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

by Leo Santoso

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ABSTRACT
The process of selecting candidate is a usual 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.

Keywords
Analytical Hierarchy Process, Scholarship, Systems 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], and human resource evaluation [11].

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 is 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.
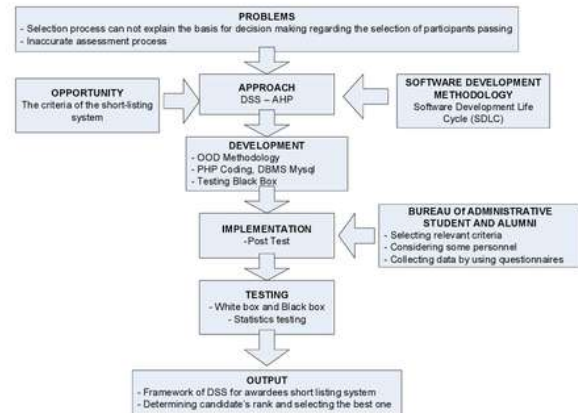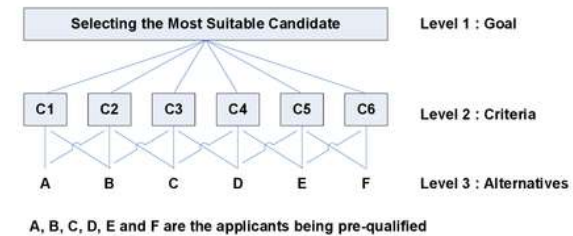

Figure 1. Research Methodology

A, B, C, D, E and F are the applicants being pre-qualified

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.
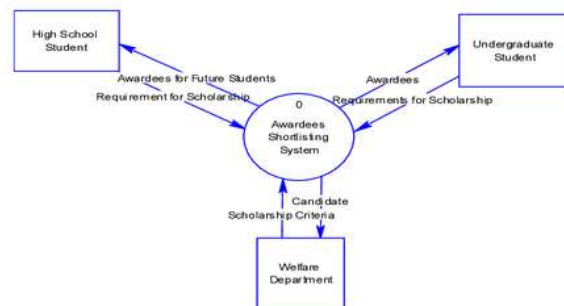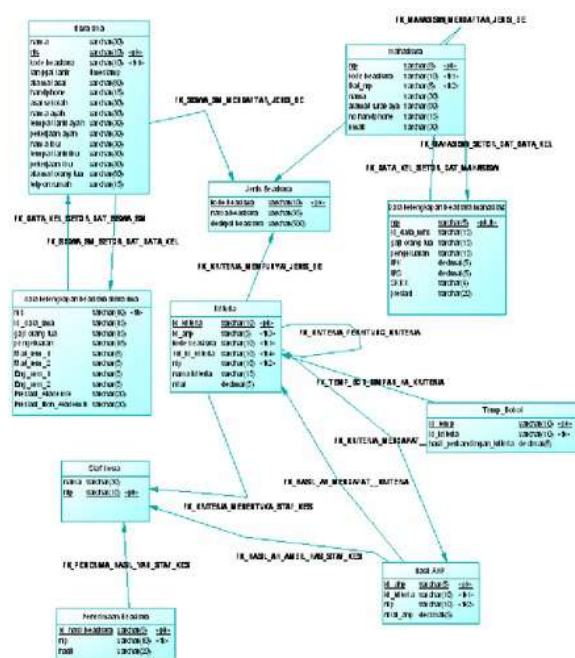

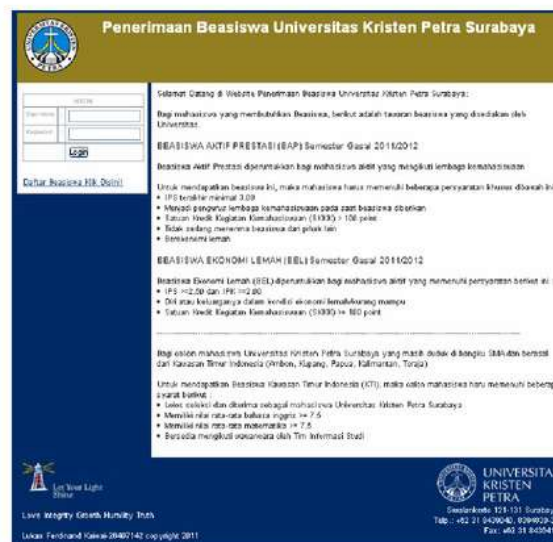
Figure 3. System Context Diagram

Application software is developed through process analysis, design, coding, whereby the software will be able to support the implementation of business processes of an organization, such as management of applicants, testing, and supporting decision for awardees short listing system.

Figure 4. Entity Relationship Diagram

The main sub-system of the proposed application is developing AHP. The design of the AHP must satisfy the goal of developing model that allowed the management to decide which candidate to be selected from the list of qualified candidate, the problems in the bureau of administrative student and alumni (BAKA/Biro Administrasi Kemahasiswaan dan Alumni) are numerous and the interrelationships among the criteria are extremely complicated. In any model development of AHP, the users needs to identify the goals of the research and the problem faced in order to achieve the goals [2].

The procedure for using the AHP can be summarized as [3]

1. Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives. Fig. 2 shows the criteria which used by the system.
2. Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. Table 1 shows scale of pairwise comparison. The table is used to compare each criterion with each other criterion, one-by-one.
3. Synthesize these judgments to yield a set of overall priorities for the hierarchy.
4. Check the consistency of the judgments. Experience suggest that the consistency ratio (CR) or inconsistency ratio (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].
5. Get a final decision based on the results of this process.

4. DISCUSSION

This part described in detail the testing process for the application that has been implemented. Tests performed on each menu as a whole, with the aim to be seen whether the program runs well. Figure 5 shows the main page of the application.

Figure 5. Screen Capture of Main Page

Firstly, data of each scholarship applicant entered into the page of applicants. Inputted data is personal data, such as name, address, place and date of birth. Moreover, there is also academic data, which includes academic achievement, education background, and English proficiency test (Fig 6). After that, criteria and sub-criteria inputted to the system, which followed by the score for each criteria and sub criteria for each available scholarship. Figure 7 depicts criteria and sub criteria of the system, and Figure 8 displays inputting value for each criteria and sub criteria. In this system, 6 criteria are used (Fig. 2). This program is built in a flexible, where the criteria can be removed, replaced and added.

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	Jabatan: Ketua Organisasi: BEM
Prestasi	Prestasi: Juara I Mobile Device Tingkat: internasional

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

Simpan 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)
⊙ Tingkat Ekonomi	○ Akademik	5
⊙ Tingkat Ekonomi	○ Prestasi	4
○ Akademik	⊙ Prestasi	3

Submit Batal

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
GV	Manajemen Pemasaran	Ekonomi	2.07314
DH	Industri	Teknologi Industri	2.07245
BR	Industri	Teknologi Industri	1.95334
TDR	Ilmu Komunikasi	Ilmu Komunikasi	1.94969
JM	Ilmu Komunikasi	Ilmu Komunikasi	1.94639

Figure 9. Screen Capture of Final Candidates

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.

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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