A Framework of Multi-Criteria Decision Making For Candidate Short Listing System

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Abstract—**Recruitment and selection processes are an important task in human resource department. Recruitment process is the first step which determines the competitiveness of the company. Concerning to this issue, developing a framework for decision support system which implements multi-criteria decision making (MCDM) is really needed. This research involved knowledge acquisition phase to capture the expert knowledge including collecting documents of current recruitment and selection processes, knowledge from the literature review and interviews with experts from various companies. The data collected are used to create a theoretical model for employee selection that represented by the Analytic Hierarchy Process (AHP). The main objective of this research paper is to eliminate the degree of personal preference. The proposed framework integrates selection set test and AHP to shortlist the application which acts as an interface between the applicants and selection panel. AHP was used to develop a model which utilizes pair-wise comparison to identify the relative importance of each criteria used to evaluate candidates. Furthermore Simple Additive Weighting Model (SAW) was used to develop a score for each candidate according to their qualifications and the weight assigned by AHP. As a testing of the proposed framework, eliminate the need for manual labor by 85.7% and speed up time by 74.8%.**

Keywords: AHP, MCDM, SAW, recruitment and selection process

I. INTRODUCTION

The main task of human resources department is providing organizations with best employee among applicants. The recruitment and selection is the first step towards achieving organizational goals by creating the valuable assets for the organizations. Recruitment process involves a systematic procedure from sourcing the candidates to arranging and conducting the interviews and requires many resources and time. The process of scoring in this recruitment tests take a long time, when there are many people who apply for jobs, say about 10 people who undergo this test at this stage then the scoring will take approximately 3 days to get the candidates who successfully pass the acceptance tests and deserve to continue to the next process, this is due to the complexity in calculating the score for each applicant. In addition to the length of time spent on the scoring stage, the Human Resources department is also sometimes less thorough in doing the scoring step.

In general, recruitment and selection processes, depending on the organization specific targets, the availability of means and the individual preferences of the decision makers (DMs), are a highly complex problem. The multi criteria nature of the problem makes MCDM methods and copes with this, given that they consider many criteria at the same time, with various weights and thresholds, having the potential to reflect at a very satisfactory degree the vague preferences of the DMs.

In this research, AHP collaborates with SAW method is suggested to solve recruitment and selection problem using multi-criteria decision-making process.

The rest of the paper is organized as follows: In the next section, some relevant studies on the recruitment and selection problem in human resources department are presented. In Section III, the research methodology is demonstrated in brief. Section IV briefly presents an empirical application of the proposed approach for the recruitment and selection of a junior IT officer. Finally, conclusion and future research challenges are discussed.

II. LITERATURE REVIEW

Nowadays, the need for more effective and efficient in making decision has become critical. To facilitate accurate decision making various techniques are continuously being introduced, one of them is MCDM.

AHP is one of new approach to solve MCDM problem which reduces complicated criteria to a series of pair wise comparisons and synthesizes the results [1, 2, 3, 4]. 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 [5], Katsumura [6], Melon [7] and Dolan [8] 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 [9], maintenance decision [10], organizational performance [11], and human resource evaluation [12].

III. 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, Microsoft Visual Basic .Net 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. Fig. 1 presents research methodology.
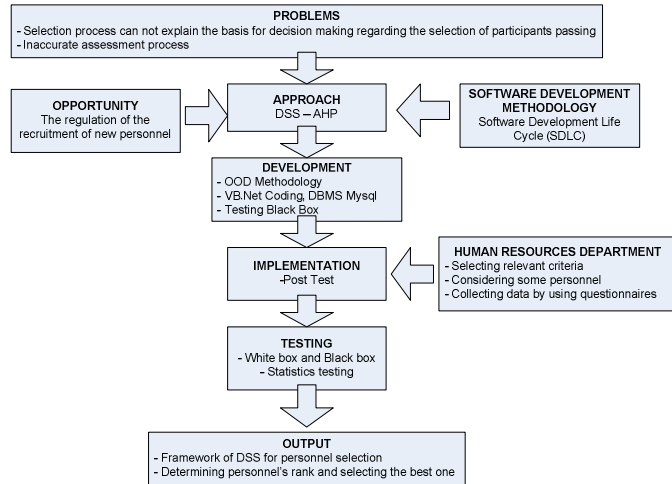

Figure 1. Research Methodology

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, "recruitment and selection criteria" and "AHP and SAW". By doing questionnaires survey and interviews, expert knowledge captured. Figure 2 presents criteria for recruiting and selecting employees.

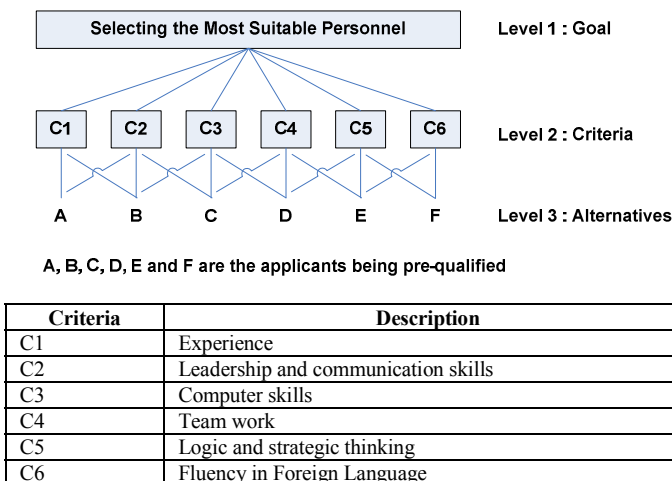| Criteria	Description
C1	Experience
C2	Leadership and communication skills
C3	Computer skills
C4	Team work
C5	Logic and strategic thinking
C6	Fluency in Foreign Language

Figure 2. Recruitment and Selection 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 systems. Fig. 3 shows system context and data flow diagram of the system. Fig. 4 shows entity relationship diagram of the system.
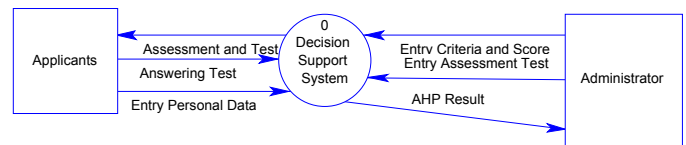

Figure 3. System Context Diagram

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 personnel selection.
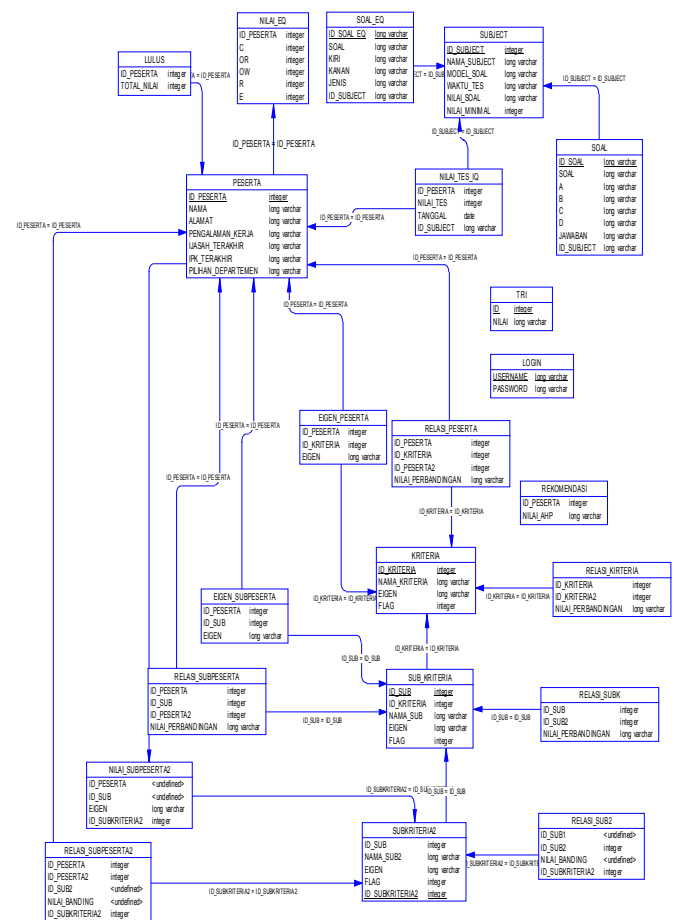

Figure 4. Entity Relationship Diagram

The main sub-system of the proposed framework 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 human resource department 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.

TABLE I.   SCALE OF PAIRWISE COMPARISONS

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong	An activity is favored very strongly over another
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

For ranking process, Simple Additive Weighting method is used, because it is a proportional linear transformation of the raw data, so the standardized scores remain equal. SAW which is also known as weighted linear combination or scoring methods is a simple and most often used multi attribute decision technique [12]. The method is based on the weighted average. An evaluation score is calculated for each alternative by multiplying the scaled value given to the alternative of that attribute with the weights of relative importance directly assigned by decision maker followed by summing of the products for all criteria.

IV. RESULT AND DISCUSSION

This part described in detail the testing process for the framework that has been implemented. Tests performed on each menu as a whole, with the aim to be seen whether the program runs well. Firstly, data of each applicant entered into the form of job applicants. Inputted data is personal data, such as name, address, place and date of birth. Moreover, there is also academic data, which includes work experience, education background, and English proficiency test. After that, criteria and sub-criteria inputted to the system, which followed by the score for each criteria and sub criteria for each job vacancy. Fig. 5 depicts criteria and sub criteria of the system, and Fig. 6 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.
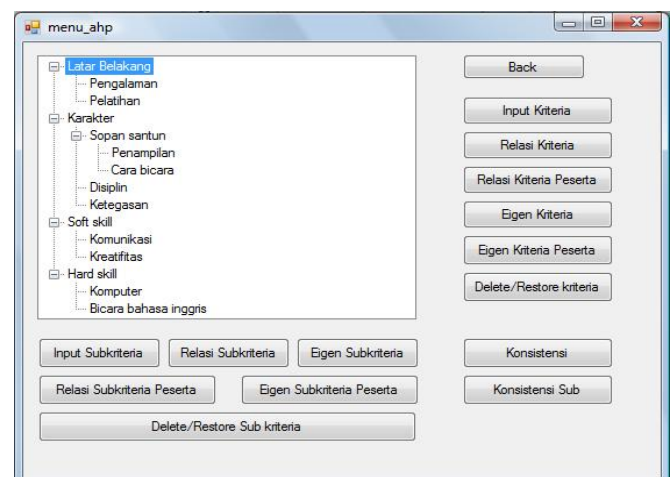

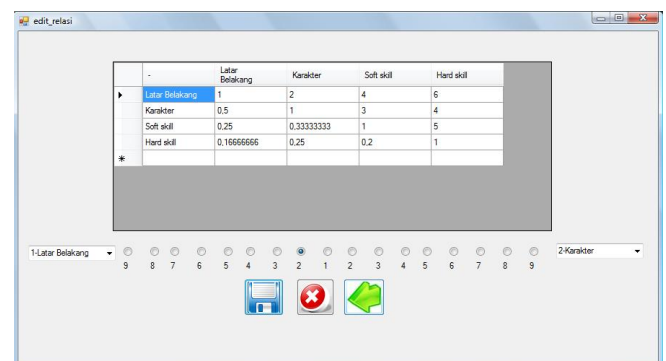Figure 5.   Criteria for selection model

Figure 6.   The verbal comparison form

This program can be used to conduct an assessment of existing employees within the company. 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 employees 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 Fig. 7 with the results that have been sorted by the highest score of an applicant.

Figure 7.   Synthesis form

Based on the investigation it was identified that though AHP-SAW 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.
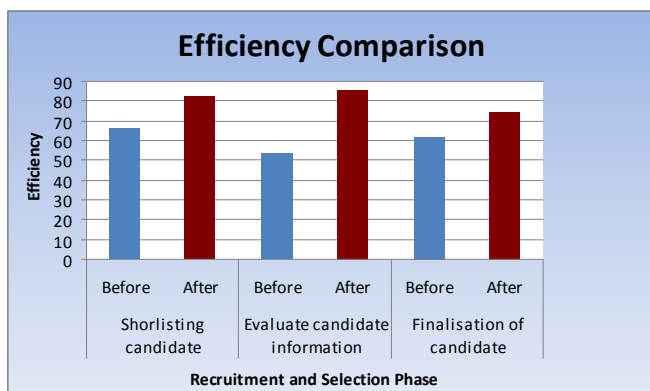

Figure 8.   Efficiency comparison test

As can be seen from Fig. 8, the implementation of the system gave positive impacts. As a result of the proposed framework the throughput efficiency of the overall recruitment and selection process improve significantly. It can reduce manual labor by 85.7% and speed up the overall time by 74.8%. Thus in conclusion the proposed solution increases the overall throughput efficiency of the candidate selection process whilst improving the quality of the overall recruitment and selection.

V.   CONCLUSIONS

In this paper, AHP-SAW approach for recruitment and selection processes was presented. The method was applied using data from a real case in the Pulp and Paper companies.

This application will generate the output score of candidates, so that employees who have the highest score will have a great opportunity to be admitted to the employee in the company.

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.

REFERENCES

[1] O.S. Vaidya, and S. Kumar, "Analytic Hierarchy Process: an overview of applications", European Journal of Operation Research, Vol. 169 No. 2006, 2006, pp. 1-29.

[2] T.L. Saaty, The Analytic Hierarchy Process, McGraw-Hill International, New York, 1980.

[3] T.L. Saaty, Decision Making for Leaders: The Analytic Hierarchy Process for Decisions in a Complex World. Pittsburgh, Pennsylvania: RWS Publications, 2008.

[4] L.W. Santoso, L. F. Kaiwai, A. Setiawan, "Application of multicriteria decision making for an online awardees short listing system," in Proc. 3rd Int. Conf. of Soft Computing, Intell. System, and Information Technology, May 24-25, 2012

[5] A. Kaka, C. Wong, C. Fortune, D. Langford, "Culture change through the use of appropriate pricing systems," Engineering, Construction and Architectural Management, vol. 15(1), pp. 66-77, 2008.

[6] Y. Katsumura, H. Yasunaga, T. Imamura, K. Ohe, H. Oyama, "Relationship between risk information on total colonoscopy and patient preferences for colorectal cancer screening options: Analysis using the Analytic Hierarchy Process," BMC Health Services Research, vol. 8, pp. 106, 2008.

[7] M.G. Melon, P.A. Beltran, M.C.G. Cruz, "An AHP-based evaluation procedure for Innovative Educational Projects: a face-to-face vs. computer-mediated case study," Omega, vol. 36(5), pp. 754-765(12), 2008.

[8] J.G. Dolan, S. Iadarola, "Risk communication formats for low probability events: an exploratory study of patient preferences," BMC Medical Informatics and Decision Making, vol. 8(14), pp. 14, April 2008.

[9] E. Bottani, A. Rizzi, "An adapted multi-criteria approach to suppliers and products selection-An application oriented to lead-time reduction," Int. J. Production Economics, vol. III, pp. 763-781, 2008.

[10] M.S.G. Cascales, M.T. Lamata, "Fuzzy Analytical Hierarchy Process in Maintenance Problem," IEA/AIE, LNAI 5027, pp. 815-824, 2008.

[11] C.R. Wu, C.W. Chang, H.L. Lin, "FAHP Sensitivity Analysis for Measurement Nonprofit Organizational Performance," Quality & Quantity, vol. 42, pp. 283-302, 2008.

[12] M.E. Genevois, Y.E. Albayrak, "A fuzzy multiattribute decision making model to evaluate human resource flexibility problem," Journal of Multiple-Valued Logic and Soft Computing, vol. 14(3) (5), pp. 495-509, 2008.

[13] F. Ma, G.X. Xu, F.X. Yang, " Capability adaptation algorithm based on joint network and terminal selection in heterogeneous networks," Journal of China Universities of Posts and Telecommunications, vol. 18 (1), pp 76-82, September 2011.