ANALYTIC HIERARCHY PROCESS IN ACADEMIC STAFF SELECTION AT FACULTY OF SCIENCE IN UNIVERSITY TECHNOLOGY MALAYSIA

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ABSTRACT

Academic staff selection is an important process for a university since the decision affects the quality of education and the success of the university. Selection committee always faces up to the uncertainty and vagueness in the conventional decision making process. These subjective perception and the experiences of decision maker can be effectively represented and reached to a more effective and unbiased decision by introducing Analytic Hierarchy Process (AHP) to the normally practiced selection process. AHP permits pair-wise comparison judgments in expressing the relative strength of impact for the criteria in the hierarchy which can be translated to quantitative data to help in improving the traditional method and simplifies the process of selecting a best academic staff by considering the criteria that may influence the decision made. This is crucial in order to formalize a decision process, reduce time commitments, create a process orientation, document the strategy, and result in better decisions for the selection process. This study embarks on finding out the potential criteria and developing an AHP aided decision making model for the academic staff selection process in the Faculty of Science, UTM. The selection criteria of Knowledge, Working Experience/Interpersonal Skill, General Traits, Scholar/ Extra Curricular Activities and References used in the model developed are determined based on the knowledge acquisition from experts' in the university and literature reviews done. The ranking of generated candidate profiles shows that Candidate 2 possesses the highest priority, thus should be selected as the academic staff, by using the AHP model developed. Microsoft Excel and Expert Choice 11.5 are used to assist in accomplishing the tedious calculations involved, as well as providing effective aids for discussions and analyzing of the results. A few suggestions for future work and research direction in the area of academic selection process is also being discussed.

ABSTRAK

Pemilihan kakitangan akademik merupakan satu proses yang penting disebabkan keputusan pemilihan akan mempengaruhi kualiti pendidikan dan kejayaan suatu universiti. Dalam proses pemilihan tradisional, jawatankuasa pemilihan selalunya menghadapi ketakpastian dan kekaburan semasa membuat keputusan. Tanggapan subjektif dan pengalaman pembuat keputusan boleh diwakilkan secara berkesan dan keputusan yang lebih efektif dan saksama dapat dibuat dengan memperkenalkan Proses Hierarki Analitik (AHP) ke dalam proses pemilihan tersebut. AHP membenarkan perbandingan penilaian secara berpasangan, mempamerkan secara jelas kekuatan relatif kritera-kriteria dalam hierarki. Dengan mempertimbangkan kriteria-kriteria yang dapat diterjemahkan kepada data kuantitatif dan berkemungkinan mempengaruhi keputusan yang dibuat, keberkesanan kaedah pemilihan dan permudahan proses pemilihan dapat dibuat. Ini bertujuan memformalkan proses pemilihan, menjimatkan penggunaan masa, mewujudkan proses yang berorientasi, mendokumenkan strategi dan menghasilkan keputusan yang lebih memuaskan dalam proses pemilihan. Kajian bermula dengan penemuan kriteria-kriteria yang berkaitan dan seterusnya membangunkan satu model pembuat keputusan dengan bantuan AHP dalam proses pemilihan kakitangan akademik dalam Fakulti Sains, UTM. Kriteria-kriteria pemilihan adalah Pengetahuan, Pengalaman Kerja/ Kemahiran Diri, Perwatakan, Kegiatan luar dan Rujukan yang ditentukan berdasarkan pengetahuan daripada pakar-pakar dalam universiti dan rujukan journal. Kedudukan calon berdasarkan profil yang dijanakan menunjukkan bahawa Calon 2 memiliki tahap keutamaan tertinggi. Microsoft Excel dan Expert Choice 11.5 digunakan dalam mempermudahkan pengiraan, perbincangan dan analisis keputusan. Beberapa cadangan untuk kerja penyelidikan seterusnya berserta hala-tuju penyelidikan dalam bidang yang sama juga turut dibincangkan.

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CHAPTER 1

INTRODUCTION

1.1   Introduction

Personnel selection is a process of identifying, weighting, and evaluating candidates against job requirements. The basic idea of personnel selection is to choose the best applicant for a job. A very common problem in the personnel selection is that the biases of those doing the rating have a tendency to creep into the selection process (Arvey, 1982). It is desirable to establish adequate selection attributes (criteria) to discuss the attributes carefully to ensure that the right person is chosen (Tung, 1981).

Academic member selection is an important process for the universities as this decision affects the quality of education and the success of the university. The decision is to select the best candidate for the faculty. Decision committee faces up to the uncertainty and vagueness in the decision-making process (Ertugrul and Karakasoglu, 2007). Analytic Hierarchy Process (AHP) can be applied to decision making in this areas. By using AHP, uncertainty and vagueness from subjective perception and the experiences of decision maker can be effectively represented and reached to a more effective decision. As academic members are related to the

success and failure of higher education institutions, well developed selection criteria can signify the essential element of the position, attract a high quality pool of applicants and provide a reliable standard that applicants can be considered against.

It is crucial that everyone in the selection committee understand the list of selection criteria and use it as the focal point throughout candidate assessment. Essential criteria are those teaching skills, past experiences, qualifications, abilities and publications and researches that are relevant to the performance of the functions of a person's duties. Ensuring the selection criteria assists in laying the foundations for future conversations around probation, performance and promotion in a more objective, fair and effective manner. The selection criteria provide structure to assist the selection committee in developing effective interview questions and in identifying the applicants to measure their own suitability. Additional information extraneous to the decision criteria is excluded from deliberation in an effort to limit rater bias. We believe the personnel selection process can be aided by some formal decision making techniques, particularly the AHP with its emphasis on decision making with intangible criteria (Gibney and Shang, 2007).

Academic member selection is a multi-criteria decision making problem and selecting the best personnel among many alternatives is also a multi-criteria decision making (MCDM) problem (Dagdeviren, 2008). The selection procedures may vary from university to university.

Multiple criteria decision making (MCDM) refers to making decisions in the presence of multiple, usually conflicting criteria (Grandzol, 2005). It is one of the well-known topics of decision making. Multicriteria is a term that comes in many variants. The terms "multicriteria", "multi-criteria" or "multiple criteria" in either title or keywords yield different, but overlapping, returns, as do "multiattribute:, "multi-attribute", "multiple objective", "multiobjective" and multi-objective". Multiple objectives tend to be associated with mathematical programming, while

multicriteria and multiattribute tend to be focused on the selection among a given set of discrete alternatives (Olson, 2008). However, the terms are used as synonyms in this study. Selection decisions are challenging because the balancing of multiple, often conflicting attributes, criteria, or objectives are required (Olson, 2008). The overall goal of any MCDA process is not to make a decision, but rather to support a decision making process (Linkov et al, 2007).

1.2   Background of the problem

In this study, the decision is to aid human's ability to select the best candidate for academic staff of faculty using Analytical Hierarchy Process (AHP). Identification of best candidates is vital to ensure the quality of education, effectiveness of program and activities attended in a university. Traditional methods choose people for specified jobs, not for an organization as a whole or for subunits, work groups, or teams (Guion, 1998). Hiring the wrong person may lead to dysfunctional of departments, dissatisfied students and eventually repeat efforts. The selection process is an important focus since it is a success factor to meeting a university's objectives of productivity, industrial harmony and growth.

A good selection system is a practical tool for users, based on sound theory and research, allows for flexibility in the environment, treats candidates equitably, achieves its purpose cost-effectively and facilitates organizational effectiveness. In addition, the evaluation process in a personnel selection process, by its very nature is subjective, leaving many areas open to bias and error. Traditional methods and criteria of personnel selection are ineffective and it is necessary to find some modern techniques since there will be arguments arose. Although evaluating applicants with written and oral exams is essential when employing the personnel needed, but it is not sufficient alone.

In personnel selection, criteria or factors that are to be the basis of assessment and evaluation must be specified and the weights of these criteria must be determined. The selection criteria provide structure to assist the selection committee in developing effective interview questions and in identifying the applicant(s) best suited to perform effectively, as well as for applicants to measure their own suitability. Each criterion has a different importance or weight in personnel assessment. Therefore, unsatisfactory selection may occur with assessment and evaluation tools, such as written or oral exams and tests which are not based upon certain criteria and weights (Dagdeviren and Yuksel, 2007). There are a couple of issues over this practice. Often, the evaluations are individual assessments where each candidate is evaluated based on the predetermined selection criteria.

Normally, the best applicant would be the one with the highest total score, but in real, a candidate who does not have the highest academic qualification may be better in terms of his working leadership and ethics while a candidate who is great in research work may not be good in teaching. Besides, the selection committee members from the different professional backgrounds may weigh the selection criteria differently. A member from the academic background may weigh academic qualification and scientific works more than the member with the management background whose priorities may be for working experience and some general traits. The same candidate may receive uneven evaluations from the different committee members (Mamat and Daniel, 2004). Generally, during the process of selection, there are individual biases and stereotypes.

As in many decision problems, academic member selection problem is too complicated. Human generally fail to make a good prediction for quantitative problems, whereas comparatively having a good guess in qualitative forecasting. The nature of the faculty member selection enables the use of well-known multi-criteria decision-making method called the analytic hierarchy process (AHP) to deal with the issues mentioned above. AHP is a systematic approach for representing the elements of this problem, hierarchically. AHP permits pair-wise comparison

judgments (which are documented and can be re-examined) to express the relative strength or intensity of impact of the elements (criteria) in the hierarchy. These judgments are then translated to numbers. This help to improve the traditional method and simplify the process of selecting a best candidate to become the academic member in this study by considering the criteria that may influence the decision made. AHP is a planning methodology which incorporates the best of formal, incremental, and systemic paradigms (Saaty and Kearns, 1985).

It is important to select an appropriate academic staff for a university to ensure the standard and quality and success of a university. Therefore, there is a need to develop a suitable and effective model to improve the existing academic staff selection model in the university. The intent of this study is to show the application of a model that is not overly complex and that does legitimately aggregate across scales can serve to formalize a decision process, reduce time commitments, create a process orientation, document the strategy, and result in better decisions.

1.3 Statement of the problem

In order to develop the model of academic staff selection, this study will embark on the problem of finding out the potential criteria which affect the selection of academic staff particularly the efficiency of selection process with a mechanism which can be free from biasness.

Selection of academic staffs in university, particularly UTM, has been done using a guideline outlined by the Registrar Office and adapted by the various departments in various faculties in the university. Even though the selection process adopted by the departments of the faculties do include elements of quantitative

evaluations as well as some qualitative assessments on the potential candidates, the various departments does not use any standardized or established selection model customized for the university.

1.4   Objectives of the study

The main aim of the study is to develop a decision making model to aid the personnel selection committee to select the most appropriate candidate to be the faculty academic staff in university. The specific objectives are:

1.4.1   To investigate and propose the potential criteria which affect the selection process of academic staff in university.

1.4.3   To develop a decision making model incorporating AHP to assist in the selection of most appropriate academic staff in university.

1.5   Scope of the study

This research on academic staff selection problem is to identify the criteria for selection of academic staff in university using knowledge acquisition phases and to assess the information which involves multi criteria decision making ability by Analytic Hierarchy Process. Faculty members are those who research, those who do teach and those who do both (Grandzol, 2005). The following are the scopes of the study:

(a) The study is focused on the application of AHP as one of the tools for implementing multiple criteria academic staff selection in university, not on the best methodology for the problem.

(b) Several criteria considered to be relevant to the selection decision are used in the ranking of the academic staff selection problem.

(c) A decision hierarchy, which is the most important aspect of the study, will be constructed. In line with this, the criteria or exact requirement of the selection of faculty academic staff will be carefully studied and considered, as inadequate and inappropriate information will affect utilization and efficiency of the decision making tool developed.

(d) The profiles of candidates used in simulation of the selection model developed are simulated data. Collection of actual profiles of those already holding the posts, as well as those of the potential candidates to the posts, is not done due to the sensitivity of the data involved and also the time constraint of this project.

(e) An in-depth study on the selection process adopted by the Registrar Office of University of Technology Malaysia (UTM) is carried out in this research in order to identify mainly the more relevant selection criteria used in the selection process of academic staffs in university. This is not a case study of whether the selection of academic staffs of UTM has been done efficiently and unbiasly.

1.6   Significance of the study

This research will contribute toward the enhancement of a decision making tool to effectively aid the selection process of academic staffs in university. The enhancement is achieved through the introduction of AHP to the normally practiced selection process. This tool will give support to decision making in problems that are too complex to be solved by the intuitive use of common sense alone and in this case, the selection process of academic staffs in university.

In addition, the developed AHP selection model will aid the personnel selection committee who are not extensively trained in AHP quickly understood the process to select the most appropriate faculty academic staff in university. The study will contribute an availability of results and solutions for comparison and validation purposes in related researches or industries.

In this research, the background information regarding the selection process is first presented. Next, the AHP as a personnel recruiting tool is described, and the methodology is applied within the context of the faculty academic staff selection process.

1.7 Structure of Dissertation

This structure of the dissertation is framed into 7 major chapters and a brief of description and summary of the content of each chapter is presented as following:

Chapter 1 gave the introduction of this study, discussed on the research project undertaken and the importance of the research. It then justifies the need for the research, aims, scope, objective and limitation of the research.

In Chapter 2, the general idea on the selection of academic staff in Faculty of Science, UTM is discussed. Literature reviews for Analytic Hierarchy Process (AHP) as one of the Multi-Criteria Decision Making (MCDM) method, process and model of the selection of academic staff as well as the brief discussion on the application of AHP in the selection of academic staff in a faculty are done.

Chapter 3 described the methodology adopted in this study. The knowledge acquisition from experts and the overview of application of AHP in the academic staff selection process in Faculty of Science, UTM are discussed in detail.

Whereas in Chapter 4, a case study on the existing academic staff selection process of Faculty of Science, UTM is done. The whole selection process which includes the flow of the process, selection committee members involved and the selection criteria are explained in detail in the chapter.

Chapter 5 presented the AHP aided academic staff selection model developed in this study. The selection criteria and their sub-criteria determined and the priority weights of the selection criteria and the sub-criteria synthesized are discussed in this chapter. The calculations involved are shown in detail.

Chapter 6 detailed the implementation of AHP model in the academic staff selection process in the Faculty of Science. Ranking of candidates are done in order to select the best candidate for the faculty and the discussion as well as the analysis is

done and presented using appropriate graphs and charts by the help of Expert Choice 11.5.

Lastly, Chapter 7 draws the conclusion and summary of the research done in this study. The finding of the research is concluded and some suggestions are listed for future works in the same area.

REFERENCES

Arvey, R. D. and Campion, J. E. (1982). The employment interview: A summary and review of recent research. *Personnel Psychology*. 35(2), 281-322.

Avery, R. D. and Renz, G. L. (1992). Fairness in the Selection of Employees. *Journal of Business Ethics*. 11, 331 – 340.

Boose, J. H. (1989). A Survey of Knowledge Acquisition Techniques and Tools. *Knowledge Acquisition*. 1, 3 – 37.

Brent, A. C., Rogers, D. E. C., Ramabitsa-Siimane, T. S.M., Rohwer, M. B. (2007). O.R Applications: Application of the analytical hierarchy prosess to establish health care waste management systems that minimize infection risk in developing countries. *European Journal of Operational Research*. 181, 403 – 424.

Brozova, H. (2004). The Analytic Hierarchy Process for the Decision Tree with Multiple Criteria. *AGRIC. ECON. – CZECH.* 50(2), 77 – 82.

Cheng, E. W. L. and Heng, L. (2001). Information Priority-Setting for Better Resource Allocation Using Analytic Hierarchy Process (AHP). *Information Management & Computer Security*. 9(2), 61 – 70.

Ciptomulyono, U. (2008). Fuzzy Goal Programming Approach for Deriving Priority Weights in the Analytical Hierarchy Process (AHP) method. *Journal of Applied Science Research.* 4(2), 171 – 177.

Daˇgdeviren, M. (2008). A hybrid multi-criteria decision-making model for personnel selection in manufacturing systems. *Journal of Intelligent Manufacturing*.

Dagdeviren, M., Yuksel, I. (2007). Personnel Selection Using Analytic Network Process. *İstanbul Ticaret Üniversitesi Fen Bilimleri Dergisi Yıl: 6 Sayı:11Bahar*. 99-118.

Dyer, R. F., Forman, E. H. (1992). Group Decision Support with the Analytic Hierarchy Process. *Decision Support System*. 8, 99 – 124.

Ertuğrul, I. and Karakaşoğlu, N. (2007). Fuzzy TOPSIS Method for Academic Member Selection in Engineering Faculty. *M. Iskander (ed.), Innovations in E-learning, Instruction Technology, Assessment and Engineering Education.* 151–156.

Faggini, M. and Lux, T. (2009). *New Economic Windows: Coping with the Complexity of Economics*. Springer Milan.

Formann, A. K. (1992). Academic Personnel Selection: Description and Prognosis of the Decision Made by the Committee for the Selection of Candidates for a Full Professorship. *Scientometrics*. 3, 401 – 414.

Gibney, R. and Shang, J. (2007). Decision making in academia: A case of the dean selection process. *Mathematical and Computer Modelling*. 1030-1040.

Golec, A. and Kahya, E. (2007). A Fuzzy Model for Competency-based Employee Evaluation and Selection. *Computers & Industrial Engineering*. 52, 143–161.

Grandzol, J. R. (2005). Improving the Faculty Selection Process in Higher Education: A Case for the Analytic Hierarchy Process. *IR Applications Using Advanced Tools, Techniques, and Methodologies*. 6, 1 – 11.

Grensing, L. (1986). *A Small Business guide to Employee Selection*. Canada. International Self-Counsel Press Ltd.

Gunion, R. M. (1998). Some Virtues of Dissatisfaction in the Science and Practice of Personnel Selection. *Human Resource Management Review*. 8(4), 351 – 365.

Hishamuddin, M. S. (2000). *Handbook on Managerial Selection Techniques*. UTM, Skudai, Malaysia. Cetak Ratu Sdn. Bhd.

Ho, W. (2008). Integrated Analytic Hierarchy process and its Applications – A Literature Review. *European Journal of Operational Research.* 186, 211 – 228.

Hwang, C.L. and Yoon, K. (1981). Multiple Attribute Decision Making. *Methods and Applications. Lecture Notes in Economics and Mathematical System*. Vol. 186. Springer-Verlag, Berlin.

Kahraman, C. (2008). *Springer Optimization and Its Application Volume 16: Fuzzy Multi-Criteria Decision-Making: Theory and Applications with Recent Developments.* Springer US.

Lam, K and Zhao, X. (1998). An Application of quality function deployment to improve the quality of teaching. *International Journal of Quality and Reliability Management.* 15(4), 389 – 413.

Leigh, I. W., Smith, I. L., Bebeau, M. J., Lichtenberg, J. W., Nelson, P. D., Portnoy, S., Rubin, N. J., & Kaslow, N. J. (2007). Competency assessment models. *Professional Psychology: Research and Practice.* 38(5), 463–473.

Linkov, I., Satterstrom, F. K. , Tkachuk, A., Levchenko, A., Seager, T.P., Figueira, J. R. and Tervonen, T. (2007). *NATO Security through Science Series: Managing Critical Infrastructure Risks*. Netherlands : Springer.

Mamat, N. J. Z. and Daniel, J.K. (2007). Statistical analyses on time complexity and rank consistency between singular value decomposition and the duality approach in AHP: A case study of faculty member selection. *Mathematical and Computer Modelling.* 46, 1099 – 1106.

Mamat, N. J. Z., Daniel, J. K. (2004). Faculty Member Selection; A Comparative Study of AHP and its Variants. *17ᵗʰ International Conference on Multiple Criteria Decision Making (MCDM 2004)*. 6 – 11 Aug 2004. Canada : Whistler.

Nussbauma, M., Singerb, M., Rosasc, R., Castilloa, M., Fliesa, E., Larad, R., Sommersd, R. (1999). Decision Support System for Conflict Diagnosis in Personnel Selection. *Information & Management*. 36, 55 – 62 .

Olson, D. L. (2008). *Handbook on Decision Support System I*. Berlin Heidelberg : Springer.

Rafikul, I. (2003). *The Analytic Hierarchy Process: An Effective Multi-criteria Decision Making Tool*. Malaysia: International Islamic University Malaysia.

Saaty, T. L. (1980). *The Analytic Hierarchy Process*. New York. Mc Graw Hill, NY.

Saaty, T. L. and Vargas, L. G. (2006). *Decision Making with the Analytic Network Process: Economic, Political, Social and Technological Applications with Benefits, Opportunities, Costs and Risks*. Springer US.

Saaty, T. L., Ramanujam, V. (1983). An Objective Approach to Faculty Promotion and Tenure by the Analytic Hierarchy Process. *Research in Higher Education*. 18(3), 311-331.

Saaty, T.L., Kearns, K.P. (1985). *Analytical Planning: The Organization of Systems*.

 London: Oxford Press Ltd.

Shih, H. S., Huang, L. C., Shyur, H. J. (2005). Recruitment and Selection Processes Through an Effective GDSS. *Computers and Mathematics with Applications*. 50, 1543 – 1558.

Slaughter, J. E., Bagger, J., Li, A. (2006). Context Effects o Group-Based Employee Selection Decisions. *Organizational Behavior and Human Decision Processes*. 100, 47 – 59.

Tadisina, S. K. and Bhasin, V. (1989). Doctoral Program Selection Using Pair-wise Comparisons. *Research in Higher Education*. 30(4), 403 – 418.

Taylor III, F. A., Ketcham, A. F. and Hoffman, D. (1998). Personnel Evaluation with AHP. *Management Decision*. 36(10), 679 – 685.

Tung, R. L. (1981). Selection and training of personnel for overseas assignments. *Columbia Journal of World business*. 16(1), 68-78.

Tung, S. L. and Tang, S. L. (1998). *A comparison of the Saaty's AHP and modified AHP for right and left eigenvector inconsistency*. Elsevier Science B.V.

Tzeng, G.H., Teng, M.H., Chen, J.J., Opricovic, S. (2002). Multicriteria selection for a restaurant location in Taipei. *International Journal of Hospitality Management*. 21, 171 – 187.

Wasil, E and Golden, B. (2003). Editorial: Celebrating 25 years of AHP-based Decision Making. *Computers & Operations Research*. 30, 1419 – 1420.

Wilson, J. R. and Corlett, E. N. (1995). Evaluation of Human Work: A Practical Ergonomics Methodology. London. Taylor and Francis.

Zhang, G. Q. and Lu, J. 2003. An Integrated Group Decision-Making Method Dealing with Fuzzy Preferences for Alternatives and Individual Judgments for Selection Criteria. *Group Decision and Negotiation*. Kluwer Academic Publishers. 12, 501– 515.