

APPLICATION OF FUZZY COMPREHENSIVE EVALUATION METHOD FOR HUMAN CAPITAL EVALUATION IN A SERVICE ORGANIZATION

*MSV. Prasad, **Dr. B. Sandhya Sri, &*** Dr.M. Ratna Kala

*Head –Department of Finance, GITAM Institute of Management – GITAM-Vizag-India

** Associate Professor, *** Associate Professor – Mrs. AVN College, Visakhapatnam – India

ABSTRACT

Purpose: The chief objective of this paper is to evaluate human capital of select Indian service organization through application of Fuzzy comprehensive evaluation method. Performance Evaluation of Human Resource Management is an uncertain concept; in the other world it is fuzzy, therefore, to judge it by precise mathematical knowledge is unrealistic. This paper applied fuzzy systems method to work out a comprehensive evaluation of human capital of a service organization with an objective of helping organizations like Port with their performance evaluation.

Design/Methodology/Approach: The study has used fuzzy comprehensive evaluation method for performance evaluation. It begins with identifying the parameters related to human capital and which is again categorized into sub categories. Since each indicator has different significance, relative weights were derived for each category by using fuzzy AHP approach. A total of 300 employees in Port has giving their impression on different indicators. Based on their rankings and relative weights, evaluation matrix was derived which was later used to form comprehensive evaluation metric.

Findings: The results show that the evaluation result of human capital of the Port is nearly good in the range of 5 to 6. Membership degree calculation shows that if an organization's full value is 100% then only 58.9% is fulfilled, due to comprehensive influence of the different factors.

Research Limitations/implications: Study is confined to single service organization and this study is concentrated on Human Capital rather than Intellectual Capital.

Practical Implications: This paper applied fuzzy systems method to work out a comprehensive evaluation of human capital of a service organization with an objective of helping organizations like Port with their performance evaluation.

Originality/Value: Adoption of fuzzy comprehensive evaluation method along with fuzzy Analytical Hierarchy Process (AHP) for evaluation of human capital is a new methodological approach among Indian companies. And further the paper shows how readily the human capital can be evaluated through fuzzy comprehensive evaluation method.

Key words: human capital evaluation – application of fuzzy AHP – fuzzy comprehensive evaluation method-case study -Indian Port.

INTRODUCTION

Human capital has aroused widespread concern with the development of the knowledge-based economy, in recent years. Human capital is organic synthesis of all kinds of human that acquires over value in the proceeds, which in turn warrants an organization to achieve sustainable competitive advantage. Human capital is relatively independent and the first capital of intellectual-based economy. Human capital is the inevitable outcome in a knowledge-based economy where knowledge has become a determinant capital for enterprise to retain and improve competitive advantage. Contrast to the traditional capital can be measured in accordance with financial reports. It is a new challenge for the organizations to evaluate the performance of human capital.

On the other hand a huge body of literature demonstrates a positive linkage between the development of human capital and organisational performance. The emphasis on human capital in organisations reflects the view that market value depends less on tangible resources, but rather on intangible ones, particularly human resources. Recruiting and retaining the best employees, however, is only part of the equation. The organisation also has to leverage the skills and capabilities of its employees by encouraging individual and organizational learning and creating a supportive environment in which knowledge can be created, shared and applied.

As for the measurement of value accounting of the human capital, it is more complicated and has created a scope for empirical research. For the purpose of measurement of value of human capital, there are broadly two major methods: monetary measurement and nonmonetary measurement. Human capital has some similar characteristics as the intangible asset. Therefore, the monetary measurement methods applied to it still remains at the stage of theoretical research.

Therefore, qualitative evaluation methods of human capital are proposed to tackle the existing problems of traditional financial report methods such as Analytic Hierarchy Process (AHP), Balanced Score Card (BSC), European Foundation of Quality Management (EFQM) and Value-Chain Scoreboard etc . According to the classification of human capital, we can understand that human capital includes many intangible factors and items which are not easily quantified. This is the dilemma for the current study of human capital. But this dilemma can be solved by application of fuzzy comprehensive evaluation method.

Performance Evaluation of Human Resource Management is an uncertain concept; in the other world it is fuzzy, therefore, to judge it by precise mathematical knowledge is unrealistic. This paper will use fuzzy systems method to work out a comprehensive evaluation of human capital of a service organization with an objective of helping organizations like Port with their performance evaluation. In this papers, we have applied fuzzy comprehensive evaluation method to evaluate human capital of Visakhapatnam Port Trust (VPT). We have derived the human capital indicators and have used fuzzy Analytic Hierarchy Process (AHP) to identify relative weights of the indicators on which an appropriate membership function is constructed. Finally evaluation result of human capital of the Port is derived at.

1. Literature Review

Commonly, Human Capital (HC) is categorized with three main constructs including human capital, organizational capital and relational capital. In the literature, the illustrative definitions of these constructs are summarized as follows:

a. Human capital is the individual-level knowledge, such as professional skills, experience, and innovativeness that each employee possesses. It is the human capital that provides the most valuable assets (Stewart, 1999).

b. Organizational capital is the sum of all assets pertaining to the firm which make the creative ability of the organization possible. The vision of the firm, management philosophy, organization culture, strategies, processes, working systems, and information technology can be mentioned among these assets (Edvinsson & Malone, 1997).

c. Technological capital – refers to the combination of knowledge directly linked to the development of the activities and functions of the technical system of the organization, responsible for obtaining products and services;

d. Relational capital is the sum of all assets that arrange and manage the firm's relations with the environment. The relational capital contains the relations with customers, suppliers, shareholders, the rival, community, the official institutions, and society (Roos & Roos, 1997). As the organization size increases, the side effects grow and it becomes difficult to exert control and influence for effective organizational functions. This in turn leads to the development of decentralization as a solution for effective control. The common trajectory of structural transition depicts a scenario in which hierarchical structure is giving way to flatter and more flexible structures in the post-modern world of business (Piercy & Cravens, 1994), therefore calling for the rise of organic structure. As a result, the organic structures improve human capital and make competitive advantage in the changing environment.

e. Business capital – refers to the value to the organization of the relationships which it maintains with the main agents connected with its basic business processes (customers, suppliers, allies, etc.)

f. Social capital – the value to the organization of the relationships which it maintains with other social agents and its surroundings (Martín de Castro & López Sáez, 2008). In this research, we consider the most popular components of human capital in the literature.

Liu Xin; et al, (2009) showed an application of fuzzy comprehensive appraisal in evaluation of human capital of a hypothecated organization. They showed new methodological approach of human capital evaluation. How financial performance of hotel industry could be improved by development of intellectual capital is highlighted by Mojtaba et al (2011). They used fuzzy Analytic Hierarchy Process (AHP) technique for evaluation of intellectual capital of a hotel industry.

Yanming & Weihua (2009) applied a fuzzy AHP model and showed that the evaluation result can objectively reflect the intellectual capital management of construction enterprises. This research provided a new methodological way for evaluation of intellectual capital management in construction organization.

Honglei Zhang (2009) established that the evaluation of human resource management performance could promote commercial banks to perfect and improve human resource management comprehensively, directionally, and intentionally, which is of practical significance. The paper eliminated the redundant data in index membership for object classification by defining distinguishable weight and extracted valid values to compute object membership. The new algorithm of membership degree transformation includes three calculation steps which can be summarized as "effective, comparison and composition", which is denoted as $M(1,2,3)$. He applied the new algorithm in fuzzy evaluation on the performance of human resources management of commercial banks.

Bozbura et al., (2007) proposed extent fuzzy analytic hierarchy process (AHP) to improve the quality of prioritization of human capital under fuzziness. With this model, the authors concludes that in Turkey, the indicators "creating results by knowledge", "employee skills index", "sharing and reporting knowledge", and "succession rate of training programmes" are the most important measurement indicators. Lee (2010) developed intellectual capital evaluation model to assess the performance contribution in a university. He has undertaken this study in Taiwan and has used fuzzy AHP to make up for the vagueness in the decision makers judgment.

Most of the studies are reported outside India. There is a great demand for extension of fuzzy analytic hierarchy process (AHP) for evaluation of human capital in India too. Our study fills this gap and may provide some guidelines for application of the same AHP for evaluation of human capital of Indian organization.

2. METHODOLOGY

General steps of Fuzzy Comprehensive Evaluation Method : Fuzzy comprehensive evaluation method is a way to make integrated decision on things for some specific purposes, taking into consideration of many factors at a fuzzy environment. According to the evaluation standard and the measured values, this method, through fuzzy transformation, makes

evaluation of the things, and then based on the evaluation results, selects the best sort. The fuzzy comprehensive evaluation of human capital is generally carried out through the following steps:

a. set up evaluation system U for human capital. Decompose the different factors related to human capital, and these factors will be further refined for a number of relevant indicators in accordance with the actual situation.

b. Thus a human capital evaluation index system $U(U_1, U_2, \dots, U_n)$ covering all factors is established. (2) establish an evaluation criteria set V . Set up the evaluation results set $V(V_1, V_2, \dots, V_m)$ that the evaluators can make about the objects (targets). During the evaluation of human capital for different indicators, we can use (quite good, good, average, bad) and similar evaluation criteria to measure it.

c. assess the indicators' weight coefficient W in the overall evaluation. Because there are differences between different factors' relevance and importance to human capital, we reflect, through the establishment of the weights set $W(W_1, W_2, \dots, W_n)$, the different roles the various factors play in the impact on human capital.

d. determine evaluation matrix R . Evaluation matrix R , also known as factor evaluation matrix, is to evaluate the votes of performance results of the owner of human capital.

e. comprehensive evaluation. By calculating and analyzing the above data, the importance and role of the owner of the human capital in all the employees are determined. Generally we use B to express the results of fuzzy evaluation, $B=W \times R$.

The followings are on the practical application of fuzzy comprehensive evaluation method in the evaluation of human capital.

Establishment of Evaluation Index System of Human Capital in Visakhapatnam Port Trust

Parameter of Human Capital in Visakhapatnam Port Trust

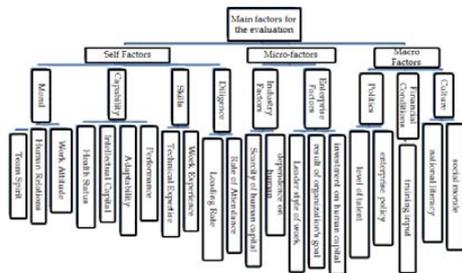


Fig 1: Factors of Evaluation

Establish the Evaluation Criteria for the Evaluated Indicators

In this study, the reference standards for human capital evaluation index are generally four or five grades, that is four grades (excellent, good, average, bad) or five grades (very good, good, average, bad, very bad). After selecting the evaluation criteria grade, we will use different expressions for different indicators. Suppose we use the five grades, for the indicator "team spirit", the evaluation criteria can be (very strong, strong, average, bad, very bad); however, for such indicator as "job attitude", the evaluation criteria can be (very good, good, average, bad, worse). VI and V3 share the same nature (for the five evaluation criteria), the slight differences lie in the choice of the expressions.

Many factors account for the impacts on the human capital of logistic enterprises and the followings are the three major ones: self-factor, micro-factor and macroeconomic factor. Clearly these three factors are not easy to evaluate because they their scope is too large. We further subdivide each category of factors. Taking into consideration the influence of economics, management, psychology and behavior on human capital, the system of evaluation elements, that is U (U1,U2, … ,U23), is set up, which is shown in Figure I of the evaluation system consisting of 21 indicators. Different organizations can set reasonable factors according to their own environment. In this paper, a total of 21 indicators and five grades as excellent, very good, good, average and poor are used for evaluation.

Determine the Weight Coefficient of the Factors

Because various indicators have different impact on human capital, the weight coefficient of the indicators should be determined by the importance of the indicators. Generally speaking, the weight coefficients can determine the level of analysis, expert analysis and questionnaires, etc. to determine the W. we have used

for this research fuzzy AHP (Analytic Hierarchy Process) method.

Fuzzy AHP Method

Zadeh (1965) first introduced the fuzzy set theory to deal with the uncertainty due to imprecision or vagueness. A fuzzy set $\tilde{A} = \{ (x, \mu_{\tilde{A}}(x)) | x \in X \}$ is a set of ordered pairs, let the universe of discourse X be the subset of real number R, where $\mu_{\tilde{A}}(x)$ is called the membership function which assigns to each Using Fuzzy AHP to Develop human Capital Evaluation Model in Hotel Industry 175 object x a grade of membership ranging between zero and one. Triangular fuzzy number is the most widely used membership function in many application fields because of its intuitive appeal and computational efficiency. A triangular fuzzy number, defined to be a normal and convex fuzzy subset of X and denoted as $\tilde{A} = (a, b, c)$, has the following membership function (Kaufmann, A., & Gupta, M. M. ,1991).

The parameter “b” gives the maximal grade of $\mu_{\tilde{A}}(x)$, the parameters “c” and “a” are the upper and lower bounds which limit the field of possible evaluation. In this research, triangular fuzzy numbers are used to represent subjective pair-wise comparisons of experts’ judgments among the options such as just equal, equally, weakly, moderately, strongly, and extremely. The triangular fuzzy conversion scale used to convert such linguistic values into fuzzy scales in the evaluation model of this paper is shown in Table 1.

Table 1: Triangular fuzzy conversion scale

Linguistic scale	Triangular fuzzy scale	Triangular fuzzy reciprocal scale
Just equal	(1,1,1)	(1,1,1)
Equally important	(½, 1, 3/2)	(2/3, 1,2)
Weakly more important	(1, 3/2, 2)	(1/2, 2/3,1)
Moderately more important	(3/2, 2 ,5/2)	(2/5, ½ , 2/3)
Strongly more important	(2, 5/2, 3)	(1/3, 2/5, ½)
Extremely more important	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)

This paper applies Chang’s extent analysis method (Chang, D. Y,1996) since the steps of this approach are similar to the conventional AHP and relatively less

complex than the other fuzzy AHP approaches (Lee, 2010). According to Chang's extent analysis method, the value of fuzzy synthetic extent is define, using the standard fuzzy arithmetic, as below:

$$S_i = \sum_{j=1}^m M_i^j \otimes \left[\sum_{i=1}^n \sum_{j=1}^m M_i^j \right]^{-1} - 1$$

Where M_i^j is a triangular fuzzy number representing the extent analysis value for decision element i with respect to goal j . M_i^j is the generic element of a fuzzy pair – wise comparison matrix like the one used in the AHP method. The degree of possibility of $M_1 \geq M_2$ is defined as:

$$V(M_1 \geq M_2) = \text{Sup}_{x \geq y} [\min(\mu_{M_1}(X), \mu_{M_2}(Y))] - 2$$

and can be equivalently expressed as follows:

$$V(M_1 \geq M_2) = \text{hgt}(M_2 \cap M_1) = \begin{cases} 1, & \text{if } b_1 \geq b_2 \\ 0, & \text{if } a_2 \geq c_1 \\ \frac{c_1 - a_2}{(c_1 - a_2) - (b_2 - b_1)}, & \text{otherwise} \end{cases} - 3$$

The degree of possibility for a convex fuzzy number to be greater than k convex fuzzy number M_i ($i = 1, 2, \dots, k$) can be defined by

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_2) \text{ and } (M \geq M_3) \text{ and } \dots \text{ and } (M \geq M_k)] = \min V(M \geq M_i), i=1,2,3,\dots,k. -4$$

Assume that:

$$d'(A_i) = \min V(S_i \geq S_k) - 5$$

For $k = 1, 2, \dots, n$; $k \neq i$ then the weight vector is given by

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T - 6$$

Where A_i ($i = 1, 2, \dots, n$) are n decision elements. Via normalization, the normalized weight vectors are

$$W = (d'(A_1), d'(A_2), \dots, d'(A_n))^T - 7$$

Where W is a non-fuzzy number. Compared to conventional AHP, The fuzzy AHP approach allows a more accurate description of the decision making process.

Evaluation of different objects to determine the evaluation matrix

According to evaluation of human capital owners in the evaluation index system of U in the performance of various factors, the jury members by Level in accordance with the evaluation criteria to vote, while the indicators of any case the evaluation criteria for

each Level in the ratio of the number of judges to vote to form the evaluation matrix R .

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{15} \\ r_{21} & r_{22} & \dots & r_{25} \\ \vdots & \vdots & \ddots & \vdots \\ r_{211} & r_{212} & \dots & r_{215} \end{bmatrix}$$

Comprehensive Evaluation

Through the above mentioned set analysis of 3.1 to 3.4 comprehensive evaluation can be employed in the form of $B = W \times R$

$$B = (w_1, w_2, \dots, w_{21}) \begin{bmatrix} r_{11} & r_{12} & \dots & r_{15} \\ r_{21} & r_{22} & \dots & r_{25} \\ \vdots & \vdots & \ddots & \vdots \\ r_{211} & r_{212} & \dots & r_{215} \end{bmatrix} = (b_1, b_2, \dots, b_{21})$$

B stands for weighted rating given for each indicator by the experts. Comparative evaluation of human capital is measured as follows :

$$F = b \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix}$$

The membership degree of the evaluation result of human capital is derived by the following formula:

$$L = F/5$$

3. RESULTS

Table 2: Category wise paired comparisons

	Morale	Capacity	Skills	Diligence	Industry Factors	Enterprise Factors	Culture	Financial Conditions	Politics
Morale	(1,1,1)	(1/3,2/5, 1/3)	(2/5, 2/3)	(1/3,2/5, 1/3)	(1/2,1,3/2)	(1/3,2/5, 1/3)	(2/5, 2/3)	(2/5, 2/3)	(2/5, 2/3)
Capacity	(2,5/2,3)	(1,1,1)	(2/5, 2/3)	(2/5, 2/3)	(1/3,2/5, 1/3)	(1/3,2/5, 1/3)	(3/2,2,5/2)	(1/3,2/5, 1/3)	(1/3,2/5, 1/3)
Skills	(3/2,2,5/2)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)	(3/2,2,5/2)	(1/2,1,3/2)	(3/2,2,5/2)	(2/5, 2/3)	(3/2,2,5/2)
Diligence	(2,5/2,3)	(3/2,2,5/2)	(2/5, 2/3)	(1,1,1)	(2/5, 2/3)	(2/5, 2/3)	(3/2,2,5/2)	(2/5, 2/3)	(2/5, 2/3)
Industry Factors	(2/3, 1,2)	(2,3/2,3)	(2/5, 2/3)	(3/2,2,5/2)	(1,1,1)	(2/5, 2/3)	(3/2,2,5/2)	(2/5, 2/3)	(2/5, 2/3)
Enterprise Factors	(2,3/2,3)	(2,3/2,3)	(2/5, 2/3)	(3/2,2,5/2)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)	(1/2,1,3/2)	(1/2,1,3/2)
Culture	(3/2,2,5/2)	(2/5, 2/3)	(2/5, 2/3)	(2/5, 2/3)	(2/5, 2/3)	(2/5, 2/3)	(1,1,1)	(2/5, 2/3)	(1/2,2/3)
Financial Conditions	(3/2,2,5/2)	(2,3/2,3)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)
Politics	(3/2,2,5/2)	(2,3/2,3)	(2/5, 2/3)	(3/2,2,5/2)	(3/2,2,5/2)	(2/5, 2/3)	(1,3/2,2)	(2/5, 2/3)	(1,1,1)

Table 2 presents the pair wise comparison of different broad categories identified as the indicators of human capital. This information was completed by taking the opinions of experts in this field.

Similarly pair wise comparisons of subcategories within each category were also carried out.

In table 3, the evaluation matrix, weights, comprehensive evaluation, comparative evaluation and the membership degree for each category is presented.

Table 3: Evaluation Data calculated for categories defined in the human capital

Category	R	W	B	F	L
Morale	0.23 0.21 0.20 0.21 0.04 0.14 0.21 0.30 0.16 0.20 0.10 0.19 0.14 0.24 0.37	(0.47, 0.32, 0)	(0.182, 0.283, 0.238, 0.166, 0.158)	3.154	0.626
Capacity	0.19 0.21 0.21 0.10 0.28 0.18 0.21 0.22 0.18 0.18 0.14 0.15 0.18 0.18 0.15 0.11 0.22 0.22 0.22 0.23 0.19 0.22 0.22 0.22 0.25	(0.25, 0.25, 0.14, 0.35)	(0.170, 0.206, 0.197, 0.197, 0.229)	2.890	0.576
Skills	0.19 0.18 0.27 0.22 0.17 0.00 0.00 0.00 0.00 0.00	(1, 0)	(0.19, 0.19, 0.27, 0.22, 0.17)	2.96	0.992
Diligence	0.18 0.21 0.29 0.18 0.24 0.00 0.00 0.00 0.00 0.00	(1, 0)	(0.18, 0.21, 0.29, 0.18, 0.24)	3.11	0.622
Industry Factors	0.18 0.28 0.19 0.22 0.19 0.00 0.00 0.00 0.00 0.00	(1, 0)	(0.18, 0.28, 0.19, 0.22, 0.19)	2.95	0.587
Enterprise Factors	0.14 0.21 0.20 0.10 0.22 0.14 0.18 0.24 0.21 0.24 0.18 0.21 0.19 0.18 0.25	(0.33, 0.33, 0.33)	(0.162, 0.189, 0.234, 0.189, 0.225)	2.974	0.574
Culture	0.17 0.24 0.29 0.22 0.10 0.18 0.25 0.21 0.14 0.25	(0.5, 0.5)	(0.154, 0.227, 0.190, 0.1, 0.227)	2.881	0.574
Financial Condition	0.18 0.25 0.28 0.19 0.17 (1)	(1)	(0.18, 0.25, 0.28, 0.19, 0.17)	3.016	0.603
Politics	0.18 0.28 0.17 0.18 0.23 0.18 0.27 0.21 0.17 0.17	(0.5, 0.5)	(0.16, 0.23, 0.18, 0.15, 0.22)	2.972	0.594

From table 3, it is seen that the port score more on the factors related to morale that includes attitude towards work, human relations and team spirit that accounts for 62.6%, followed by diligence that includes loading rate and rate of attendance. Financial conditions which includes training cost is accounted for a score of 60.3%. Whereas port scores less in categories such as enterprise factors that includes corporate culture, organizational structure, leader's style of work, investment on human capital and culture which includes national literacy and social morale.

The result indicates that when it comes to the interpersonal relationships and working among the peers, the human resources employed in the port is evaluated to be satisfactory but some improvement is necessary in the overall organizational structure, management and the culture that prevails in the organization.

After all comparisons and weighing process are done, we obtain the overall priority weight of each categories and sub categories. This is shown in table 4.

Table 4: Priority weights of all categories and sub-categories for their performance contribution is as follows:

Indicators	Morale	Capacity	Skills	Diligence	Industry Factors	Enterprise Factors	Culture	Financial Condition	Politics	Weights
attitude towards work	0.677507	-	-	-	-	-	-	-	-	0
Human relations	0.322493	-	-	-	-	-	-	-	-	0
Team spirit	0	-	-	-	-	-	-	-	-	0
health status	-	0.256223	-	-	-	-	-	-	-	0.062782
Intellectual level	-	0.230434	-	-	-	-	-	-	-	0.059422
adaptability	-	0.189468	-	-	-	-	-	-	-	0.046478
Performance	-	0.333872	-	-	-	-	-	-	-	0.087198
Technical expertise	-	-	1	-	-	-	-	-	-	0.079776
Work experience	-	-	0	-	-	-	-	-	-	0
Loading rate	-	-	-	1	-	-	-	-	-	0.477973
Rating attendance	-	-	-	0	-	-	-	-	-	0
scarcity of human factors	-	-	-	-	1	-	-	-	-	0.561134
dependent on human	-	-	-	-	0	-	-	-	-	0
leader style of work	-	-	-	-	0.33333333	-	-	-	-	0.303355
result of organization goal	-	-	-	-	0.33333333	-	-	-	-	0.303355
investment on human capital	-	-	-	-	0.33333333	-	-	-	-	0.303355
national literacy	-	-	-	-	-	0.5	-	-	-	0.046408
social morale	-	-	-	-	-	0.5	-	-	-	0.046408
Training input	-	-	-	-	-	-	1	-	-	1
the level of talent	-	-	-	-	-	-	-	0.5	-	0.383298
to enterprise policy	-	-	-	-	-	-	-	-	0.5	0.383298

From table 3, it is seen that for human capital evaluation, more weight is given to the financial condition, enterprise factors, skills and politics i.e., level of talent and enterprise policy and less weight is given to morale, culture and capacity factors.

Based on the above weights, the evaluation matrix, comparative evaluation and membership degree is as follows:

$$R = \begin{bmatrix} 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.06 & 0.06 & 0.06 & 0.06 & 0.06 \\ 0.06 & 0.06 & 0.06 & 0.06 & 0.06 \\ 0.04 & 0.04 & 0.04 & 0.04 & 0.04 \\ 0.09 & 0.09 & 0.09 & 0.09 & 0.09 \\ 0.19 & 0.15 & 0.27 & 0.22 & 0.17 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.18 & 0.21 & 0.29 & 0.18 & 0.14 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.15 & 0.25 & 0.19 & 0.22 & 0.19 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.14 & 0.21 & 0.26 & 0.18 & 0.22 \\ 0.14 & 0.18 & 0.24 & 0.21 & 0.24 \\ 0.18 & 0.21 & 0.19 & 0.18 & 0.25 \\ 0.05 & 0.05 & 0.05 & 0.05 & 0.05 \\ 0.05 & 0.05 & 0.05 & 0.05 & 0.05 \\ 0.15 & 0.25 & 0.25 & 0.19 & 0.17 \\ 0.15 & 0.28 & 0.17 & 0.15 & 0.25 \\ 0.18 & 0.27 & 0.21 & 0.17 & 0.17 \end{bmatrix}$$

B= (0.15, 0.23, 0.24, 0.18, 0.20)

F = 2.94

L = 0.589 in other words 58.9 per cent

The above result shows that the evaluation result of human capital of the Port is nearly good it is in the range of (5-6). Membership degree calculation shows

that if an organization's full value is 100% then only 58.9% is fulfilled, due to comprehensive influence of the different factors.

4. CONCLUSIONS

The fuzzy comprehensive evaluation method of human capital, with the combination of quantitative study and qualitative study, is more objective and impartial, and it is also more logical and practical. This method has proposed a new thought for the evaluation of human capital among Indian organization. By establishing the human capital evaluation index system, which may enables the management of Port not only to assess the results of the human capital evaluation, but also confirm the factors that influence the effects of human capital which may facilitate both optimization of human capital management and increase Port value.

Assessment of performance of Indian ports has become one of the most important challenges for Indian Government to develop new strategies which could help to improve their performance within their limited resources in the competitive environment. However a few applicable models have been addressed that concentrate on assessment of tangible performance of the major Ports in India. Assessment of human capital performance is not invented by either government of India, owner of the major Ports in India, or by the management of major Ports even though it has been recognized to be crucial for achieving over all success of the Ports. This study presents the development of a four category IC model for Visakhapatnam Port in particular and major Ports in general that distinguishes between human, structural, end-customer-relationship and non-end customer- relationship capital. The empirical study of Visakhapatnam Port showed that Human capital is the strongest IC category, with a weight of 0.589.

The weakest IC category is non-end-relationship capital which received a weight of 0.064. The study showed that in Human capital's sub-categories, employees' competence and employees' attitudes to work have equal weights and employees' innovativeness is the weakest sub-category in structural capital's sub-category. In addition, culture is the strongest and management philosophy is the weakest sub-category. End customer-relationship capital's sub-categories direct distribution channels is the strongest and image & brand is the weakest sub-categories and finally in non-end-relationship capital's sub-categories the both of the sub-categories have equal weights. In this paper, it is evident that Laleh's hotel management must

concentrate their efforts on the development of both kinds of relationship capital and less on the development of the human and structural capital. This research suggests persuasively that hotel firms should recognize the importance of IC for financial performance and consequently manage the IC subcategories in order to boost their financial results. It has been stated that all IC categories directly or indirectly influence financial results. Thus only end-customer-relationship capital has a significant direct impact on financial performance. This suggests that human, structural and non-end customer-relationship capital result in financial performance just through end-customer-relationship capital.

At the end, it can be concluded that financial performance in the Port can be improved by increasing the development of human capital which, in turn, must be developed concomitantly with other IC components. Thus, top management of the Port should be aware of that the development of human, structural, end-customer-relationship and non-end-customer-relationship capital can facilitate the financial growth of the business of the Port.

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