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Evaluation model for the human resources management with analytic hierarchy process (Part: Power distribution companies)

H. Nadiheidari, Z. Yanchun*

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Abstract The purpose of the present study is to present an integrated model for evaluating the comparative performance of units in power distribution companies. For this purpose, BSC technique is used to classify evaluation indices, statistical analysis is used to evaluate the significance and the significance of the identified indices, and finally, fuzzy AHP multi-criteria decision-making technique is used to compare and rank units. In this paper, we will discuss the research method. The research method is based on the purpose and method of data collection, the tools and methods of data collection, the statistical population, and the sample. Then the performance evaluation indices of the units are identified using 4 perspectives of BSC, a review of research literature, a meeting with organization managers, and a research questionnaire designed to identify essential indicators from the experts' point of view of the organization. The validity and reliability of the questionnaires are also described. Finally, methods for analyzing the results are presented. The purpose of this study is applied research and the results of this study can be used by power distribution companies to evaluate the performance of operational units and ultimately strategic planning to improve performance. It is also descriptive in terms of data collection and survey type. For this purpose, after creating the appropriate hierarchy of problems using BSC technique, AHP multi-criteria decision-making technique is used to determine the weight and priority of each indicator with a team of experts and managers of the organization.

Keyword: Designing an Evaluation, Human Resources Department, Analytic Hierarchy Process (AHP).

1 Introduction

An organization's performance is an index that measures the extent to which the goals set by the organization have been achieved [1]. In today's competitive business environment, characterized by scarcity of resources, management and performance evaluation play a vital role, and companies strive to improve their productivity and performance to succeed in such a global competition [2]. Hence, designing a rigorous and appropriate performance appraisal framework is beneficial to the organization [3, 4].

* **Corresponding Author. (✉)**
E-mail: gzhuzyc@163.com (Z. Yanchun)

H. Nadiheidari
School of Management and Business Administration, Guangzhou University, Guangzhou, China, 510006

Z. Yanchun
School of Management and Business Administration, Guangzhou University, Guangzhou, China, 510006

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One of the important prerequisites for an organization's survival in today's competitive environment is that the organization places the principle of continuous improvement at the heart of its business. Achieving continuous improvement can only be achieved by obtaining the necessary feedback from the internal and external environment of the organization through the creation and implementation of an efficient and effective performance evaluation system. Performance appraisal is a process that measures, evaluates, and judges' performance over a given period. Performance appraisal is an important task in facilitating organizational effectiveness. Nowadays, all companies and organizations have found that the implementation of organizational strategies requires the use of management system and performance measurement [3].

And on the other hand, such as the massive amount of information needed and the judgments that are made, it complicates the process of performance evaluation. Multi-criteria decision-making techniques would be a good tool to overcome the shortcomings and complexity of BSC performance evaluation and decision making.

The Analytical Hierarchy Process (AHP) technique was developed by Thomas Hourly in 2000 to solve complex decision problems in a relatively simple manner. It is one of the multi-criteria decision analysis methods and can be used to solve problems with more than one decision criterion [5]. The AHP technique makes it possible to evaluate the consistency of judgments made by experts, which is very important in validating the results [6]. This multi-criteria decision-making approach is used to rank decision options in addition to rating and weighting criteria.

AHP is a method in which a complex procedure is broken down into smaller sections, then subdivided into a hierarchical structure. In this method, numerical values are assigned on the basis of subjective judgments and the importance of each criterion is determined and the criteria that matter most are identified. In other words, the order of priority of the criteria is determined. The applications of this method have so far been proven in many scientific fields. It is a convenient way of analyzing complex issues and allows decision-making to be made by subjective judgments alongside the structure of influential criteria. In fact, the AHP has helped to understand the structure of a system and its environment in a way that has the interaction of components, reducing the likelihood of error, and in this way a large number of factors can be interfered with and used by gaining the weight of each factor [7].

Given the pressures and pressures of organizations, especially large organizations, to find comprehensive performance metrics and rational, applicable and applicable performance evaluation methods, as well as the need raised by Alborz Province Electricity Distribution Company, the present study is based on this.

The hierarchical analysis process begins with identifying and prioritizing decision elements. These elements include goals, criteria, or potential attributes and options that are used in the prioritization. The process of identifying the elements and the relationship between them that leads to a hierarchical structure is called a hierarchy. The structure is hierarchical because the decision elements (decision options and criteria) can be summarized at the levels.

2 Literature review

The hierarchical analysis process begins with identifying and prioritizing decision elements. These elements include goals, criteria, or potential attributes and options that are used in \prioritization. The process of identifying the elements and the relationship between them that leads to a hierarchical structure is called a hierarchy. The structure is hierarchical because the decision elements (decision options and criteria) can be summarized at the levels. In [3] they evaluated the performance of the insurance company using BSC and TOPSIS techniques. In this study, four branches of the insurance company were selected as the sample and prioritized according to the four BSC criteria by TOPSIS method.

In recent years, several methods for decision making have been proposed [8-17]. In [8], colleagues evaluated the performance of the organization using the combined approach of BSC, AHP and TOPSIS. The research results confirm the appropriateness of incorporating these techniques in planning and improving corporate performance. In addition, they developed a strategic model of performance evaluation in construction companies by combining BSC and AHP approaches. In this research, first, using the Balanced Scorecard model, a performance appraisal model is developed in an active company in the construction and construction industry. Afterwards, in order to eliminate the disadvantages of balanced perspectives and goals, a hierarchical analysis process is used to weight. In addition, using BSC technique and fuzzy network analysis process to assist senior executives in evaluating the performance of departments is discussed. In [12], e-banking performance is evaluated by combining BSC technique and fuzzy network analysis. In this study, the e-Banking Performance Indicators of Pasargad Bank were firstly collected based on the research background. Finally, fuzzy network analysis is used to determine the weight of landscapes and indicators. In [3], they presented a model for evaluating the performance of ICT units in relation to environmental issues. In this study, the BSC technique was used to identify bullets and the AHP technique to weight them. Finally, the Green Pyramid model is obtained to evaluate the performance of ICT units. Lee et al. applied a fuzzy BSC and AHP method to evaluate the performance of the IT department in the Taiwan manufacturing industry. The BSC method was used to identify hierarchies with four main dimensions and the fuzzy AHP approach to overcome information ambiguity and uncertainty [13]. Tsang also developed four BSC dimensions and 22 criteria for evaluating the performance of the Private University of Science and Technology in Taiwan. Bentz et al. Evaluated multidimensional organization performance using BSC and AHP hybrid techniques. The proposed approach is implemented in a Brazilian telecommunications company. This study showed that BSC and AHP can be combined for the purpose of performance evaluation [12]. In 2015, Chen et al. evaluated the educational performance of higher education institutions using the fuzzy AHP technique. In this paper, after determining and weighting the factors and subfactors, we evaluate the educational performance of the institute using fuzzy assessments [15]. Podgórski evaluated the operational performance of the occupational health and safety management system using the AHP technique. In this study, after reviewing the comprehensive literature, key performance indicators were identified and then weighted and selected using AHP technique. The purpose of this paper is to illustrate the application of the AHP technique to the selection of key performance indicators in measuring the operational performance of an organization's safety and health [6]. Opti has been ranking the strategic business units using fuzzy AHP techniques and balanced scorecard. The proposed approach in a large steel company is used to rank strategic units [16]. Hu et al. Evaluated the performance of knowledge resources in R&D organizations using BSC and ANP techniques. In this study, four indices and three components of knowledge value, including labor value, technology value and exploitation value are discussed [5]. Kartik et al. evaluated the sustainability performance and ratings of shipping agencies using the AHP technique. The selection criteria identified in this study are limited to the Indian transport and logistics industry [17]. Shavardi presented a model for evaluating the financial performance of the organization using fuzzy AHP and fuzzy TOPSIS techniques. In this study, the main criteria were identified by studying the literature and expert opinion, and then a hierarchical performance evaluation model was developed using financial criteria and sub-criteria. This model is used to rank units in the Iranian petrochemical industry [4].

3 Proposed model

The multi-criteria decision making technique (AHP) is based on pairwise comparisons that allow for the formulation of questions in a hierarchical fashion, as well as showing the degree of consistency or incompatibility of the decision.

The first step in the hierarchical analysis process is to create a hierarchical structure of the subject under consideration, in which the goals, criteria, options, and the relationship between them are shown. The next four steps in the AHP include calculating the weight (importance factor) of the criteria, options, calculating the final score of the options, and checking the rational consistency of the judgments.

The following are the main steps of the AHP technique:

1-Making a decision hierarchy tree

Whenever the AHP is used as a decision-making tool, a proper hierarchical tree should be provided that expresses the problem under study. The decision hierarchy is a tree that has several levels depending on the issue under consideration. The first level represents the purpose of the decision and the last level indicates the options that are compared with each other and compete for choice. The middle surface of this tree is composed of factors that are the criteria for comparing options.

2-Paired comparisons

At this stage, the criteria and sub-criteria are compared in a pairwise comparisons matrix. In order to obtain a comparative ranking with the query of all decision makers, each decision maker comments on its own judgment of the importance of the criterion to the criterion and in relation to the stated purpose. This matrix is as follows (n is the number of criteria and is the decision maker [16].

$$D^k = \begin{pmatrix} x_{11}^k & \cdots & x_{1n}^k \\ \vdots & \ddots & \vdots \\ x_{n1}^k & \cdots & x_{nn}^k \end{pmatrix}.$$

The basis of the judgment is based on the 9-hour hourly table. The matrix elements of the pairwise comparisons are all positive and have the opposite condition principle in the hierarchical analysis process (if the value of i over j is k for k, the value of j over i is 1 /k).

1-Determining the significance factor of the criteria

After completing the pairwise comparisons matrix by the experts, the weight of each criterion is determined using the mathematical processes of normalization and rhythmic intermediate. The following four main methods are used to calculate the significance coefficient of the criteria. The above methods are more commonly used by the special vector method. However, if the pairwise comparisons matrix is larger in size, the calculation of eigenvalues and vectors will be lengthy and time consuming. Unless computer software is used to help solve it. That is why the clock has presented the following four approximate methods: a. 2. Total column.
3. Arithmetic mean. 4- Geometric mean [17].

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2- Determine the significance factor of the options

After determining the significance coefficients of the criteria and sub-criteria, the significance coefficient of the options should be determined. At this stage, the preference of each option is judged in relation to each sub-criterion. The basis of this judgment is the same 9-hour hour scale, but which is the preferred option when comparing options? And to what extent? Arises.

3- Determine the final score (priority) of the options

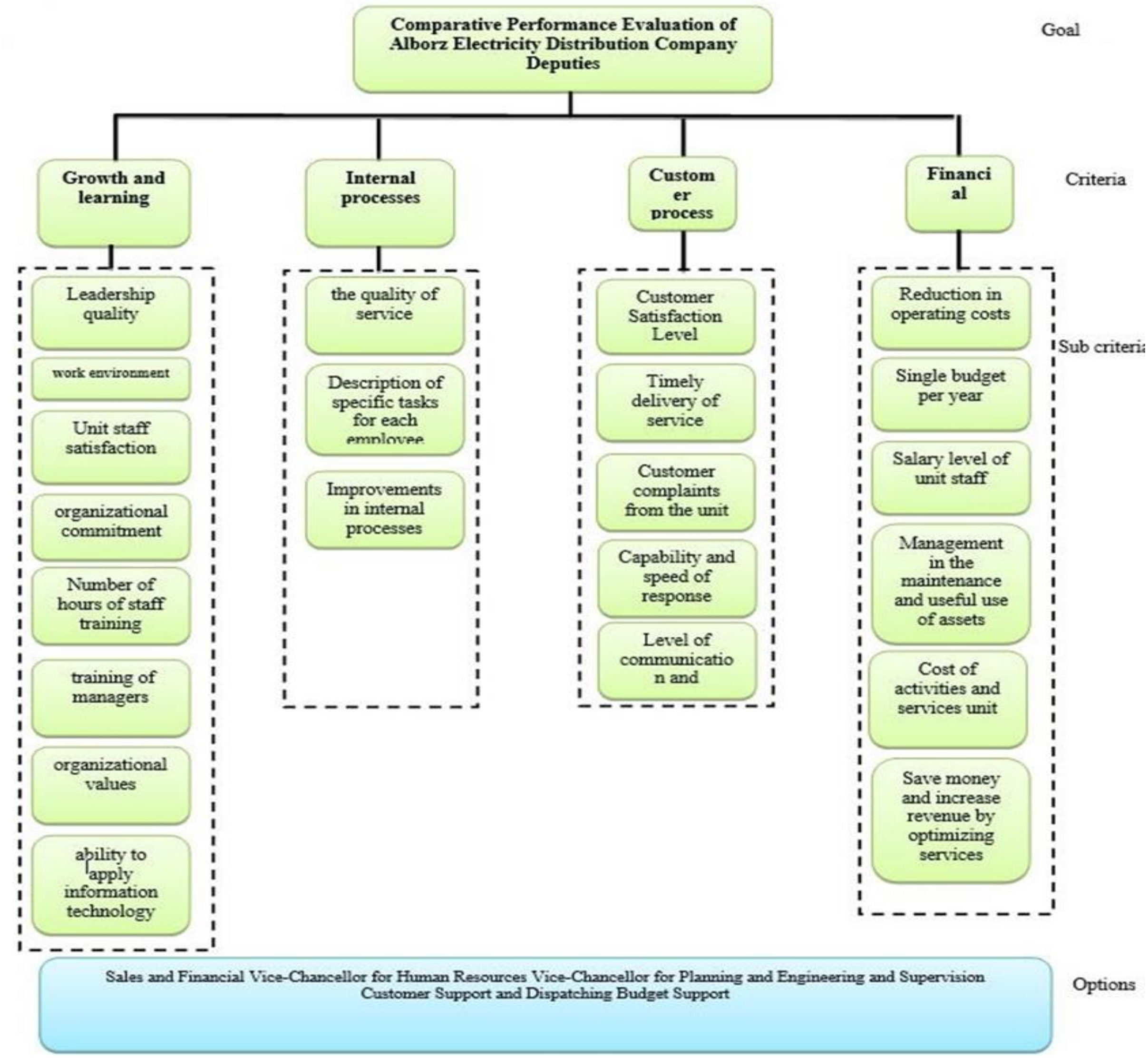

Fig. 1 A hierarchical model of research

At this stage of the integration of these coefficients of importance, the final score of each option will be determined. To do this, the principle of hierarchical clock composition that leads to a priority vector with all judgments at all hierarchical levels will be used:

$$\sum_{k=1}^{n}\sum_{i=1}^{m} W_k W_i \left(g_{ij}\right) = \text{Final score } \left(\text{priority}\right) \text{ option } j$$

where in:

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K-criterion significance factor
Significance factor below criterion
Option rating in relation to the following criteria
Calculate the incompatibility rate (IR)

The fourth step is to calculate the inconsistency rate. Incompatibility is a mechanism that shows the degree of confidence in the priorities that have been achieved.
One of the advantages of the hierarchical analysis process is the ability to examine the consistency in judgments made to determine the significance coefficient of the criteria and sub-criteria. In other words, how much consistency is there in judging the comparative matrix of binary criteria? When it comes to the importance of criteria to each other, there is a possibility of disagreement in judgments. That is, if it is more important and, more importantly, it must be more important. But in spite of all the efforts, preferences and feelings of the people, they are often uncoordinated and asymmetrical. So, we need to find a measure that shows the extent of the disagreement of the judgments. The clock mechanism used to investigate inconsistencies in judgments is a computation called the incompatibility coefficient, which is obtained by dividing the incompatibility index (I.I) into the randomness index (R.I). If this coefficient is less than or equal to 0.1, consistency in judgment is acceptable, otherwise judgments should be revised. In other words, the binary benchmarking matrix should be reconstituted:

$$\text{Incompatibility index } = I.I = \frac{\lambda_{\max} - n}{n-1}$$

4 Proposed analytic hierarchy process technique

The principles of the hierarchical analysis process are based on the experience and knowledge of the decision maker [18]. In the real world the decision maker faces problems, limitations, and outcomes that are not practically accurate and transparent [19]. In addition, one's evaluation and judgments on quality issues are always subjective and inaccurate. Therefore, investigating the use of fuzzy set methods in individual evaluations is a necessity and has been extensively studied more than 40 years ago [20]. For this purpose, the fuzzy hierarchical analysis process, which is the fuzzy development of the hierarchical analysis process was introduced to solve the fuzzy hierarchical problems. The fuzzy hierarchy process is a systematic approach that uses the concepts of fuzzy set theory and hierarchical structure analysis [21]. In 1996, a method for the fuzzy analytic hierarchy process was developed under the heading "Development Analysis Method" by a Chinese researcher named Chang [22]. The numbers used in this method are fuzzy triangular numbers. Chang's extended method is most commonly used for FAHP calculations.
The steps for analyzing and performing FAHP calculations from Chang's perspective are:
Step One: Draw a hierarchical graph
Step Two: Define triangular fuzzy numbers for pairwise comparisons
Step Three: Form the Pair Matrix
Step 4: Calculate the Si value for each of the matrix rows of the pairwise comparisons
If the triangular fuzzy numbers are defined, they are calculated as follows:

$$S_i = \sum_{j=1}^{m} m_{g_i}^{i} \times \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \right]^{-1}$$

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Where denotes row number and denotes column number. Also, in the formula above, the triangular numbers in the pairwise comparison tables are:

$$\sum_{j=1}^{m} m_{g_i}^{j} = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right)$$

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{i=1}^{n} 1_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i \right)$$

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j} \right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} 1_i} \right)$$

Step 5: Calculate the degree of Si relative to each other.
In general, if M_1 and are two triangular fuzzy numbers, the magnitude of M_2 over M_1 is defined as follows:

$$V\left(M_2 \geq M_1\right) = hgt\left(M_1 \cap M_2\right) = \mu_{M_2}\left(d\right) = \begin{cases} 1, & if\ m_2 \geq m_1 \\ 0 & if\ l_1 \geq u_2 \\ \dfrac{l_1 - u_2}{\left(m_2 - u_2\right) - \left(m_1 - l_1\right)} & otherwise \end{cases}$$

5 Conclusions

Every organization needs to establish appropriate systems for measuring its own performance in order to understand the desirability and quality of its activities and performance in dynamic and complex environments. Eventually, death will result in dynamic, active organizations and eventually society. The performance measurement framework not only reflects the behavior of managers responsible for developing a competitive position, but also includes all executive personnel. However, the concept of performance measurement is to some extent always prioritized to achieve strategic goals. Performance appraisal is one of the main tasks of any organization and one of the aspects of performance management that has been implemented in the past through the use of financial indicators [23]. Performance monitoring and, more generally, performance management is a process that can help us gain useful insights into how organizational issues work to achieve success, enhance strengths, and correct or eliminate weaknesses. Performance management is one of the most important strategies to promote effective organization and is highly sensitive. This paper proposes an integrated model for evaluating the comparative performance of units in power distribution companies. For this purpose, BSC technique is used to classify evaluation indices, statistical analysis is used to evaluate the significance and the significance of the identified indices, and finally fuzzy AHP multi-criteria decision making technique is used to compare and rank units. The research method was determined based on the purpose and method of data collection, tools and methods of data collection, statistical population and sample. [24,25]

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The purpose of this study is applied research and the results of this study can be used by power distribution companies to evaluate the performance of operational units and ultimately strategic planning to improve performance. It is also descriptive in terms of data collection and survey type. The required information will be collected through the study of library documents, questionnaires and interviews. To continue, the process will be that after conducting library studies to become familiar with the subject literature, a wide range of performance indicators will be identified through a comprehensive literature review and then screening the indicators to identify them. The indigenous indicators of the organization are determined by experts, experts and managers of Alborz Electricity Distribution Company. For this purpose, a questionnaire is designed and distributed among the statistical population.

For this purpose, after creating the appropriate hierarchy of problem using BSC technique, AHP multi-criteria decision making technique is used to determine the weight and priority of each indicator with a team of experts and managers of the organization. In this way, the required data is collected through paired comparison forms designed by the decision maker of the organization and then final weights are determined using Expert Choice software. Finally, the performance of a number of operational units of the organization will be evaluated, compared and ranked through the developed hierarchical model.

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