



## Improving the Faculty Selection Process in Higher Education: A Case for the Analytic Hierarchy Process

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### Abstract

The selection of faculty in academic institutions is an important process – one that has long-lasting effects on an institution's ability to fulfill its mission. Faculty influence the quality of the education delivered, the effectiveness of the programs and activities offered, and the financial efficiency of the delivery processes. Failed searches waste time and incur needless expense. Inadequate searches – those that result in candidates who are poorly qualified or lack organizational fit can have profound negative impact on these three key strategic elements. Hiring the *wrong* person may lead to dysfunctional departments, dissatisfied students, and, eventually, repeat efforts. Applying a sound process, one that structures the search, identifies and relates the selection criteria, allows for qualitative and subjective assessments, and encourages full participation of search committee members, can enhance the desired outcome, i.e., identification of best candidates that will contribute to the quality, effectiveness, and efficiency of higher education.

### Improving the Faculty Selection Process in Higher Education: A Case for the Analytic Hierarchy Process

Selection of faculty in academic institutions is a process that has long-lasting effects on an institution's ability to fulfill its mission. Faculty influence the quality of the education delivered, the effectiveness of the programs and activities offered, and the financial efficiency of the delivery processes. Failed searches, when no suitable candidates are identified, result in lost time and needless expense. Worse are inadequate searches – those that result in candidates who are poorly qualified or lack organizational fit. In these cases the opportunity for negative impact on these three key strategic elements can be substantial. Hiring the *wrong* person frequently results in repeated search efforts in the short-term, duplicating the expenses of time, money, and effort.

Cole (1995) suggested improvements in faculty selection result from a “studied approach of the processes” (page 60). This studied approach must incorporate a collaborative assessment of institutional constituents' needs. This approach extends well beyond a piecemeal and subjective process that may suffer from personal biases and perceptions. The faculty selection process requires a structured problem solving methodology that considers organizational context. It must constitute a “defensible and documentable management accountability system” (page 59). Arguing from a total quality management perspective, Cole (1995) emphasized the strength of a disciplined process analysis, driven by data, and continuously improved. Marchese and Lawrence (1987) suggested eight activities critical to effective faculty searches: (1) rethink the vacancy; (2) establish the committee; (3) define the job; (4) conduct the search; (5) screen the applicants; (6) interview the candidates; (7) consummate the selection; (8) support the selectee. While these activities encompass the *activities* of a faculty search, it is the *processes* within these steps that are critical to successful recruitment.

Faculty, those who teach, those who research, and those who do both, frequently lack the time to develop such a process for selecting their colleagues – a process that captures the essence of their definition of a suitable colleague. However, as expressed by one frustrated appointment seeker, “hiring a new colleague is too important to be regarded as an obligation to duck or to get over with as quickly as possible” (Gray, 1999). The selection process is two-way; candidates assess institutions as well. A shallow, inefficient, or ill-defined selection process can make quite an impression (albeit negative). Administrators have vested interests to ensure legitimacy and documentation of a selection process that can withstand potential inspections and challenges from various parties and perspectives.

Hahn (2002) recognized the lack of a structured process

for decision making, one based on information, in many corporations. Without arguing the pros and cons of the business model, higher education institutions are perhaps more similar to corporate entities than not in today's environment. To be successful, Hahn argued (from a marketing perspective) the need for a structured approach to decision making; one that allows necessary trade-offs in systematic fashion, with all perspectives and considerations included. Having a well-documented selection process that facilitates clear articulation of important criteria, explicit definition of preferences, efficiency in accurately assessing applicant profiles, and selection of a well-qualified individual contributes to the overall academic well being of an institution. Faculty and administrators effectively and efficiently invest their time and effort to assist the institution in its drive for sustained mission fulfillment. This case review describes such a process, incorporating Saaty's (1990) analytic hierarchy process (AHP), a decision methodology applied commonly in numerous industries and organizational settings, yet having relatively few reports of application in higher education.

Perhaps too frequently, decisions rely on a single criterion that serves as the basis for comparison of alternatives; an example would be choosing equipment based on acquisition cost alone. So long as scales are consistent and numeric measures accurately capture expected performance, summary statistics may be sufficient for decisions involving more than one criterion of importance. For example, choosing equipment based on acquisition cost, maintenance costs, repair costs, and salvage value can be reasonably accomplished by adding the costs for each alternative and then choosing the equipment having the minimum total cost (so long as the time value of money and opportunity costs are incorporated). When scales are not consistent, whether in direction or unit of measure or magnitude, making decisions based on multiple criteria becomes very complex and risky.

Multiple criteria methods, both qualitative and quantitative, were developed to better model decision scenarios. These vary in their mathematical rigor, validity, and design. Simple additive and multiplicative models, weighted or not, aggregate scores for each alternative across all criteria. The scale inconsistencies mentioned above confound these methods, usually requiring forced transformation to some arbitrary unit-less scale. Difficulties arise when non-ratio scales are included in this process; frequently unique ratio scale properties are simply assumed for interval, ordinal, and nominal (qualitative) data. The resulting summary *representative* statistics may have little validity and hence inappropriate for important applications.

Mollaghasemi and Pet-Edwards (1997) discussed multiple criteria methods based on *when* the decision

maker's preference structure becomes crystallized. When this structure is articulated beforehand, appropriate methods for comparing alternatives across many criteria include scoring methods (such as those already mentioned), preference-based methods (applying utility theory), the analytic hierarchy process, outranking methods (e.g., ELECTRE), and goal programming (an extension of linear programming). In decision scenarios involving progressive articulation of preferences, constraint-based approaches prevail (such as the STEP method or interactive goal programming). Finally, posterior articulation of preferences may require methods such as data envelopment analysis.

The intent of this paper is to show how applying a model that is not overly complex and that does legitimately aggregate across scales and addresses consistency in judgments from multiple participants can serve to formalize a decision process, reduce time commitments, create a process orientation, document the strategy, and result in better decisions. As discussed below, the analytic hierarchy process was chosen for these, and more formal mathematical, reasons.

### **The Analytic Hierarchy Process**

Saaty (1994) described the analytic hierarchy process (AHP) as a decision making approach based on the "innate human ability to make sound judgments about small problems" (page 21). Desirable characteristics of such an approach include simplicity, usefulness for both individuals and groups, accommodative of intuition, compromise, and consensus building, and without prejudice toward specialized skills or knowledge. Saaty suggested AHP as a process that requires structuring the decision problem to demonstrate key elements and relationships that elicits judgments reflecting feelings or emotions, and whose judgments can be represented by meaningful numbers having ratio properties. These numerical representatives can be used to generate weights or priorities that represent the relative importance of decision criteria. Finally, alternatives can be compared to some absolute standard (as was done in this case) or to each other such that the comparison results and the criteria priorities can be synthesized into single statistics, each representing an alternative that can be further analyzed for sensitivity to changes in judgments.

The structure of AHP consists of a hierarchy of criteria and sub-criteria cascading from the decision objective or goal. By making pairwise comparisons at each level of the hierarchy, participants can develop relative weights, called priorities, to differentiate the importance of the criteria. The scale recommended by Saaty (1994) is 1 through 9, with 1 meaning no difference in importance of one criterion in relation to the other and 9 meaning one criterion is extremely more important than the other, with increasing degrees of importance in between. Only half the comparisons need be made; the "reverse" comparisons

simply use the reciprocal values in the matrix of comparisons that results. The essence of the AHP calculations involves solving an eigenvalue problem involving this reciprocal matrix of comparisons. Expert Choice (1995) software performs this task (latest basic version costs approximately \$600 for higher education); it is also relatively simple to approximate the solution in spreadsheet software, involving only computations of normalized values and averages so long as certain conditions are met (Liberatore & Nydick, 1997). The appendix contains Excel spreadsheets that demonstrate these calculations for both the arithmetic means and geometric means approaches.

Several issues in the AHP process deserve special attention. The first is the consistency of the judgments or comparisons. As Saaty (1994) described, the method involves redundant comparisons to improve validity recognizing that participants may be uncertain or make poor judgments in some of the comparisons. This redundancy leads to multiple comparisons that may lead to numerical inconsistencies. For example, if criterion A is just as important as criterion B, then the pairwise judgments for A and B to any other criterion should be identical. When this doesn't happen in the judgment process, inconsistency can arise. Saaty suggested the error in these measurements is tolerable only when it is of a lower order of magnitude (10%) than the actual measurement itself. Consistency ratios (CR) can be calculated and compared to indexes derived from random judgments. As long as the  $CR \leq 0.10$ , analysis can proceed. Saaty also emphasized that greater consistency does not imply greater accuracy, and judgments should be altered only if compatible with one's understanding. Otherwise, more information may be necessary or the hierarchy may need reexamination. The Excel spreadsheets in the appendix demonstrate sample consistency ratio calculations.

Another potential difficulty is rank reversal, i.e., reordering of alternatives when new alternatives, even if irrelevant, are introduced. Early in the development of AHP this issue was debated in the literature (see, for example, Harker & Vargas (1987) and Dyer (1990)). Saaty (1994) resolved this issue by defining three different modes of AHP, the distributive and ideal modes in the relative measurement (pairwise comparison) approach and an absolute measurement approach. The process presented here used the distributive mode of the relative measurement approach in weighting the criteria (which were deemed comprehensive and exhaustive), and the absolute measurement mode for rating the applicants. Rank reversal was not an issue.

While the focus of this paper is the decision process, some further elaboration of these modes will facilitate understanding the AHP methodology. In the distributive mode, the priorities for the sub-criteria (called local priorities) of a given *parent* criterion at any level of the hierarchy sum

to one. "It is used when there is dependence among the alternatives and a unit priority is distributed among them" (Saaty, 1994, p. 130). "The ideal mode is used to obtain the single best alternative regardless of what other alternatives there are (p. 130)." In this mode, for each criterion at each level, the local priorities are divided by the largest among them, resulting in one alternative becoming *ideal* with a priority of one. Saaty (1999, p. 130) offers the following: "To choose the relevant mode one asks: Do you want to choose an alternative that is better relative to the others (distributive) or do you want the best of the alternatives (ideal)." When interested in the degree of difference among alternatives, such as for proportional allocation of some benefit, the distributive mode is appropriate. To choose just one from many, the ideal mode applies. Because the committee members were able to develop relevant scales having appropriate units of measure for the lowest level criteria, assessment of the candidates at this level was achieved by evaluation relative to these scales rather than to each other. Hence, the absolute mode was the choice.

### Literature Review

Reports of the AHP methodology, its discussion, and its applications number more than 1500 (Lombardo, 2001). The *potential* applications of AHP in higher education are numerous and include funding research support requests, deciding on sabbatical proposals, assessing performance and allocating rewards or compensation, choosing students for admission, financial aid, scholarships and awards, and evaluating candidates for campus interviews (Liberatore & Nydick, 1997). Successful administrative applications have included faculty evaluation (Tummala and Sanchez, 1988), university strategic planning (Saaty and Rogers, 1976), university budgeting (Arbel, 1983), and MBA curriculum design (Hope and Sharpe, 1989). Review of the literature, however, reveals only a few applications involving personnel choices or similar higher education contexts. These include a study to differentiate the importance of instructional responsibilities, intellectual contributions, and service in evaluating business faculty (Ehie & Karathanos, 1994) and evaluating potential doctoral programs to identify the most appropriate, as a function of the style of institution (Tadisina & Bhasin, 1989).

In a healthcare educational setting, Hemaida and Kalb (2001) demonstrated the value of AHP in selecting first-year participants in a family practice residency program. The decision context required both objective and subjective factors; the participation of individuals having managerial responsibility fostered reduction of complexity and agreement on the results. Another education application involved assessment of adult learning preferences (Lee, McCool, and Napieralski, 2000). Student participants made the requisite pairwise comparisons inherent in the AHP methodology, providing the data for the researchers to

determine learning preferences among lectures, discussion, group projects, and individual projects. Other interesting applications in the higher education context include faculty planning (Benjamin, Ehie, & Omurtag, 1992), and graduate school admissions (Saaty, France, & Valentine, 1991).

The literature contains other interesting reports of AHP applications as well, and while not in a higher education setting, these are relevant to the group dynamics frequently at play regardless of organizational setting. For example, Davies (1994) applied AHP as a client support aid for advertising agency selection. This application incorporated perceived levels of individual power and how these perceptions influenced overall group preferences. Chan and Lynn (1991) studied uses of the AHP to alleviate subjectivity in performance evaluation systems by inviting participation from groups having differing perspectives. Canada, et al. (1985) presented the use of AHP in making career choices; Millet (1998) looked at resolving ethical dilemmas that frequently involved divisive and emotional issues; and Ross and Nydick (1992) addressed the selection of licensing candidates in the pharmaceutical industry (Ross & Nydick, 1992).

The applications of AHP are numerous and varied, with consistent reports of success in reducing complex decision contexts and incorporating qualitative and subjective criteria and assessments. Those related to higher education or personnel selection, and in particular faculty selection, are indeed few. This case study seeks to mediate this paucity by emphasizing the long-term benefits of applying AHP in faculty selection; namely, the creation, documentation, and application of an efficient and effective process that stimulates participation and that results in suitable choices acceptable to interested stakeholders.

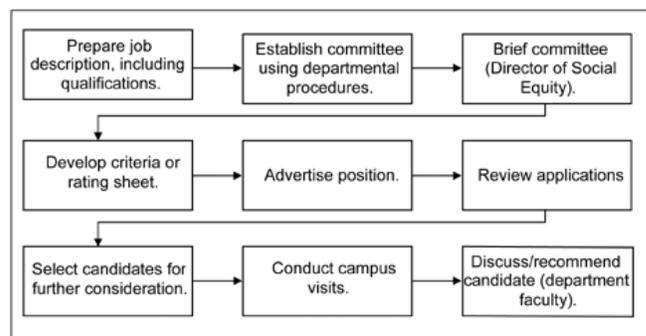
### Case Study: Improving the Faculty Selection Process

The organizational context for this case was a mid-sized, state-related school located in a semi-rural area of the northeastern United States. The faculty position involved quantitative methods/operations management, set in a management department in a college of business. This information is important because it helps orient the reader to the decision context. First, the position itself was a hybrid requiring candidates to have rather broad academic preparation and business experience. Second, the department had only one of its nine members qualified in these fields, the others being primarily organizational behavior, human resource management, business ethics, and strategy. These mostly *qualitative* fields differ significantly in focus and preparation from the mostly *quantitative* fields in the position at hand. These two issues would contribute to the complexity of the decision, the conflicting perspectives on requisite skills, and the process through which a search and selection would be conducted.

### Background

Detailed procedures and guidelines for faculty searches already existed at this university. Affirmative action and bargaining unit issues made compliance mandatory, and a step-by-step sequence of recruitment activities was well defined. Figure 1 illustrates these steps. Other than the requirement for a rating sheet that included the criteria (and their relative weights, if appropriate) to be applied in assessing candidates in the initial review, there was no direction concerning how to elicit these criteria, how to differentiate their importance, and how to perform the actual assessments. This procedure simply listed a sequence of activities; it did not convey a *process* for identifying the best candidate from among many applicants. For this, faculty committees are left to their own experiences, past practices, personal preferences, or any other set of events that may emerge from the committee. Consistency may be non-existent as search committees are frequently ad hoc in their nature, established on a vacancy-by-vacancy basis.

Figure 1  
University-Wide Selection Process



While avoiding detailed process definition may seem consistent with academic freedom, it is inconsistent with the requirements of a quality process discussed and mandated in the introduction. Recognizing that the absence of any clearly defined assessment process leads to undue redundancy, inefficient use of time, needless deliberations, and insufficient audit trails, this committee discussed and developed the process indicated in Figure 2. It applies to

Figure 2  
Committee-Defined Selection Process

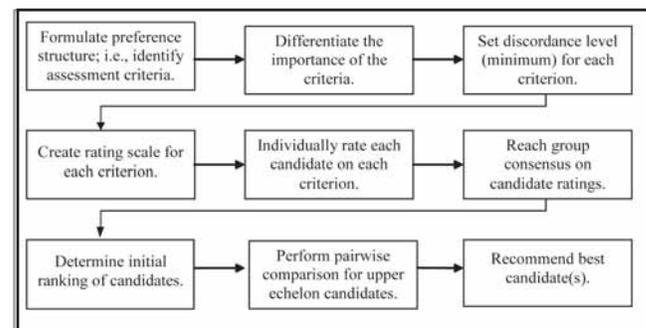


Figure 3: Committee Preference Structure

Level 0	Identify Best Candidate																					
Level 1	Experience						Scholarly Activities						Technological Skills			Flexibility in Teaching Capabilities		Experience with Diverse Populations				
Level 2	Education			Teaching Skills			Business			Research Record			Research Potential			Collaboration	GP & Application Software		Web & Online Course Delivery			
Level 3	QM	BS	OM	QM	BS	OM	QM	BS	OM	QM	BS	OM	QM	BS	OM							

the latter steps of the process outlined in Figure 1; namely, “select candidates for further consideration” and “discuss/recommend candidate.”

**Formulate the Preference Structure**

Step 1. Formulating the preference structure means deciding on the selection criteria most important to the department of management for the position at hand. Committee members should take into account all constituents, rather than focus exclusively on their own perceptions related to “best fit” definition of a colleague. This first step consumes the most time; however, it is the most important step. Misspecification of the key criteria or factors that are critical to identifying not only suitable, but best candidates invalidates all succeeding activities. It is basic, foundational, and seminal. The highest-level criteria agreed upon by the committee members were (1) experience, (2) scholarly activities, (3) technological skills, (4) flexibility in teaching capabilities, and (5) experience working with diverse populations.

Next the committee identified sub-criteria (level 2 of the hierarchy) for the highest-level criteria (as necessary). For example, experience was categorized as education (i.e., academic), teaching skills, and business. Teaching skills at this level mean quality of classroom instruction (not to be confused with the higher level criterion “flexibility in teaching capabilities,” which addresses the variety of courses for which a candidate is academically and/or professionally qualified). Scholarly activities were distilled into research record, research potential, and collaboration. Technological skills consisted of general purpose and application software, and Web-enhanced and online course delivery. The remaining two first-level criteria, flexibility in teaching capabilities and experience working with diverse populations, had no sub-criteria.

Finally, a third level of sub-criteria was generated for five of the level 2 sub-criteria; however, these were identical and based on the hybrid nature of the position being recruited. The third level sub-criteria for experience, quantitative methods (QM) – business statistics (BS)– operations management (OM), were common to the three second level sub-criteria (education, teaching skills, business) and applied to two of the scholarly activity sub-criteria (research record and research potential) as well. Creating a parsimonious model is always a concern in

decision analysis and avoiding needless additional sets of criteria is appropriate so long as those chosen for application across a level of the hierarchy adequately and accurately capture key elements of the decision structure. Note that the scales associated with these common sub-criteria were not, however, the same (discussed later). Figure 3 depicts the complete hierarchy.

**Differentiate the Importance of the Criteria**

Step 2. The next step in the process is differentiating the relative importance of the criteria by completing pairwise comparisons for each set of criteria and sub-criteria. Each committee member completed software-generated questionnaires similar to those depicted in Figure 4. The questionnaire at each level of the hierarchy grouped sub-criteria for comparison within criteria one level above. For example, Figure 4 lists each possible pairwise comparison for the five level 1 criteria; a separate questionnaire listed the three sub-criteria within the experience criterion, yet another listed pairwise comparisons for the three sub-criteria within the education sub-criterion, etc. Expert Choice (1995), the software that facilitates application of AHP, generated these questionnaires; these facilitate direct comparison using the 1-9 scale recommended by

Figure 4  
Sample Pairwise Comparison Questionnaire

Compare the relative IMPORTANCE with respect to: GOAL																			
1 = EQUAL			3 = MODERATE			5 = STRONG			7 = VERY STRONG			9 = EXTREME							
1	EXP	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SCH
2	EXP	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TECH
3	EXP	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FLEX
4	EXP	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DIV
5	SCH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TECH
6	SCH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FLEX
7	SCH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DIV
8	TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FLEX
9	TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DIV
10	FLEX	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DIV
Abbreviation		Definition																	
GOAL		Identify Best Candidate																	
EXP		Experience																	
SCH		Scholarly Activities																	
TECH		Technological Skills																	
FLEX		Flexibility in Teaching Capabilities																	
DIV		Experience with Diverse Populations																	

**Figure 5**  
**Committee Preference Structure with Priorities**  
**(Level 1 criteria sum to 1; Level 2 sub-criteria sum to 1 within each Level 1 criterion, etc.)**

Level 0	Identify Best Candidate																			
Level 1	Experience 0.450						Scholarly Activities 0.243						Technological Skills 0.145			Flexibility in Teaching Capabilities 0.109		Experience with Diverse Populations 0.053		
Level 2	Education 0.230			Teaching Skills 0.648			Business 0.122			Research Record 0.268			Research Potential 0.614			Collaboration 0.117	GP & Application Software 0.750	Web & Online Course Delivery 0.250		
Level 3	QM 0.167	BS 0.167	OM 0.667	Q M 0.167	BS 0.167	OM 0.667	QM 0.167	BS 0.167	OM 0.667	QM 0.143	BS 0.143	OM 0.714	QM 0.143	BS 0.143	OM 0.714					
QM = Quantitative Methods BS = Business Statistics OM = Operations Management																				

Saaty (1994), with numbers to the left of center indicating a preference for the criterion listed on the left; the opposite being true for the scale on the right. The first column on the left simply indexes the comparisons for easy reference and cumulative total. Aggregating individual responses via consensus or calculating the geometric mean (the *n*th root of the product of the *n* judgments) (Davies, 1994) resulted in the criteria weights, or priorities as they are called in AHP, shown in Figure 5. Note that the weights for criteria at each level, within their parent (or higher level) criterion, sum to one (called local priorities). For example, Experience (0.450) was considered approximately twice as important as Scholarly Activities (0.243), three times more important than Technological Skills (0.145), etc. This step prioritizes the criteria in a series of cascading allocations within levels and within criteria. Experience has sub-criteria Education, Teaching Skills, and Business; the priorities at this level were allocated 0.230, 0.648, and 0.122, respectively, based on the members' aggregated judgments.

**Set Discordance Levels**

Step 3. Setting discordance levels (Mollaghasemi & Pet-Edwards, 1997) means establishing minimum acceptable scores (representing experience or exposure or performance, etc.) for each criterion. For example, the committee may have agreed that at least three years of university-level teaching experience in business statistics was a prerequisite to successful candidacy. Any applicant not meeting this minimum level would be excluded from further consideration regardless of his or her rating on any other criterion. Because this can drastically reduce a pool

of potential candidates, the committee decided to avoid setting such levels, instead relying on the position announcement and strict application requirements to eliminate marginal or insincere candidates from further consideration. Using application requirements in lieu of setting discordance levels may eliminate a "diamond in the rough" from consideration; however, in terms of efficient use of time and effort, the committee decided it was the appropriate approach to follow. Being inundated with Web software-triggered resumes and vitas (and the resultant high number of very marginal applications) reinforced this notion. The check sheet shown in Figure 6 represents the "discordance" levels for the application process. Upon receipt of initial application materials, applicants received an acknowledgement letter specifying missing materials and required receipt date. Absence of a checkmark in any one cell after this date eliminated the candidate from further consideration.

**Create Rating Scales**

Step 4. Determining the appropriate scales to measure or assess each candidate can be problematic. The first difficulty is the nature of the scale itself and whether one already exists. In the latter case, careful definition of ratings within the scale helps preclude unintended implicit weighting. The committee selected a single verbal scale covering all criteria; what differed, depending on the criterion, was the scale definition. When possible, objective (quantitative) measures were applied to differentiate the ratings. The rating scale consisted of these options: excellent, very good, good, fair, and poor. As indicated in Figure 7, the majority of the ratings were derived based on

**Figure 6: Discordance (yes/no) Checksheet**

Name	D.B.A Ph.D A.B.D.	Letter	Transcripts	Vita	Teaching Capabilities	Publication Samples	Research Plan	Reference Letters
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Figure 7: Committee Preference Structure with Priorities and Scales

Level 0	Identify Best Candidate																			
Level 1	Experience 0.450						Scholarly Activities 0.243						Technological Skills 0.145		Flexibility in Teaching Capabilities 0.109	Experience with Diverse Populations 0.053				
Level 2	Education 0.230			Teaching Skills 0.648			Business 0.122			Research Record 0.268			Research Potential 0.614			Collaboration 0.117	GP & Application Software 0.750	Web & Online Course Delivery 0.250		
Level 3	QM 0.167	BS 0.167	OM 0.667	QM 0.167	BS 0.167	OM 0.667	QM 0.167	BS 0.167	OM 0.667	QM 0.143	BS 0.143	OM 0.714	QM 0.143	BS 0.143	OM 0.714					
Scale	# Graduate Courses			Student Evaluations & Peer Reports			# Months Experience			# Articles, Presentations, Proceedings			Narrative Description			Frequency	# & Types	# & Extent	# Distinct Courses	Cover Letter & Resume

frequencies or time intervals. For the experience-education criterion, the number of courses studied at the graduate level differentiated the ratings. For experience-business, the number of months actually *practicing* a business, ranging from none to 24 months, determined the rating. The committee attempted to quantify the ratings in this manner to the greatest extent possible subject to retention of useful information.

Not all criteria could be measured applying this technique. Teaching skills were evaluated based on student evaluations and peer reports. These vary substantially in format and interpretation across institutions. Figure 8 lists the rating definitions as *measure dependent*. For this experience-teaching skills criterion, committee members reviewed pertinent materials individually, attempting to accurately interpret the results (considering issues like the types and numbers of questions asked, the response scales, and whether comparative analyses such as relative standings were included) and then discussed them to

consensus. The technological skills-general purpose and application software criterion was rated using a verbal delineation of software, while the scholarly activity-research potential and experience working with diverse populations criteria were assessed qualitatively based on review of application materials such as the research plan, cover letter, and resume. Refer to Figure 8 to review the completed hierarchy representing the committee's complete *preference structure* for this search process.

**Rate Each Candidate**

Step 5. Committee members individually reviewed each accepted application (recall step 3) and completed a rating scorecard for each applicant. Given the majority of criteria were rated based on objective measures, there was little, if any, disagreement on the appropriate ratings for these criteria. Minor differences typically involved particular course titles (and what they actually meant), how far into the past experience should be reviewed, or

Figure 8: Committee Preferences Structure with Priorities, Scales, and Measures

Level 0	Identify Best Candidate																			
Level 1	Experience 0.450						Scholarly Activities 0.243						Technological Skills 0.145		Flexibility in Teaching Capabilities 0.109	Experience with Diverse Populations 0.053				
Level 2	Education 0.230			Teaching Skills 0.648			Business 0.122			Research Record 0.268			Research Potential 0.614			Collaboration 0.117	GP & Application Software 0.750	Web & Online Course Delivery 0.250		
Level 3	QM 0.167	BS 0.167	OM 0.667	QM 0.167	BS 0.167	OM 0.667	QM 0.167	BS 0.167	OM 0.667	QM 0.143	BS 0.143	OM 0.714	QM 0.143	BS 0.143	OM 0.714					
Scale	# Graduate Courses			Student Evaluations & Peer Reports			# Months Experience			# Articles, Presentations, Proceedings			Narrative Description			Frequency	# & Types	# & Extent	# Distinct Courses	Cover Letter & Resume
Excellent	4			Measure Dependent			24			4			Qualitative			4	Specific Application	4	4	Qualitative
Very Good	3						18			3						3	SAS SPSS	3	3	
Good	2						12			2						2	Office Suite Excel Add-ins	2	2	
Fair	1						6			1						1	Word Excel PowerPoint	1	1	
Poor	0						0			0						0	None	0	0	

clarification of technology-related activities. For the criteria rated qualitatively, members discussed individual ratings until achieving consensus. There was little disagreement. This was attributed to the well-defined position announcement that made very clear exactly what the position entailed, the minimum qualifications, and the exacting nature of the application materials. Nearly all accepted applicants presented detailed, descriptive, and clear reviews and explanations of their research goals and projects.

By far the most difficult criterion to rate was experience-teaching skills. The variety of formats and scales in student evaluations led to interesting debates about what the results really indicated. Overall, the rating process was efficient and the time required was less than expected. Time and effort spent developing the hierarchy and eliciting the preference structure facilitated the rating process, arguably without any loss of effectiveness or accuracy.

### Determine Initial Ranking

Step 6. This step involved application of the AHP algorithm, which was accomplished using Expert Choice (1995) software. This software is not mandatory; ratings can be developed using spreadsheet software as well, so long as the consistency (see below) among comparisons is high. Figure 9 shows the results for the eight candidates that emerged successfully from the application review (step 3) and the rating process (step 5).

### Select Candidates for Further Consideration

Step 7. At this stage, the committee reviewed the results and decided to continue consideration of the top five candidates. This step can incorporate direct comparison of candidates (pairwise) on each criterion if so desired, rather than relying exclusively on the

level criteria. These results would be aggregated within the program and relative rankings again assigned. The results, in terms of rank order, would be the same so long as the earlier rating process was handled diligently. For example, two candidates having the same number of graduate courses or having the same length of business experience should have received identical ratings on those criteria. While the summary numeric ratings (and hence the difference among candidate scores) may change, especially considering the qualitatively assessed criteria, the order would not.

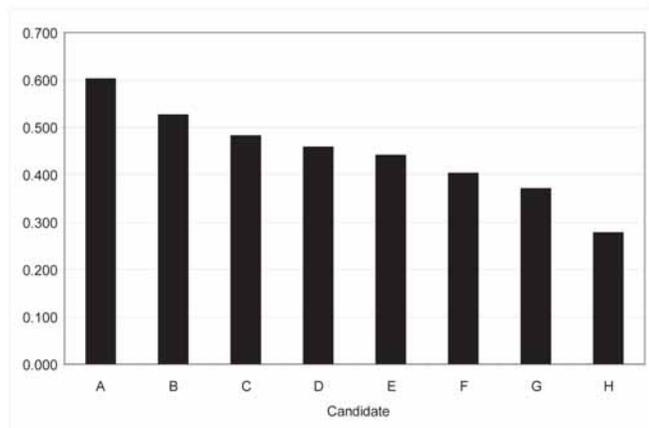
### Measuring Inconsistency of Judgments

Saaty (1994) offered suggestions to maintain consistency in judgments: homogeneity of the elements (criteria or alternatives) being compared; sparseness of elements being compared; and knowledge and care of the decision maker. The process implemented in this search committee's quest to identify the best candidate incorporated these traits. The criteria are not so different as to make comparison illegitimate or inappropriate, nor were the backgrounds in education and experience disparate among the applicants. The numbers of both criteria and candidates were kept reasonably small, the latter being achieved by the rigor of the position announcement and application process. Finally, each member of the committee was a member of the department and definitely had a vested interest in the quality and *fit* of the candidate chosen for the position. These factors were reflected in the consistency ratios (the relevant AHP statistic) computed for the different sets of pairwise comparisons, with a highest of 0.07 and the majority below 0.02. All were well within the tolerance specified in the AHP literature.

### Results

Application of the AHP methodology, principally constructing hierarchies, establishing priorities, and verifying logical consistency (Saaty, 1999) had several worthwhile outcomes that can be grouped into three categories: decision process, group dynamic, and decision outcome. As mentioned at the outset, the existing guidelines and procedures for faculty search committees prescribed the *what* to do. They did not provide any guidance or procedures on the *how*. Each time a search committee was organized, unless it consisted of the exact same faculty having experience working on a very similar position, committee members either (a) spent little time organizing a process to ensure reasonably accurate identification of the best candidate(s) or (b) spent too much time performing this function leading to frustration or disinterest because of time and effort inefficiencies. Applying the sequential steps based on AHP principles supported relatively quick and painless organization of the tasks at hand. As a result, a clearly documented decision process led to efficient focus of committee members' time

Figure 9: Final Ratings



comparisons to the absolute scales already completed. The process is identical to that described in step 2; the software-generated questionnaires would be modified to include candidate comparisons on each of the lowest

and effort in evaluating the qualitative and subjective (i.e., difficult and important) aspects of the candidates' qualifications. Finally, the Director of Social Equity, after reviewing the file materials expressed, with delight, that the process was without a doubt the best she had ever seen.

As indicated in the introduction, faculty members within the department of management had substantially different education, experience, and research activities, with the majority having limited knowledge and experience in the field being recruited. Other differences in perspectives were evident from past issues in the department, so group cohesiveness could not be expected automatically. Time, however, is always limiting, and this case was no exception. By delineating the process, linking the position announcement to the initial application review, and proceeding directly to defining the preference structure (both criteria and their relative weights), committee members very quickly arrived at group cohesiveness in identifying and resolving differences of opinion and judgments.

Finally, the ranked list that resulted from this process clearly differentiated the candidates, and the sensitivity analysis techniques available in the Expert Choice (1995) software enabled anyone interested in the outcome to understand the influence of the criteria selected and the priorities derived. Some faculty leaned much more heavily toward teaching experience; others, toward research record or potential. Some felt the ability to teach operations management was most important; others, business statistics. By reviewing the committee's work, detailed in various outputs and notes, it became clear to department colleagues that the committee had executed its responsibility in a legitimate fashion that incorporated all interests.

### **Conclusions**

Chan and Lynn (1991) reported the improved organizational climate resulting from participants internalizing organizational goals by participating in establishing the preference structure represented by the AHP hierarchy and priorities and the perception of fairness and equity that was absent when more arbitrary methods of assessing multiple criteria were applied. Djang (1993) discussed the value of decomposing complex decisions using AHP and the ease of assessment using structured interviews or questionnaires (reference Figure 4). Liberatore, Nydick, and Sanchez (1992) suggested the structured approach of AHP could better capture the subjective judgments of participants. Millet (1998) found that the process could enhance shared understanding of decisions, save time, and facilitate consensus. Liberatore and Nydick (1997) noted that AHP forced individuals to think through the strength of relationships leading to a process that was less biased and less political, and had more consistency than in the past.

Saaty (1989) argued that AHP facilitates honest exploration of a decision by expression of judgments according to some preference intensity that leads to a choice that rigorously captures these intensities in comparative magnitudes. Permitting tolerable inconsistencies in judgments is not limiting; rather, it is reality. The AHP is a method that treats group decision making and individual decision making consistently. In their psychometric comparison of decompositional approaches (such as AHP) and holistic approaches, Morera and Budescu (1998) found the former better support defining the decision context, allow for considering a larger number of attributes, can be attacked and defended, and permit more in-depth sensitivity analysis. Saaty (1994) supported this preference for decomposition, adding the importance of the synthesis phase, and noting how many models fail to execute it in ways that maintain the advantage of comparative ratio data.

Experience reported here agrees with these benefits. What should be viewed as a critical, positive, and worthwhile process, i.e., faculty recruitment, can become a tedious, time consuming, and frustrating one for all parties involved (committee members, administrators, and applicants) when it is not well-defined, effective, and efficient. It needs to result in qualified best candidates. It needs to minimize consumption of resources. It needs to capture all pertinent preference issues. It needs to be fair and equitable to all participants (faculty and applicants). And finally, it needs to be reusable (which is where real efficiency manifests itself). The process articulated here satisfies these objectives.

Application or imitation of this process demands recognition of its limitations as well. "Selling" the methodology in unfriendly or unfamiliar environments can be difficult and may be perceived as oversimplification (by quantification) or time consuming. Technical issues such as the type of measurement (relative or absolute) and the mode (distributive or ideal) may require supplemental investigation by at least one member of any decision committee to ensure proper application of methodology. Using application software clearly simplifies the methodology and moderates these issues. Rank reversal, if it is an issue, must be addressed; however, given the rather rigid timing, sequence, and review process recommended here, the chance for last-minute relevant alternatives influencing results is minimal.

### **Editor's Notes**

In the preceding article Grandzol took a technique that has achieved a high level of successful use in Operations Research and Decision Science, and applied it to a problem that we are very likely to face in higher education, improving faculty selection. Without his contribution many of us would simply have used algebraic averages and qualitative consensus building techniques.

As he mentioned, this methodology is extremely valuable when it comes to setting priorities and selecting alternatives in areas such as planning and other management activities. In addition to his good work I also recommend to you the article from *Research in Higher Education* that he referenced for Liberatore and Nydick (1997) where they include further discussion of this technique and alternative techniques such as Multitrait Utility Theory (MAUT) and goal programming. There is also an interesting book on this topic called *Decision By Objectives* (How to convince others that you are right) by Foreman and Selly (2001, World Scientific). In addition, the use of the terms - "Analytical Hierarchy Process" - gives about 13,600 hits with Google.

There are several points worthy of note. The first point is that Analytical Hierarchy Process (AHP) is one of a large number of decision choice models that combine a hierarchical set of criteria in an analytic manner. As one might expect there are also a large number of differing variations on each of the primary methodologies. For example one can estimate the weights with either an arithmetic mean or a geometric mean. The primary concern however, is for the institutional researcher to go from something such as a set of goals to a set of criteria to a set of operational alternatives and to combine these different aspects of the decision process into some methodology which allows further discussion of priorities and relative preference. The AHP seems to be a fairly straightforward way for executing this combination. One of the key points is that the methodology produces ratio scales from preference judgments for the higher-level aspects being rated. This is central if we are to conclude that one criterion is twice as important as another criterion, or one goal is three times as important as another goal. Without this ratio scale on higher-level attributes, it makes no sense to use metrics from these attributes for weighting alternatives.

Another aspect of AHP is that, as with all pair-comparison techniques, it has redundant data. As Grandzol mentions, this allows for a check on the consistency of the data. While standard software does not seem to have an easy method for computing the traditional measure of consistency (the author does include an example in his appendix), it is likely that techniques such as multidimensional scaling can give a close approximation. This comes because scaling techniques such as AHP are based on the assumption of a single underlying dimension. If one wants to use multidimensional scaling or principal components from a standard package such as SPSS, one rule might be to look at the size of the first extracted dimension compared to the remaining dimensions.

While the consistency index deals with the internal consistency of a set of ratings, there is also the issue of consistency across raters. One way to handle this (as

Grandzol did) is to consider setting minimum standards for the faculty. Another way that he dealt with this challenge was to have extensive training sessions and discussions with his raters. If someone so chose, the/she could also use various nonparametric techniques such as Freedman's Two Way Analysis of Variance for Ranks and Kendall's Coefficient of Concordance to establish the agreement of the raters across the objects being rated. The choice here is a bit dependent on the participants in the process and the audience of reviewers. Keeping the process relatively non-mathematical may be preferred.

There is also an issue of the type of assumptions made about the errors in the included ratings and preference statements. With a multiplicative model, it is not a safe assumption that random errors will cancel out as the number of events become larger. One alternative has been to assume a log-normal distribution of errors, but the addition of the multiplied terms doesn't go well with this assumption. This apparent inconsistency reinforces the desirability to find non-parametric methodologies when working with these summary decision support tools.

In conclusion, this article deals with a pressing issue of qualitative judgments and it gives us an easy to use methodology. It provides an alternative to complex judgments by breaking things down into logical components and helping us analyze priorities. It also reminds us why the decision sciences are a key part of our foundation of skills - they add value to the solution of real problems.

Appendix: Sample Spreadsheet Calculations for Consistency Indexes

Level 1 Criterion Experience  
 Level 2 Criterion Education  
 Level 3 Criterion 1 QM  
 Criterion 2 BS  
 Criterion 3 OM

**Consistency calculations based on the arithmetic mean.**

Education			
	QM	BS	OM
QM	1.000	1.000	0.250
BS	1.000	1.000	0.250
OM	4.000	4.000	1.000

QM	BS	OM
0.167	0.167	0.167
0.167	0.167	0.167
0.667	0.667	0.667

Average Consistency Measure	
(by row)	
0.167	3.000
0.167	3.000
0.667	3.000

**0.000 Consistency**

This 4.000 indicates that education in Operations Management is moderately-to-strongly preferred over education in Quantitative Methods.

Here values are normalized so they sum to 1 (by column).

See Saaty (1999, p. 80-84) for discussion and random consistency table.

**Now introduce inconsistency in comparisons and see result in consistency index.**

Education			
	QM	BS	OM
QM	1.000	3.000	0.250
BS	0.333	1.000	0.250
OM	4.000	4.000	1.000

QM	BS	OM
0.188	0.375	0.167
0.063	0.125	0.167
0.750	0.500	0.667

Average Consistency Measure	
(by row)	
0.243	3.114
0.118	3.039
0.639	3.261

**0.119 Consistency**

Note that the 3.000 in the QM-BS cell indicates inconsistency as the OM-QM and OM-BS comparisons are still identical.

The inconsistency in the comparisons is reflected in this index that now exceeds acceptable limits.

Calculation of Consistency

- 1) Compute the eigenvalue for the matrix with n rows and select the maximum eigenvalue ( $\lambda_{max}$ )
- 2) The Consistency Index (CI) is  $(\lambda_{max} - n)/(n - 1)$
- 3) The Consistency Ratio (CR) is CI/RI where RI is the Random Consistency Index

For n = 3, RI = 0.52; n=4, RI = 0.89; n = 5, RI = 1.11; n = 6, RI = 1.25; n = 7, RI = 1.35; n = 8, RI = 1.40, n = 9, RI = 1.45 Saaty (1999)

Level 1 Criterion Experience  
 Level 2 Criterion Education  
 Level 3 Criterion 1 QM  
 Criterion 2 BS  
 Criterion 3 OM

**Consistency calculations based on the geometric mean using natural logarithms.**

Education			
	QM	BS	OM
QM	1.000	1.000	0.250
BS	1.000	1.000	0.250
OM	4.000	4.000	1.000

LN(product)/3	EXP()
-0.462	0.630
-0.462	0.630
0.924	2.520

Average Consistency Measure	
EXP/SUM	
0.167	3.000
0.167	3.000
0.667	3.000

**0.000 Consistency**

This 4.000 indicates that education in Operations Management is moderately-to-strongly preferred over education in quantitative Methods.

These values are derived using the natural logarithm approach to calculating the geometric mean.

Note the result here is identical to that derived using the arithmetic mean approach.

**Now introduce inconsistency in comparisons and see result in consistency index.**

Education			
	QM	BS	OM
QM	1.000	3.000	0.250
BS	0.333	1.000	0.250
OM	4.000	4.000	1.000

LN(product)/3	EXP()
-0.096	0.909
-0.828	0.437
0.924	2.520

Average Consistency Measure	
EXP/SUM	
0.235	3.136
0.113	3.136
0.652	3.136

**0.117 Consistency**

Note that the 3.000 in the QM-BS cell indicates inconsistency as the OM-QM and OM-BS comparisons are still identical.

Here the result is approximately the same as that derived using the arithmetic mean approach

Another method to derive geometric means is to multiply the elements by row and take their nth root. The procedure then continues as in the arithmetic mean case. Saaty (1994) discusses potential difficulties.

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