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Organizational Performance Evaluation Considering Human Capital Management Approach by Fuzzy-DEA: A Case Study

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A B S T R A C T

In recent years, researchers in their studies considered human capital as one of the most important capitals of every organization and even some of them placed it beyond this definition and introduced it as the unique factor of creating the competitive advantage in the organization. Due to the importance of human capital management, by evaluating the performance of human capital management system, managers can be aware of their organization's status from the perspective of human capital management creation and perform corrective practices better. In this study, a method for the performance evaluation and ranking of organizational unit is presented using fuzzy DEA. Therefore in the beginning, the performance of organizational units was evaluated using fuzzy DEA and then with the use of sensitivity analysis, the most effective criteria on the efficiency of organizational units were determined. Then using the efficiency of organizational units in the best and the worst states, ranking of organizational units has been paid. Finally to examine the functionality of the proposed method, Foolad Technic Company has been chosen as a case study and the procedure has been implemented in this company.

Keywords: *Performance evaluation, data envelopment analysis, fuzzy, human capital management, ranking, sensitivity analysis.*

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1. Introduction

In recent years, many researches have been carried out in the area of human capital management. The majority of them explained that human capital development and investment in the organization cause the performance improvement in the individual level, productivity improvement in the organizational level and economic development and other advantages in the social level [1, 2]. The existence of human capital in individual and organizations produces the individual productivity and so the individual performance will be improved in the labor market and usual increases the income [3].

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Many researchers relate performance variations among the organization to the different resources and capital. The organizations are consisted of both tangible (for example building, equipment and financial resources) and intangible resources (for example human capital). While tangible resources are very important in the organization's success, intangible resource like human capital has also great potential to create competitive value and advantage. In most organizations, intangible assets such as human capital play a key role in economic development [4].

Human capital concepts have developed during 1960s. Human capital of the organizations are considered as an intangible asset which refers to knowledge, information, ideas, experiences and skill of the individuals and it is recognized as one of the most important assets of any organization. Peoples can obtain more job opportunity by increasing their human capital level. Human capital level development depends on staff training to increase their knowledge and skill's level. Therefore we can say that there is a direct relationship between training and efficiency increasing and staff's innovation. In many jobs, continues work development is essential and even in some organizations, a part of the wage relates to it and individuals must develop their competencies, skills and knowledge [5].

Regarding the importance of human capital for the organization, its management is very important. For this reason in recent years, the researchers presented various models and methods for the performance evaluation of human capital management. For example Bassi and McMurrer in a study presented five drivers of human capital management and explained that drivers of leadership practices, employee engagement, knowledge accessibility, workforce optimization and learning capacity can be used to evaluate the level of human capital management. These five drivers have 23 executive practices and managers can use them for implementation purpose [6]. One of the results of increasing the human capital management level in the organization is the employees' organizational commitment [7]. Griffeth et al. (2000) in their studies stated that people how have the common objectives with the organization have a high level of affective commitment and their learning the organization has less probability [8]. Organizational commitment is a multi-dimensional aspect that produces several positive work results such as reduced absence and displacement, better citizenship behavior, increase of work effort and improvement of work performance [9].

To evaluate the level of human capital management, data envelopment analysis technique can be used. Data envelopment analysis is a nonparametric method for performance evaluation which evaluates the efficiency of decision maker units relatively [10]. This method which was introduced firstly by Charnes et al. (1978) needs only several input and output and their values. When the study is done in terms of quality, the results are not precise and the majority of managers and decision makers cannot state a precise number for it and they use mostly verbal statements instead of special numerical values [11, 12]. On this basis, Fuzzy theory can help to resolve the ambiguity in the verbal statement [13]. In traditional DEA method, efficiency evaluation is also done using crisp data, so in recent years, researchers presented new models of DEA that evaluates the efficiency with the use of Fuzzy and crisp data [14].

In this study a method for the evaluation of organizational units' performance will be presented with the approach of human capital management and to do so, data envelopment analysis technique is used. To evaluate the performance in this study, at first the input and output of DEA model are defined and then each input and output value will be specified in Fuzzy form. Next using fuzzy DEA the performance evaluation and ranking are paid. Ultimately to examine the functionality of the proposed method, Foolad Technic International Engineering Co. is selected as a case study.

In this research, note to this point that data collection of intellectual capital, is done with verbal variables approach, and that might be ambiguous, therefore, fuzzy data are used. Thus to evaluate the performance of organizational units, Data Envelopment Analysis will be used, which is assessing DMU's performance comparatively. Then, in the second part, research background is being considered. In the t third part, DEA would be explained. To resume, the methodology of the study would be mentioned in tow separated sections. At first, the proposed approach is being expressed, then case study would be stated. At the end, conclusion will be explained.

2. Literature Review

Wu et al. [15] in a research evaluated the performance of a bank's branches using DEA. To deal with environmental variables, they used fuzzy logic and they considered two input groups of financial and environmental and eight output types. They also performed the performance evaluation using DEA in crisp and fuzzy states and compared their results.

In a paper, Tseng and lee [16] used DEA/AHP to study the importance of relationship between human resource drivers and organizational performance variables. To show and compare the impact of human resource drivers an organizational performance, they used DEA/AHP in 129 companies in Taiwan electronic industry and 112 branches in china. In this study five human resource variable and seven organizational performance variables have been considered. Their results showed that that the employees' request to engage in the company's activities has been ideal in both Taiwanese and Chinese companies and also the importance of relationships between the employees in logical and hierarchical culture was higher than developmental and collaborative culture.

Carlucci and schiuma [17] in their article presented a model to determine and evaluate the knowledge value in organization. To do so, they used analytical network process (ANP) and by its usage, they could examine the internal dependencies and the relation of knowledge asset to obtain the objectives of organization performance and finally they selected an engineering company in south Italy as a case study to show the application of their model. This model helped the organizations to determine and evaluate their knowledge asset and thus improved the organization performance. Lee [18] in his research developed the evaluation model of human capital with the use of analytical hierarchy process. To determine the criteria of intellectual capital of the university based on the performance, they considered three subsets of human capital, relational capital and organizational capital, and determined three related criteria which are consisted of administration, curriculum, technology, transportation, research, education and service, then they regarded some sub-criteria for them

and performed the criteria ranking. Their results created the possibility for the universities to be aware of their made decision's outcome and performance the necessary anticipation. Birasnav et al. [19] presented a hierarchical structure of knowledge management and used it to develop or create the human capital in an organization, and then they did experimental analysis of the model competency with data. Their results show that knowledge management concepts have been proved in human capital development through knowledge management and problem solving processes, relationship oriented culture and innovation culture. In another investigation, Li [20] evaluated the output efficiency of the university's human resource using data envelopment analysis. In this article with the aid of statistical data of the year 2008 and DEA method, the output efficiency of the university's human resource and also its scale evaluation have been carried out. The results of this research showed that the universities should try to increase their human resources output in terms of quality and numbers. In another study Chou et al. [21] used Fuzzy AHP and Fuzzy DEMATEL to evaluate human capital criteria in the science and technology. For this purpose, at first they determined each criteria weight using AHP and then with DEMATEL method created relations between these criteria. Their results showed that the criteria of infrastructure improvement is an appropriate choice for long term and the criteria of education and R&D costs placed in the following ranks.

Costa [22] in his article paid to the efficiency and productivity evaluation with the approach of intellectual capital and (IC) thus examined the best methods for successful implementation of IC management strategies. For this reason DEA technique and Malmquist productivity criteria have been used. This article presented two scientific and practical insights which can be used for strategic and operational IC management in fact their results give some instructions to the inefficient companies. Yu et al. [23] in their article followed the presentation of an approach to allocate the human recourses in the airport organizations in Taiwan, thus they used DEA and three policies of man force reallocation. Their results showed that if the employees' output level is considered to be constant, this method will be effective in reducing employees' displacement and increases the organization's productivity. Mehralian et al. [24] in a study performed the evaluation and ranking of IC criteria in knowledge based industries. In this paper, they determined IC criteria using research literature and next they prepared a questionnaire and confirmed its stability and validity. Fuzzy TOPSIS has also been used to rank the questionnaire data. The results of ranking showed that knowledge and skill factors in human capital, factors investment rate in R&D and the number of R&D project in structural capital and factors of customer care and strategic collaboration in relational capital were identified as the most important factors.

Amado et al. [25] in their paper tried to expand a conceptual framework to evaluate decision-maker units. Therefore, using the Balanced Scorecard (BSC) and nonparametric method of DEA, they offered a way for the evaluation of the units' performance. They illustrated their model through studying several rational companies and using DEA and four aspects of BSC (including financial, customers, internal process and learning and growth), they evaluated the company's performance and presented some guide lines for improvement. Also Kong and Fu [26] in a study using two- stage DEA evaluated the performance of public universities in Taiwan and the efficiency of education cost in these universities and in

addition using regression, they examined the relationship between IC and the university productivity. Their results showed that the cost efficiency of university is higher in comparison with education efficiency. Furthermore, regression analysis expresses the important impact of IC on the education productivity. Kuah et al. [27] in their article provided a model for measuring knowledge management performance in a random environment. To do so, they used Mont Carlo DEA and genetic algorithm. In this study, they presented a comprehensive model of knowledge management and with the application of genetic algorithm, proved the accuracy and validity of the model data. Next using Mont Carlo DEA, they evaluated the productivity of knowledge management and its processes and eventually, the proposed model was used to evaluate the performance of knowledge management in higher education institutions. The results of their proposed model were used by managers to determine the future strategies of knowledge management.

Saeedi et al. [28], in a research provided the ranking of IC components using Fuzzy TOPSIS. Their results showed that in SAPCO Company, factors of "staff's knowledge, skill and expertise", "identity acquisition form organizational value" and "associative staff's capability in decision" were the most important sub–criteria of IC and factors of strategic management leadership, "staff's characteristics" and "organization's operational performance" were also in the lowest ranks.

3. Data Envelopment Analysis

Data envelopment analysis is a mathematical technique which can be used for efficiency evaluation of decision making units with multiple input and output [10]. This method was firstly introduced by Charnes et al. [11] and named as CCR. DEA is a nonparametric approach that for efficiency evaluation, it only needs input and out of each decision making units [10]. Due to the fact that in the majority of investigations crisp data are not available, researchers presented DEA models with Fuzzy data.

In a study, Wang and Chin [14] presented a Fuzzy DEA model. Based on this model for calculating the efficiency of decision – maker units, the following model is used.

$$\text{Max } \theta_p = \sum_{r=1}^{s} (u^L{}_r y^L{}_{rp} + 2u^M{}_r y^M{}_{rp} + u^U{}_r y^U{}_{rp})$$

S.t

$$\sum_{i=1}^{m} (v_i{}^L x^L{}_{ip} + 2v_i{}^M x^M{}_{ip} + v_i{}^U x^U{}_{ip}) = 1,$$

$$\sum_{r=1}^{s} (u^L{}_r y^L{}_{rj} + 2u^M{}_r y^M{}_{rj} + u^U{}_r y^U{}_{rj}) - \sum_{i=1}^{m} (v^L{}_i\, x^L{}_{ij} + 2v^M{}_i\, x^M{}_{ij} + v^U{}_i\, x^U{}_{ij}) \le 0$$

$$(j = 1 \ldots n)$$

$$v^U{}_i \ge v^M{}_i \ge v^L{}_i \ge 0 i = 1,2..m$$

$$u^U{}_r \ge u^M{}_r \ge u^L{}_r \ge 0 r = 1,2..s$$

In a form that $\tilde{u}_r = (u^L{}_r, u^M{}_r, u^U{}_r)$ and $\tilde{v}_i = (v^L{}_i, v^M{}_i, v^U{}_i)$ are triangular fuzzy weights for triangular fuzzy input $\tilde{x}_{ij} = (x^L{}_{ij}, x^M{}_{ij}, x^U{}_{ij})$ and triangular fuzzy output $\tilde{y}_{rj} =$

$(y^{L}_{rj}, y^{M}_{rj}, y^{U}_{rj})$. In this model, if $\theta^{best} = 1$, unit will be efficient. Also for ranking decision maker units, the proposed method by Wang and Chen (2011) is used. According to this method, in fuzzy environment, two values of the best efficiency (θ^{best}) and the worst efficiency (θ^{worst}) are calculated.

In this method, the best efficiency for each of DMUs is obtained as the following model.

$$\text{Max } \theta_P^{best} = \sum_{r=1}^{s} (u^{L}_{r} y^{L}_{rp} + 2u^{M}_{r} y^{M}_{rp} + u^{U}_{r} y^{U}_{rp})$$

S.t

$$\sum_{i=1}^{m} (v_i^{L} x^{L}_{ip} + 2v_i^{M} x^{M}_{ip} + v_i^{U} x^{U}_{ip}) = 1,$$

$$\sum_{r=1}^{s} (u^{L}_{r} y^{L}_{rj} + 2u^{M}_{r} y^{M}_{rj} + u^{U}_{r} y^{U}_{rj}) - \sum_{i=1}^{m} (v^{L}_{i} x^{L}_{ij} + 2v^{M}_{i} x^{M}_{ij} + v^{U}_{i} x^{U}_{ij}) \le 0$$

$$(j = 1,2..n)$$

$$v^{U}_{i} \ge v^{M}_{i} \ge v^{L}_{i} \ge 0 \qquad i = 1,2..m$$

$$u^{U}_{r} \ge u^{M}_{r} \ge u^{L}_{r} \ge 0 \qquad r = 1,2..s$$

Next, once again DMUs' efficiency is measured in the worst state. Therefore the following model is used.

$$\text{Min } \theta_P^{worst} = \sum_{r=1}^{s} (u^{L}_{r} y^{L}_{rp} + 2u^{M}_{r} y^{M}_{rp} + u^{U}_{r} y^{U}_{rp})$$

S.t

$$\sum_{i=1}^{m} (v_i^{L} x^{L}_{ip} + 2v_i^{M} x^{M}_{ip} + v_i^{U} x^{U}_{ip}) = 1,$$

$$\sum_{r=1}^{s} (u^{L}_{r} y^{L}_{rj} + 2u^{M}_{r} y^{M}_{rj} + u^{U}_{r} y^{U}_{rj}) - \sum_{i=1}^{m} (v^{L}_{i} x^{L}_{ij} + 2v^{M}_{i} x^{M}_{ij} + v^{U}_{i} x^{U}_{ij}) \le 0$$

$$(j = 1,2..n)$$

$$v^{U}_{i} \ge v^{M}_{i} \ge v^{L}_{i} \ge 0 \qquad i = 1,2..m$$

$$u^{U}_{r} \ge u^{M}_{r} \ge u^{L}_{r} \ge 0 \qquad r = 1,2..s$$

At the end for ranking the organizational units, geometric mean of each DMUs' efficiency in the worst and the best states is measured and ranking is done based on it. Ranking criteria is measured as the following relation.

$$\theta_p^{Geometric} = \sqrt{\theta_p^{best} \times \theta_p^{worst}}$$

4. Methodology

In this study, a method for performance evaluation of human capital management system is presented using fuzzy DEA. Thus in the beginning, DEA model consisted of input and output is defined and them input and output data are collected and next using fuzzy DEA model, the performance of human capital management will be evaluated and sensitivity analysis is done. Afterwards organizational units ranking is performed. Ultimately, Foolad Technic international engineering co. is selected as a case study to examine the functionality of the proposed method. The procedure is shown in Figure 1.

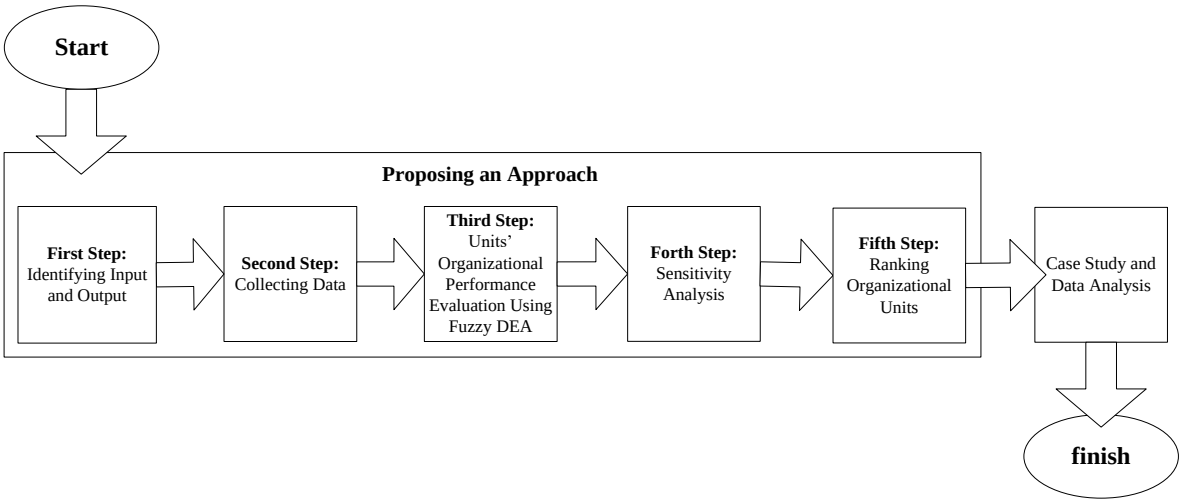

Figure 1. Methodology

4.1. Proposing an Approach

First step: in the beginning, DEA conceptual model is specified. To this end evaluation criterion of human capital management are considered as DEA model input and results of implementing human capital practices in the organization such as organizational commitment, staff's loyalty and team participation will be regarded as the model output. Organizational units are supposed as decision maker units (DMU).

Second step: in this stage, data are collected. For this purpose, each input and output value of DEA model is calculated for each DMU.

Third Step: in this stage, the performance evaluation of organizational units is carried out. Therefore using fuzzy DEA introduced by Wang and Chen, the efficiency of organizational units will be evaluated. Since the human capital management criteria considered as undesirable input, for evaluating efficiency, their values in the model should be reversed.

Fourth Step: in this step, sensitivity analysis of human capital management drivers will be done. To do so, each time one of the input or criteria of human capital management is removed from the problem and once again the organizational units' efficiency is calculated. Each time the difference of organizational units' efficiency with the general state is measured

and then the sum of absolute differences is calculated. Removed of any input that makes the most difference expresses its highest impact on the efficiency of the organizational units.

Fifth Step: in this step, organizational units ranking is done. Here fuzzy ranking presented by Wang and Chen is used which based on the worst and best efficiency, it performs the ranking.

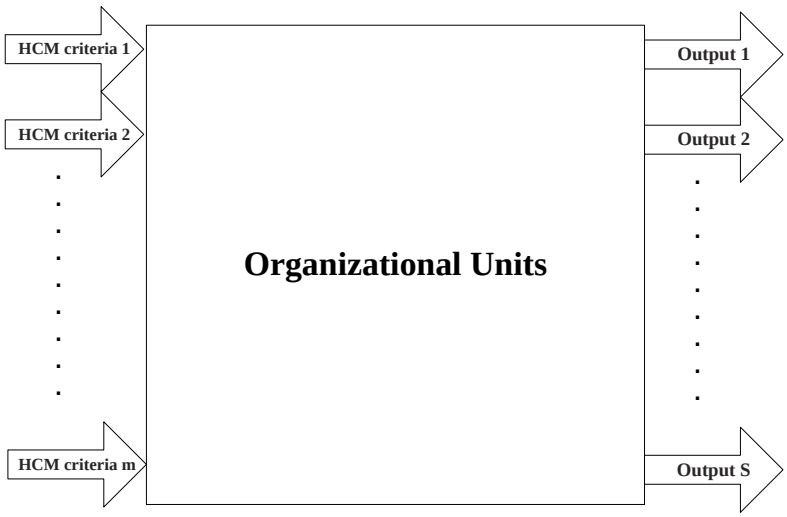

Figure 2. DEA model

4.2. Case Study and Data Analysis

The problem under investigation is the efficiency evaluation of organizational units in Foolad Technic International Engineering co and their ranking with the approach of human capital management. Foolad Technic is an international engineering company which was formed following the structural changes in design and consulting institute of Steel company in Esfahan. Through effective and efficient conduct of private and public capitals in industrial and construction projects in the form of feasibility studies, management, engineering, procurement and implementation, this company tried to service the domestic and foreign market both integrated or separately. The company's activities were merely engineering and consulting more than ten years after it's founding, but according to the market changes and ability to develop, its activities have developed from engineering consultancy to the general contractor. Today its most activities are in the area of cooperation projects with steel companies and oil, gas and mining project and in this regard, the company has received numerous certificates. Due to the high volume of the company's activities in different fields, the company has specialized units including 27 specialized and support units. But the basic question in this company are that each of the organizational units are at what level of human capital management and which condition they have in comparison with each other (Foolad Technic August 2012). Therefore in this study, the efficiency evaluation and ranking of

organizational units in Foolad Technic International Engineering are performed with the approach of human capital management. The work is as follows.

First step: in the first step, conceptual model of DEA is characterized. For this purpose based on Bassi and McMurrer human capital management, its five drivers are considered as the model input which includes leadership practices, employee engagement, knowledge accessibility, work force optimization and learning capacity. Given that these drivers' implementation provides many advantages', one of these advantages like the organizational commitment is considered as the model output. DEA conceptual model of this study is shown in Figure 3:

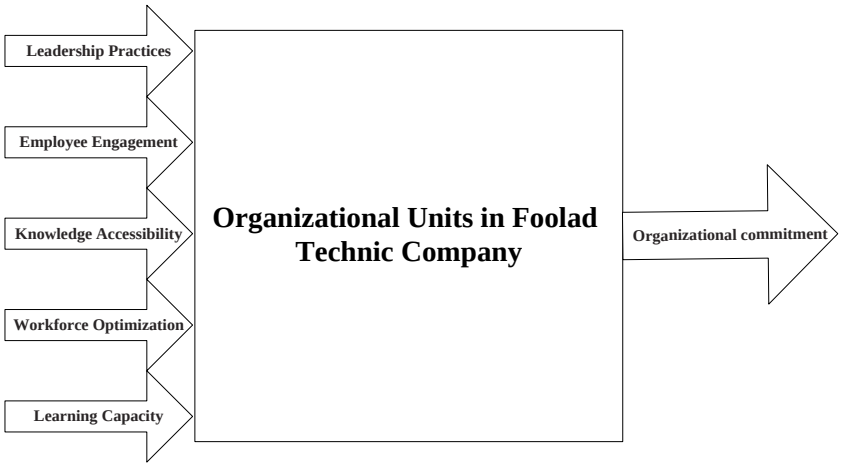

Figure 3. DEA model in case study

Second step: in this step to collect the input and output data of the model based on Bassi and McMurrer model, porter questionnaire has been used. In this step, a questionnaire was designed according to the organization's activities and its validity was confirmed by several university experts in the field of human capital management. To measure its stability, Cronbachs' alpha has been used which was calculated 0.95 for the whole questionnaire and due to the fact that Cronbachs' alpha coefficient higher than 0.7 is acceptable, the test has acceptable stability thus the stability of the mentioned questionnaire can be considered as desirable. After collecting questionnaires, Fuzzy value is defined as Table 1.

Table1. Fuzzy values of linguistic variable [29]

Very high	5	(0.8,1,1)
High	4	(0.6,0.7,0.8)
Average	3	(0.3,0.45,0.6)
Low	2	(0.1,0.2,0.3)
Very low	1	(0,0,0.1)

The level of each five criteria includes leadership practices, employee engagement, knowledge accessibility, work force optimization and learning capacity was determined as

input and organizational commitment as output of the model with fuzzy value which are shown in Table 2.

Table2. Number of inputs and output

Criteria / Units	LeadershipPractices	EmployeeEngagement	KnowledgeAccessibility	WorkforceOptimization	LearningCapacity	Organizational commitment
Systems	(0.1, 0.44,0.8)	(0.1, 0.48,0.8)	(0.3, 0.51,0.8)	(0, 0.49,0.8)	(0.1, 0.48,0.8)	(0.35,0.46,0.57)
Information technologies	(0, 0.41,0.8)	(0, 0.31,0.8)	(0, 0.34,0.8)	(0, 0.41,1)	(0, 0.39,1)	(0.44,0.56,0.67)
Financial accounting	(0, 0.5,0.8)	(0.1, 0.46,0.8)	(0.1, 0.52,0.8)	(0.1, 0.53,0.8)	(0, 0.53,0.8)	(0.43,0.55,0.66)
Organizational development	(0.1, 0.5,1)	(0.1, 0.5,0.8)	(0.1, 0.56,0.8)	(0.1, 0.53,1)	(0.1, 0.58,0.8)	(0.38,0.52,0.64)
Industry accounting	(0.1, 0.56,1)	(0, 0.47,0.8)	(0.1, 0.58,1)	(0.1, 0.48,0.8)	(0.1, 0.59,1)	(0.48,0.62,0.72)
Telecommunication	(0, 0.55,1)	(0, 0.39,0.8)	(0, 0.41,1)	(0, 0.42,1)	(0.1, 0.54,1)	(0.32,0.45,0.57)
auto mission	(0, 0.57,1)	(0, 0.48,1)	(0, 0.53,1)	(0, 0.46,1)	(0.1, 0.53,1)	(0.45,0.58,0.68)
Research & development	(0, 0.62,1)	(0, 0.67,1)	(0.1, 0.64,1)	(0, 0.59,1)	(0.1, 0.71,1)	(0.51,0.64,0.73)
Civil engineering	(0,0.56,1)	(0, 0.44,1)	(0, 0.59,1)	(0, 0.49,1)	(0, 0.47,1)	(0.41,0.53,0.63)
Administration	(0,0.48,0.8)	(0.1, 0.41,0.8)	(0.1, 0.49,0.8)	(0.1, 0.43,0.8)	(0.1, 0.51,0.8)	(0.43,0.56,0.65)
Gas & oil process engineering	(0.3,0.73,1)	(0.3, 0.64,1)	(0.3, 0.81,1)	(0.3, 0.74,1)	(0.3, 0.71,1)	(0.58,0.73,0.8)
Metallurgy & production process engineering	(0.1,0.65,1)	(0.1, 0.54,0.8)	(0.3, 0.63,0.8)	(0.1, 0.56,0.8)	(0.1, 0.59,0.8)	(0.52,0.65,0.75)
Technical inspection and quality control	(0.1,0.59,1)	(0, 0.49,1)	(0, 0.55,1)	(0, 0.48,1)	(0, 0.55,1)	(0.4,0.54,0.64)
Computer center	(0.3,0.7,1)	(0.3, 0.59,1)	(0.1, 0.67,1)	(0.1, 0.64,1)	(0.3, 0.67,1)	(0.4,0.53,0.69)
Estimation and contractor	(0.1,0.54,1)	(0.1, 0.54,1)	(0.1, 0.64,1)	(0.1, 0.57,1)	(0, 0.53,1)	(0.4,0.53,0.65)
General plan and road engineering	(0.3,0.63,0.8)	(0.1, 0.53,0.8)	(0.3, 0.58,0.8)	(0.3, 0.65,1)	(0.3, 0.62,1)	(0.47,0.59,0.69)
Logistic	(0.1,0.68,1)	(0, 0.61,1)	(0.1, 0.7,1)	(0, 0.65,1)	(0.1, 0.69,1)	(0.58,0.72,0.8)
Economical studies	(0.1,0.51,0.8)	(0.1, 0.41,0.8)	(0.3, 0.61,0.8)	(0.1, 0.51,0.8)	(0.1, 0.51,0.8)	(0.46,0.59,0.68)
Electrical engineering	(0.1,0.78,1)	(0.1, 0.51,0.8)	(0.1, 0.56,1)	(0.1, 0.58,1)	(0.1, 0.55,0.8)	(0.39,0.51,0.63)
Information resource	(0.3,0.74,1)	(0.3, 0.7,1)	(0.3, 0.67,1)	(0.1, 0.67,1)	(0.3, 0.68,1)	(0.56,0.69,0.78)
Architect and urban engineering	(0.1,0.14,1)	(0.1, 0.15,1)	(0, 0.12,1)	(0.1, 0.13,1)	(0.1, 0.12,1)	(0.49,0.62,0.73)
Project accounting	(0,0.49,1)	(0.1, 0.44,0.8)	(0.1, 0.59,1)	(0.1, 0.51,1)	(0.1, 0.57,1)	(0.43,0.57,0.68)
Business management	(0,0.56,1)	(0.1, 0.51,1)	(0, 0.59,1)	(0.1, 0.62,1)	(0.1, 0.58,1)	(0.48,0.61,0.7)
Equipment mechanics	(0,0.64,1)	(0, 0.54,1)	(0.1, 0.63,1)	(0, 0.63,1)	(0.1, 0.59,1)	(0.4,0.53,0.63)
Energy & facilities mechanics	(0,0.42,0.8)	(0.1, 0.48,0.8)	(0.1, 0.55,1)	(0, 0.47,0.8)	(0.1, 0.52,1)	(0.46,0.59,0.69)

Criteria / Units	LeadershipPractices	EmployeeEngagement	KnowledgeAccessibility	WorkforceOptimization	LearningCapacity	Organizational commitment
Fluid mechanics	(0,0.5,1)	(0, 0.45,0.8)	(0, 0.55,1)	(0, 0.48,0.8)	(0.1, 0.54,1)	(0.39,0.53,0.64)
Project planning and control	(0,0.57,1)	(0.1, 0.48,0.8)	(0.1, 0.56,1)	(0, 0.52,0.8)	(0.1, 0.57,1)	(0.47,0.6,0.7)

Third step: In this step, performance evaluation of organizational units is done. Therefore using the questionnaire's data shown in table 2 and fuzzy DEA presented by Wang and Chen, the efficiency of organizational units will be evaluated. Since the human capital management criteria considered as undesirable input, for evaluating efficiency, their values in the model should be reversed in Table 3.

Table 3. Efficiency of units

Organizational units	efficiency	Organizational units	Efficiency
Systems	0.509861	Estimation and contractor	0.667
Information technologies	0.46	General plan and road engineering	0.769
Financial accounting	0.608	Logistic	0.978
Organizational development	0.651	Economical studies	0.657
Industry accounting	0.748	Electrical engineering	0.844
Telecommunication	0.542	Information resource	1
auto mission	0.67	Architect and urban engineering	0.776
Research & development	0.933	Project accounting	0.669
Civil engineering	0.609	Business management	0.73
Administration	0.582	Equipment mechanics	0.703
Gas & oil process engineering	1	Energy & facilities mechanics	0.626
Metallurgy & production process engineering	0.864	Fluid mechanics	0.605
Technical inspection and quality control	0.653	Project planning and control	0.701
Computer center	0.824		

Fourth step: in this step, sensitivity analysis of human capital management driver will be addressed and the impact of each driver on the units' efficiency is determined. To do so, each time, one of the human capital management drivers is removed from the problem and once again the units' efficiency is calculated. Then the difference of the units' efficiency which is created by the removed of each input will be calculated and any criteria that create more total difference will be recognized as the most effective criteria.

Table 4. Sensitivity analysis

Unconsidered	LeadershipPractices	EmployeeEngagement	KnowledgeAccessibility	WorkforceOptimization	LearningCapacity

criteria					
efficiency difference	0.4989	0.1312	0.1723	0.5593	0.1312
Significant rank	2	4	3	1	4

Fifth Step: In this step, organizational units ranking is done and fuzzy ranking presented by Wang and Chen is used for this purpose. This is ranking the organizational units based on the best and the worst efficiency. To do this, the efficiency of each organizational unit is obtained in the best stage and in the worst stage and geometric mean of the best and the worst efficiency is determined for each organizational unit and on this basis, the ranking will be performed. Results of ranking are shown in Table 5.

Table5. Ranking of units

Organizational units	θ^{Best}	θ^{worst}	**efficiency**	**rank**
Systems	0.509861	1	0.714045	26
Information technologies	0.46	1	0.678233	27
Financial accounting	0.608	1.27	0.878726	20
Organizational development	0.651	1.294	0.91782	18
Industry accounting	0.748	1.378	1.015256	11
Telecommunication	0.542	1	0.736206	25
auto mission	0.67	1.282	0.92679	15
Research & development	0.933	1.657	1.243375	4
Civil engineering	0.609	1.156	0.839049	23
Administration	0.582	1.101	0.800489	24
Gas & oil process engineering	1	2.202	1.483914	1
Metallurgy & production process engineering	0.864	1.653	1.19507	5
Technical inspection and quality control	0.653	1.221	0.892924	19
Computer center	0.824	1.705	1.185293	6
Estimation and contractor	0.667	1.323	0.939383	14
General plan and road engineering	0.769	1.668	1.13256	7
Logistic	0.978	1.996	1.397171	3
Economical studies	0.657	1.302	0.924886	16
Electrical engineering	0.844	1.328	1.058694	10
Information resource	1	2.026	1.423376	2
Architect and urban engineering	0.776	1.615	1.119482	8
Project accounting	0.669	1.269	0.921391	17
Continued				
Business management	0.73	1.553	1.064749	9
Equipment mechanics	0.703	1.451	1.009977	12

Energy & facilities mechanics	0.626	1.145	0.846623	22
Fluid mechanics	0.605	1.189	0.848142	21
Project planning and control	0.701	1.44	1.004709	13

5. Conclusion

Today, the organizational and industry managers understand the importance of human capital management and consider this capital as one of the most important capitals of the organization. Due to the importance of human capital management, its performance evaluation is quite important and the organizations try to determine their human capital management level and take corrective practices accordingly. In this study a method for the performance evaluation of human capital management system and the organizational units ranking has been presented with the approach of human capital management. To this end data envelopment analysis technique has been used. In this method, first of all, DEA conceptual model including input, output, and decision maker units is determined and in the next step, each input and output value in each of DMUs is obtained. Then using fuzzy DEA model presented by Wang and Chen, the performance of organizational units is evaluated. In the following stage, sensitivity analysis of organizational units is done and the most effective driver on human capital management is obtained. Finally the organizational units ranking is carried out using the best and the worst efficiency and it is done through geometric mean of the best and the worst efficiencies for each unit. Finally to demonstrate the functionality of the proposed method, Foolad Technic International Engineering Company was chosen as a case study.

The results of applying the proposed technique on Foolad Technic Company showed that the units of Gas & oil process engineering and Information resource were efficient with efficiency value of one and it suggests that these two units have a higher level of human capital management among other units of this company. Also sensitivity analysis of human capital management drivers showed that the removal of human work force optimization criteria created the most difference in the efficiency value of the organizational units and we can say that these criteria have the most impact on the organizational units efficiency. Then units ranking was paid with the approach of human capital management and it was done with the use of fuzzy logic and the worst and the best efficiencies. The results of ranking the organizational units showed that the Gas & oil process engineering unit won the first place with the highest mean in the worst and in the best state.

The advantage of this method compared to similar approaches of performance evaluation of human capital management system is that in this method the performance evaluation is done relatively and also regarding that the values of each input and output are obtained using a questionnaire and verbal variables, it may have error, so the usage of fuzzy logic helps to reduce the errors rate.

This method gives managers the ability to evaluate their organizational units' efficiency relatively and focus their most corrective actions on inefficient units with lower rank. Also

managers can use the result of the sensitivity analysis to detect the most effective drivers of human capital management and concentrate the most executive practices of human capital management on them. Achieving this objective helps the organization to use their time and financial resources more purpose fully in order to take maximum productivity. In addition to the mentioned advantages, this study has also limitations among which it may be noted that in this study, the problem was evaluated by assuming constant returns to scale and thee case study was only done on an organization and a special industry. In addition for determining the input and output, Bassi and McMurrer model has only used and organizational commitment was only considered as the model output.

Due to the limitations expressed in the previous step, researchers can perform the efficiency evaluation with variable returns to scale and compare the results. Also, this study can be done in several industries. Moreover in the future researches, a combination of several basic models of human capital management can be used to determine the input and output of DEA model and the other results of implementing human capital management can be used as the output.

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