Analysis of the Human Resources Efficiency by the Use of Data Envelopment Analysis (A Case Study of the Public Sector)

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Abstract: *One of the important issues in Islamic management is attracting the employees' attention to their strengths and weaknesses.Strong employee recognition and rewarding them, and thereby creating an incentive to improve their efficiency are among the leading causes of efficiency evaluation. The main objective of the current study is to investigate the factors and characteristics affecting the effectiveness of employee efficiency evaluation system. For this purpose, firstly the factors and indices effective on leadership and management of the organization managers will be investigated and then, a desired pattern for efficiency determination will be provided. The statistical population of the study primarily included the senior managers of the public sector.the measurement instrument of the study was a 95-question questionnaire which was formed by the researcher by the use of management and administration theories based on the previous studies, analyzed by the confirmatory factor analysis. The questionnaire validity was measured by Cronbach's alpha and the total test validity was calculated as 0.823. The factor analysis results indicated that 7 factors affect the organization managers' leadership and administration.For this purpose, by the use of available information and questionnaires, the input data were collected for 8 selected units for Data Envelopment Analysis (DEA) that regarding the input nature of the CCR model vector, the model was solved with three different approaches (definitive approaches, the definitive approaches with the fuzzy combination of the homogenous parameters, and the fuzzy approach with limited weights). By comparing the efficiency of different units and comparing their rankings in these three approaches, the efficient unit 5 and 6did well in terms of efficiency.*

Keywords*: Human resources efficiency, confirmatory factor analysis, data envelopment analysis, fuzzy approach with limited weights, input-directed CCR model*

I. Introduction

Efficiency Evaluation in facilitating the organizational effectiveness is an important task of human resources management. In recent years, much attention has been paid to the role of efficiency evaluation.According to experts, an effective system of efficiency evaluation can lead to many advantages for organizations and their employees. Longenecker and Nykodym (1996) have expressed that efficiency evaluation system a) Provides specific efficiency feedback to improve employee efficiency, b) determines the employee training requirements, c) Provide and facilitate staff development, d) make a close relationship between the personnel conclusion and efficiency, and e) Increase motivation and productivity of employees. Also, Roberts and Pavlak (1996) believe that efficiency evaluation can be used for different administrative and developmental purposes such as a) to assess individual efficiency based on organizational needs, b)prediction of feedback to employees in order to improve or strengthen their behavior, and c) allocation of bonuses and promotions.

Meantime, many of the conventional management and human resources systems do not seem proper and old patterns are considered inefficient. During the last decade, many organizations have come to the result that, in practice, that have no efficiency evaluation system through which they transfer their priorities and goals to employees and follow the employees' improvement. Human, due to extensity of cognitive areas and using different instruments, such as feeling, observation, perception, experience and power of belonging and thinking on various topics, is especially sensitive about the analysis and evaluation of the employees' behavior and efficiency and the set of these factors have affected the managers access to the effective efficiency evaluation (Stredwick, 2005). Based on what has been mentioned above, the main question of the study is that what the effective factors and characteristics on the employees'efficiency evaluation system effectiveness are? What pattern can be used for calculation of the employees' efficiency?

In today's organizational environments, identification of the factors effective on the success of the managers and their respective organizations is of a great importance. Through identification of these factors, the way for the meaningful decision-making is paved and application of appropriate strategies is facilitated. On the other hand, the organizations and institutes, with consideration for these factors, can carefully compare their situation with that of their corresponding organizations at the national and international levels in future, and continuously improve it. So far, various studies have been conducted on identification of the factors effective on

managers' success, each of which coming to different results. In many of these studies, benchmarks and indices to measure the success of managers have been provided.

The public sector, as the sector for implementation of public services, is one of the strategic institutions of the country.Thus, the requirement to provide appropriate public services is presence of the prospective leaders and managers.Leadership traits and management of the public sector, in most cases, have major differences with the leadership and management of the business sector and commercial organizations.In other words, the realization of this subject requires identification of the factors and indices of leadership and management proportionate to future conditions. The prerequisite of durability, persistence and survival of the public services in the field of rapid developments (which in this organization is more than other organizations)is to identify the factors and indices of effective leadership and management in the future. In this way, the top managers of the organization should re-examine the habits and practices and with a critical view, better identify the factors and indicesof leadership and management.Thus, organizational development is a function of the variability of this important sector, particularly in terms of leadership and management.

II. Review Of Related Literature

The factors and indices of effective leadership and management have been researched in several studies that some of them will be discussed below.Imam Ali (pbuh) (epistle 53, Nahj Al-Balaghah, narrated by Dashti, 2010) commands Malek Ashtar that: assign a person as your commander of your army who meets the following ten characteristic: 1) is the most benevolent and compassionate to the God, prophet, and the Imam, 2) is the most chaste, 3) is the wisest and smartest, 4) is irritated so rarely, 5) accepts apology timely, 6) is gracious and kind to the poor, 7) is strong and rigid against the powerful and arrogant. 8) Traumatic events never stops him, 9) never succumb to weakness and cowardice, and 10) is from a decent, personable, competent, and brave family.

Borden and Baneta (2008) in a study have described the indices of the management and leadership as pre-active leadership, a new mental structure, constant change and innovation, organizational development, understandinghis and his respectful organization mission, identifying the threats and opportunities, considering the environmental factors, strategic planning, value-orientation in affairs, and the application of the rules of human relationships.

Educational Resources Information Center (ERIC) (2010) in a study have expressed the most important indices of leadership and management: A) the unique personality characteristics (such as mobility, ability to influence others, honesty and integrity, confidence, positive self-concept, intelligence, deep technical and general knowledge), B) the unique behavioral characteristics (such as initiation, respect for the subordinates, etc.).Mitchel (2007) in a study divided the indices and the factors effective on leadership and management into three groups: 1) Leadership characteristics (such as extraversion, physical abilities, social acceptance, education, intelligence, independence, self-confidence, popularity and propriety), 2) Leadership and management behavior (such as initiative, ability to influence others, etc.), 3)Action and leadership management practices (such as setting the desired goals, maintenance for the goals, maintenance of group structure, facilitating the interaction, facilitating the group efficiency, maintain morale, etc.).

Mirkamali (2010) in study divided the factors and indices affecting the leadership and management into three groups: A) Basic skills are those abilities that are required to continue a normal career such as physical health, emotional health, sanity, thinking and perception, health of faith (monotheistic and organizational) and the piety and commitment;B) the maturity abilities: are abilities that put a person at a higher level than a normal person, leading to clean power, reasoning and rational conclusions on the issues for the leader such as knowledge (general and specialized), human skills, conceptual skills and professional skills, experience, distinguishing, judgment, decision making and problem solving, being purposeful and being motivated in doing things; C) leadership ability: He believes that the general and maturity abilities are more dedicated to themanagement and leadership abilitieswhich include the committed aspects of authority such as the ideology, executive authority, practical authority, political power, social power, etc. are related to leadership. Shirouye et al (2009) in a study titled "Evaluation and analysis of employee efficiency using data envelopment analysis" investigated and measured the efficiency of human resources by the use of DEA and questionnaire for data collection. In the DEA model, the salary, job responsibilities, work environment and employee size are taken as input and job satisfaction, organizational commitment, motivation and job displacement are taken as output. After calculation of efficiency in DEA, the ranking and statistical analyses were carried out in different categories of personnel.

Najafi et al (2004) in a study titled "measurement decision-making support systems and provision of appropriate solutions to improve the productivity of human resources" have introduced a supporting system for decision-making. This system, by the help of various mathematical tools, fuzzy logic, Analytic Hierarchy Process and etc. represented the productivity of human resources and then identified the factors and causes which played a role for the current status of human resources in the order of importance and offered the

appropriate strategies for enhancing productivity of human resource to its users.Alirezaei (2011) in a study titled "Development of methods of AHP / DEA for ranking decision making units" dealt with developing the AHP/DEA method. In the first stage of the two-stage method, for determination of the pairwise comparisons matrix values, in addition to measurement of units' efficiency ratio, they have also measured the effect of each of the units on the other units in order to have a more comprehensive look at the issue of rankings.In the second stage, they showed that the proposed method, in addition to provision of a logical ranking of decision-making units, conform to the efficient/inefficient DEA ranking. Numerical examples are also given in this article by the help of which, in addition to explaining the procedure, a more intuitive understanding of the issues raised in the article is provided.

III. Methodology

The current study is a descriptive study from the survey type using the field study. For choosing the case group, by the use of stratified random sampling and sample size formula, 202 people were chosen as the samples, including six top managers, 76 middle managers, and 130 general experts. The measurement instrument was a 95-question questionnaire made by the researcher by the aid of management and leadership theories as well as the previous studies results. The questionnaire was then analyzed and interpreted by the confirmatory factor analysis. The reliability of the measurement instrument was calculated as 0.823 by the use Cronbach's alpha. The results of the factor analysis indicate that there are 7 factors effective on the organization's leadership and management: first factor is spiritual characteristics with 18 indices, second factor is professional capabilities with 22 indices, third factor is personal characteristics with 12 indices, fourth factor is the behavioral characteristics with 17 indices, fifth factor is the mental health with 14 indices, sixth factor is leadership and management capability with 7 indices, and seventh factor is job output with 5 indices. The responses to each question was rated based on the Likert 5-point scale. Also the content validity of the questionnaire was confirmed by some of the members of the faculty. For ranking the efficient units, the Anderson-Peterson (AP) model was used in the current study. Also the descriptive statistics indices such as mean and standard deviation as well as the statistical procedures such as Cronbach's alpha, correlation coefficient, and confirmatory factor analysis by the use of LISREL software were used for initial analysis.

IV. Findings

1- Determination of the Indices
The results in table 1 describes the seven dimensions of the questionnaire of the effective factors on human resource efficiency measurement among which, the highest mean belongs to the mental health. On the other hand, figure one represents the relationship between human resource and sub-scales.

Table 1: Questionnaire Subscales Characteristics

Factor	Min.	Max.	Mean	Variance	Standard deviation	Elongation	Skewness
Spiritual characteristics	2	7	5.75	1.25	1.11	-1.2	0.87
Personal characteristics	1	7	5.15	1.83	1.35	0.01	0.13
Behavioral characteristics	1	7	4.25	1.73	1.31	-0.82	0.54
Mental health	2	7	5.65	2.64	1.62	-0.57	1.25
Management capabilities	1	7	5.02	2.46	1.56	-0.87	0.95
Professional capabilities	1	7	5.25	1.68	1.29	0.01	0.13
Job output	1	7	5.12	1.35	1.16	-0.84	0.64

Figure 1: seven factors of human resources efficiency

The table 2 shows that the chi-square value 0.26 is the square of chi-square value 11.22. Since the most important statistic of the fitness is chi-square value, it measures the difference between the observed and predicted matrices. This statistic is very sensitive to sample size, so it is divided on the degree of freedom. If the result is less than 2, it is appropriate. As it is seen in table 3, it is less than 2. Among the other indices is the Goodness of Fitness Index (GFI) which indicates the acceptable and desirable fitness. Root Mean Square Error *of Approximation (*RMSEA) of the GFI is 0.38. Since it is less than 0.05, it is acceptable and it confirms the model of the study. Other indices such as CFI, NNFI, NFI, GFI, and AGFI were all above 0.9 which confirm the fitness of the model.

Table 2: Human Resources Efficiency Model Fitness

	χ^2	df	CFI	NNFI	NFI	GFI	AGFI	RMSEA
Rate	0.26	11.22	0.99	0.98	0.95	0.98	0.93	0.39
Criterion	Less than 2	----	More than 0.9	More than 0.9	More than 0.9	More than 0.9	More than 0.9	More than 0.9
interpretation	Optimal fitness	Optimal fitness	Optimal fitness	Optimal fitness	Optimal fitness	Optimal fitness	Optimal fitness	Optimal fitness

2- Units Ranking
At this stage, we deal with the efficiency measurement of the selected units by the CCR input-based model with three different approaches. In each approach, the information and parameters combination method specific to that method was used and then, the results of the approaches were compared.

2-1- Input-based CCR Model with Fuzzy Combination of the Homogenous Parameters
In this method also the conventional CCR model was used save for the difference that the inputs and outputs of this model were not calculated by summation of the subsets of each input or output, but they are calculated by fuzzy combination of the subset factors of each element. Also, the AHP method was introduced in a fuzzy multi-method manner. In the current study, the Buckley method was used. This table was distributed to 10 experts. The weights of different types of the above costs were: 0.541, 0.2426, and 0.2164, respectively.
For other tables of pairwise comparisons, the final weights of the subsets of the input and output elements were calculated as follows: (however, the weight of the different levels of education and the score of experience in that level, as well as the weight of air defense equipment were calculated by another method. In this regard, the public sector experts were asked to determine the weights of different education levels in a scale of a maximum of 10 points and each year of experience in that level proportionate to each level. The final weight of each of the equipment was also calculated through averaging each dedicated weight).

Table 3: the final weight of each educational level and the score of each year of experience in that level

	Educational levels weights	Score per each year of educational level
High school diploma	2.436	0.223
Diploma	4.518	0.457
Associate degree	5.805	0.549
Bachelor	7.845	0.815
Master's degree	10	1

Table 4: final weight of each types of costs

Weight of movable property costs	Weight of administrative costs	Weight of labor costs
0.2426	0.2164	0.541

Table 5: weight of each factor

Spiritual characteristics	Personal characteristics	Behavioral characteristics	Mental health	Management capabilities	Professional capabilities	Job output
0.184	0.09	0.149	0.131	0.152	0.123	0.171

If we put the above inputs and outputs, instead of the definitive CCR model inputs and outputs, another definitive model titled "CCR model with fuzzy combination of homogenous parameters" will be obtained in which for combination of the homogenous parameters and reduction of the number of inputs and outputs, the approximate opinions of the public sector experts have been used. The results of the implementation of this model are shown in table 8. In this model also the Anderson-Peterson model was used for ranking the efficient units.

2-2- Input-based CCR model with Fuzzy Approach and Limited Weights

This model is generalized from the model mentioned before. The approximate opinions of the experts were used for combination of the homogenous parameters. In doing this, after designing the CCR model with fuzzy combination of the homogenous parameters approach, a series of weight controlling limits were applied. For obtaining these limits and adding them to the mentioned model, the experts' ideas on the relative importance of each input and output by the aid of the two tables of pairwise comparison of different types of inputs and outputs, were used. The final weight of each input and output of the model is calculated as follows:

Table 6: model input weights

Equipment weight	Capital weight	Personnel weight	Costs weight
0.3098	0.091	0.3193	0.212

Table 7: model output weights

Weight of service quantity	Factors weight	Time weight	Weight formalities records
0.167	0.2744	0.1624	0.2442

If the above weights are placed in the model, the definitive efficiency per unit, with regards to the experts' ideas will be obtained. However, since by placement of the weights in the model, the problem may be unjustified, a confidence area should be considered for the above obtained weights. Since it is unknown in which confidence area, the problem is justified, an extensive range was considered for confidence area with regards to the "α" variable, in which the closer the "α" value is to 1, the calculated efficiency is more definitive and the expert's ideas are applied more precisely. On the other hand, the closer the "α" value is to zero, the calculated efficiency is fuzzier and the expert's ideas are applied for a larger range of the wights.Here, it was assumed the minimum allocated weights of each input and output is zero and the maximum alloated weights of each of them is two times the weight allocated to each parameters. For example the costs weight in the model, instead of the defenitive number 0.212 is shown as the range [0 and 0.424] and the α variable was also used as follows:

$$0.212 0.212 - (1-\alpha)\ 0.212 \leq v_1 \leq + 0.212\ (1-\alpha)$$

In which the v_1 is the weight of the first input (costs wieght). If =1,$v_1$is exactly equal to 0.212, however the more α moves towards 0, the model will be fuzzier and v_1 value will be obtained in the range of 0 and 2*.0212. The above limit indicates a triangular fuzzy number as 0.424, 0.212, and 0, which is shown with the α cut. The above mentioned bounded limit, if simplified, can be shown as two following limits:

$$\alpha \times 0.212 \geq v_1 \qquad \qquad \alpha \times 0.424 - 0.212 \leq v_1$$

The efficiency of the units with solving this problem and in α=0.6 is shown in table 8. Here also for ranking the efficient units, the Anderson-Peterson (AP) model is used.

Table 8: comparison between the efficiency rate and complete ranking of Kahatam-al-Anbia air defense in three different approaches

Unit	Fuzzy approach with limited weights			Elements fuzzy combination			Definitive approach		
	Unit rank	Efficient units efficiency rate	Unit efficiency value	Unit rank	Unit efficiency rate	Unit efficiency value	Unit rank	Unit efficiency rate	Unit efficiency value
1	6		0.4918	6		0.7818	8		0/4585
2	4		0.6128	5		0.8499	5		0.7276
3	7		0.4449	3	1.032	1	2	2. 356	1
4	8		0.4071	8		0.5503	7		0.5017
5	2	1.5503	1	2	1.79	1	4	1.319	1
6	1	2.356	1	1	5.17	1	1	5.376	1
7	5		0.5519	7		0.7488	6		0.6083
8	3		0.6276	4		0.893	3	1.832	1
Mean			0.59147			0.86193			0.85648

In the current study, for measurement of the efficiency of the public sector units as well as the ranking, the input-oriented CCR model with three different approaches were used. In this chapter, the data obtained from these approaches are analyzed and interpreted. Two types of analyses and interpretations have been conducted on the results:
- Comparison of the rankings and efficiency of the units in three different approaches
- The correlation between the obtained rankings and efficiency in three different approaches.

2-3- Comparison between the Units Rankings and Efficiency in Three Different Approaches

In the following table, the number of the efficient units, the percentage of the efficient units, the minimum and maximum efficiency, as well as the mean efficiency of the units in three different approaches are provided. As it shown, in the definitive approach, 4 out of the 8 units (almost 0.5 of the units) were diagnosed efficient which indicates the lack of proper separation between units. Also, in the second approach (definitive approach with fuzzy combination of homogenous parameters) the number of the efficient units is so high (3 units, which means 0.37 of the units are efficient). However, in the third approach (fuzzy approach with limited weights) the number of the efficient units is reduced and only two units are efficient, which indicate the high ability of this model in separation. Also, regarding this table, it is observed that the mean calculated efficiency for the first and second approaches are almost the same, while for fuzzy approach with limited weights, it is much less than the other two approaches.

Table 9: comparison between the ranking and efficiency of the bank units in three different approaches

	Definitive approach	Definitive approach with fuzzy combination of homogenous parameters	Fuzzy approach with limited weights
Number of efficient units	4	3	2
Efficient units percentage	0.5	0.37	0.25
Minimum efficiency	0.4585	0.5503	0.4449
Maximum efficiency	1	1	1
Mean efficiency	0.8564	0.8619	0.5914

2-4- Correlation between the Ranking and Efficiency Obtained in Three Different Approaches

In the current study, the selected units' efficiency as well as their ranking based on the efficiency was measured in three approaches as definitive, definitive with fuzzy combination of the homogenous parameters, and fuzzy with application the fuzzy weights of the inputs and outputs. The results are shown in table 8. Now, for testing whether there is a different between the definitive approach and the other two approaches in terms of ranking, the Spearman correlation coefficient is used. The reason behind the use of this statistical procedure is that the obtained mean efficiencies for the unit in the three approaches may have significant differences, but the rankings in these three approaches do not have big difference. Also, for exploring whether there is a difference between the efficiency rate for the unit obtained in the three different approaches, the Spearman correlation coefficient has been used. This coefficient is also used for evaluation of the correlation between the obtained efficiency rates in the three approaches whose results are shown in table 10.

Table 10: correlation between the ranking and efficiency in three different approaches

Pearson correlation coefficient between the definitive and definitive with fuzzy combination of homogenous parameters approaches in terms of efficiency	r= 0.8267
Pearson correlation coefficient between the definitive approach and definitive with fuzzy approach with limited weights in terms of efficiency	r= 0.3978
Pearson correlation coefficient between the definitive approach with fuzzy combination of homogenous parameters and fuzzy approach with limited weigh in terms of efficiency	r= 0.4639
Pearson correlation coefficient between the definitive and definitive with fuzzy combination of homogenous parameters approaches in terms of ranking	r_s= 0.906
Pearson correlation coefficient between the definitive approach and definitive with fuzzy approach with limited weights in terms of ranking	r_s= 0.507
Pearson correlation coefficient between the definitive approach with fuzzy combination of homogenous parameters and fuzzy approach with limited weigh in terms of ranking	r_s= 0.57

As it is shown in table 10, the correlation between the efficiency rate of the unit in the two approaches definitive and definitive with fuzzy combination of the homogenous parameters is high. Also, the rankings in these two approaches are highly correlated. Therefore, it can be concluded that the weights given by the experts for combination of the similar input and output factors are not significantly effective on the unit ranking and their efficiency rate.However, the correlation between the two approaches definitive and definitive with fuzzy with limited weights, and the two approaches definitive with fuzzy combination of the homogenous parameters and fuzzy with the limited weights is very low both in efficiency rate and unit ranking. It is indicative of the high impact of the fuzzy weight given by the experts on the unit efficiency rate and its ranking. In other words, the application of the approximate weights given by the experts of the public sector has led to a visible replacement in the units ranking.

V. Conclusion And Suggestions

The current study aimed at ranking the units of a public sector organization. The factor analysis was proposed in the current study for identification of the factors and indices effective on public sectors managers' leadership and the effective factors on the leadership and management were determined for prioritization of the

factors. Then, the selection procedure of the factors effective on the leadership and management was provided by formulation of a stepwise factors analysis model and as the next step, its validity was expressed. The results of the factor analysis indicate that the factors effective on leadership and management are 7: first factor is spiritual characteristics with 18 indices, second factor is professional capabilities with 22 indices, third factor is personal characteristics with 12 indices, fourth factor is the behavioral characteristics with 17 indices, fifth factor is the mental health with 14 indices, sixth factor is leadership and management capability with 7 indices, and seventh factor is job output with 5 indices. Finally, these 7 factors constitute up to 70.3% of the total variance of leadership and management of the public sector high managers.

Regarding the results obtained from the current study, the following suggestions can be adapted and provided:
- Using more qualitative indices alongside with the quantitative indices
- Using a larger statistical population

Using other techniques beside the DEA such as Gray relational analysis, TOPSIS techniques and hierarchical analysis

Ultimately, it is suggested that regarding the importance leadership and management factors, the current study should be re-conducted by more experienced researchers in the form of a national study. Generally, in this pattern, the factors and indices can determine the public sector management and leadership in a systemic manner. It is hoped the components and indices derived from the current study are effective for measurement of the leadership and management of the public sector managers as a valid and reliable means, in a way their application enables the public sector to measure the factors creating their leadership and management and use it to change their direction from being plan-laden to planning.

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