0	0	
		[redacted]					
		Q	A	A	A	O	
		0	0.02			0.18	
	R	0					M
	R		0.08			0.72	M
	R						M
	R						
			R	R	R		
		[redacted]					
		R	I	A	O	M	
		0.00	0.08	0.02	0.18	0.720.72	

$$O = 0.18,$$
$$A = 0.02 + 0 + 0 = 0.02,$$
$$I = 0.08 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 = 0.08,$$
$$M = 0.72 + 0 + 0 = 0.72,$$
$$Q = 0 + 0 = 0,$$
$$R = 0 + 0 + 0 + 0 + 0 + 0 + 0 = 0,$$
$$A* = \{\frac{0.72}{M}, \frac{0.18}{O}, \frac{0.02}{A}, \frac{0.08}{I}, \frac{0}{R}, \frac{0}{Q}\}.$$

In *Table 4*, the type of qualitative Needs in fuzzy Kano's classification with the α-cut method has been shown.

Table 4. Determining the type of qualitative needs in fuzzy Kano's classification with the α-cut method.

Row	Type of Indicator / Indicators	Reverse Fuzzy Mode (R)	Indifferent Fuzzy Mode (I)	Attractive Fuzzy Mode (A)	One-Dimensional Fuzzy Mode (O)	Must-be Fuzzy Mode (M)	Final Results
1	Learning, training and development index	0	4	9	12	62	M
2	Physical condition index in proportion to the working environment	0	7	18	14	65	M
3	Attention to physical and psychological health	0	10	27	20	41	M

Table 4. Continued.

Row	Type of Indicator / Indicators	Reverse Fuzzy Mode (R)	Indifferent Fuzzy Mode (I)	Attractive Fuzzy Mode (A)	One-Dimensional Fuzzy Mode (O)	Must-be Fuzzy Mode (M)	Final Results
4	Good relation between managers and employees	0	7	55	23	25	A
5	Creation of opportunity for creativity	0	10	31	12	54	M
6	Occupational diversity and avoiding monotonousness	0	5	69	5	22	A
7	Health and treatment needs	0	5	28	11	64	M
8	Justice and fairness	0	5	20	45	32	O
9	Appreciation	0	6	65	17	21	A
10	Modern software and hardware equipment	0	5	36	41	28	O
11	Recreational and entertainment services	0	6	56	27	17	A
12	Occupational security	0	5	42	42	19	O
13	Duties matching with skills	0	5	39	19	39	M
14	Sports and medical reservation system	0	7	27	51	17	O
15	Participation in decision-making	0	5	35	50	24	O
16	Desirable performance evaluation system	0	2	38	54	14	O
17	Efficiency rewards	0	2	52	39	14	A
18	Protecting human dignity	0	3	3	13	82	M
19	Reinterment bonuses and salaries	0	6	48	11	39	A
20	Low-interest loans and credits	0	3	46	28	32	A
21	Housing credits for employees	0	3	46	31	26	A

Step 3. Ranking of each of the classified needs in the Fuzzy Kano model using the Fuzzy Analytic Hierarchy Process (FAHP).

After employee needs and expectations were determined and classified using fuzzy Kano and alpha cut methods, the coefficient of importance and ranking of each of the needs and the indicators should be determined in this stage. For this, a widely used method known as the FAHP method based on Buckley's geometric mean was used. Since the needs were supposed to be prioritized into three classes basic, performance, and motivational needs, we had three pairwise comparison matrices for the items relating to each of the above-mentioned needs, and a final pairwise comparison matrix for the indicators, themselves. In the following, relevant computational steps are demonstrated. In this step, after determining the fuzzy pairwise comparison matrix for 12 basic needs, 4 one-dimensional needs, and 5 attractive needs, and also providing a fuzzy pairwise comparison matrix for the indicators (three basic, performance, and motivational indicators), the Buckley's geometric mean and Gogus and Butcher methods were used to carry out computations relating to determining the incompatibility rates of each of the matrices, as the incompatibility rates for all the pairwise comparison matrices were less than 0.1. After confirming the incompatibility of the matrices and using the Minkowski formula, the

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defuzzification of the results from the fuzzy inference was performed to make the reports and results obtained more comprehensible. After the final weights were determined, each of the needs and indicators was finally prioritized using the FAHP. First, a fuzzy pairwise comparison matrix was performed for all the items, and the questionnaire reliability was confirmed by using the Gogus and Butcher incompatibility rate. In other words, the computations revealed that the incompatibility rates of all the items, and the indicators were less than 0.1. It is noteworthy that the act of defuzzification of the fuzzy responses gathered is a method to convert fuzzy numbers into crisp numbers so that the results of a fuzzy computational system are made comprehensible and simple for the users.

Thus, because defuzzification methods are widely used, and are aimed at simply converting fuzzy results into non-fuzzy numbers, thus, following the confirmation of pairwise matrix compatibility, a simple de_fuzzing method, called the Minkowski method, was used for defuzzification. This de_fuzzing method is taken from the Minkowski distance concept [42], [43]. Minkowski distance, used as a Fuzzy C-Means, instead of Euclidean distance is, in fact, a clustering algorithm, at every point at which, data are related to the cluster through the degree of membership. Thus, Minkowski's defuzzification formula is taken from this concept which is used for ease of use (*Table 5*). Meanwhile, articles related to this concept are given in the references. If a triangular fuzzy number such as F={L, M, U}, we have Minkowski's formula is the following:

$$x = M - \frac{U - L}{4}. \tag{1}$$

Table 5. Fuzzy pairwise comparison matrix of must-be, one-dimensional, and attractive criteria.

	M			O			A			Fuzzy Geo Mean		
M	1	1	1	2	3	4	6	7	8	2.289	2.759	3.175
O	0.500	0.333	0.250	1	1	1	2	3	4	1.000	1.000	1.000
A	0.166	0.142	0.125	0.500	0.333	0.250	1	1	1	0.436	0.362	0.315

At *Table 6*, it has been shown to calculate fuzzy and de-fuzzified weights of criteria.

Table 6. Calculating fuzzy and de-fuzzified weights of criteria (must-be, one-dimensional, and attractive).

$\widetilde{W}$ *Fuzzy	M	O	A	$\widetilde{W}$ * De-Fuzzified Minkowski	$\widetilde{W}$ * De-Fuzzified Normalized
M	0.50992	0.66961	0.85215	0.75517	0.69039
O	0.22273	0.24263	0.26841	0.25405	0.23225
A	0.09716	0.08777	0.08454	0.08461	0.07736

The above matrix was divided into two pairwise comparison matrices using the middle limit of experts' opinions and their upper and lower limits, and the rate of inconsistency was calculated for each one separately. The results showed that the inconsistency rate of the "criteria" in the fuzzy pairwise comparison matrix was less than 0.1, that is, the results were more consistent and less uncertain. In the end, the final weight of each item, calculated from the multiplication of the weight of the indicators by the weight of the items, as well as the rank of each of them was determined in the relevant class.

Prioritization of indicators using FAHP is shown in *Table 7*.

Table 7. Prioritization of indicators using FAHP.

The Employee Needs based on the Kano Model	Item Weight	Criteria Weight	Final Weight	Priority
(Must-be needs)				
Health and treatment needs	0.0533	0.6904	0.03682	5
Learning and training	0.1332	0.6904	0.09194	3
Physical conditions suitable for the working environment	0.1250	0.6904	0.08629	4
Attention to physical and psychological health	0.3178	0.6904	0.21939	1
Protecting the human dignity	0.3082	0.6904	0.21280	2
Duties matching with skills	0.0299	0.6904	0.02063	7
Creation of opportunities for creativity	0.0326	0.6904	0.02253	6
(One-dimensional Needs)				
Participation in decision-making	0.0415	0.2323	0.00963	4
Desirable performance evaluation system	0.1320	0.2323	0.03065	3
Reservation system for clinics	0.0183	0.2323	0.00425	6
Occupational security	0.5195	0.2323	0.12065	1
Software and hardware equipment	0.0529	0.2323	0.0.01228	5
Fairness and justice	0.2359	0.2323	0.05480	2
(Attractive -Needs)				
Occupational diversity and avoiding job monotonousness	0.0306	0.0774	0.00237	7
Low-interest rate loans and credits	0.0423	0.0774	0.00327	6
Appreciation	0.0238	0.0774	0.00184	8
Efficiency rewards	0.1272	0.0774	0.00984	4
Housing credits	0.3695	0.0774	0.02858	1
Retirement salaries and bonuses	0.1636	0.0774	0.01265	2
Good relation between manager and employee	0.1087	0.0774	0.00840	5
Recreational and entertainment services	0.1345	0.0774	0.01040	3

Considering that the comparative study is given below and the meme method is used, only the calculation *Table 8* mentions the method of its calculations, and detailed explanations are given in parts 3-2:

Table 8. Ranking of the needs by MIM method.

Ranking	Employee Needs	Sample size	Mean	SD
1	Job diversity and avoiding monotony	18	5.000	0.000
2	Duties matching with skills	18	5.000	0.000
3	Opportunity for creativity	18	4.944	0.229
4	Protecting human dignity	18	4.889	0.314
5	Efficiency reward	18	4.833	0.373
6	Health care needs	18	4.611	0.487
7	A good relationship between manager and employee	18	4.611	0.591
8	Participation in decision making	18	4.556	0.497
9	Retirement salaries and bonuses	18	4.556	0.497
10	Software and hardware equipment	18	4.556	0.497
11	Attention to physical and mental health	18	4.389	0.678
12	Appreciation	18	4.333	0.577
13	Recreational services	18	4.333	0.745
14	Good physical conditions	18	4.278	0.650
15	Medical and sports services	18	4.222	0.629
16	Housing credits	18	4.222	0.629
17	Learning and training	18	4.167	0.687
18	Occupational security	18	4.167	0.601
19	Low-interest loans	18	4.111	0.657
20	Justice and fairness	18	4.111	0.737
21	Desirable performance evaluation system	18	3.833	0.687

3.2 | Comparative Analysis

To check the validity of the proposed hybrid approach (FDM, FKM, FAHP), a comparative analysis has been conducted between, the proposed method and the identified needs of employees by the Delphi method by the mean index (MIM) to rank the needs. The MIM method is a simple method to analyze the relative importance of indicators [22], [44]. In the present study, MIM was used to rank 21 components identified by experts using the traditional Delphi method. After collecting the experts' opinions through the traditional Delphi questionnaire, the average of their opinions and the value of the standard deviation (dispersion) were determined. Then the components with higher average and lower standard deviation were ranked and prioritized. The rights component was recognized as the highest need and was ranked 1st, and meeting medical needs and the need for job diversity were ranked second and third, respectively (*Table 7*). In our new hybrid approach, fuzzy logic is used for the Delphi method, as experts use their mental models to predict and identify needs that are accompanied by uncertainties. The uncertainty that governs these conditions. is a possibility, not a probability.

4 | Discussion and Conclusion

This research was conducted at the Abadan's Oil Refinery, which is one of the major oil refineries in the Middle East. The conduct of this research was critical because it addressed the satisfaction of the employees, and investigated the meaningful gap between the managers' understanding of the needs and expectations of the employees and those expressed by the employees themselves. This study used the fuzzy Delphi method to identify 21 needs. Fuzzy logic was used because managers use their subjective paradigms, which are fraught with uncertainties, to make a decision; thus, to remove these uncertainties and reduce decision-related biases, fuzzy logic is used to provide more acceptable results. The new proposed approach, involving fuzzy Kano, fuzzy Delphi, and fuzzy AHP methods, helped create a conclusive model which provided a desirable classification of the needs by using the fuzzy Kano model, as 7 components of the needs fell under the basic needs; for example, attention to employees' physical and psychological health, protecting human dignity, learning and training were respectively the first to third of the components in the basic need class. Occupational security, justice and fairness and evaluation system of desirable performance ranked first to third of performance needs, suggesting that these are the same needs that, if not met, cause dissatisfaction; in the end, housing credits, retirement salaries and bonuses, and recreational and welfare services for the employees ranked first to third of motivational needs. These are the needs that, if met, can create competitive advantages for the organization. Experts in this study identified several needs and used a comprehensive model to rank and prioritize them which, eventually, provided reliable results. The proposed mix method managed to identify and rank the needs, thus alleviating problems facing the managers and the employees. This method helped create a new unit called "voice of the employees to hear the concerns of the employees and pursue their problems. Also, a strong programming team was established to provide an evaluation plan of desirable performance that helped alleviate employee dissatisfaction. Meanwhile, a treatment reservation system was launched for the employees to better make reservations and access medical services through internal Internet sites. It was also suggested to work on managers' mental paradigms and investigate the decision-making-related uncertainties. However, future research can investigate and identify the combination of mental paradigms of managers and employees and find the roots of ambiguities in the mental structure of both groups and achieve a model so that with minimal error, the parties can find a common understanding of each other's expectations. Thus, the use of an effective method can not only remove the biases of both sides but also helps develop utility profit, a competitive advantage strategy, which would increase managers' and employees' satisfaction.

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Conflicts of Interest

All co-authors have seen and agree with the contents of the manuscript and there is no conflict of interest to report. We certify that the submission is original work and is not under review at any other publication.

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