AHP Modeling in Selection of Students for a Part-Time Work: International Burch University Case

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Abstract: Making the right decision for an enterprise is very important for its profit, efficiency, and effectiveness. For these reasons, Decision making in an organization takes a very important place. In this paper, the most appropriate selection of a student for a particular part time work in a university will be examined. There are several methods to make a decision. A multi-criteria Decision Making method will be used to select the most suitable student. The method for this selection will be Analytic Hierarchy Process (AHP). While making a decision many factors should be considered. And Analytic Hierarchy Process is a quite useful method to cover many determinants.

Keywords: Multi-Criteria Decision Making, AHP, Part-Time work,

1. Introduction

Decision Making is a very hard and complicated procedure in many cases through the life of human being. There are usually many factors affecting the decision problem. So some methods have been developed. These are all 'Multi-criteria Decision Making' methods.

1.1. Multi-Criteria Decision Making

Parallel to the progress of the science and technology, it is a well-known reality that one dimensional or one variable analysis is not enough to solve more complex problems. In one dimensional analysis, the most important assumption is to suppose all the other variables constant except the one which was analyzed. However, all the events in the universe happen with the influence of many inside and outside effects, and this forms a very complex structure. So the events and the objects should be defined with respect to many variables and collective effects of them (Daşdemir, Güngör, 2002-2003-2004 Vol. I-II). Therefore the importance of Multi-Criteria Decision Making cannot be questioned. AHP is one of Multi-Criteria Decision techniques.

1.2. Personnel Selection

Human Resources in an organization has an extremely important place (Werther and Davis, 1994). So the preliminary condition is to detect the need for qualified personnel and select them efficiently and effectively. This is the most crucial issue for the organization and the procedure should work fast and correctly (Özgörmüs, Mutlu, and Güner, 2005). And the scientific approach to the problem has a great account. So in this study for giving the decision scientifically Analytic Hierarchy Process will be used.

1.3. Part Time Work in a University

As a result of Both Economic developments in the world and changes on the necessities of work environment, the need for and the importance of 'Part-Time work' have been increased. Organizations employ regular and part-time workers at the same time. While employing a Part-time student, there are some points which should be taken into consideration. And both the university and the student should get benefit from this procedure.

2. Research Background: Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) was developed by Thomas L. Saaty in 1977. It is one of the methods which are used for Multi-criteria Decision Making. The main advantage of this method is that the multi-criteria can easily be managed. Additionally, AHP can be understood easily and it does not contain unnecessary mathematical operations (Başligil, 2005). Through AHP, The observations of Decision Maker's in different psychological and sociological situations can be taken into account and his decision making mechanism will be tried to define. So, the aim is to provide a better environment to Decision Makers (Dağdeviren, Akay and Kurt, 2004).

The required steps to be satisfied via AHP are given below. The necessary explanations with formulas are done in each step.

2.1. Defining the Decision Problem

This step is also known as Decomposition Phase. This phase is the process of decomposition of the problem into sub-problems. In short, this is the formulation of the decision hierarchy. First, the objective of the study is identified. Then the suitable criteria of the objective are indicated. There may be more than one criterion or sun-criteria related with the problem. These criteria should be clear and understandable. At the top of the Decision Hierarchy, there is the main goal. At the bottom, there are decision alternatives. The hierarchy may contain more than one phase according to the degree of the details related to the criteria.

2.2. Comparison

The pair-wise comparison matrix is formed by evaluating each criteria and sub-criteria with respect to each other (Kuruüzüm, 2001). There is a comparison matrix shown in Table 1 for four criteria.

$$\begin{bmatrix} 1 & 1/a_{21} & 1/a_{31} & 1/a_{41} \\ a_{21} & 1 & 1/a_{32} & 1/a_{42} \\ a_{31} & a_{32} & 1 & 1/a_{43} \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix}$$

Table 1. Pair-wise Comparison matrix for four criteria

While comparing the alternatives a comparison scale which is called Analytic Hierarchy Scale is used. It is given in Table 2.

Intensity of Importance	Definition
1	Equal importance
3	Weak importance of one over other
5	Strong Importance
7	Demonstrated Importance
9	Absolute Importance
2,4,6,8	Intermediate Values
Reciprocals of the above	If activity *i* has one of the above numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*.
1.1 – 1.9	When elements are close and nearly indistinguishable

Table 2: Analytic Hierarchy scale

2.3. Synthesis

After developing pair-wise comparison matrices, the calculations are done for the relative order of the criteria among each other. This section is called "Synthesis Section". If the number of the criteria is five or more, the calculations are very hard in this step. While setting up the priority vectors, Linear Algebra techniques are used. This phase contains the steps: The calculations of maximum eigen-value and corresponding eigen-vector and normalization. There are several methods for normalization. According to the literature most common method is, first the percentages of each element according to its column are calculated and the average of each row is taken. Thus for every criteria priority vectors are found (Kuruüzüm, 2001).

2.4. Consistency Ratio

An important subject for the quality of the resultant decision is the consistency of the evaluation of the decision maker. Being consistent is accepted as a prerequisite for rational thinking. But it is almost impossible to be fully consistent. To get new knowledge is possible by allowing some amount of consistency. AHP does not request perfect consistency. It permits consistency, but in each decision it measures the consistency level. To measure the consistency of the decisions, the Consistency Ratio which was developed by Saaty, is used. The formula for consistency is, $CI = \frac{\lambda_{max} - n}{n-1}$

To get consistent results, consistency ratio should be smaller than 0,1. The Random Index for 15 criteria is shown in Table 3. If the number of the criteria is greater than 15, then the probability of getting healthier results will be lessened (Kwiesielewicz and Uden, 2004).

Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R. Index	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Table 3: Random Index

3. Application

In this study, the aim is to select the most appropriate student for a part time work by using a multi-criteria decision making method AHP.

The selection is done among Economics Department students which applied for the work. The applied students have filled out application forms at first. The conditions in the application form are determined by the Administration of the university and also the criteria of Higher Education Committee of Turkey were considered. The information in the forms has been used in the selection. In addition to this, a survey was applied on the members of the administration. And the results of this survey were inserted to the decision matrix. Hence the criteria which have been considered in this study are,

- Economic Situation
- Psychological and Medical Situation
    - Mental problems
    - Medical problems
    - Good mannered
- Clean wear and neat appearance
- Work Qualifications
    - Work experience
    - Adaptability to the group-work
    - Adaptability to the work environment
    - Work discipline

The hierarchical structure is shown in the Figure 1. At the top of the hierarchy, there is the decision problem. Then in the second step, there are the main criteria. And in the last step, there are sub-criteria.

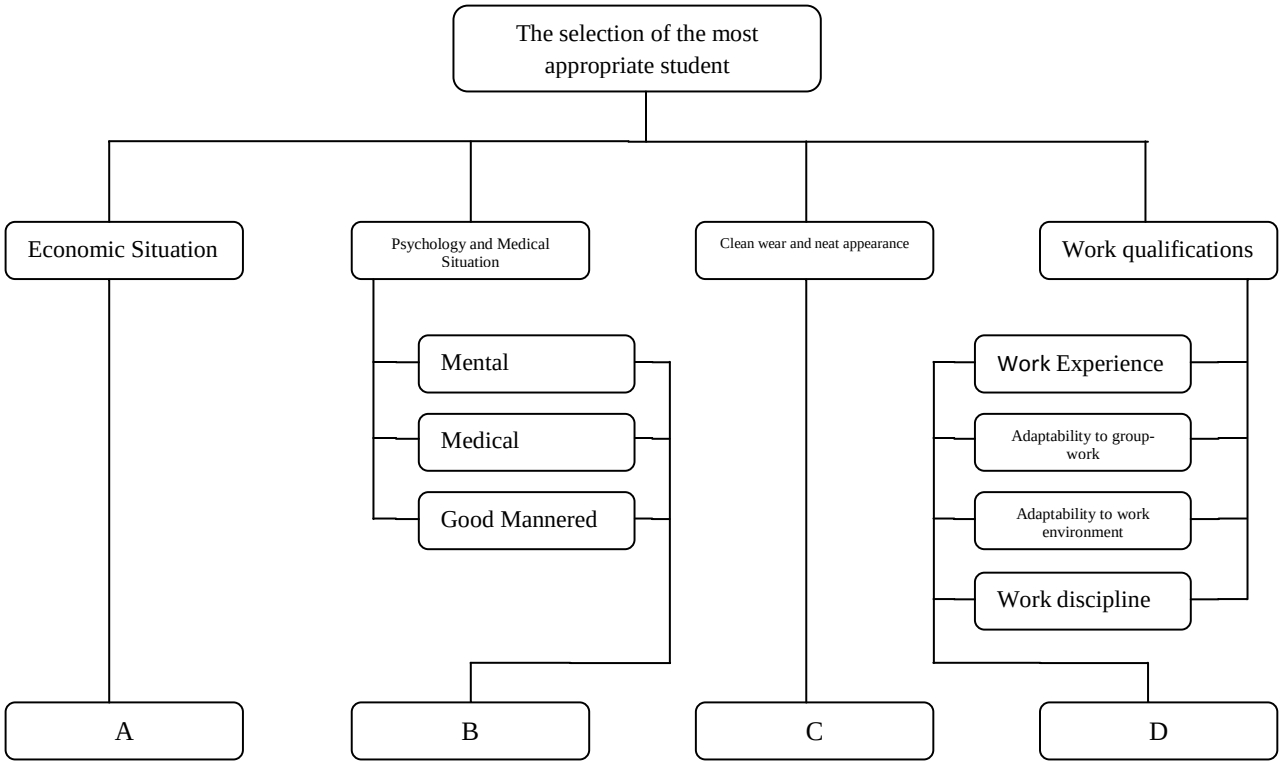

Figure 1: The hierarchical Structure of the model

The following tables are obtained after the calculation of the means of the survey results. In Table 4, there are the normalized results of the main criteria and their weight vector. It can be easily observed that the most important criterion is Work quality.

Criteria	Economic Situation	Psychology and Medical Situation	Clean wear and neat appearance	Work qualifications	Weight Vector
Economic Situation	0,136	0,313	0,214	0,083	0,187
Psychology and Medical Situation	0,136	0,313	0,357	0,417	0,306
Clean wear and neat appearance	0,045	0,063	0,071	0,083	0,066
Work qualifications	0,682	0,313	0,357	0,417	0,441
Consistency Ratio					% 9,887

Table 4: The normalized matrix of the main criteria and their weights

Then the rank of the criteria according to the importance is as follows.

1. Work qualifications
2. Psychology and Medical Situation
3. Economic Situation
4. Clean wear and neat appearance

The results in the tables are obtained by using Microsoft Office 2007 Excel. But for easy calculations for AHP problems The Software program Expert Choice may be used.

In Table 5, the sub-criteria of Psychology and Medical Situation are examined and accordingly, the importance of 'Mental problem' is seen.

Psychology and Medical Situation	Mental Problem	Medical Problem	Good Mannered	Weight Vector
Mental Problem	0,714	0,714	0,714	0,714
Medical Problem	0,143	0,143	0,143	0,143
Good Mannered	0,143	0,143	0,143	0,143
Consistency Ratio				% 0,000

Table 5: The normalized matrix of the criterion Psychology and Medical Situation and its weights

In Table 6, the weights of sub-criteria of the criterion 'Work qualifications' can be seen. 'Work discipline' is the most important criterion and the least important criterion is 'Adaptability to work environment'.

Work qualifications	Work experience	Adaptability to the group-work	Adaptability to the work environment	Work discipline	Weight Vector
Work experience	0,125	0,188	0,125	0,107	0,136
Adaptability to the group-work	0,125	0,188	0,375	0,179	0,217
Adaptability to the work environment	0,125	0,063	0,125	0,179	0,123
Work discipline	0,625	0,563	0,375	0,536	0,524
Consistency Ratio					% 7,030

Table 6: The normalized matrix of the criterion Work qualifications and its weights

In the conclusion part, the pair wise comparison of alternative students according to the criteria was done. And the result which is shown in Table 7 appeared. As seen in the table, the most appropriate alternative is the alternative B.

	0,187	0,306			0,066	0,441				**Weight Vector**
		0,714	0,143	0,143		0,136	0,217	0,123	0,524	
	ES	**MNP**	**MDP**	**GM**	**CWA**	**EW**	**AG**	**WE**	**WD**	
A	0,229	0,491	0,25	0,283	0,323	0,231	0,208	0,200	0,252	0,298
B	0,343	0,291	0,25	0,418	0,295	0,231	0,525	0,200	0,554	0,379
C	0,326	0,067	0,25	0,082	0,214	0,231	0,109	0,333	0,097	0,169
D	0,103	0,151	0,25	0,217	0,168	0,307	0,158	0,267	0,097	0,154
										1,000

Table 7: The normalized matrix of the students and their weights

4. Result And Evaluation

Decision making takes place in every part of the life. Especially in large organizations, there are many criteria to select staff. When the number of the criteria is increased, then it would be hard to select the worker. So the selection should be done in a more scientific way. AHP method offers the decision maker an alternative. A software program using AHP can be developed, to do multi criteria decisions.

The same type of study can be applied on many decision cases in the life. The study shows that in many specific and complicated situations, Analytic Hierarchy Process can be easily done. And it can offer the best decision alternative to the Decision Maker.

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