The Potential Utilization of the Analytical Hierarchy Process (AHP) for the Selection of a Tenure Track Faculty Position

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The staffing management area of an office of human resources is simply the process agency responsible for determining human resource needs in any organization and securing enough talent to carry out the strategic goals of that organization. The success of any organization is clearly dependent on its ability to select and acquire talent. Likewise, in academia, the selection of tenure track faculty is also a critical element for any college or university in carrying out its vision and strategic goals in the higher education arena. This paper will examine the selection of a tenure track faculty member by using the Analytical Hierarchy Process (AHP) in order to select the best applicant for a tenure track position. A pairwise analysis will be developed in order to evaluate three potential applicants based upon four primary factors including: 1) Ph.D. or ABD; 2) teaching experience; 3) research and number of publications; and 4) work experience. The paper will conclude with an evaluation of the AHP approach as a viable selection tool for attaining the best tenure track candidate.

BACKGROUND

The staffing management area of human resources is involved with the process of determining human resource needs in an organization and securing the talent to carry out its strategic goals and objectives. In other words, staffing is simply the process of determining human resource needs in a company and securing qualified individuals to fill job vacancies. The primary objective of the staffing management process is to ensure that the proper numbers of new hires, with the appropriate skills, are placed in the right jobs at the right time to carry out the company's goals and objectives in order to fulfill organizational needs.

The success of any organization is clearly dependent on its ability to select and acquire talent. External recruitment methods are used to identify and attract job applicants from outside the company. Selecting the appropriate applicant is extremely difficult because it requires making judgments from among a group of job applicants and then selecting the individual who is deemed the best qualified for a particular job opening. In corporate America, employers use a variety of substantive assessment methods, such as interviews, cognitive ability tests, job knowledge tests, personality tests, and work samples, in order to select the appropriate job applicant. Hiring unqualified employees can lead to costly production results and other quality problems, as well as high employee turnover. So critical is the staffing management process in corporate America, that it is estimated that 19% of human resource

management budgets are spent on staffing activities and 15% of human resource management time is spent on various staffing activities (Society for Human Resource Management, 1993).

Likewise, in academia, the selection of each tenure track faculty member is also critical for any college or university to carry out goals in the higher education arena. Typically, the selection process for a tenured track position begins with the development of a specific job description and the formation of a search committee. The members of the committee review vitas, conduct interviews, and recommend the best candidate, consistent with the job description, for the tenure track position to the Department Chair/Head, as well as to the Dean of the School and/or other higher-level administrators who might be involved in making the hiring decisions. An important question remains whether as objective, fair, and effective as possible a method or process can be utilized in the selection of tenure track faculty positions.

One potential method is the Analytical Hierarchy Process (AHP), which was developed by Thomas L. Saaty in the 1970s and which has been used with almost all applications related to decision making in such areas as government, business, industry, healthcare and education (Vaidya and Kumar, 2006). This paper will examine the potential use of the AHP to assist search committees in the selection of tenure track faculty positions. Based on this approach, a pairwise analysis will be used to evaluate three potential applicants, involving four primary factors including: 1) Ph.D. or ABD status; 2) teaching experience; 3) quality of research, quality of publications, and the number of publications; and 4) work experience. An evaluation of the AHP will also be presented to determine if this assessment method is a viable selection tool for selecting the best tenure track candidate.

ANALYTICAL HIERARCHY PROCESS (AHP) MODEL DEVELOPMENT

This paper describes the use of AHP in selecting a tenure track faculty member. The goal is to choose the most suitable applicant based on the previously mentioned four criteria. Having a Ph.D. or being an ABD is the most important criterion with respect to meeting the goal, followed by research, teaching experience, and work experience. Table 1 presents the three potential applicants' background.

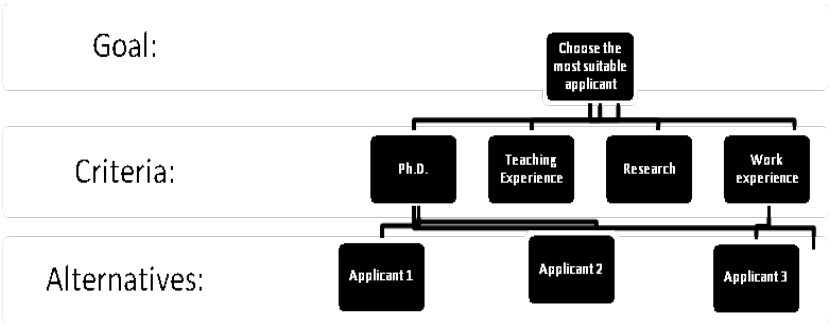
TABLE 1
APPLICANTS' BACKGROUND

Background	Applicant 1	Applicant 2	Applicant 3
Education	Ph.D. 3 years	Ph.D. recent	ABD
Teaching Experience	3 years teaching experience	Grad Assistant	No teaching Experience
Research	3- Publications	1 Article under review	No Publications
Work Experience	No Work Experience	5 years Corporate Experience	2 years Corporate Experience

The procedure for using AHP to select the most suitable applicant can be summarized as follows:

1. Model the problem as a hierarchy containing the decision goal, the alternative to reaching it, and the criteria for evaluating the alternatives. A hierarchy is an arrangement of items (objects, names, values, categories, etc.) in which the items are represented as being "above," "below," or "at the same level as" one another (Saaty, 2008). Abstractly, a hierarchy is simply a stratified system of ranking and organizing people, things, ideas, etc. Hierarchy can be described mathematically or through pyramid-shaped diagrams. Figure 1 exhibits the hierarchy used for this paper.

FIGURE 1
HIERARCHY USED IN SELECTING A TENURE TRACK POSITION



2. Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. The criteria are pairwise compared against the goal for importance. The alternatives are pairwise compared against each of the criteria for preference. AHP is essentially a process of ranking the importance of each objective and then rating how well each alterative meets each objective. The result is a score for each alternative, in this case is the applicant, with higher scores preferred.
   In order to sort n alternatives, the AHP requires *n(n-1)/2* comparisons. In this paper, *n* is equal to three applicants, therefore, 3(2)/2 = 3 comparisons are needed to compute the priorities. Priorities are numbers associated with each node of an AHP hierarchy. Priorities are dimensionless absolute numbers between zero and one. A node with priority of 0.4 has twice the weight in reaching the goal as one with priority of 0.2. The priority of the goal is one, the priorities of the alternatives always add up to one, and the priorities of the criteria also always add up to one.
   The decision makers will start evaluating the criteria with respect to their importance in reaching the goal. A series of pairwise comparisons will be discussed. Table 2 interprets the values used in the pairwise comparison matrices (Albright and Winston, 2009).

TABLE 2
VALUES USED IN THE PAIRWISE COMPARISON MATRICES

Value of a_{ij}	**Interpretation**
1	Objective i and j are **equally** important
3	Objective i is **slightly more** important than j
5	Objective i is **strongly more** important than j
7	Objective i is **very strongly more** important than j
9	Objective i is **absolutely more** important than j

The decision makers agree on these relative weights for the various pairs of criteria, as shown in Table 3. Table 4 exhibits the pairwise comparison matrix among the four objectives:

TABLE 3
CRITERIA'S RELATIVE WEIGHTS

Having Ph.D.	5	Teaching Experience	1
Having Ph.D.	4	Research	1
Having Ph.D.	7	Work Experience	1
Teaching Experience	1	Research	3
Teaching Experience	4	Work Experience	1
Research	5	Work Experience	1

TABLE 4
PAIRWISE COMPARISON MATRIX A

	Ph.D.	**Teaching**	**Research**	**Work Exp.**
Ph.D.	1	5	4	7
Teaching	1/5	1	1/3	4
Research	1/4	3	1	5
Work Exp.	1/7	1/4	1/5	1

To determine the weights for each of the four objectives, matrix A needs to be normalized and the matrix's normalized Eigenvector is calculated as shown in Table 5.

TABLE 5
MATRIX A NORMALIZED

	Normalized matrix A				**Weights**
Ph.D.	0.6278	0.5405	0.7229	0.4118	0.5757
Teaching	0.1256	0.1081	0.0602	0.2353	0.1323
Research	0.1570	0.3243	0.1807	0.2941	0.2390
Work Exp.	0.0897	0.0270	0.0361	0.0588	0.0529

To determine how well each applicant scores on each objective, decision makers use the same scale described in Table 2 to construct pairwise comparison matrices for each criterion. Therefore, four matrices needed to be constructed, one for each criterion. Then, each of these four matrices should be normalized. The scores for each applicant on each criterion are then calculated by averaging the three values from the normalized matrices as shown in Table 6.

TABLE 6
PAIRWISE COMPARISONS AMONG APPLICANTS

Pairwise comparisons among applicants on Ph.D.				**Normalized matrix**				**Scores**
	App.1	App.2	App.3					
App.1	1	1/3	5	App.1	0.2381	0.2258	0.3846	0.2828
App.2	3	1	7	App.2	0.7143	0.6774	0.5385	0.6434
App.3	1/5	1/7	1	App.3	0.0476	0.0968	0.0769	0.0738

Pairwise comparisons among applicants on teaching				**Normalized matrix**				**Scores**
	App.1	App.2	App.3					
App.1	1	5	7	App.1	0.7447	0.7895	0.6364	0.7235
App.2	1/5	1	3	App.2	0.1489	0.1579	0.2727	0.1932
App.3	1/7	1/3	1	App.3	0.1064	0.0526	0.0909	0.0833

Pairwise comparisons among applicants on research				**Normalized matrix**				**Scores**
	App.1	App.2	App.3					
App.1	1	3	5	App.1	0.6522	0.6667	0.6250	0.6479
App.2	1/3	1	2	App.2	0.2174	0.2222	0.2500	0.2299
App.3	1/5	1/2	1	App.3	0.1304	0.1111	0.1250	0.1222

Pairwise comparisons among applicants on work experience				**Normalized matrix**				**Scores**
	App.1	App.2	App.3					
App.1	1	1/5	1/3	App.1	0.1111	0.1304	0.0769	0.1062
App.2	5	1	3	App.2	0.5556	0.6522	0.6923	0.6333
App.3	3	1/3	1	App.3	0.3333	0.2174	0.2308	0.2605

3. The scores obtained for each applicant on each criterion should be combined with the weights for each of the four criteria. This step will merge the decision makers' judgment about having Ph.D./ABD, research, teaching experience, and work experience for the three applicants into overall priorities for each applicant. AHP suggests that the decision maker should accept applicant 2, since he/she has the highest overall scores. The calculations are shown in Table 7. Figure 2 exhibits the hierarchy including all the weights.

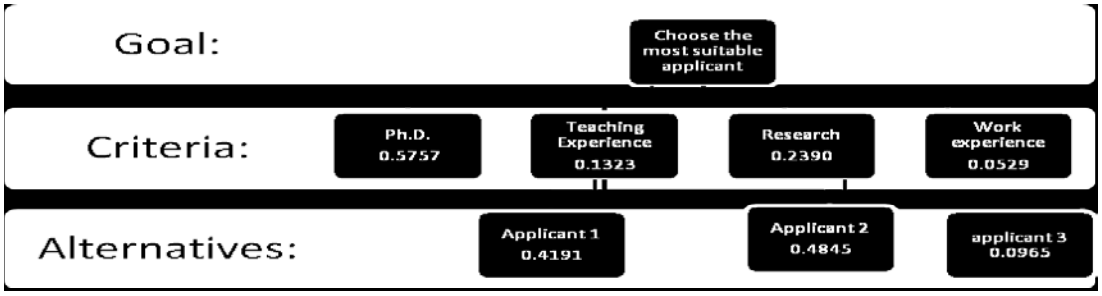
TABLE 7
BEST APPLICANTS CALCULATIONS

Determining best applicant

Matrix of scores

	PhD	Teaching	Research	Work Exp.		Weights		Weighted scores	
App.1	0.2828	0.724	0.648	0.106		0.5757		0.4191	
App.2	0.6434	0.193	0.230	0.633	X	0.1323	=	0.4845	← Applicant 2 has the highest score
App.3	0.0738	0.083	0.122	0.260		0.2390		0.0965	
						0.0529			

FIGURE 2
AHP HIERARCHY WITH FINAL PRIORITIES



4. Check the consistency of the judgment. For a consistent reciprocal matrix, the largest Eigenvalue is equal to the size of the comparison matrix, i.e. $\lambda_{max} = n$. The Consistency Index (CI) is a measure of deviation and is calculated as: $CI = (\lambda_{max} - n) / (n-1)$. The CI can then be compared with the appropriate consistency index, called the Random Consistency Index (RI), as shown in Table 8 (Saaty, 1994).

TABLE 8
RANDOM CONSISTENCY INDEX

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

A comparison of CI and RI is done by the calculation of the Consistency Ratio (CR), according to the formula: CR= CI / RI. Then, CR is used to decide if the judgments are consistent or not. Values of the Consistency Index (CI) are displayed in Table 9. According to Saaty (2006), if *CI/RI* < 0.10, then the degree of consistency is satisfactory, whereas if *CI/RI> 0.10,* serious inconsistencies exists, and AHP may not yield meaningful results. In this application the *CI/RI* is 0.0905 which is less than 0.10. Therefore, the decision makers' initial matrix does not reveal any inconsistencies. The *CI/ RI* ratios are also calculated for the other four pairwise comparisons matrices among the applicants. The results are, 0.0565, 0.0567, 0.0032, and 0.0334 respectively. All of these ratios are less than 0.10, which means that the degrees of inconsistencies are satisfactory and AHP results are meaningful.

TABLE 9
CHECKING FOR CONSISTENCY

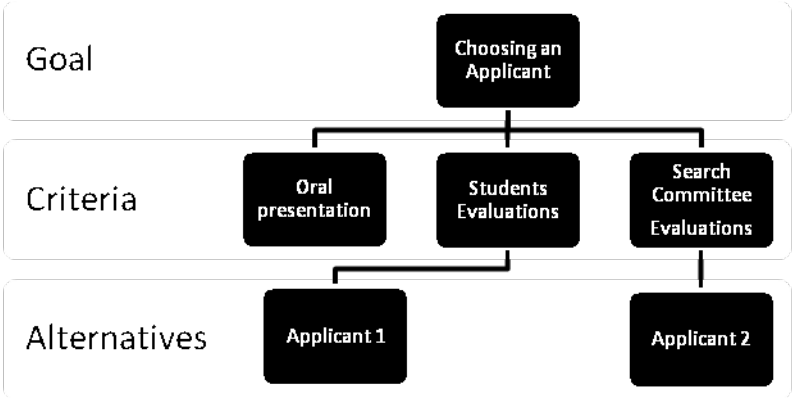
Checking for Consistency

	Ph.D.	Teaching	Research	Work Exp.		Weights		Product	Ratios
Ph.D.	1	5	4	7		0.5757		2.5638	4.4530
Teaching	1/5	1	1/3	4	X	0.1323	=	0.5388	4.0726
Research	1/4	3	1	5		0.2390		1.0445	4.3696
Work Exp.	1/7	1/4	1/5	1		0.0529		0.2161	4.0826
								CI	0.0815
								CI/RI	0.0905

5. A final decision is based on the results of this process. Reflecting on the best applicant calculations, applicant 2 has a slightly higher weighted score than applicant 1. An important question that still remains is whether other criteria could be used during an on-site interview at the college or university clearly to select the best qualified candidate for the tenure track faculty position. The other criteria would include the applicant's oral presentation to the faculty, student evaluations conducted after the applicant taught a class, and the search committee evaluations of the candidate. The following three criteria will be used to finalize the decision between the first two applicants:
    1. Oral presentation to the faculty
    2. Student evaluations after teaching one class
    3. Search committee evaluations

Figure 3 exhibits Round Two hierarchy model.

FIGURE 3
ROUND TWO HIERARCHY MODEL



Values from Table 2 are used again in round two to construct the pairwise comparison matrices. The decision makers agree on these relative weights for round 2 as shown in Table 10. Table 11 exhibits the pairwise comparison matrix among the three criteria:

TABLE 10
ROUND 2 CRITERIA'S RELATIVE WEIGHTS

Oral Presentation	1	Student Evaluations	3
Oral Presentation	1	Search Committee Evaluations	4
Student Evaluations	2	Search Committee Evaluations	1

TABLE 11
ROUND 2
PAIRWISE COMPARISON MATRIX

Round Two

Pairwise comparisons among objectives

	Oral Presentation	Students Evaluations	Search Committee
Oral Presentation	1	1/3	1/4
Students Evaluations	3	1	2
Search Committee	4	1/2	1

To determine the weights for each of the three criteria, round two matrix needs to be normalized and then the calculation may be made of the weights as an average for the three values as shown in Table 12.

TABLE 12
ROUND TWO NORMALIZED MATRIX

Pairwise comparisons among objectives

Round Two

	Oral Presentation	Students Evaluations	Search Committee	Normalized matrix			Weights
Oral Presentation	1	1/3	1/4	0.1250	0.1818	0.0769	0.1279
Students Evaluations	3	1	2	0.3750	0.5455	0.6154	0.5119
Search Committee	4	1/2	1	0.5000	0.2727	0.3077	0.3601

To determine how well each applicant scores on each objective, decision makers use the same scale described in Table 2 to construct pairwise comparison matrices for each criterion. Therefore, for round two, three matrices needed to be constructed: one for each criterion. Then, each of these three matrices should be normalized. The scores for each applicant on each criterion are then calculated by averaging the two values from the normalized matrices as shown in Table 13.

TABLE 13
ROUND TWO PAIRWISE COMPARISONS AMONG APPLICANTS

Pairwise comparisons among objectives — Round Two

	Oral Presentation	Students Evaluations	Search Committee	Normalized matrix			Weights
Oral Presentation	1	1/3	1/4	0.1250	0.1818	0.0769	0.1279
Students Evaluations	3	1	2	0.3750	0.5455	0.6154	0.5119
Search Committee	4	1/2	1	0.5000	0.2727	0.3077	0.3601

Pairwise comparisons among applicants on oral presentation — Normalized matrix

	App.1	App.2				Scores
App.1	1	3	App.1	0.7500	0.7500	0.75
App.2	1/3	1	App.2	0.2500	0.2500	0.25

Pairwise comparisons among applicants on student teaching evaluations — Normalized matrix

	App.1	App.2				Scores
App.1	1	1/3	App.1	0.2500	0.2500	0.25
App.2	3	1	App.2	0.7500	0.7500	0.75

Pairwise comparisons among applicants on Search Committee — Normalized matrix

	App.1	App.2				Scores
App.1	1	2	App.1	0.6667	0.6667	0.67
App.2	1/2	1	App.2	0.3333	0.3333	0.33

After combining the scores obtained for each applicant on each criterion with the weights for each of the three criteria, the final scores for the two applicants will be determined. AHP suggests that the decision maker should accept applicant 2 again, since he/she has the highest overall scores. The calculations are shown in Table 14. Figure 4 exhibits round two hierarchy including all the weights.

TABLE 14
ROUND TWO BEST APPLICANTS CALCULATIONS

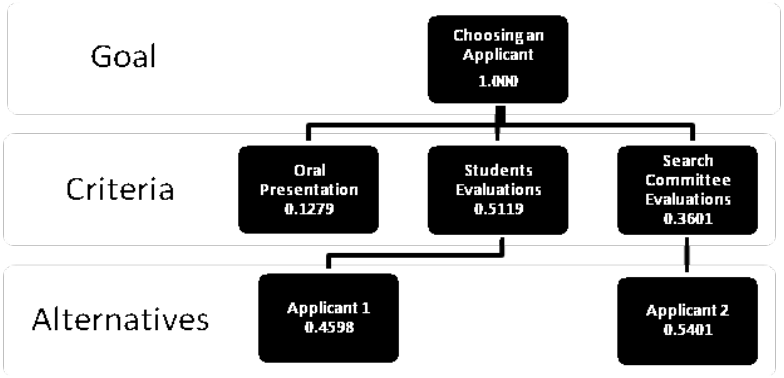
Determining the best applicant — Round Two

Matrix of scores

	Oral present.	Students E'	Search com.	Weights	Scores
App.1	0.750	0.25	0.6667	0.141558442	0.4598
App.2	0.250	0.75	0.333333	0.524675325	0.5401
				0.333766234	

← Applicant 2 has the highest score

FIGURE 4
ROUND TWO AHP HIERARCHY WITH FINAL PRIORITIES



To check the consistency of the judgment for round two, the only *CI/ RI* ratio that is needed to be calculated is the pairwise comparisons matrix among the three criteria. The other three matrices have only two comparisons. Therefore, there is no need to calculate the consistency ratio for them. Table 15 exhibits the calculations for the *CI/ RI* ratio for round two initial matrix. The *CI/ RI* ratio is equal to 0.0937, which is less than 0.10. Therefore, according to Saaty (2006), the degree of consistency is satisfactory, and AHP method has produced meaningful results.

TABLE 15
CHECKING FOR CONSISTENCY

Checking for consistency

Round Two

Pairwise comparisons among objectives

	Oral Presentation	Students Evaluations	Search Committee		Weights		Product	Ratios
Oral Presentation	1	1/3	1/4		0.1279		0.388598	3.03796507
Students Evaluations	3	1	2	X	0.5119	=	1.615967	3.15651679
Search Committee	4	1/2	1		0.3601		1.127768	3.13147249
							CI	**0.0543**
							CI/RI	**0.0937**

Therefore, the final decision using AHP method is to select applicant number 2.

CONCLUSION

Analytic Hierarchy Process (AHP) is a multiple criteria decision making tool that has been widely used by researchers and decision makers. AHP has been used in many fields such as planning, resource allocation, resolving conflict, optimization, selecting a best alternative, forecasting, total quality management, and priority setting. Many AHP applications are used at high levels of large organizations where privacy and security prohibit the disclosure to the world at large. Therefore, these applications are used but have been relatively unnoticed. AHP is most useful when complex problems develop involving high stakes such as human perceptions and judgments. Reduction of problems of human perceptions and judgments could have long-term repercussions and, hence, adoption of AHP methodology needs to be considered in a careful manner. AHP has a unique advantage when communication among team members is impeded by their different specializations, terminologies, or perspectives. It may also

advantageous to use AHP when important elements of the decision making process are difficult to quantify or compare equally.

In retrospect, this paper focused on the potential usage of the Analytical Hierarchy Process in order to select the best applicant for a tenure track position. A pairwise analysis was developed to evaluate three potential applicants based upon four primary factors which included: Ph.D. or ABD status, teaching experience, research and number of publications, and work experience. Additionally, three other criteria such as oral presentation to faculty, student evaluations after teaching a class, and search committee recommendations were also used to finalize the hiring decision for the tenure track faculty position. In essence, the AHP has the potential to be a very useful selection tool to secure and acquire talented tenure track assistant professors for a university to carry out its strategic goals. It remains to be seen if the AHP gains popularity as a viable selection tool within academia.

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