

Application of Multi Criteria Decision Making for an Online Awardees Short Listing System

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ABSTRACT

The selecting candidate is a usual process in any organization, for example personnel recruitment, supplier selection, and awardees short listing system. The selection process in the area of awarding scholarships often uses a manual process which examines the candidate's qualifications according to that specified by the scholarship scheme. The main objective of this research is to reduce the inefficiencies within the process and improving the quality of the final decision by minimizing the degree of personal preference. In this research, Analytical Hierarchy Process (AHP) has been implemented in awardees short listing system at Petra Christian University. Based on these needs, required a system that can provide considerations determine the decision of the scholarship recipients. Such systems provide objective results based on the terms and conditions have been determined by comparing the value of each scholarship recipients. So the result is in accordance with input provided by potential recipients. Based on the questionnaire result, this application meets with end user requirements, 70% of the respondents said this application improve the efficiency of decision making process in terms of multi criteria decision making ability.

Keywords

Analytical Hierarchy Process, Scholarship, Decision Making.

1. INTRODUCTION

Petra Christian University Surabaya is one of the oldest private universities in Surabaya. By continually improving the quality of education, Petra Christian University continues to improve services and facilities that support academic atmosphere, such as by providing scholarships for students. A scholarship is an award of financial aid for a student to further their education. Scholarships are awarded on various criteria, which usually reflect the values and purposes of the donor or founder of the award. The types of scholarships are: merit-based scholarship, need-based scholarship, and student specific scholarship.

Scholarships are offered not only for undergraduate students, but for prospective students as well. In the awardees short listing system, Petra Christian University requires an application that can assist in determining priorities which candidate will receive a scholarship, so that decisions can be made efficiently. It requires a method that can assist in determining priorities so as to assist in decision making.

One method of decision making that can be used in the selection process of scholarship recipients is the method of Analytical

Hierarchy Process (AHP). AHP is a systematic method and the appropriate selection using the method of decision-making based on a systematic analysis of the data.

The purpose of this research is to develop an awardees short listing application to support decision making in the selection of candidates for scholarship recipients using AHP in accordance with criteria set by Petra Christian University Surabaya.

The remaining part of this paper is organized as follows. Section 2 presents an overview of current proposal for dealing with analytical hierarchy process. Section 3 presents the methodology of this research and the approach that we have delineated to solve the proposed problems. Section 4 discusses the performance of proposed methods. Finally, section 5 concludes the paper.

2. ANALYTICAL HIERARCHY PROCESS

AHP is one of new approach to solve Multi-Criteria Decision Making (MCDM) problem which reduces complicated criteria to a series of pair wise comparisons and synthesizes the results [1, 2, 3]. One of the real world problems which could be encountered by MCDM is the recruitment and selection processes in human resources department. AHP have been implemented extensively in the recruitment and selection of human resources. Kaka [4], Katsumura [5], Melon [6] and Dolan [7] implemented AHP in the area of pricing system selection, cancer screening option, educational project evaluation, and patient preferences respectively.

AHP can be combined with other technique, like fuzzy system. This combination could solve problems in supplier selection [8], maintenance decision [9], organizational performance [10], human resource evaluation [11] and terminal selection [12].

AHP was chosen for this study based on the following reasons:

- The ability of AHP to incorporate tangible and intangible factors in a systematic way.
- It can solve constructed problems in a variety of decision making situation, ranging from the simple personal decisions to the complex capital intensive decision.
- The problem is broken down in a logical fashion from the large elements to smaller elements.
- It works by examining judgments made by decision makers and measure the consistently of those judgments.

AHP define the frameworks with a hierarchy of objective. It helps the user to achieve the goal from the attributes of problems, by

decompose into a hierarchy. A hierarchy is a three-like structure that represents a complex problem on a number of levels [2]. The hierarchy develop consists of several levels. The top level represents the goal or the objective in terms of a problem statement. At the next level, the major criteria are defined in broad terms. Each criterion may be broken down to smaller level or individual parameter depending on the how many details are called in the model. The bottom level of the hierarchy contains the actual condition of the alternatives which under laying the problem.

Once the hierarchy has been structured, the next step is to establish the priority each factor on a given level of the hierarchy. The decision-maker makes judgments about the relative importance of the element with respect to elements at the higher level in the hierarchy using pairwise comparison. In the AHP pairwise comparison a nine-point scale. (1-9) ratio be used to quantify the decision make's strength of feeling between any two alternatives with respect to given criterion.

In the pairwise comparison a matrix is the preferred form. In general, if 'n' (elements) are being compared for given set of matrix, a total of $n(n-1)/2$ judgments are necessary to fill in the matrix. Saaty (1995) describes pairwise comparison on matrix as the element that appears in the left hand column is always compared with the element appearing in the top row, and the value is given to the element in the column as it compared with the element in the row. The next process is synthesis.

Synthesis is a process to complete the relative weights of the elements with regard to an element on the next level. This process must be performed for all matrix developed in the pairwise comparison, by using normalized eigenvector associated with the longest eigenvalue of their comparison matrix.

One of the advantages of the AHP is that it provides consistency checking of judgments call consistency Index (CI). Consistency is the intensities of relations among ideas or objects based on a particular criterion justify each other in same logical way. To add perspective, the consistency index can be verified in terms of inconsistency ratio (IR). Experience suggest that the CR or IR value should be between 0 and 0.10 or within ten percents of what would be the outcome from random judgments is acceptable [2].

3. METHODOLOGY

In this part, research methodology will be described. The methodology involves using selected tools and techniques. There are Microsoft Project 2007 to manage the project, Power Designer 6.0 as a CASE tool, PHP as a programming language and MySQL as a database management system. All these tools are very important to ensure the project is carried out smoothly. Figure 1 presents research methodology.

The framework is developed through System Development Life Cycle (SDLC) methodology. The first step is investigation and planning phase. Literature review and knowledge acquisition are done. In this research, literature review is focus on two main topics, "selection criteria" and "AHP". By conducting questionnaires survey and semi-structured interviews, expert knowledge captured. Figure 2 presents criteria for awardees short listing.

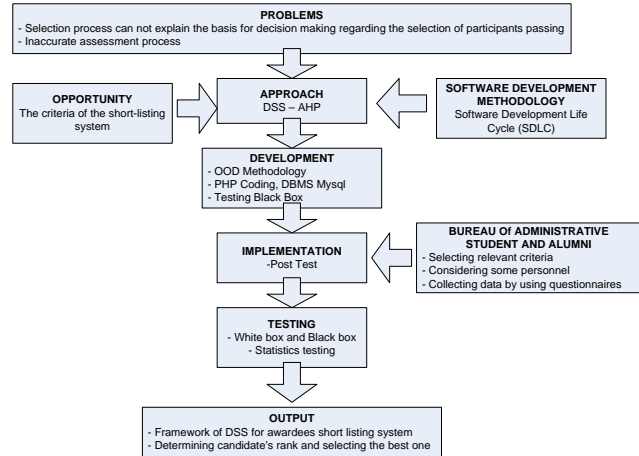
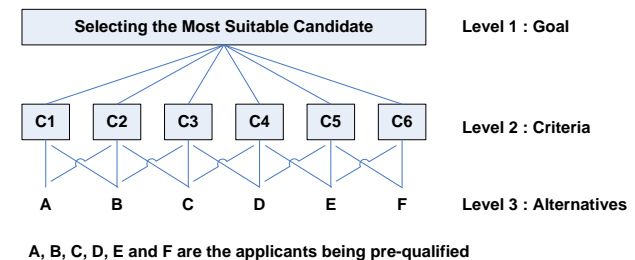


Figure 1. Research Methodology



Criteria	Description
C1	Academic Achievement
C2	Socioeconomic Status
C3	Personality
C4	Leadership Qualities
C5	Cooperative Attitude

Figure 2. Awardees Short Listing System and Criteria

In this research, context diagram and data flow diagram (DFD) are used for modeling processes, while Entity Relationship Diagram (ERD) is used to define the data storage for the system. Figure 3 shows system context and data flow diagram of the system. Figure 4 shows entity relationship diagram of the system.

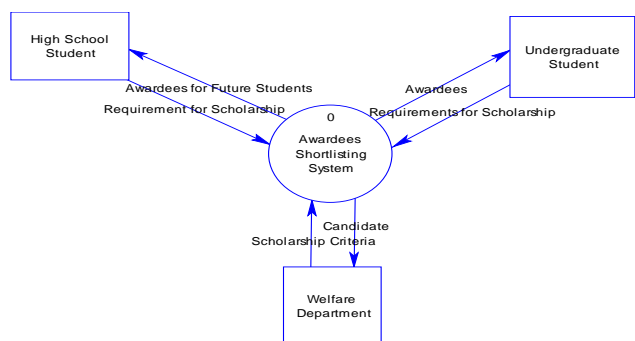


Figure 3. Context Diagram

Data Calon Penerima Beasiswa BAP

Id (Nomor Induk Mahasiswa/Pelajar)	: 26407142
Nama Calon	: Lukas Ferdinand Kaiwai
Pendidikan	: mahasiswa
Jurusan	: Informatika
Fakultas	: Teknologi Industri
Alamat Calon	: Siwalankerto Permai 5/J25
Telp Calon	: 081803053900
Nama Orangtua	: Hans Kaiwai
Alamat Orangtua	: Komp.Uncen kotaraja no 4
Telp Orangtua	: 0967 586387

Data Penilaian Seleksi Calon Penerima Beasiswa BAP

Gaji Orangtua	: 5000000				
Jumlah Tanggungan Orangtua	: 3				
IPK Mahasiswa	: 3.04				
IPS Mahasiswa	: 4				
SKKK	: 347				
Jabatan Organisasi	<table border="1"> <tr> <th>Jabatan</th> <th>Organisasi</th> </tr> <tr> <td>Ketua</td> <td>BEM</td> </tr> </table>	Jabatan	Organisasi	Ketua	BEM
Jabatan	Organisasi				
Ketua	BEM				
Prestasi	<table border="1"> <tr> <th>Prestasi</th> <th>Tingkat</th> </tr> <tr> <td>Juara I Mobile Device</td> <td>internasional</td> </tr> </table>	Prestasi	Tingkat	Juara I Mobile Device	internasional
Prestasi	Tingkat				
Juara I Mobile Device	internasional				
<input type="button" value="Batal"/>					

Figure 6. Screen Capture of Entry Page of Applicant

Daftar Aturan Nilai Skala Konversi Subkriteria

BEASISWA	KRITERIA	SUBKRITERIA	NILAI MIN	NILAI MAKS	VALUE	AKSI
BAP	Tingkat Ekonomi	Gaji Orangtua	0	1000000	5	Edit Hapus
BAP	Tingkat Ekonomi	Gaji Orangtua	1000000	5000000	3	Edit Hapus
BAP	Tingkat Ekonomi	Gaji Orangtua	5000000	10000000	1	Edit Hapus
BEL	Tingkat Ekonomi	Gaji Orangtua	0	1000000	5	Edit Hapus
BEL	Tingkat Ekonomi	Gaji Orangtua	1000000	5000000	3	Edit Hapus
BEL	Tingkat Ekonomi	Gaji Orangtua	5000000	10000000	1	Edit Hapus
KTI	Tingkat Ekonomi	Gaji Orangtua	0	1000000	5	Edit Hapus
KTI	Tingkat Ekonomi	Gaji Orangtua	1000000	5000000	3	Edit Hapus
KTI	Tingkat Ekonomi	Gaji Orangtua	5000000	10000000	1	Edit Hapus

Halaman :
[1]

Manajemen Aturan Nilai Skala Subkriteria

Beasiswa	: Beasiswa Aktif Prestasi
<input type="button" value="Simpan"/> <input type="button" value="Batal"/>	

Figure 7. Screen Capture of Criteria for Selection Model

Matrik Perbandingan Berpasangan Beasiswa BAP

Skor yang dipakai adalah Skala Perbandingan Saaty (1-9)

1	: sama penting
3	: sedikit lebih penting
5	: lebih penting
7	: sangat penting
9	: mutlak sangat penting
2,4,6,8	: nilai antara dua nilai pertimbangan yg berdekatan

Contoh : ☒ Kedisiplinan | ☐ Perilaku | 5

Penjelasan : Contoh diatas berarti kriteria kedisiplinan lebih penting dari kriteria perilaku.

KRITERIA 1	KRITERIA 2	NILAI (BOBOT KRITERIA)
<input checked="" type="radio"/> Tingkat Ekonomi	<input type="radio"/> Akademik	5
<input checked="" type="radio"/> Tingkat Ekonomi	<input type="radio"/> Prestasi	4
<input type="radio"/> Akademik	<input checked="" type="radio"/> Prestasi	3

Figure 8. Screen Capture of Comparison Form

This program can be used to conduct an assessment of existing candidate within the organization. The system will process the score of each criteria based on the results of the criteria multiplied by the value of the sub-criteria. The expectation is if there are applicants who are less fit, it is advisable to be transferred to another position. The results of the implementation of the system can be seen in Figure 9 with the results that have been sorted by the highest score of an applicant.

NAMA_CALON	JURUSAN/PRODI	FAKULTAS	TOTAL_NILAI
RW	Ilmu Komunikasi	Ilmu Komunikasi	2.21378
AD	Desain Interior	Seni dan Desain	2.21014
KA	Manajemen Pariwisata	Ekonomi	2.08495
CP	Manajemen Pemasaran	Ekonomi	2.08426
HMT	Manajemen Bisnis	Ekonomi	2.07436
OB	Informatika	Teknologi Industri	2.07384

Figure 9. Screen Capture of Final Candidates

According to this calculation, it can be said that, candidate can be ranked in descending order according to their total score (Fig. 9) as:

- RW, from Faculty of Communication Studies having a score of 2.21378.
- AD, from Faculty of Art and Design having a score of 2.21014.
- KA, from Faculty of Economics having a score of 2.08495.
- CP, from Faculty of Economics having a score of 2.08426.
- HMT, from Faculty of Economics having a score of 2.07436.
- OB, from Faculty of Industrial Technology having a score of 2.07384.

Based on the investigation it was identified that though AHP has an enormous impact in reducing the degree of subjectivity in the decision making process. The Consistency Ratio (CR) was used to inform the decision maker is any personal preference was involved into the recruitment and selection process.

5. CONCLUSIONS

In this paper, AHP approach for awardees short listing system was presented. The method was applied using data from a real case in the educational industries. This application will generate the output score of candidates, so that applicants who have the highest score will have a great opportunity to be awarded a scholarship in the educational industry. Based on the questionnaire, gathered from head of BAKA and Welfare Policy Staff, the results show that:

- 70% of the respondents said that the features of this application are complete, including entering applicant's data until generating the reports.
- 70% of the respondents investigated that this application improves the efficiency of decision making process in terms of multi criteria decision making ability.

For the future research, considering the fuzziness of executives' judgment during the decision-making process is crucial. By using fuzzy theory, it can be implemented to reduce uncertainty condition.

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