PRIORITIZING THE FACTORS AFFECTING THE PRODUCTIVITY OF HUMAN RESOURCES USING MULTI-CRITERIA DECISION-MAKING TECHNIQUES IN WATER AND WASTEWATER COMPANY OF QAZVIN

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Resumen: La metodología de esta investigación es descriptiva según la recopilación de datos y es práctica y analítica. El estudio se administra a través de la realización de cuestionarios y se utiliza el método AHP para priorizar los factores. El objetivo principal de este estudio es priorizar los factores que afectan la productividad de los recursos humanos en la empresa de agua y aguas residuales en Qazvin utilizando técnicas de toma de decisiones multicriterio. Se han utilizado métodos T-test y M.A.D.M para analizar los datos. La validez de contenido se utiliza para probar la validez del cuestionario y Cronbach alfa (0,96) se utiliza para probar la fiabilidad.

Palabras clave: productividad, recursos humanos, toma de decisiones de atributo multiple

Abstract: The methodology of this research is descriptive according to data collection and is practical and analytical. The study is administered through the completion of questionnaires and AHP method is used in order to prioritize the factors. The main objective of this study is to prioritize the factors affecting the productivity of human resources in Water and Wastewater Company in Qazvin using multi-criteria decision making techniques. T-test and M.A.D.M methods have been used in order to analyze the data. The content validity is used to test the validity of the questionnaire and Cronbach alpha (0.96) is used to test the reliability.

Keywords: productivity, human resources, Multiple Attribute Decision Making

1. INTRODUCTION

In today's rapid and transformational world, all evidences indicate the centrality of the role of man and human resources in problem solving, creating advanced technologies and production of diverse products. Human resource development is a means to improve individual productivity in the workplace.

A country's human resources, from every aspect to be considered, whether as policy makers and legislators at the macro level and managers and employees as micro-level, are the most important factor of development (Isaac Hosseini et al., 1998). Basically, human resources are the most valuable natural resources of a country. Some developed countries have long recognized their human resources' skills, training attitudes and motivations as the main and the only source of growth and development. Investment in these factors will improve the quality of human resources. Human resources are very important both in the dimension of human decision-makers of society and the dimension of workers in economic sectors of the country. There will be productivity when all productive, social and service sectors are trying to use a suitable productive system. In other words, they can take advantage of the human ware system properly. Human–based systems are those systems that focus on the reduction of losses by human action. These factors can be divided into two main branches as follow (Khaki, 2007, 154). This paper explores the factors affecting the productivity of human resources in Water and Wastewater Company in Qazvin.

2. THEORETICAL FRAMEWORK:

The framework is comprehensive in the sense that handles all variables affecting productivity. The framework states that human resource productivity is a process of individual factors, occupational factors, organizational factors and environmental factors and each of the variables plays a significant role in improving productivity. The basic questions of research are essentially in a particular theoretical framework that has been built theoretical model of the research.

The following three basic steps are necessarily taken in designing and delivery of this model. The first step is to review different approaches: a review of existing approaches in the field of human resource efficiency demonstrates that firstly, there is no comprehensive theory encompassing all aspects of efficiency in a coherent way. Secondly, similarities in different theories are obvious and the attitudes are more similar rather than different, so complement each other. The second step is the choice of a theoretical framework: theoretical studies, familiarity with existing attitudes, refereeing to the results and integration of various approaches will guide researchers offering a model of integration and logical link of these theories is comprehensive of all aspects of theoretical side of the research.

The model presented in this study links the existing theories with each other, so that all contributing effective factors are considered in the efficiency of human resources. This theoretical framework actually has two functions. First, it allowed formulating or, more precisely expressing the initial question. Second, this framework is used as the basis for hypotheses that will be provided a coherent and convincing answer to the opening questions. The third step is the detection of the theoretical framework of study: the model is inclusive of all existing theories. This model as a theoretical framework represents a dynamic approach to the issue of productivity where mutual affective factors are considered in the productivity of human resources. Due to the limited resources available to the organizations and as many resources are non-renewable or scarce that providing these resources requires a lot of costs, hence the possibility of meeting unlimited needs is not possible though reliance on such resources and facilities. Therefore, the only logical and possible process is to earn maximum efficiency and benefit from minimal resources and this is implied in the question of productivity and considering it will benefit the organization and the community in which the organization is working (Soltani, 2007, 58). The word productivity has many different definitions. Kuntz interpreted productivity as the efficiency and effectiveness (Kuntz, 1991). Since definitions of productivity are specified in various fields, by the perspective of administrators, productivity in work place is different according to the roles, knowledge and skills of employees, subordinates and circumstances (Bast 2005). In another view, the productivity is considered as the efficiency, effectiveness, product quality, satisfaction of stakeholders, and etc. (Pritchard, 1992).

Technical definition of simple productivity is the relationship between the output of goods and services or set of goods and services in relation to one or more data used to produce these outputs. Nowadays, productivity is not only the equivalent to production increment and performance improvement, but productivity is the equivalent for the sum of the effectiveness and efficiency (Robins, 2014), which refers the "effectiveness" as doing the right things and "efficiency" as doing things right and, knows reaching business and organizational goals closely related with these two terms (Luthans, 1994).

2.1. Factors affecting productivity:

Factors affecting productivity can be divided into several categories (Soltani, 2002):
- factors related to human resources (staffing levels, professional training, salary and benefits)
- Factors related to management (expertise, managing relationships with employees, ...)
- Factors related to the government (laws, regulations, policies, ...)
- Equipment and facilities (equipment, machinery, land and buildings, facilities, ...)
- Technology (type of process, product quality, technical knowledge of scheme, ...)
- Environmental factors (product market, attractions, enviro-ecological factors, ...)
- Materials and energy (raw materials, consumables, energy ...)

Productivity will be realized in the community when all productive, social and service parts' productivity are trying to use a suitable system. In other words, productivity improvement system relates to all systematic and structured efforts to eliminate or reduce losses of products, machinery, human or incorrect interaction between them which are oriented into three groups of hardware-based system, software -based system and human ware-based system.

2.2. Productivity measurement steps:

It's better to call for a general classification of the models and methods beforehand in order to describe some of the methods and productivity measurement models which are presented in Table 1.

Table 1. Productivity measurement models

A- Models	The models based on Total-Factor Productivity,	A	Kendrick - Kramer (1965): Total-Factor Productivity and total factor, and three minor criteria.
			Craig - Harris (1972): Total-Factor Productivity
			Heinz (1976): Total-Factor Productivity
			Taylor – Davis (1977): Total-Factor Productivity

	Total and minor factor	B	Somant (1977): Total-Factor Productivity and five minor criteria, with accurate comparison of periods
		C	APC (1979): TFP and all minor criteria, with accurate comparison of periods. MFPMM (1980): TFP and all minor criteria, with accurate comparison of periods
		D	Mandel (1976): total Production productivity index
	The models based on financial indicators		Gold (1976): return of investment and its relation to earnings and nominal capacity and output
			Aggarowal (1979): productivity based on a combination of benefit and value added and the purchase and sale
			QPA (1984): overall assessment of profitability and Productivity
			Value added (1990): value added and related ratios
	The models based on resource efficiency		Kurosawa (1980): The efficiency of working hour factor and employee productivity
			MURR (1980): The efficiency of materials and production resources
	The models based on unit cost		Adam (1981): the proportion of the number of the production to costs per unit of output with the processing cost per defective unit
	Model based on production functions		The use of production functions to estimate the inputs and outputs and productivity
(B) Methods	Normative Productivity Measurement (NPMM) and (1977): Providing basic process of measuring performance and productivity of organization		
	Multifactor method of measuring the performance and Productivity (MCP / PMT) (1977): selection and prioritizing multi-criteria and combination of them and providing a Compound factor		
	Stewart (1978): selection and prioritizing of multi-criteria and their combinations and providing a Compound factor		
	Array method (1970): Comparison of organization productivity with its competitors using standard productivity		
	Lawler (1980): defining five criteria and examining them.		
	Mao Method (1965): comparing rate of return on projects with the benchmark and their selection		

2.3. Literature review:

Summary of Recent studies are summarized in Table 2 below.

Table 2. Literature review

Title	Researcher(s)	Analyzing tool	Results
Identifying and ranking the critical success factors for technology transfer of information systems in the automotive industry	Sabeti and Razavi 2011	Friedman ranking test	Commitment and support of top management, a clear understanding of business objectives and corporate needs, Preparation and organization of appropriate infrastructure (organizational factors), sufficient members participate in the project and retaining qualified and trained personnel (technical factors), Strong project manager and fit and strong team (tactical factors) as the critical success factors identified and prioritized based on key indicators: 1. Organizational Factors 2. tactical factors 3. technical factors

Providing a method for evaluating qualitative characteristics of enterprise architecture based on Fuzzy AHP	Eliee, Razavi, Davoodi and Badie 2010	Fuzzy AHP	Two scenarios are presented for the study, the fitness level in first scenario is 0.4 and the fitness level in second scenario is 0.6. The second scenario is selected according to fitness level.
Prioritizing the factors affecting productivity using fuzzy- non-fuzzy MCDM model in West Regional Electric Company	Motakayee, Deangizan and Hashemi 2010	AHP,T OPSIS FUZZY ,FUZZ Y AHP	The important measures of labor productivity policy are known among the factors of management, human resources and customer , management with separation of management information system index as the most important factor.
Identification and prioritizing the factors affecting productivity betterment using MCDM model	Tavari, Sokhkianaand Mirnejad 2008	ELECT RE TOPSIS SAW ، AHP	Administrative, social - psychological, demographic, economic, environmental and cultural factors have been identified as factors affecting productivity. Based on MADM, management factors are the most important factor and then are individual, cultural, psychosocial and environmental factors.
Determining and prioritizing the factors affecting the success of knowledge management in science and technology parks in Yazd province	Salari, Porserajian, Saleh Olia and Kohi 2011	AHP	Developing appropriate strategies and investment management, creation of a special team to carry out knowledge management projects and participation and support from senior management are known as more effective than other measures.
Prioritization of individual characters in a performance measurement system	Beskese, Bozbura, Cavusoglu 2011	FUZZY AHP	The prioritization of research has shown that education was among the most important measures of performance and prioritizing other factors based on the importance were as follows: 2-analytical thinking, 3. Experience 4. leadership 5. communication skills 6. Motivation 7. adoption of innovation, 8. organizational skills 9. service delivery. 10. teamwork skills 11. Problem solving
Prioritization transportation projects using multiple decision-making methods	Medina Shelton, 2009	AHP,T OPSIS	In this research, using AHP and TOPSIS methods. transportation projects are prioritized based on availability, the ability to connect to other paths, project cost, safety and environmental factors.

3. RESEARCH METHOD:

The study seeks to identify and prioritize the factors affecting efficiency, thus the research is applied. The method is descriptive in terms of data collection. The population of the research consists of all expertise in the water industry with a history of working in Water and Wastewater Company in Qazvin province. Due to the limited number of experience and expertise experts in the enterprise, sampling has not been performed in determining the number of population. Field and library methods have been used in this research. Library method is used for the development of theoretical factors and research background. Field method is used to verify the hypothesis and research inquiries. In this study, the response spectrum Likert scale is used to determine how to prepare and adjust the questionnaires. The total number of 43 questions are used in the questionnaire. Scoring for questions varies from very low to very much from 1 to 5. SPSS software is used to obtain the reliability. Thus, "Alpha Cronbach" is used for the analysis of the reliability of the model which was 0.96 for the questionnaire. The value indicates that the questions have good overlapping and alignment and also demonstrates the fact that respondents have responded to questions with complete accuracy and consciousness. Data analysis was performed using two methods of descriptive and inferential statistics. In the descriptive level, data analysis is performed using statistical characteristics such as frequency, percentage, mean and standard deviation and for inferential statistics, t-test was used.

4. FINDINGS:

4.1. Demographics: After analysis and extracting information from questionnaires the following results were obtained.

A- gender: 45.8% of respondents were female and 54.2 percent of the respondents were male. As specified, the number of male and female forces have not significant differences with each other.

B- Age: most of employees are aged between 25 and 35 years and so, it can be said that the company's workforce is comprised mainly of younger employees.

C - Education: Approximately 92% of employees in Qazvin Province Water and Wastewater Company are university graduates and of those, about 85% of employees have a bachelor degree or higher.

D – Work experience: workforce with more than 20 years of experience have been accounted for only 5% of the company's employees and 10% of employees are between 16 and 20 years of work experience.

4.2. Statistical description of questionnaire:

The highest percentage of responses for individual indices at high level relates to "respect for the character in the workplace" with 72.7 percent and the lowest percentage of responses relates to "attitude to the job, overall work and the

organization " with 36.4 percent. The highest percentage of responses at high level relates to (there are managers who provide growth and progress in work) with 69.7percent and the lowest percentage of response relates to (there are clear and short official communication channels) with 30.3 percent. The highest percentage of responses at high level relates to (using all the knowledge and skills in practice) with 48.5% and the lowest percentage of response relates to (diverse and waste job duties) with 21.2 percent. The highest percentage of responses at high level relates to (administrative situation in the country (such as the management of the whole country)) with 48.5% and the lowest percentage of response relates to (the political situation such as (political stability)) with 21.2 percent.

The data in this section are statistically analyzed in order to test the hypotheses. For this purpose, sample T-test of a community is considered to check the status of the organization in the studied variables. After running the test, two outputs are obtained. The first output provides descriptive statistics for hypothesis testing and the calculated numbers are, respectively, the number of data, mean, standard deviation and standard error of the mean. Table (3) shows descriptive data about the specified variables.

Table 3. Descriptive statistics of the population mean test

	The number of data	mean	D	Standard error of the mean
Individual factors	6	.55	.995	.091
Organizational factors	6	.60	.095	.100
Occupational factors	6	.96	.212	.111
Environmental factors	6	.70	.826	.075

The second output provides inferential statistics and test results. Analyzing the results indicated in Table 4 shows that T-statistic value for individual factors is equal to 6.058 with 65 degrees of freedom. Since this test sig is equal to 0.00 and less than 5%, the null hypothesis is rejected and equality of average can be dismissed and the lower. As upper bounds are positive, we conclude that the average value is greater than the test statistic and personal factors are so effective on productivity of organization. The second row of Table 4 shows one-sample average test results about the organizational factors. As it is clear, T-test statistic is 6.000 and sig is equal to 000. As a result, the null hypothesis is rejected about equality with 3. Due to positive lower and upper bounds in this test, at the confidence level of 95% it can be said that organizational factors can also affect

organizational productivity. The one-sample average test results on the occupational factors are in the third row of Table 4. T-test for Focus was 15.928 and sig is equal to 0.000. Thus, at 95% confidence level, the null hypothesis can be rejected which is about no effect of occupational factors on productivity in Water and Wastewater Company of Qazvin province. As the lower and upper bounds of test are positive, it is clear that the average of occupational factors and tested value has significant difference. According to the one-sample average test results on environmental factors in the fourth row of Table 4, T-test statistic equals 9.283 and sig is 0.000. Is. As a result, null hypothesis about the average environmental factors in water and wastewater company in Qazvin province is rejected and because of positive upper and lower limits, at 95% confidence level we can say that the effect of these factors in the organization is high.

Table 4. single-sample average test results

	Test statistic3 =				Confidence interval 95%	
		Degree of freedom	Sig	Sample SD	Lower limit	Upper limit
Individual factors	.058	5	.00	.550	.37	.73
Organizational factors	.000	5	.00	.600	.40	.80
Occupational factors	5.928	5	00.0	5.0	45.0	55.0
Environmental factors	.283	5	.00	.700	.55	.85

Inconsistency rate was analyzed after determining the important indicators using AHP, developing priorities and integrating judgments. The geometric mean of all pairwise comparisons of the group members has been calculated and main elements of AHP model matrices were determined. Table 5 shows individual operating paired comparison matrix.

Table 5. Integrated judgments' matrix

	Degrees	Experience and skills	Possibility of progress	Respect for the personality	Attitude to the organization	Occupational success
Degrees	1	5683.0	0651.2	6093.1	9617.3	8884.3
Experience and skills	7550.1	1	5251.2	8543.0	7264.1	8428.0
Possibility of progress	3926.0	3300.0	1	2800.0	7681.3	9390.1
Respect for the personality	2384.1	1688.1	5630.3	1	9954.1	0764.1
Attitude to the organization	2519.0	5783.0	2647.0	4998.0	1	3370.0
Occupational success	2599.0	1840.1	0266.1	9276.0	9576.2	1
all	8978.4	8294.4	444.10	171.5	4092.15	0836.9

To obtain the relative priority of each of the index, the values in each column are added together and the values in each column are divided by the sum of the values of that column.

This matrix causes a meaningful comparison among all the elements. Finally, the numbers in each row of the matrix are added together and the mean is obtained. This determines the relative priority percent of each index (Table 6).

Table 6. Average Weighted Matrix of Personal Factors Indices

	Degrees	Experience and skills	Possibility of progress	Respect for the personality	Attitude to the organization	Occupational success	$\sum$	$\dfrac{\sum}{6}$
Degrees	20410.	11760.	19770.	31120.	25700.	42800.	5156.1	25150.

Experience and skills	35830.	20700.	24170.	16120.	11200.	09270.	17690.1	19610.
Possibility of progress	08010.	06830.	09570.	05410.	24450.	21340.	75610.	12650.
Respect for the personality	25280.	24200.	34110.	19330.	12940.	11840.	277.1	21180.
Attitude to the organization	05140.	11970.	02530.	09660.	06480.	03700.	39480.	060.
Occupational success	05300.	24510.	09820.	17930.	19190.	11000.	87750.	140.

Based on Table 6, the first priority of individual factors relates to degrees with 0.2515 percent and the last priority relates to the organization's attitude as 0.06 percent.

Acceding to the process of prioritizing indicators related to each factor, the factors affecting the efficiency were done by paired Comparison separately, which ultimately Table (7) shows the results of paired comparisons and determines the final weight of each factor.

Table 7. 4-factor operating weight values

	Individual	Occupational	Environmental	Organizational	$\sum$	$\dfrac{\sum}{6}$
Individual	5123.0	4810.0	3483.0	5437.0	8853.1	0.47
Occupational	1426.0	1610.0	3573.0	0958.0	7567.0	0.18
Environmental	1744.0	0534.0	1187.0	1791.0	5256.0	0.13
Organizational	1705.0	3044.0	1754.0	1813.0	8316.0	0.20

According to the results of the criteria comparison in MADM model, the first priority is related to ((individual)) as 0.47percent and the last priority is related to ((environmental)) as 0.13percent; So, prioritizing four-factor terms by responders had not the same effect on the efficiency of human resources. The most effective factor was personal and the least effective factor was environmental.

The rate of incompatibility was used for all five tables to determine whether there is compatibility between the paired comparisons. The results of incompatibility rate for metrics are presented in Table 8. Since the rate of incompatibility in paired comparisons index table is less than 0.1, there is an acceptable adjustment in comparisons.

Table 8. inconsistency ratio of paired comparisons' tables

Criteria	Inconsistency rate
Individual factors	001288.0
Organizational factors	00355.0
Occupational factors	002359.0
Environmental factors	000908.0
Overall index	000586.0

5. CONCLUSIONS AND RECOMMENDATIONS:

The results showed that the respondents considered personal factors as effective in increasing productivity on the basis of multi-criteria decision-making model and binary comparison of factors affecting efficiency increment. And it can be concluded that this factor plays an important role in the efficiency of human resources. Using statistical analysis through multi-criteria decision-making in prioritizing factors affecting productivity was conducted with high accuracy by the respondents since were performed through pairwise comparisons of agents and two by two. This model prioritizes the factors different from investigation methods. Therefore, the results are not comparable with the results of other researches. Table 9 shows prioritizing individual factors affecting the efficiency according to the degree of importance.

Table 9. Prioritizing a subset of individual factors based on the degree of importance

rate	index
1	Degrees
2	Respect your dignity in the workplace
3	Job-related skills and experience
4	Occupational achievements
5	Employment and innovation capability
6	Your attitude to the job, organization and overall work

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