



International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS)

(Open Access, Double Blind Peer-reviewed, Refereed and Indexed Journal)

www.iasir.net

Prioritization of Loyalty Factors of Human Resources in the After-Sales Service Network using Fuzzy ANP Technique (Case study: ISACO Company)

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Abstract: Undoubtedly, human resource is the most valuable factor among different resources of every organization, which is very important in field of progress of affairs. The centers supplying auto after-sale services are also cases that human resource is important for them abundantly and they face crisis of personnel. Hence, this study has classified the factors affecting loyalty of human resources in the after-sale service network in ISACO Company. For this purpose, first the main factors affecting human resource loyalty are identified. Then, paired comparison questionnaire is constructed and distributed among personnel employed in departs of technical staff and personnel. Afterwards, using Super Decision Software and ANP technique, a model is presented to rank these factors. This study has been conducted to design a reliable and scientific model to evaluate factors and finally, the results obtained from the study showed that value or behavioral factors on behalf of personnel are in first rank and financial factors are in last rank. Quantitative nature of outputs of this model can help managers to have clearer understanding of the causes of displacement of manpower.

Key words: FUZZY Analytical Network Process, human resource, personnel loyalty, paired comparisons, ISAXO

I. Introduction

At the current world, human resource is undoubtedly the most important; i.e. strategic factor in production and servicing cycle.

Capital enters to the production and servicing cycle by human, equipment and technology are used by manpower (personnel) and finally, the manpower (management) manages and runs the process.

Increased efficiency of organizations and increasing development of them is depended on efficiency and growth of employees and empowerment of their incentives.

Problem statement

The most important capital of the organizations can be loyal and specialist staff, which have perfect dominance and control on their activities within the organization and what they should do. It is necessary to find out that what factors can make staff work in after-sale service network effectively. Hence, identification, analysis and prioritization of these factors can play key role in Iran's industry. Ranking can be done using various qualitative and quantitative approaches. In way of selecting multi-criteria decision making methods, it is important to consider features of method and status of problem; otherwise, obtaining wrong results in not unexpected.

According to importance of human resource and necessity of its loyalty and commitment, this study has attempted to use first opinions of experts and classify these factors and prioritize the results using Fuzzy analytical network process (FANP).

Research significance

As one of the problems with managers of authorized dealers is identifying and behaving the factors causing commitment of human resources, identification and prioritization of these factors is very important; because these centers may face various costs in case of negligence. Therefore, the question here is that how these factors could be identified and what methods are existed to prioritize them? Through studying the literature, some researches could be found that have just emphasized identification of these factors or have been focused on use of decision making methods in field of prioritization and a few studies have considered the two issues alongside.

The main objectives of this study are as follows:

- Identification of factors affecting human resource loyalty in the after-sale service network
- Assessment of Fuzzy ANP in prioritization of loyalty factors

Managers of authorized dealers can use the results of this study to identify important factors of human resource loyalty and planning for management of them.

Research questions

According to research nature, this study has no hypotheses and tends just to answer following question:

- How is the process of prioritization of human resource loyalty factors in after-sale service network using Fuzzy analytical network process (Fuzzy-ANP)?

Research scope

Research area

As prioritization of factors based on FANP is not presented in ISACO Co till now, this study has innovation in terms of research area.

Research topic scope

In terms of research topic, this study is focused on investigating factors affecting human resource loyalty and prioritization of these factors.

Time scope

This study and data collection and presenting the obtained results has been completed in time scope of Sep 2016-Oct 2016

II. Theoretical framework

Analysis of qualitative data within the organizations is one of the most important concerns of managers and scholars. Evaluation of job satisfaction, organizational culture, customer satisfaction, quality of working life and many other organizational components seem too complicated in addition to be very important because of their nature. To quantify the data related to the said strategic variables, various methods have been proposed in statistics. However, the proposed methods are not highly reliable because of their abundant weaknesses. Using Fuzzy logics, the existing shortcomings and defects can be decreased and more useful analytical results could be obtained.

There are various types of fuzzy numbers, among which triangular and trapezoidal fuzzy numbers are more prospered because of easy use in modeling and interpretation. In this study, triangular fuzzy numbers are used as membership function as it is illustrated in figure. The cause of using triangular fuzzy numbers is their ease in terms of calculation and application that can help decision maker to make decision simply. Triangular Fuzzy number (M) is illustrated in figure. A triangular fuzzy number is illustrated as (l,m,r).

Membership function of each triangular fuzzy number is as follows:

$$\mu(X|M) = \begin{cases} \frac{x-l}{m-l} & l \leq x \leq m \\ \frac{u-x}{u-m} & m \leq x \leq u \\ 0 & \text{other} \end{cases} \quad (1)$$

The parameters l, m and u respectively present lowest possible value, most probable value and most possible value.

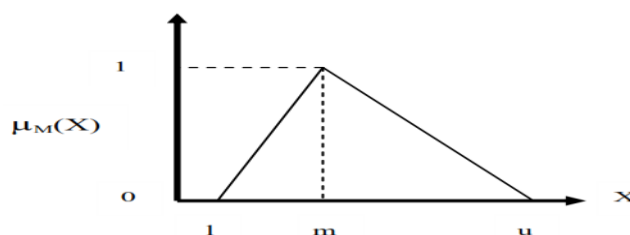


Figure 1: diagram of triangular fuzzy number

The other reason for using triangular fuzzy variables in this study is simplicity is using them to perform paired comparisons by individuals and to enhance accuracy of obtained results.

Fuzzy ranges

In classic ANP method, the experts are asked to use numbers and exact ratios to perform paired comparisons of features in same level in a network structure. The presented ratios by person could form paired comparisons matrix and through calculating the matrix of special values, weight of each feature could be obtained. Majority of scholars believe that because of existence of a kind of uncertainty in expert while performing paired comparison and allocating the ratio to it, this kind of decision making is inaccurate and unreliable. Hence, in the step of collection opinions of experts, the tangible and common expressive items in FANP paired comparison questionnaire are used in addition to certain common ratios in traditional ANP method. Fuzzy numbers used in this study to form paired comparison matrix proposed by Dagdeviren et al (2001) are presented in table 1.

Table 1: paired comparison of Dagdeviren et al (2001)

lingual scales	direct fuzzy numbers	reverse fuzzy numbers
equal importance	(1,1,1)	(1,1,1)
very low importance	(1.2, 1, 3.2)	(2.3, 1, 2)
low importance	(1, 3.2, 2)	(1.2, 2.3, 1)
high importance	(3.2, 2, 5.2)	(2.5, 1.2, 2.3)
very high importance	(2, 5.2, 3)	(1.3, 2.5, 1.2)
absolute importance	(5.2, 3, 7.2)	(2.7, 1.3, 2.5)

Literature review

- "evaluation and measurement of employee loyalty to the organization" by Heydar Amiran (2005)

In this study, an innovative method is presented to evaluate employee loyalty to the Iranian organizations. Evaluation and measurement of loyalty of employees is a strategic and fundamental analysis to make relevant decisions and policies in field of human resources and personnel of organization. In this field, presenting appropriate models, methods and patterns for this purpose is essential.

- "the process of appointing organizational personnel using FANP and F DEA with case study" by Sadeghinejad S (2012)

In this study, in addition to analyzing available approaches to appoint personnel, a method is presented to assess the job criteria and conditions and lead to a system to employ manpower with highest competency in terms of other determined criteria. For this purpose, combination of FANP and FDEA method is used and the model is developed in such manner that can enter significance of criteria of selecting personnel to the process and create a framework to integrate opinions of people in decision making group.

- "determining indices affecting human capital and prioritizing them using ANP method in Islamic Culture Ministry (staff)" by Aslani Farhadloo A (2013)

The aim of this study was to determine the indices and sub-indices affecting human capital and prioritizing them in Islamic Culture Ministry (staff). Statistical population in the study consisted of experts of Islamic Culture Ministry on 2012-2013 (n= 80). Data collection instrument in the study has been two questionnaires of Likert scale and paired comparison questionnaire. Validity of the questionnaire is obtained to 0.85 using Cronbach's Alpha. In this study, ANP method is used to measure the correlation between indices and sub-indices of human capital and the best index and sub-index of human capital are selected.

- "An Empirical study of employee loyalty, service quality and firm performance in the service industry" by Yee, w.y Rachel , Yeng, cl Andy & Cheng t.c, Edwin (2010)

In this study, it has been mentioned that according to obtained results, loyalty of employee within the organizations is in correlation with quality of the services and the results of such correlation could be customer loyalty to the organization and this could cause profitability and improvement of organizational performance.

- "Psychological Empowerment and Job Satisfaction An Analysis of Interactive Effects" by Wang, Guangping & D.lee, peggy (2009)

This study was focused on this concept that job satisfaction is an important and effective issue in performance of employees of every organization. The aim by job satisfaction is a kind of enjoyment and positive feeling to work that is a function of the relationship between what the employee expects from the job and what is supplied for the individuals.

III. Methodology

The aim by selecting methodology is to specify that what method and approach is given to help the author to achieve to answers for research questions exactly, easily, rapidly and cost-effectively.

In terms of purpose, the present study is a applied research and in terms of nature and method, it is descriptive-mathematical research, since it analyzes the present time and describes what is presently existed. Descriptive research includes a series of methods with the aim of describing studied conditions or phenomena. Descriptive studies have both applied and fundamental dimensions. In applied dimension, the results of these studies can be

used in processes of decision making, policy making and planning. Decision making and policy making is in scope of works of management. To be aware of these affairs and works, descriptive researches are required.

The method used in this study is applied method in terms of orientation and in terms of purpose, it is a descriptive research and in terms of strategy, it is a survey. It means that the study has firstly identified the effective factors and then has used ANP technique to weight the obtained data.

In short, 4 main steps in frame of 4 phases should be passed to achieve the main research objective:

In phase 1, the required data are collected and the main and secondary factors affecting human resource loyalty are identified.

In phase 2, the questionnaire of paired comparisons is prepared and scoring is performed and the said questionnaire is distributed among the employees employed in staff department including reception agent, technical personnel in field of auto mechanics or auto electronic. Then, through putting the paired comparisons in Super Decision software, the significance coefficients of factors are determined.

In phase 3, the criteria are weighted and the sub-criteria are ranked through group fuzzy paired comparisons and through putting all results in ANP Super Matrix.

Finally in step 4, the adjustment of each main factor and validation is done.

Introducing data collection instruments

Data collection instruments in this study include interview and questionnaire.

Interview

Interview was with some managers and experts of after-sale service industry in field of combination and total schematic of the questionnaire and the manner of designing it. The questions of interview were in general frame of research hypotheses and questions and have resulted in designation of the questionnaire.

Questionnaire

Questionnaire as one of the most common data collection instruments in survey studies refers to a series of goal-oriented questions that measure the idea and attitude of a respondent using various scales.

At the present study, in order to validate research instrument and to test its accuracy, the questionnaires were distributed among the experts of after-sale service industry for test and after meeting the defects in it, final questionnaire was designed.

In order to conduct this study, 3 groups of questionnaires were provided and were distributed in statistical population consisting 80 people of technical and staff personnel employed in authorized dealers in Tehran and other provinces.

The first questionnaire was arranged for paired comparisons of main criteria to goal.

Second questionnaire was arranged and distributed for paired comparisons of main criteria with each other and to determine interactions of main criteria with each other.

The third questionnaire was arranged to perform paired comparisons of sub-criteria with main criteria.

Design of items of questionnaires was in such manner that the respondents had to choose one qualitative option from equal importance to very high importance or absolute importance for each item.

In the step of distribution of questionnaire, in order to prevent any kind of ambiguity affecting answers and to facilitate understanding the concept of ANP method, a combination of interview and questionnaire methods is used to meet the respondents in person to explain the concept and content of questionnaires for them. After collection of questionnaires, the data in the questionnaires were classified and used to weight each index of ANP technique.

Determining criteria and sub-criteria

The first step in the paired comparison process is creating a graphical illustration of the problem to show purpose, criteria and sub-criteria. The first level has shown the purpose that is identification of human resource loyalty factors in after-sale network. The second level of hierarchical structure includes 3 main factors affecting employee loyalty including financial factors, value (behavioral) factors and environmental factors

The third level has shown the sub-criteria and secondary factors related to each main criterion of second level. Therefore, each level includes factors caused by previous level and hence, as realization of main objective in first level is caused by main criteria in second level, the second level criteria are also affected by secondary criteria of third level. In order to determine weight and priority of the mentioned factors and criteria in hierarchical structure, question form is regulated for each factor that compares each factor in paired form with another factor.

Reliability of the questionnaires in this study has been measured through calculating the rate of incompatibility of paired comparison matrixes.

In field of using ANP method to show reliability of all paired comparisons and calculations, total incompatibility of network should be measured. According to Sa'ati, if the incompatibility value is below 0.1, the paired comparison data could be reliable. Total incompatibility of network in this study is estimated using Super Decision software.

Data collection methods

The present study is in kind of library-field method in terms of data collection method.

In the section of data analysis, data collection is done using field method and using questionnaire and observations and interview with personnel and documented information existed in authorized dealers.

Statistical population

Statistical population consists of assumptive or real individuals, to which the results of research are generalized. In each study, the studied population is usually a population that the author is interested in studying variables feature or features of its units.

Statistical population in this study consists of authorized dealers of ISACO Company that include 2 following groups in this study:

First group consists of staff personnel responsible for management and providing required coordination to implement the affairs properly and second group consists of technical personnel responsible for doing auto repairing in authorized dealers.

Moreover, according to findings of Salermon, Lopez et al, it could be mentioned that at least 8-18 and in maximum level, 100 numbers can be good sample size for studies, in which AHP and ANP methods are used. Hence, this study has selected 80 people of personnel employed in authorized dealers.

IV. Data analysis

In order to analyze the status of types of factors affecting loyalty of employees and measuring them, an appropriate model is designed as follows.

The model has been simulated for purpose of estimating limit super matrix and estimating incompatibility rate in super decision software in 3 levels in form of 3-level decision network.

In order to obtain weight of main and secondary factors, paired comparisons are required.

Paired comparisons of main criteria

The decision making group consists of 80 people of technical and staff personnel. Therefore, paired comparison matrixes are obtained by the geometric average obtained from paired comparisons of 80 people.

As sample, after collecting responses of personnel about importance of C1 factor (financial) compared to C2 (behavioral or value factor), it was found that 19 personnel believed that C1 has absolute importance compared to C2 and 5 personnel believed that C1 had very high importance.

Then, to form paired comparison matrixes to weight the criteria, geometric average calculations of the comparisons are presented to achieve to consensus of personnel as follows:

1- Collecting opinions of 80 personnel in relation with degree of importance of C1 compared to C2:

Assuming $K_i = (l, m, u)$ is the opinion of i personnel in relation with importance of C1 compared to C2,

$k_1 = (1, 1, 1)$, $k_2 = (1, 1, 1)$, $k_3 = (1, 1, 1)$, $k_4 = (2/7, 1/3, 2/5)$, $k_5 = (5/2, 3, 7/2)$, $k_6 = (2/7, 1/3, 2/5)$ and

2- Estimating geometric average of total opinions of k personnel:

In order to perform paired comparisons in group form, after obtaining fuzzy paired comparison table for each person, the following equation is used to combine opinions of individuals and to obtain final tables of paired comparisons (Ataei, 2010):

$$Z_{ij}^k = (\sqrt[k]{l_1 l_2 l_3 \dots l_k} \text{ (and } \sqrt[k]{m_1 m_2 m_3 \dots m_k} \sqrt[k]{u_1 u_2 \dots u_k} \text{)} \quad (2)$$

For C1 compared to C2, the values (0.9158, 1.0746, and 1.2436) are obtained

Table 2: consensus of paired comparisons of main criteria compared to purpose in fuzzy form

consensus of paired comparisons of main criteria compared to purpose in fuzzy form			
	C1	C2	C3
C3	(1.1331, 1.2753, 1.4193)	(1.6633, 1.9481, 2.232)	(1, 1, 1)
C2	(0.9158, 1.0746, 1.2436)	(1, 1, 1)	
C1	(1, 1, 1)		

Paired comparisons of main criteria with each other

Personnel have mentioned their opinions about the importance level of each main criterion using lingual variables of table 1. In this field, all main criteria are evaluated compared to a criterion and in next step, they are

weighted. Through changing lingual estimations to fuzzy numbers, initial direct correlation matrix of $A = [a_{ij}]$ is obtained; where, A is a nonnegative $n \times n$ matrix and the a_{ij} is a triangular fuzzy number.

Tables 3, 4 and 5 have presented consensus of paired comparisons done by personnel for all main criteria towards a component.

Table 3: consensus of paired comparisons of main criteria with each other in fuzzy form compared to C1

compared to C1	C2	C3
C3	(1.4142, 1, 581.1, 1.7321)	(1,1,1)
C2	(1,1,1)	

Table 4: consensus of paired comparisons of main criteria with each other in fuzzy form compared to C2

compared to C2	C1	C3
C3	(0.529, 0.853, 0.6325)	(1,1,1)
C1	(1,1,1)	

Table 5: consensus of paired comparisons of main criteria with each other in fuzzy form compared to C3

compared to C2	C1	C2
C2	(0.825, 1, 1.225)	(1,1,1)
C1	(1,1,1)	

Paired comparisons of sub-criteria with main criteria

As it was observed, in same manner, the paired comparisons of sub-criteria compared to their main criterion are done based on opinions of personnel.

Weighting main criteria and sub-criteria

In order to weight the criteria and sub-criteria, all elements of paired comparison matrixes in triangular fuzzy numbers should be changed into definitive numbers, methods used for this purpose are called as general title of defuzzification methods. The applied defuzzification method used in this study is centroid method. In this method, the center of gravity of the area under the fuzzy membership function diagram has been determined as absolute value of fuzzy number. For this purpose, following process is used:

In order to change fuzzy number $\tilde{M}=(l,m,u)$ to definitive number, the equation $\frac{(U-L)+(M-L)}{3}+L$ is used;

where, L refers to low boundary of membership function, M is the component with highest degree of membership and U is the upper boundary of membership function of triangular fuzzy number.

Weighting and estimating compatibility

After changing the fuzzy numbers to definitive numbers, super decision software is used to weight matrixes and to estimate consistency rate. The results obtained for comparing factors with purposes are presented in tables following.

Table 6: consensus of paired comparisons of main criteria with purpose after defuzzification and weighting

factors	C3	C2	C1	weight
C1	0.2759	1.9478	1	0.3624
C2	1.078	1		0.3969
C3	1			0.2406

Inconsistency rate is also estimated using Super Decision software and $CR= 0.026$ is obtained, which is lower than 0.1 and this shows consistency of responses of personnel.

As it was observed, C2 has the highest importance and C3 has the lowest importance level. Final weight of each

main criterion to purpose is in form of matrix A: $\begin{bmatrix} 0.3624 \\ 0.3969 \\ 0.2406 \end{bmatrix}$ and then, comparison of criteria with each other is done as follows:

Table 7: consensus of paired comparisons of main criteria to C1

compared to C1	C3	C2	weight
C2	1.5758	1	0.6117
C3	1		0.3882

Table 8: consensus of paired comparisons of main criteria to C2

compared to C2	C3	C1	weight
C1	1.5815	1	0.3676
C3	1		0.6323

Table 9: consensus of paired comparisons of main criteria to C3

compared to C3	C2	C1	weight
C1	1.0167	1	0.5041
C2	1		0.4958

According to the results obtained from the table, importance level of C2 to C3, to C1 is higher to 1.5758. The remained results are also interpreted in same manner. Therefore, under the C1, weights of other main criteria are obtained.

Moreover, inconsistency rate estimated here is equal to 0.0001 and this value shows consistency of the results. After obtaining weight of all main criteria to each other, the obtained results are presented as matrix B:

$$B = \begin{bmatrix} 0 & 0.3676 & 0.5041 \\ 0.6117 & 0 & 0.4958 \\ 0.3882 & 0.6323 & 0 \end{bmatrix}$$

After obtaining weight of all sub-criteria to their main criterion, the obtained results are presented as matrix C:

$$C = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0.3044 & 0 & 0 \\ 0.2587 & 0 & 0 \\ 0.2159 & 0 & 0 \\ 0.2209 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0.2077 & 0 \\ 0 & 0.1718 & 0 \\ 0 & 0.1929 & 0 \\ 0 & 0.1919 & 0 \\ 0 & 0.2355 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0.2465 \\ 0 & 0 & 0.2289 \\ 0 & 0 & 0.1299 \\ 0 & 0 & 0.2518 \\ 0 & 0 & 0.1428 \end{bmatrix}$$

Formation of unweighted super matrix

As all comparison matrixes in this study are estimated in structure of unweighted super matrix (A, B and C) and their consistency has been also controlled, through replacing these matrixes in initial super matrix, the unweighted super matrix is obtained.

Cluster Node Labels		purpose 0.1	main criteria 0.2			sub-criteria 0.3			
		manpower loyalty factors	C1	C2	C3	C1-1	C1-2	C1-3	C1-4
purpose 0.1	manpower loyalty factors	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
main criteria 0.2	C1	0.362443	0.000000	0.367689	0.504140	0.000000	0.000000	0.000000	0.000000
	C2	0.396951	0.611771	0.000000	0.495860	0.000000	0.000000	0.000000	0.000000
	C3	0.240607	0.388229	0.632311	0.000000	0.000000	0.000000	0.000000	0.000000
sub-criteria 0.3	C1-1	0.000000	0.304433	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	C1-2	0.000000	0.258715	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	C1-3	0.000000	0.215949	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	C1-4	0.000000	0.220902	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Figure 2: unweighted super matrix

Estimating weighted super matrix

The weighted super matrix is such a matrix that summation of its columns is equal to 1. In order to change the unweighted super matrix to weighted super matrix, the unweighted super matrix should be multiplied in cluster matrix. Cluster matrix can reflect the effect of each cluster to achieve research objectives. Cluster matrix is

obtained from paired comparison of clusters in framework of initial super matrix structure. According to suggestion of Sa'ati, to obtain relative importance of clusters in initial super matrix, it is essential to calculate cluster matrix in such manner that its columnar clusters can be considered as control elements. Now, to obtain weighted super matrix, each element of columnar clusters of unweighted super matrix should be multiplied in vector of relative importance of the cluster. Obtained weighted super matrix is probable; meaning that summation of its columnar elements is equal to 1.

Cluster Node Labels		purpose 0.1	main criteria 0.2			sub-criteria 0.3			
		manpower loyalty factors	C1	C2	C3	C1-1	C1-2	C1-3	C1-4
purpose 0.1	manpower loyalty factors	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
main criteria 0.2	C1	0.362443	0.000000	0.183844	0.252070	0.000000	0.000000	0.000000	0.000000
	C2	0.396951	0.305886	0.000000	0.247930	0.000000	0.000000	0.000000	0.000000
	C3	0.240607	0.194114	0.316156	0.000000	0.000000	0.000000	0.000000	0.000000
sub-criteria 0.3	C1-1	0.000000	0.152217	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	C1-2	0.000000	0.129358	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	C1-3	0.000000	0.107975	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	C1-4	0.000000	0.110451	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Figure 3: unweighted super matrix

Estimating limit super matrix

The aim by limiting weighted super matrix is to obtain long-term relative effect of elements in each other (for divergence of importance coefficient of each element in weighted matrix). Hence, it reaches to k exponent that is a big arbitrary number, so that all elements in super matrix are replicated. This is done with iteration. Under such conditions, limit super matrix is obtained.

Cluster Node Labels		purpose 0.1	main criteria 0.2			sub-criteria 0.3			
		manpower loyalty factors	C1	C2	C3	C1-1	C1-2	C1-3	C1-4
purpose 0.1	manpower loyalty factors	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
main criteria 0.2	C1	0.151484	0.151484	0.151484	0.151484	0.000000	0.000000	0.000000	0.000000
	C2	0.177482	0.177482	0.177482	0.177482	0.000000	0.000000	0.000000	0.000000
	C3	0.171034	0.171034	0.171034	0.171034	0.000000	0.000000	0.000000	0.000000
sub-criteria 0.3	C1-1	0.046117	0.046117	0.046117	0.046117	0.000000	0.000000	0.000000	0.000000
	C1-2	0.039191	0.039191	0.039191	0.039191	0.000000	0.000000	0.000000	0.000000
	C1-3	0.032713	0.032713	0.032713	0.032713	0.000000	0.000000	0.000000	0.000000
	C1-4	0.033463	0.033463	0.033463	0.033463	0.000000	0.000000	0.000000	0.000000

Figure 4: limit super matrix

V. Conclusion

According to obtained results from this study (table 10), personnel employed in staff and technical departments believe that behavioral and value factor is the most important effective factor among factors affecting human resource loyalty in the after-sale service network. In order to enhance the satisfaction of employees in this

component, senior management of every company should create a suitable human resource management (HRM) system to make personnel have high satisfaction and job security in their workplace. After this factor, environmental factor plays the most important role in creating manpower loyalty. In relation with this factor, ineffectiveness of training courses and problem with holding training courses can result in dissatisfaction of employees.

Table 10: final weight of each effective criterion and sub-criteria based on Fuzzy ANP technique

main criteria	total weight of main criteria of limit matrix	final rank	sub-criteria	total weight of sub-criteria of limit matrix	rank in group	final rank
financial factor C1	0.1514	3	C1-1	0.0461	1	1
			C1-2	0.0391	2	5
			C1-3	0.0327	4	11
			C1-4	0.0334	3	10
behavioral (value) factor C2	0.1774	1	C2-1	0.0368	2	6
			C2-2	0.0304	5	12
			C2-3	0.0342	3	8
			C2-4	0.03406	4	9
			C2-5	0.0418	1	4
environmental factor C3	0.171	2	C3-1	0.0421	2	3
			C3-2	0.0391	3	6
			C3-3	0.0222	5	14
			C3-4	0.04306	1	2
			C3-5	0.0244	4	13

Moreover, the results show that wage and salary level has possessed first rank among the effective factors. This is because; this factor can cause enhancement of motivation in individuals. However, managers found gradually that financial rewards as motivating factor are not sufficiently powerful anymore and the employees generally tend to have job security and sense of emotional mutual belonging with the organization instead of making least wage.

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