Web-based Decision Support System for Job Selection Using Analytic Hierarchy Process

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Abstract

Decision Support System (DSS) provides information, models, and data manipulation tools to help make decisions in semi-structured and unstructured situations where no one knows exactly how the decision should be made [3]. DSS on the web and the Internet are being developed to support decision making, providing to various database and information pool along with software for data analysis. Computer based DSS are widely deployed in real projects. Analytic hierarchy process (AHP) is a technique to solve multicriteria decision problems. In this paper, the decision support system for job selection is implemented by using AHP approach. AHP makes comparison between criteria and comparison between alternatives and then calculate the overall ranking of the alternatives by mathematically combining the priority matrices of criteria. The system assists jobseekers to find appropriate job easily within a short time.

1. Introduction

DSS are interactive, computer-based systems that aid users in judgment and choice activities. They provide data storage and retrieval but enhance the traditional information access and retrieval functions with support for model building and model-based reasoning. They support framing, modeling, and problem solving. Typical areas of DSSs are management and planning in business, health care, the military, and any area in which management will encounter complex decision situations. Decision support systems are typically used for strategic and tactical decisions faced by upper-level management, decisions with a reasonably low frequency and high potential consequences, in which the time taken for thinking through and modeling the problem pays off generously in the long run.[3]

The Analytic Hierarchy Process (AHP) is a theory of measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales. It is these scales that measure intangibles in relative terms. The comparisons are made using a scale of absolute judgments that represents, how much more, one element dominates another with respect to a given attribute. The judgments may be inconsistent, and how to measure inconsistency and improve the judgments, when possible to obtain better consistency is a concern of the AHP. The derived priority scales are synthesized by multiplying them by the priority of their parent nodes and adding for all such nodes. [8]

Job choosing with jobseeker's preferences is very popular today. AHP technique is a way to structure decision problem. AHP formalize the relative importance and evaluate each job vacancy. There are a lot of job vacancy offers from computer field. When employer was mulling over his job offers, he can choice the most worthy job with important factors to him. In this system, Salary, Experience, job content, work time and location are set as the important criteria for job choosing. The companies or organizations which announce the job vacant may be the alternatives. Jobseeker can select four companies which are most preferred. After receiving multiple job offers which are more than one, he can distinguish the most worthy job for him using the Analytical Hierarchy Process (AHP). The rest of the paper is organized as follows: section 2 presents the related work. AHP theory concepts are involved in section 3. In section 4, the decision support system for job selection using AHP is presented. Section 5 contains the system performance analysis. Finally conclusion is presented in section 6.

2. Related Work

AHP has been used in a large number of applications to provide some structure on a decision making process. A Rama Mohan Reddy, Prof. M M Naidu and Prof. P.Govindarajulu implemented the AHP method in the selection of software architecture in October 2007[2]. Reza Rostamzadeh and Saudah bt. Sofian developed the Prioritizing Effective 7Ms to improve production systems performance by using AHP technique[7].

Companies and other organizations are often confronted with the decision to select the right projects for their business. The decision on selecting and implementing projects must be carefully considered. Organizations deal with many different problems and opportunities that surround them. They have to recognize the right opportunities. Thus, Palcic, I. and Lalic, B. developed the analytical

hierarchy process as a tool for selecting and evaluating projects in 2009[5]. Ahmed M. Kafafy , M. M. El-Sherbiny, Waiel F. Abd EL-Wahed and Nabil A. Ismaeel implemented a paper that is using analytic hierarchy process (AHP) to select the most suitable efficient solution for multiobjective optimization based on decision maker preference in March 2007[1].

3. Analytic Hierarchy Process (AHP)

AHP is an approach to decision making that involves

1. structuring multiple choice criteria into a hierarchy
2. assessing the relative importance of these criteria
3. comparing alternatives for each criterion and
4. determining an overall ranking of the alternatives

AHP is a powerful and flexible decision-making process. It makes the best decision when both qualitative (such as the cost of the system) and quantitative (such as the risk of the system) aspects of decision need to be considered. AHP not only helps the decision makers to arrive the best decision but also provides a clear rationale that it is the best.

Steps of the analytic hierarchy process (AHP) are

1. Building the hierarchy
2. Pair wise comparison
3. Establishing priority vector
4. Obtaining the overall ranking

3.1 Building the hierarchy

The first step of AHP is building the hierarchy which states the overall goal, the criteria and alternatives.

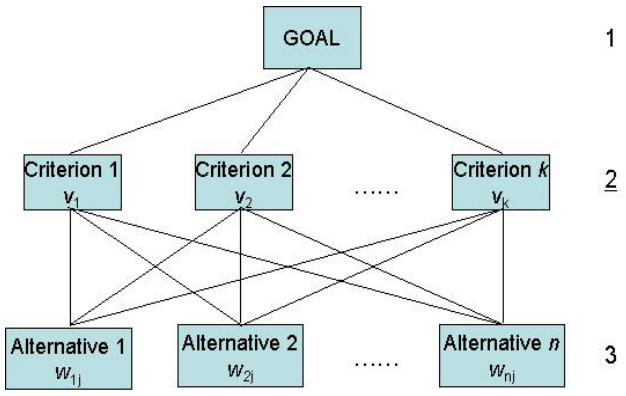

Figure 1. A Hierarchy for AHP

In figure1, the first level denotes the overall goal of the decision maker, the second level consists of several different factors (criteria) that contribute to the goal and the third level of the hierarchy describes the alternatives which are to be evaluated in terms of the criteria in the above level.

3.2 Pair wise comparison

In this step, pair wise comparisons are done on criteria and alternatives base on each criterion. The pair wise comparison scales are used as user's preference.

Table 1.The Pair wise Comparison Scale for the AHP

Importance	Definition
1	Equally important
3	Moderately important
5	Strongly more important
7	Very Strongly important
9	Extremely important

3.2.1 Comparison of Criteria

To determine the relative importance of each criteria, the criteria from the second level of the hierarchy are compared with each other by creating (n x n) matrix for n criteria.

3.2.2 Comparison of Alternatives base on Criteria

In this step, we have to make comparison between alternatives, based on each criteria by the decision maker's preference.

3.3 Establishing priority vector

The third step is to obtain priority values for criteria and alternatives that have been pair-wised in step2. AHP uses the synthesization procedure that provided the priorities for selecting the best result. Synthesization procedure includes three steps

1. Sum the values in each column of the pair wise comparison matrix
2. Divide each element in the pair wise comparison matrix by its column total
3. Compute the average of the elements in each row of the matrix, that provide the priorities for the criteria

3.4. Obtaining the overall ranking

Evaluating the overall ranking is final step in AHP. To obtain the overall ranking, we have to multiply the priority matrix of criteria from step3 and the priority matrix of alternatives from step3 which are based on each criteria.

4. Decision Support System for Job Selection Using AHP

The Analytical Hierarchy Process (AHP) is a systematic method for comparing a list of objectives or alternatives. In this paper, decision support system

for job selection is implemented using AHP approach.

4.1. Building Hierarchy for Job Selection System

Firstly, it begins with setting up an evaluation hierarchy structure for the problem based upon interrelated criteria drawn from the problem itself. In system, the overall goal is the best job. The five criteria used in this system are Location, Salary, Content, Experience and Work time. Myanmar Info Tech, Myanmar Inspiration, Bagan Cyber Tech and Net Info are set as alternatives.

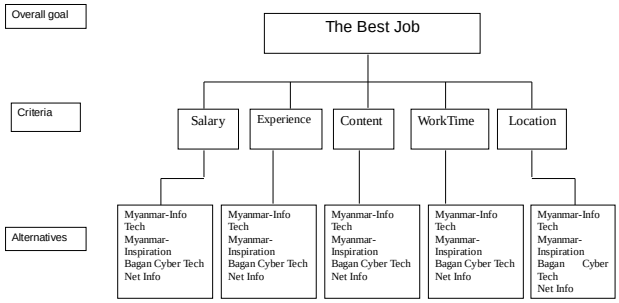

Figure 2. A Hierarchy for the Job Choosing

4.2 Pair wise Comparison

The next step is a matrix of pair-wise comparisons of the interrelated criteria for each clusters of the hierarchy is made by the decision maker.

1. Comparison of Criteria
2. Comparison of Alternatives base on Criteria

4.2.1 Pair wise comparison for criteria

In figure3, salary (S), experience (E), job content (C), work time (W) and location (Loc) are list on the top and on the left. The matrix is filled in with numerical values denoting the importance of the factor on the left relative to the important of the factor on the top. We set aii= 1 (where i=1or i=2 or i=3 or i=4 or i=5). Furthermore, if we set aij=k, then we set aji=1/k.

	S	E	C	W	Loc
S	1	9	7	5	3
E	1/9	1	5	3	7
C	1/7	1/5	1	5	3
W	1/5	1/3	1/5	1	7
Loc	1/3	1/7	1/3	1/7	1

Figure 3. Pairwise comparison matrix for criteria

4.2.2 Comparison of Alternatives base on Criteria

	M_Info	M_Insp	B_Cyb	N_Info
M_Info	1	1/3	1/5	7
M_Insp	3	1	5	9
B_Cyb	5	1/5	1	3
N_Info	1/7	1/9	1/3	1

Figure 4. Comparison Alternatives for salary

In figure4, Myanmar Info Tech, Myanmar Inspiration, Bagan Cyber Tech and Net Info which the third level alternatives in hierarchy are compared with each other by jobseeker's preference based on the salary criteria. Ratings mean that M-Insp is 3 times more important than M-Info and M-Insp is 5 times more important than B-Cyb.

4.3 Establishing priority vector

4.3.1 Obtaining Priority Value for Criteria

We calculate the synthesization procedure to get the local priority matrix for criteria.

	S	E	C	W	Loc
S	0.560	0.843	0.517	0.354	0.143
E	0.162	0.094	0.369	0.212	0.333
C	0.080	0.019	0.074	0.0354	0.143
W	0.112	0.031	0.015	0.071	0.333
Loc	0.187	0.013	0.025	0.010	0.048

Figure 5. Normalized matrix of pairwise comparison for criteria

local priority will get according to the following.
local priority=[0.560+0.843+0.517+0.143]/5=0.483

	Priority
S	0.483
E	0.214
C	0.134
W	0.112
Loc	0.057

Figure 6. Local priority matrixes for criteria

4.3.2 Obtaining Priority Value for Alternatives

The calculation steps of local priority of the alternatives are the same way as the calculation of local priority criteria. We calculated the matrices of figure 5 and figure 6 to get local priority for criteria according to synthesization procedure. In the following figure 7, we got the local priority matrix based on the Salary criteria. Then we got the local priority matrix for alternatives based on the five criteria.

	M_Info	M_Insp	B_Cyb	N_Info	Priority
M_Info	0.109	0.203	0.031	0.350	0.173
M_Insp	0.328	0.608	0.765	0.450	0.538
B_Cyb	0.547	0.122	0.153	0.150	0.243
N_Info	0.016	0.068	0.051	0.050	0.046

Figure 7. Local priority matrix for alternatives base on Salary criteria

4.4. Obtaining the overall ranking

The last step in AHP is to obtain the overall ranking of the five alternatives by mathematically combining the two priority matrices from figure 6 and figure 7.

Alternatives	Rank
M_Info	(0.173*0.483)+(0.538*0.214)+(0.576*0.134)+(0.498*0.112)+(0.518*0.057)=36.0%
M_Insp	(0.538*0.483)+(0.302*0.214)+(0.218*0.134)+(0.310*0.112)+(0.272*0.057) = 40.3%
B_Cyb	(0.243*0.483)+(0.124*0.214)+(0.131*0.134)+(0.119*0.112)+(0.136*0.057)=18.2%
N_Info	(0.046*0.483)+(0.052*0.214)+(0.076*0.134)+(0.074*0.112)+(0.074*0.057)=05.6%

Figure: 9 Obtaining the overall ranking for each alternative

The result shows that Myanmar Inspiration is the overall rating of 40.3%. Thus, Myanmar Inspiration is the best job for that jobseeker.

4.5Flow Diagram of the system

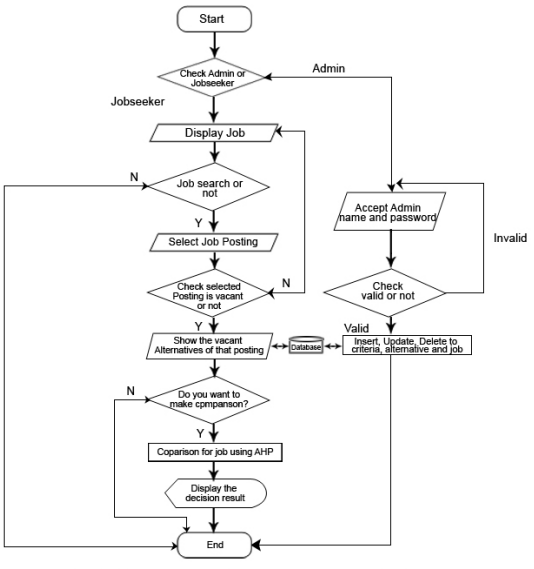

Figure: 10 Flow Diagram for user and admin

This system provides for jobseeker to search jobs and admin to implement the system. A jobseeker can select job postings and if the job posting, he selected is vacant, the company names or organization names will be displayed. After receiving multiple job offers, jobseeker can make comparison between alternatives by using AHP pairwise comparison. Then he may get the most suitable job for him.

From administrator's part, he must login by admin name and password. And then he can insert, update and delete for job postings, alternatives, criteria and company information.

5. System Performance analysis

It is essential to subject to performance analysis any decision making processes that are dependent upon qualitative assessments. The sensitivity analysis or system performance analysis identifies the pair-wise comparison weights that the overall decision is most sensitive too. These weights are the ones that must be assigned with the greatest accuracy and the AHP results should be qualified by referring to these high sensitivities [6]. Sensitivity analysis can show the robustness of the overall priority rating. Sensitivity analysis shows to what extent the overall priorities are sensitive to changes in the importance of criteria[4]. In this system, the consistency of each judging matrix is using the following formula,

$CR = CI / RI$, $CI = (\lambda_{MAX} - n)/(n-1)$

CR is the random consistent proportion of judging matrix. n is the number of ranks of judging matrix. RI is the averagely random consistent indicator of judging matrix. The 1-10 ranks matrix's RI is as the following table (table 2):

Table 2. The averagely random consistent indicator RI of 1-10 judging matrix

The number of tiers	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.12	1.25	1.35	1.42	1.46	1.49

When the CR< 0.10, the result of the whole hierarchy sort has satisfying consistency [4]. In this system the performance analysis for the whole hierarchy is 45%. Thus the system has satisfying consistency.

6. Conclusion

The AHP is a useful way to deal with complex decisions that involve dependence and feedback analyzed in the context of benefits, opportunities, costs and risks. It has been applied literally to hundreds of examples both real and hypothetical. The AHP produce outcomes that are best not simply according to the decision maker's values but also to the external risks and hazards faced by the decision. This study constructs a DSS to support jobseekers, stands on their ideas and helps them in determining the best decision in the job choosing. By using this system, jobseeker can easily get the vacancy job information. Jobseekers can find appropriate job and employers can find qualified employee.

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