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ABSTRACT

This paper reports on the development and use of a multiattribute evaluation model for making resource reallocation decisions in a large College of Education. Multiple criteria with measurable attributes, procedures for use, and software templates are identified, along with data from a recent cycle of reviews. Final estimates on weighted utility values for each of the program reallocation requests (largely targeted on faculty line items) are ranked and illustrated for the decision maker. Eight step-by-step processes in multiattribute evaluation techniques are discussed; as well as several criteria used (i.e., quality of outcomes, centrality to mission, program demand, uniqueness of program, and cost-effectiveness), along with their related measurable attributes. The study examined specific data concerning the performance of 17 identified measurable attributes found within five criteria that were collected from a 2-year study of 16 alternative reallocation requests. The study showed how these 16 alternatives were ranked from the most effective and highest valued option, having a utility value of 81, to the lowest valued request, having a utility value of 16. (Contains 23 references.) (GLR)

USING MULTIATTRIBUTE EVALUATION TECHNIQUES FOR ASSISTING REALLOCATION DECISIONS IN HIGHER EDUCATION

by

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Abstract

This paper reports on the development and use of a multiattribute evaluation model for making resource reallocation decisions in a large College of Education. Multiple criteria with measurable attributes, procedures for use, and software templates are identified, along with data from a recent cycle of reviews. Final estimates on weighted utility values for each of the program reallocation requests (largely targeted on faculty line items) are ranked and illustrated for the decision maker.

This paper reports on the development and use of a multiattribute evaluation model for making resource reallocation decisions in a large research oriented College of Education. Multiple criteria with measurable attributes, procedures for use, and software templates are identified, along with data from a recent cycle of reviews. Final estimates on weighted utility values for each of the program reallocation requests are ranked and illustrated for the decision maker.

The multi-dimensional nature of program and college goals and the multiple number of stakeholders involved in reallocation decisions in higher education require the unique methods and procedures of multiattribute decision making structures and evaluation techniques. This paper reports on the deployment and findings from the use of this technique in an institutional case study. Several criteria (i.e., quality of outcomes, centrality to mission, program demand, uniqueness of program, and cost-effectiveness), along with their related measurable attributes, are defined and reported. Procedures for (a) weighting the importance of each criteria and attribute, (b) assigning utility values for varying degrees of performance, (c) collecting institutional and program data derived from program reallocation requests (largely targeted on faculty line items), and (d) conducting the analysis and estimating the final weighted utility rankings are illustrated.

Given the chronic nature of financial problems higher education is expected to face during the decade of the 1990s, it is a certainty that almost all institutions will

be reviewing and reallocating resources as faculty retire and leave their teaching and research positions. The model and procedures illustrated in this study should be useful to decision makers as they face these problems.

The Multiattribute Evaluation Framework

Multiattribute utility [MAU] evaluation techniques have been employed within the management sciences for a number of years as a means of structuring decisions for private sector strategic planning (Carroll & Johnson, 1990; Poole & DeSanctis, 1990) and for evaluating program alternatives with multiple purposes and outcomes (Edwards & Newman, 1982; Keeney & Raiffa, 1976). They have also had recent use in assessing and selecting among alternatives in some public sector social programs relating to public health (Kaplan, Atkins & Wilson, 1988), the criminal justice system (Edwards, 1980), and public education (Levin, 1983; Lewis, 1989; Lewis, Johnson, Erickson & Bruininks, 1992). However, in spite of many appeals for making rational decisions relative to allocating resources within higher education institutions (Hardy, 1988), only two other studies dealing with multiattribute evaluation and decision making have been reported in higher education. One study reported on the ranking of candidates for tenure decisions (McCartt, 1986) and another reported on the selection of a student-information system (Blanchard, Pierce & Hood, 1989) using multiattribute evaluation techniques.

As an evaluation and decision making framework, MAU analysis is especially appropriate for assisting decision makers in higher education. The multi-dimensional nature of goals and the multiple number of stakeholders in higher education require the unique methods and procedures of MAU analysis. Edwards, Guttentag, and Snapper (1975) have noted that MAU evaluation methods and procedures are most appropriately used in settings where (1) the evaluations are comparative; (2) programs normally serve multiple constituencies; (3) programs normally have multiple goals, not all equally important; (4) judgments are a required part of the evaluation; (5) judgments of magnitude can be assisted by numerical measurement; and (6) the evaluation is relevant to decisions. All of these characteristics are commonly found within higher education when decision makers need to identify appropriate outcome attributes and make choices about allocating resources between alternative programs.

In simplest terms, a MAU process for decision making and evaluation

structures the decision process for a group of stakeholders to make judgments about identifying outcomes which measure effectiveness, weighting the importance of these indicators, and ranking the alternatives. It requires a comparison among two or more alternatives against two or more criteria. These criteria also may have several different dimensions (i.e., measurable attributes) which need to be identified. After importance weights are attached to each of the criteria and attributes, measured dimensions of each attribute are then assigned utility values for varying degrees of performance. Based on the measured performance of each attribute (either through actual measured performance or judgments about performance) within each alternative, utility scores are then computed and attached to each of the attributes. These attribute values are then multiplied by their importance weights and summed to derive a composite score for each alternative. If cost data are available, and if it was not one of the criteria or attributes in the evaluation model, cost per unit of utility can be estimated for determining the relative cost-effectiveness or cost-utility (i.e., internal technical efficiency) of each alternative.

The unique quality of a MAU decision and evaluation model is its ability to structure the decisions of stakeholders with regard to selecting among alternatives with multiple goals, and to frame the evaluation decision into a weighted "utility" index for comparison purposes. The term "utility" is used to measure the extent to which an alternative satisfies an attribute or criterion. It is simply a conventional way of expressing worth, value, or satisfaction in a common numerical metric. A MAU model essentially permits an evaluator to aggregate the utility or satisfaction derived from each of the various attributes into a single measure of the overall utility of the multiattributed alternative.

MAU procedures may appear to be relatively complex when viewed simultaneously; however, when broken down into a step-by-step process the task becomes straightforward and fairly simple. There are eight steps in the process and include the following activities:

(1) Identifying the purpose and objects of evaluation.
(2) Identifying relevant stakeholders to assist in making judgments about the criteria/attributes and their importance.
(3) Identifying and organizing the educational criteria and attributes into a meaningful structure for analysis.
(4) Assigning importance weights to the criteria and attributes through

stakeholder judgments.

(5) Assigning utility values to the measurement scales for each attribute.

(6) Collecting measurable performance data on each of the attributes for each of the alternatives being evaluated.

(7) Conducting the MAU technical analysis by aggregating the attribute performance measures with their measures of utility and importance for each of the alternatives.

(8) Adding costs, when appropriate, for estimating cost-utility ratios and relative efficiency.

Each of these steps has been described in detail and illustrated for use in other settings outside of higher education (see, for example, Edwards & Newman, 1982; Lewis et al., 1992).

Case Study Context and Purpose

In this case study it was determined that the purpose of the evaluation was to assist college decision makers in selecting among alternative programs for the expansion, replacement, or retrenchment of program resources. This was necessary not only for internal reallocation, but for making decisions about the reversion of resources to the central administration of the university. The college facing these decisions is a large College of Education located within a large urban research university.

The College of Education of this case study had been undergoing chronic financial stress over the past two decades and had recently been required to cut additional resources and remit them to central administration. At the same time, the college wanted to insure that it maintained program vitality and needed to give consideration to reallocating resources to existing and new program needs. Short of declaring legal "financial exigency" and terminating current staff, the principle source of discretionary resources available to the college for retrenchment or reallocation resided in an annual pool of funds that resulted from recent faculty and staff resignations, retirements, and deaths. The college had been managing a position control system for the past 15 years whereby funding for all vacant line items in the budget reverted to the Office of the Dean for review and reallocation or retrenchment.

All data for the case study were drawn from 16 program allocation requests submitted by six large departments representing the College of Education and incorporating over 48 different programs. Although judgments and decisions

about allocations and retrenchments were made annually by the college, for the illustrative purposes of this paper all reallocation requests from two years (i.e., the 1985-87 fiscal periods) were combined. This combining of reallocation requests over two years was done to mask the original rankings and to provide a more robust sample for case study illustration.[1]

Identifying the Relevant Stakeholders

The relevant stakeholders for making judgments about the reallocation of resources within the case study college were the Dean of the college and a faculty consultative committee composed of elected representatives from the constituent departments of the college. All final determinations concerning budget allocations within the college were given to the Dean through the authority and responsibility vested in the position by the college constitution and university policy. Other institutions might have differing institutional arrangements for such stakeholder decision making and consultation.

Identifying the Criteria and Measurable Attributes for Reallocating Resources

Most colleges in major universities have mission statements that identify such obligations as "to extend continuously the frontiers of knowledge and tested skill..., to provide education of high quality..., and to afford leadership in...." Obviously, the criteria for planning, evaluating, and making resource allocation decisions for program development within colleges or other academic units must relate in some way to such goals. Such goal statements, however, neither state nor imply the criteria that are to be used in making judgments relating to assessment and resource allocation. Operational criteria that can be used in conjunction with these types of goal statements or other statements of priority must be developed. Following such development, rational judgments can then be made (using quantitative measures of attributes where these are reasonable) to determine the degree to which these criteria are met.

Originally, the identification of criteria for determining an effective program within the case study college had been determined during the mid-1970s through a joint administration and faculty governance committee of the college over an extended two-year period of time (Lewis & Kellogg, 1979). Based upon review of existing collegiate statements of mission, planning, and priority, our case study college concluded that the major criteria for assessing programs could be summarized as quality of outcomes, centrality of mission, program demand, and

cost-effectiveness. These criteria were subsequently modified with the addition of uniqueness of program and adopted by the university as guidelines for all colleges within the university as they faced similar resource issues in the mid-1980s (Benjamin, Sauer & Vanselow, 1986). In the all-university guidelines the criteria were identified in general terms without reference to their relative importance.

The identification of criterion indicators was similarly general and only suggestive in the all-university guidelines. Each college was encouraged to use whatever data they might have available for making judgments on the identified criteria. It was generally assumed that the identification and use of attributes would rest upon the judgments of a Dean with consultative assistance from faculty. It was believed that the combined evidence based on each of these criteria could provide a useful profile for assessing a program and for rationally establishing priorities for allocating resources to and among the many areas of a college or university. It was recognized that the role of these criteria and the evidence relating to them would likely vary from one area to another according to purposes and functions.

The role of these criteria and their measurable attributes take on different meanings depending upon the context under which they are being used. During expanding or even steady-state financial conditions within higher education, many of these general criteria were often employed, in both our case study institution and in others, in an informal intuitive manner in making resource allocation decisions. In the context of these conditions, most resource allocation decisions were viewed as incremental additions to individual programs. Often when a senior (i.e., high salaried) faculty member retired or left the university, the line item was divided and reallocated to two or more different functions or programs. Decision making was at the margin and most often led to the expansion of programs. In this context of incremental decision making most of the focus was on program quality and enrollment demand. Little serious attention was typically given to making hard judgments about centrality, uniqueness, or cost-effectiveness (Massy & Wilger, 1992). Obviously, no program or group of faculty wanted to be told that their activities had low centrality, uniqueness, or cost-effectiveness. Most decisions were driven by student demand and enrollments. When low program quality was mentioned, it was largely addressed through the counter-argument that a new line item would give the program greater capacity to advance its quality.

After decades of effortless growth and prosperity, America's postsecondary institutions have come under increasing financial stress and waning public support. During the first part of the 1980s, this stress largely resulted from a slowdown in the economy, with many state legislatures assigning a lower priority to higher education than to other social services that included K-12 education. In the latter part of the 1980s, overall enrollments in institutions of higher education also declined (with concurrent revenue losses), which was compounded with a renewed national recession and declining state revenues. At times, these lower state revenues, lower priorities to higher education, and lower enrollments have resulted in institutional retrenchments. The National Center for Educational Statistics (1989, pp. 17-28) projects enrollments to continue falling throughout the 1990s. Froomkin (1990) has asserted that if revenues in higher education continue to depend mainly on the number of students, "a prolonged depression will be experienced by higher education, more serious than anything in the past fifty years" (p. 212). Institutional financial stress is currently with us in higher education and will likely continue through the present decade of the 1990s.

During this past decade budgets were balanced partly at the expense of maintenance and repair of buildings and partly at the expense of faculty and staff compensation, thus creating additional internal stress within most institutions. Unlike expenditure cuts for the maintenance and repair of buildings, lack of growth in wage funds resulted in immediate cries of exploitation and despair. With the increase in financial troubles and internal strife, higher education also faced increasing external demands for greater public accountability along with a general loss of public esteem. In response to these calls for greater public accountability and the chronic financial stress felt by higher education institutions, many of these institutions (especially public universities) have today begun to get serious about *restructuring* and *reallocating* resources across and within their colleges. For the current decade additional criteria relating to mission centrality, program uniqueness, and cost-effectiveness have emerged as important dimensions for planning, restructuring, and resource reallocation decisions.

Many institutions are no longer asking what needs to be added at the margin to make a program stronger or more effective. Rather, they are asking what would be lost if the program or activity were no longer being provided by the institution. The questions relative to planning and reallocation today are tougher questions

than those of the past. They require thinking in terms of opportunity costs rather than opportunity gains, and often in terms of bigger issues and greater amounts of resources.

Quality of outcomes. The quality of program outcomes must be a primary focus of any assessment and reallocation effort. Each activity must be viewed in the context of how it contributes to the strength and overall excellence of the programs and departments of the collegiate unit. Evidence of the quality of departments and programs can come from various sources (e.g., rankings by external professional associations, faculty publications, participation of faculty in professional meetings, special awards and other professional recognition, placement of graduate students, average GRE scores of graduate student applicants and admissions, number and competitive quality of external grants and contracts awarded, peer evaluation, student evaluation, and professional constituency evaluation). Distinctions should be made among invited, refereed, and other types of professional contributions; among types of placement; among types of recognition; and among levels of significance of research and service activities.

Program evaluations by external bodies such as the American Psychological Association and the American Council of Graduate Schools illustrate important qualitative estimates of a program's vitality over time. The qualitative assessment of a program should include the evaluation of teaching both at the graduate and undergraduate levels. Related evidence includes evaluations by students and peers, as well as followup assessments by graduates. Such assessment also includes whether the program area has paid special attention to the task of consolidating, reorganizing, and otherwise revising the structure and content of courses and programs to improve instruction and to serve as a model for similar programs in other institutions. Evidence of faculty development addressed to meeting new teaching needs should also be reviewed.

Analogous quality concerns apply for noninstructional program and service efforts across a unit. Contributions to professional practice and knowledge are of relevance in the qualitative evaluation of professional programs, particularly in a professional college. The focus of evaluating contributions to practice in a professional college should be on examining the nature and strength of a program's relationship to the work of agencies and practitioners in the field.

From an understanding of these attributes of quality, the following **measurable**

attributes of quality were identified by the Dean and faculty consultative committee within our case study college:

- Graduate program national ranking
- Quality of faculty publications
- Quality of external funding
- Quality of instruction
- Quality of professional service

Centrality to mission. Centrality refers to the relative germaneness of an activity to the stated programmatic goals and objectives of an organizational unit. If one considers the programmatic alternatives that contribute to achieving particular goals and purposes, what is the relative necessity of supporting each? The critical question to ask is whether the mission (goals and purposes) of a college would be compromised if the program or activity under review were diminished or not in existence. In what ways would its absence be noted? If, for example, a particular program area were to be eliminated, would this compromise the college's national ranking as a professional school in terms of scholarly productivity and research, graduate program rankings, and service to students, the state, and other constituencies?

Judgments about the centrality of a program or activity are particularly difficult for several reasons. It is a very complex decision and can involve several levels of centrality. It is a decision that necessarily rests more on nonquantitative or subjective determinations than do the other criteria. It also often rests with perceived important political constituencies outside the institution. For these reasons a judgment about the centrality of a program or function may be difficult to rationalize and act upon. Agreement on the relative centrality of programs and activities may be difficult to achieve, especially in the absence of fairly specific standards and measures. Nevertheless, the contribution of centrality to resource decision making must be considered. To what degree is the substance of an activity pertinent to agreed upon program needs and intentions? In this context, two programs might demonstrate the same degree of quality, demand, uniqueness, and even cost-effectiveness but might differ in their centrality to collegiate programmatic intentions. In a professional college located within a large state university, this centrality to "professional mission and purpose" becomes all the more imperative, given its stronger need for focus and rationale to preserve it's separate status as a college.

Because a college is part of a university, and a department is part of a college, consideration of centrality suggests concern for at least three levels: centrality to the mission and purposes for the larger university, centrality to the mission and purpose of the college, and centrality to the mission and purpose of a specific department. Centrality of activities at the program level might be considered an additional level or perhaps an alternative to considering the departmental level.

While the criteria suggested here are thought to have application on several organizational levels, the primary focus of this discussion and multiattribute decision model is on review of departmental programs at the collegiate level. However, collegiate review must be in the context of the total institution (i.e., it is always possible that a program or activity might have lesser centrality for a college than it might have for the larger university or institutional framework). Does it contribute materially to programs of instruction found outside the college in other parts of the university? When such cases of institutional centrality might exist, it is important that appropriate consultations occur among the various administrative levels, especially as regards decisions affecting program terminations.

Perhaps the most direct indication of centrality is the degree of correspondence between program activity and the stated goals and missions of the college (the more specifically these are stated, the easier it is to establish the degree of correspondence). Most important, does the activity or program contribute directly to the research and instructional priorities of the college? If the activity were missing, would the college be compromised in carrying out its central mission? Another important indicator of centrality is the number of students from other units within the college who are enrolled in a program's courses. However, caution should be used when reviewing such data. Such enrollments must be reflective of specific programmatic links with other areas of the college. One cannot, for example, have programs in teacher training without courses relating to learning theory, or programs at the graduate level without courses in statistical methodology. Thus, one form of centrality is the degree to which an activity or program provides specific programmatic services to other parts of the college.

Yet another view of centrality is the degree to which the program or activity is related to the unique teaching and creative inquiry functions of the college as part of the university. Does it contribute materially to the interaction of instructional

programs with disciplined inquiry, of graduate level programs with initial licensure programs, or of discipline-oriented fields with problem and practice-oriented programs? All such questions must be considered as part of the concern about centrality in relation to mission.

From these understandings about centrality to mission, the following **measurable attributes of centrality** were identified in our case study college:

- Contribution of research to college mission
- Contribution of instruction to college mission
- Contribution of instruction to other university programs
- Contribution of service to college mission

Program demand. A higher education institution is a basic resource and serves societal needs as an important part of its mission. Central to this mission, and one of the distinguishing characteristics of an American higher educational institution, is its primary role in providing instruction and training. Based on current enrollments, projected societal needs, and demographic trends one must try to predict likely future changes in program demand for presently existing and projected programs.

Three aspects of program demand should be considered: (1) student demand for educational opportunity (i.e., individual student and social choice); (2) demand of the market for personnel (i.e., market and manpower forecasting); and (3) demand for ideas, information, and methods that may be developing through inquiry or testing (i.e., knowledge based social and professional requirements for research and development). These are obviously quite different demands and each should be viewed on its own merits. Their common element is that each judgment involves a comparison of a present program operation with an estimate of future student demand or expectations about future social needs.

Information from department and program units regarding their perceived needs for new directions is one way to project student demand changes within and among programs. Such information, along with actual trends in programs and enrollments, should assist in the planning process of a college. For example, in considering programs often associated with colleges of education, increasing student and societal interest in early childhood education, educational technology, adult and community education, and continuing professional education clearly point to some directions for the future. A review of recent curricular changes concerning the addition or dropping of courses, along with

infrequently offered or low enrollment courses and program enrollment shifts over time, may also suggest student demand changes. Such information, combined with available demographic projections, should provide additional insight as to where an expansion of resources is likely to be needed or where reductions should be considered.

It is important to note that quantitative measures of student and social demand should not be the only guide for determining demand in a public professional college. These measures are useful for reviewing areas with either expanding or declining enrollments, but they have limitations. For example, if student enrollments have fallen off in some initial licensure program areas, this may not necessarily justify retrenching large portions of their budgets. The resource base may have been originally inadequate. Or, with programmatic shifts involving new clinical experiences or with an expansion into postbaccalaureate licensure programs, smaller numbers of students may be essential, and additional resources even might be required. Although related to program quality, the ratio of qualified applicants to number of students admitted to a program also serves as evidence of student demand. Appropriate instructional ratios (e.g., full year equivalent students or student credit hours per full time equivalent staff, degrees per full time equivalent faculty, and the like), which might have different benchmarks for different areas and program levels, could be used as one type of information in developing guidelines for enrollment related resource needs. Other ways of operationally defining a "critical mass" of faculty and students (including acceptable floors and ceiling for student enrollments in individual programs) might also be developed for the different areas and programs across a college.

With respect to the market (i.e. manpower) demand for personnel, one should review very carefully the history of placements for the program graduates wherein both the quality and proportion of such placements are examined. However, the most common form of projecting market demand for personnel in educational planning has been the use of manpower-forecasting techniques. In its simplest form, manpower-forecasting attempts to signal future labor market surpluses and shortages. When such models have been carefully developed with field-specific observations, they can provide useful guidelines as to the direction and intensity of expected changes. On the other hand, it is important to note that manpower-forecasting has generally proved to be a most elusive guide to social

and economic policy in both macro- and microeducation planning. The very real limits of such forecasting techniques have been frequently documented in the policy and planning literature (e.g., Psacharopoulos & Woodhall, 1985).

From these descriptions of program demand, the following **measurable attributes for demand** were identified:

- Current student enrollment
- Projected social and student demand

Uniqueness of program. The fundamental question being asked under this criterion is: What are the unique characteristics of this program that make it particularly appropriate to this university? Any argument for program uniqueness in a college is related to the social need (i.e. demand) for such a program in the region, as well as the limited availability and accessibility of similar programs in other colleges within the state or region; however, the uniqueness of a program can and should be viewed as a separate criterion and dimension. Where such programs or aspects of programs (e.g., undergraduate instruction, inservice education, master level studies) are not geographically unique to a college and when they could be offered or are duplicated in other accessible colleges in the region, serious consideration should be given to the reallocation of such effort and resources. On the other hand, the possibility also exists that entirely new programs are needed (i.e., being demanded) and the comparative advantage of the university's mission and resources argue that it should be at the university. Periodically, each state supported college should review its curriculum and programs to consider whether there are programs offered elsewhere, but not in the region, that carry strong social need (i.e., demand) and are clearly within the department's or college's mission. Such programs should be considered for development.

From these understandings about uniqueness of program, the following **measurable attribute of program uniqueness** was identified:

- Uniqueness of program in state and region

Cost-effectiveness of program. The extent of cost-effectiveness in any given program or activity is usually measured by comparing the costs or resources used with the outcomes or benefits achieved. It is a technique of selecting from alternative activities the one that will attain a given outcome at the lowest cost or the greatest benefits at given costs. The greater the benefits with given costs, or the lower the costs with given benefits, the greater the cost-effectiveness. It is

particularly useful where benefits cannot be measured in money terms. Such comparisons for determining cost-effectiveness are almost always expressed as ratios. The underlying notion in all such comparisons is that the use of resources involves a cost and that the outcomes should be compared with that cost. Thinking in "real" terms, the real cost of producing anything are the alternatives that are foregone. For example, the real cost of any given program or activity in a college would be the outcomes of the next best alternative program or activity given up that might otherwise have been produced with the same resources. Thus, for any resource allocation decision within a college, the extent of cost-effectiveness must be assessed by comparing the outcomes (at the margin) with the outcomes that might have been achieved if the same resources had been used in an alternative activity. To decide whether a department or a program should be maintained, expanded, or contracted, one must assess whether more desirable outcomes could be realized by reallocating resources into an area or out of it.

In discussion dealing with cost-effectiveness, three fallacies are frequently stated: (1) lower costs are better, (2) quality should not be related to cost, and (3) reduced costs mean reduced quality. Lowest or lower cost is not necessarily better. The key question is, What outcomes of what quality for what cost? Too often administrators fail to view the substantive differences in training methods and modes such as between professional and general education, between graduate and undergraduate education, and between a college with a relatively simple or unitary mission and a college in a multipurpose university with a multipurpose mission. Significant differences in quality of output are also frequently ignored. A second error is to judge cost-effectiveness only in relation to outcomes by assuming that certain improved outcomes are desirable and should be sought irrespective of cost. The third error is the assumption that the quality of outcomes will necessarily fall if the costs for a given outcome are reduced. Comparisons of similar data among peer programs in other institutions often show this not to be the case. In higher education (as in any production process), there are a number of alternative ways in which contributing resources can function in order to produce outcomes. Some of these alternatives are obviously more cost-effective than others. The important idea is to recognize that cost-effectiveness involves a relationship between costs and outcomes. For example, to add to costs in a program area would not be cost-effective if the outcomes gained

were less valuable than the outcomes that the added resources would have yielded in another area. On the other hand, to cut costs would not be cost-effective if the outcomes given up were more valuable than the outcomes of the saved resources used in another area.

It is important to note that departments and programs that operate at a low rate of expenditure per student are not necessarily cost-effective because of their limited resources. They may be cost-effective because of the way in which they manage their inputs (e.g., the consolidation of courses or sections with low enrollments) or because they do not require specialized training methods (e.g., large lecture classes as compared with individualized laboratory instruction), or because they have reoganized their curriculum to require core courses for cohorts of students. Departments and programs that are cost-effective are not necessarily the lowest quality or lowest cost. In fact, examples of almost all combinations can be found across most institutions. Again, the critical question underlying advice on cost-effectiveness is: How are program outcomes and costs related? For example, how can program outcomes be maintained (or enhanced) while reducing (or holding constant) costs? Or, what will be the tradeoffs in outcomes if resources are transferred from one program area to another?

A major problem in all such assessments is how best to conceptualize and measure the inputs and outputs in order that they may be compared and evaluated. In higher education, inputs have often been thought of as dollar costs, although they might also be thought of as activity levels of faculty and staff (e.g., numbers of full time equivalent faculty and staff).[2] Outcomes tend to be more complex and often more difficult to measure. Some of the simplest measures of output variables can be weighted (by level) student credit hours, student counts (full year equivalent or head counts), numbers of graduates, numbers of placements, numbers of publications, and numbers of external grants and contracts. Examples of more complex outcome variables include cognitive and affective changes in students, research and development contributions to professional practice, economic benefits (e.g., rates of return) to students and society, and other social benefits. The choice of which inputs and which outcomes will be used and how they will be defined, weighted and related are crucial determinations and should involve the most informed judgments of faculty and administrators. In a large university, useful comparisons can be made among

similar types of departments and programs within the college, as well as with other "peer" programs in other colleges and universities.

Rather than seeking to establish an acceptable and comprehensive definition of program output for all units within a college (which is probably not possible), it seems best to make use of the concept of cost-effectiveness by determining selected indexes of effectiveness and by considering these indexes in relation to some measure of costs.

From these understandings about cost-effectiveness, the following **measurable attributes of cost-effectiveness** were identified:

- Average costs per student FYE
- Average number of doctorates produced per year per FTE faculty
- Average number of MEds produced per year per FTE faculty
- Average number of BA/BSs produced per year per FTE faculty
- FYE students per FTE faculty

Assigning Importance Weights to the Criteria and Attributes

After both criteria and attributes have been identified and structured into an attribute tree (as illustrated in Table l), the next step is to assign importance weights to both criteria and attributes. Not all of the criteria and attributes identified by stakeholders and/or by the decision maker are likely to be considered equally important; although this scenario would pose no threat to the overall evaluation. Most often, there are those criteria and attributes to any educational program which are considered more critical to the program's effectiveness than others. These differences in comparative value may also vary greatly from one individual stakeholder to another. "Weighting" these variables is one way in which these comparative values can be analyzed.

[Insert Table 1 about here]

Although there are several different procedures for ranking criteria and assigning importance weights, the one most conventionally used is to assign each criterion with a value of relative importance on a scale of 0 to 100 and then to convert these values into proportion weights. This procedure is relatively easy to implement. A useful way to begin is to have the stakeholders first rank each of the criteria in terms of their relative importance. Then each stakeholder should assign a value of 100 to the most important criterion. Next stakeholders should assign a value between 0 and 100 to each of the remaining criteria that reflect their importance relative to the most important criterion. After these importance

weights have been established for each of the criteria, the same ranking procedure and assignment of importance weights should be undertaken by each stakeholder with respect to each set of attributes identified within each of the criteria.

This simple method offers some important advantages to other possible systems of weighting. One of the primary advantages is that is provides for the independent assessment of each individual criterion. Such freedom is not provided, for instance, in situations where the stakeholders may be forced to divide 100 points of importance among the differing criteria. This method of scoring importance weights also has the advantage that it is easily understood and can be quickly implemented. This method also has the advantage of allowing for equal importance weights to be placed on the entire criteria set. If any stakeholder should judge that all of the individual attributes for one of the criteria have equal importance, this should present no problem because the individual can simply assign 100 points to each of the items.

Following this assignment of individual importance weights, the analyst should then convert the average scores of these weights into "proportion weights" by simply dividing each of the importance weights by the sum of the total values for the set of criteria or set of attributes. By definition, the total of all proportion weights for any set of criteria or attributes will equal 1.00.

As each set of criteria and attributes are reviewed, the results of the individual importance rankings should be presented to the entire stakeholder group for further discussion. If any of the criteria or attributes evidence large variability in responses from stakeholders, another individual ranking exercise should be conducted for the set under review. It is anticipated that by doing this, the individual variability of rankings will be minimized through a group process of consensus building. The individual results of this second weighting should again be totaled and averaged to determine the final weights for the main criteria categories and attribute subcategories of the attribute tree.

Although a common set of averaged weights (where each stakeholder has given similar weights to each criteria and attribute) with limited individual variability is the desired objective, this may not always be possible. In general, averaging is a useful technique when consensus is desired for the final valuing product.[3] An alternative approach suggested by Newman and Edwards (1982) is

for the groups to essentially negotiate among themselves to arrive at an agreed upon set of weights. They correctly note that models using such negotiated weights are essentially political models of negotiated policy positions, jointly formulated by multiple groups or individuals. Just as political and social policies are the result of group consensus, MAU models that reflect policy positions also result from group consensus-- in this case, regarding the appropriate weights to use.[4]

In Table 1 the importance weights for both the criteria and attributes of our case study have been identified. In viewing Table 1, the reader should note that the numbers in the attribute tree are "proportion weights" for each of the criteria and attributes, and that they sum to one for all the criteria and for each subset of attributes. This is a conventional way of displaying the weights and in organizing for their subsequent use. In this procedure the final weights have been "normalized" (i.e., will sum to one), and assign to the most important and least important criteria and attributes the largest and smallest weighted numerical values respectively.

The final weighted importance values for each of the individual attributes can now be calculated by a process defined as "multiplying through the tree." The reader should note from Table 1, for example, that when attribute AA is multiplied through the tree it has a weighted importance value of .08. That is, when attribute AA's proportion weight of .26 is multiplied by its criterion (A) weight of .29, the product totals .08. It is this latter value which will be used in the technical analysis part of the evaluation when "weighted" utility values are estimated for each of the attributes found within each of the program alternatives.

Assigning Utility Values to the Attributes

The next task is to assign utility values to each of our individual attributes through the construction of transformation graphs or utility functions. The transformation of measurable attributes to utility values is a straight forward procedure which can be explained either graphically or mathematically. Consider our case of evaluating resource allocation requests in higher education and assume that the stakeholders have determined that one of the attributes they wish to measure relating to program quality is the national ranking of the graduate program.

[Insert Figure 1 about here]

The utility box in Figure 1 models graphically the transformation of this measurable dimension from quintile units of ranking scores into utility values. It illustrates, for example, that for each quintile from the bottom quintile of the national rankings, the program area would gain 25 units of utility. Knowing this exchange ratio permits the evaluator to then collect actual performance data from the alternative programs and compute the utility corresponding to the performance data. Other utility indexes and graphs can just as easily be constructed for other measurable attributes with other units of measure and scales, such as judgments about the quality of instruction and external funding, average costs per student FYE, and the like.

There are two important points to remember. First, the transformation of differing scales and types of attributes into a standardized unit of measure is accomplished by the simple process of converting all raw score measures into utility values. Second, this transformation process is easily accomplished by establishing the exchange ratio or slope of the line in Figure 1.

The usual transformation procedure for constructing the utility box and exchange ratio illustrated in Figure 1 is to first examine the likely range of expected performance on the attribute with maximum and minimum values; and then establish this range as the relevant range for estimating the zero and 100 end points on the utility scale. Graphically, a single 45 degree line can then be drawn within the utility box to approximate the utility transformation and functional relationship. In the case of Figure 1, the slope of the 45 degree line expresses the exchange rate between quintiles of national rankings and units of utility (i.e., value or satisfaction). This exchange ratio is simply the slope coefficient of a straight line and also can be expressed in mathematical form.

The utility relationships of this case study all assume a linear relationship throughout the relevant ranges. This linear relationship is represented by the straight 45 degree line in the utility box of Figure 1. Other curvilinear relationships can just as easily be constructed and in some cases may be better representations as to how some people might judge rates of satisfaction (i.e., utility). However, research in the field (Edwards, 1980; Keeney, 1977) has indicated that such curvilinear representations almost never make any difference to the decision outcome largely because of the small differences in utility values which might result. Nevertheless, if linear relationships for certain attributes prove troublesome to any decisionmakers or stakeholders, it is a very simple process to

create a utility box with curvilinear transformation lines. The evaluator can simply draw a graph similar to Figure 1 with the measurable dimension of the attribute on the X axis and the 0 to 100 point utility scale on the Y axis, and then draw whatever functional curve most appeals to the stakeholder or group.

The task of assigning utility scales to each of the attributes in a MAU evaluation is usually undertaken by the evaluator, in consultation with knowledgeable individuals in the field for making estimates about the plausible ranges of attribute performance. This results because the determination of ranges is largely an empirical and technical question. However, in higher education once plausible performance ranges have been tentatively established, it is almost always a useful strategy to review these ranges and the shape of the utility functions with the principle stakeholder(s). When employing an MAU evaluation in higher education, the involvement of faculty stakeholders in this process is important primarily because of the significant political role faculty play in both the development and execution of college policy. The validity and utilization of the entire evaluation will be largely determined by the acceptance and support given to the process of the evaluation by participating stakeholders. When they have a role in determining not just the identification of attributes and assignment of importance weights, but also a role in confirming utility values, their support and the validity of outcomes will be enhanced.

Collecting Performance Data from/for the Reallocation Requests

After our MAU evaluation model was framed and assigned importance weights and utility scales for each of the attributes, we collected data from and for each of the 16 reallocation requests. In the assessment of programs in higher education, it is expected that such attribute performance data will come from one of three sources of information. Some data will be collected from the college's internal records that include information on such items as costs, teaching loads, degrees awarded, external funding, and the like. Other data will be drawn from surveying the judgment(s) of the decision maker or stakeholders on such issues as the uniqueness of the program in the state or region. However, most of the data needed for scaling the attributes should come directly from the reallocation requests themselves, particularly when the submitting program areas understand and know that their requests will be judged against certain specific criteria with associated attributes. The instrumentation for collecting this information in the case study can be viewed in Table 2 wherein scales are also

identified for each of the attributes.

[Insert Table 2 about here]

Conducting the MAU Analysis

Through the procedures of the previous steps in developing our MAU evaluation model, we constructed three sets of numbers for each of the attributes in our evaluation model: (1) weighted importance values, normalized to sum to 1.0; (2) utility values assigned to each unit of measured performance, expressed on a utility scale of satisfaction from 0 to 100; and (3) adjusted performance measures for each alternative decision package, wherein raw performance scores are adjusted for lowest plausible performance level. The next step in our MAU procedure was to aggregate these numbers into a weighted utility score for each attribute for each alternative request, and then sum all of these weighted utility scores for each alternative.

The assignment of weighted utility to each attribute is a simple process which requires only multiplying the weighted importance assigned to each attribute times its assigned utility unit value times its adjusted performance measure for each alternative. Total weighted utility for each resource reallocation request is then derived by just adding up the products for each of the attributes. This procedure is illustrated in Table 3 wherein each of the attributes are listed along with their assigned normalized importance weights (column 1) and constructed unit utility values (column 2) common to all the alternatives. Also included in Table 3 are the adjusted measured performance (column 3) on each attribute from each alternative. It is important to note that these performance measures are adjusted according to whether "more is better" or "less is better" as the desired performance value. When more is better on the performance scale, the adjustment is to subtract the minimum plausible score from the actual performance number. When less is preferred as a performance outcome, the adjustment is to subtract the actual performance number from the maximum plausible score. Each of these three values (i.e., the normalized importance weight, the attribute transformation ratio, and the adjusted performance score for the ith attribute) are then multiplied through the table to arrive at a weighted utility value (column 4) for each of the attributes for each of the alternatives.

[Insert Table 3 about here]

The weighted utility values for each of the attributes are then added up for each of the alternatives to arrive at a total weighted utility value for each alternative.

Because of the methodology used in this MAU evaluation, the larger the numerical value of each total weighted utility score, the "better" or "more effective" that alternative program can be considered by the evaluator or final decisionmaker. This total weighted utility value of each alternative can be now used in making comparisons between alternative programs, or between differing timespans of the same program. With the values reported in Table 3, for example, we can rank the reallocation request for the Alternative #9 program as having the highest priority for reallocation consideration among the four alternatives illustrated.

Table 3 also illustrates several distinguishing characteristics relative to program performance (i.e., column 3) across four of our case study allocation requests. Note that the performance profiles for our top two alternatives #9 and #1 give clear evidence that both programs have outstanding quality, strong centrality to college mission, adequate student demand and uniqueness, and are highly cost-effective. Alternative #2, on the other hand, looses utility value because of its very weak quality while holding strong in centrality, student demand, and cost-effectiveness. Finally, alternative #3 is generally weak across all criteria, except that it appears to be relatively cost-effective in its instructional activities.

Table 4 reports on the relative ranking of all 16 of the alternative program requests. Although there was considerable variability across the 16 alternatives on their adjusted performance on individual attributes, this variability was somewhat muted through the assignment of importance weights. This resulted in less variability in the total weighted utility scores for some of the alternatives. Nevertheless, the final ranking of effectiveness scores (i.e., as measured through weighted utility scores) gives clear indication that several of the alternative programs are at least four to five times more effective across all of the attributes than the lowest alternatives. We note from Table 4 that the three highest utility values were assigned to allocation request numbers 9, 1, and 16 with values of 81, 76, and 74 respectively. On the other hand, at least five of the allocation requests were ranked as clearly on the bottom (i.e., allocation request numbers 8, 13, 11, 10, and 3) with weighted utility values of only 30, 30, 26, 17, and 16.

[Insert Table 4 about here]

The ranking of all 16 of the allocation requests in Table 4 gives clear evidence that MAU modeling and evaluation procedures can provide meaningful scaling of

the perceived worth and effectiveness for resource allocation decision making. It is clear that three of the programs have the strongest case for preservation and funding, another group of four to eight programs have some strength but apparent weaknesses as well, while the five lowest ranked requests should signal them as clear candidates for retrenchment.

Checking the Final Results for Sensitivity of Analysis to Assigned Weights and Judgments

In order to test the results in our case study to determine whether the assignment of an additional criteria, differing importance weights, or differing performance judgments might make any material differences in our final ranking results reported in Table 4, we conducted several sensitivity tests with different numbers. In none of these additional tests were the final results materially changed. For example, the additional criteria of "uniqueness" that was adopted by the all-university planning process was removed from the attribute tree (i.e., assigned an importance value of zero) and all other parameter and performance values were retained. In this case, none of the top three rankings were changed and the bottom five rankings remained at the bottom. Only some of the intermediate rankings changed places but only by one to three unit changes in weighted utility. Similarly, when importance weights were modestly changed by entering the independent judgments of a new assistant dean who did not participate in the original MAU exercise, the final rankings did not materially change. Other independent judgments on several of the performance scales were also entered as a separate simulation to test for the sensitivity of this dimension, and no material changes in either the final ranking or the variance between requests were observed.

Summary

Data on the performance of 17 identified measurable attributes found within five criteria were collected from a two-year sample of 16 alternative reallocation requests within a large college of education. These performance data were then converted into utility measures (see Figure 1) and loaded into an attribute value tree with assigned importance weights for determining the final utility weights for each of the 16 resource requests (see Table 3). The total weighted utility values in Tables 3 and 4 indicate the relative *effectiveness* (i.e., expected value) of the 16 alternatives based on their respective performances. From the results reported in Table 4 it can be seen that the 16 alternatives can be ranked from the most effective

and highest valued option with a weighted utility value of 81, to the lowest valued request with a weighted utility of 16.

The use of MAU evaluation techniques in assisting decisionmakers in higher education for making resource allocation decisions about retrenchment and reallocation is clearly invaluable. It not only adds validity and rationality, but it adds an orderly structure and process as well. However, the cards will not always read themselves. Inherent in all major resource decisions in higher education is the need to be sensitive to extenuating circumstances that are not always apparent in the data. For example, programs for which there is high demand and are highly cost-effective, but that tend to be marginal with respect to other criteria, are especially bothersome. Such programs must be reviewed very carefully so as not to detract from other more central programs and from the primary mission of a college. Support decisions are also difficult when highly central programs are of generally low quality combined with limited demand and high cost. Extra effort might need to be directed to improving the quality and cost-effectiveness of such programs. Similar problems arise when a program exhibits generally high quality but is viewed as being low with respect to demand or centrality. Nevertheless, the overall program profile that emerges from considering all elements and their relationships as in an MAU type analysis will make a useful contribution to the complicated and judgmental resource allocation process of most colleges.

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Endnotes

1. The original list from the combined two years included 20 total allocation requests. However, four of the requests were duplicates over the two years and were accordingly removed from the combined number of alternatives for this case study.
2. The advantage of defining input in dollar terms is to establish a readily available measure of input that is comparable across programs. In no sense should this conceptualization of inputs be assumed to mean that budgeted finances are the only important inputs to higher education. In some instances dollars may be a poor surrogate or indirect measure of the true resources that contribute to outcomes.
3. However, consensus (or near consensus with limited variability in individual responses) is not always possible. When individuals or groups of stakeholders disagree on importance weights, it is usually a good idea to discuss the disagreement and attempt to resolve whatever the issue might be. On the other hand, when such disagreement is fundamental, it is best to save both sets of weights for later analysis. Fundamental differences in importance weights can be either treated as a separate evaluation or they can be addressed with subsequent sensitivity analysis. In sensitivity analysis with MAU models, where the alternative weights are placed into a separate analysis, the literature indicates (see Newman, 1977; Huber, 1980) that the final results are often insensitive to whichever set of weights are used. Nevertheless, it is essential that such separate treatment of material differences in opinions be preserved in order to test for possible important differences in the final results, and to insure the face validity and integrity of the process with the stakeholder groups.
4. There are several other techniques for establishing rank ordering and weighting of listed items, including rank sum weighting and rank reciprocal weighting; however, all rank weighting methods in MAU analyses are at best approximations. Our ranking procedure is recommended largely on the bases of its simplicity and ease in use. For the reader interested in reviewing these other ranking techniques, an excellent source can be found in Van Winterfeldt and Edwards (1986).

Table 1: Value Tree of Criteria and Measurable Attributes Showing Proportional Weights and Final Importance Weights

		Proportional Weights		Weighted Importance
A		**0.29**	**Quality of Outcomes**	
	AA	0.26	Graduate program national ranking	0.08
	AB	0.25	Quality and rate of faculty publications	0.07
	AC	0.16	Quality and rate of external funding	0.05
	AD	0.23	Quality of instruction	0.07
	AE	0.10	Quality of professional service	0.03
B		**0.23**	**Centrality to Mission**	
	BA	0.31	Contribution of research to college mission	0.07
	BB	0.31	Contribution of instruction to college mission	0.07
	BC	0.16	Contribution of instruction to other university programs	0.04
	BD	0.22	Contribution of service to college mission	0.05
C		**0.14**	**Demand for Program**	
	CA	0.47	Current student enrollments	0.07
	CB	0.53	Projected social and student demand	0.07
D		**0.06**	**Uniqueness of Program**	
	DA	1.00	Uniqueness in state and region	0.06
E		**0.28**	**Cost-Effectiveness of Program**	
	EA	0.25	Average costs per FYE student	0.07
	EB	0.25	Average doctorate per FTE faculty	0.07
	EC	0.13	Average MEd per FTE faculty	0.04
	ED	0.12	Average BA/BS per FTE faculty	0.03
	EE	0.25	FYE students per FTE faculty	0.07
			Total	1.00

Table 2: RATING OF INDIVIDUAL ALLOCATION REQUESTS ON SCALES OF MEASURABLE ATTRIBUTES

==========

A. QUALITY:

AA) Graduate program national ranking
1)_____, 2)_____, 3)_____, 4)_____, 5)_____
unranked top 20-40 top 10-20 top 5-10 top 5

AB) Quality of faculty publications
1)_____, 2)_____, 3)_____
low medium high

AC) Quality of external funding
1)_____, 2)_____, 3)_____
low medium high

AD) Quality of instruction
1)_____, 2)_____, 3)_____
low medium high

AE) Quality of professional service
1)_____, 2)_____, 3)_____
low medium high

B. CENTRALITY

BA) Contribution of research to college mission
1)_____, 2)_____, 3)_____
low medium high

BB) Contribution of instruction to college mission
1)_____, 2)_____, 3)_____
low medium high

BC) Contribution of instruction to other university programs
1)_____, 2)_____, 3)_____
low medium high

BD) Contribution of service to college mission
1)_____, 2)_____, 3)_____
low medium high

C: DEMAND

CA) Current student enrollments (i.e., average tenure track faculty SCH)

1)_____, 2)_____, 4)_____, 4)_____

4th quartile 3nd quartile 2rd quartile top quartile

CB) Projected social and student demand

1)_____, 2)_____, 3)_____

low medium high

D. UNIQUENESS

DA) Uniqueness of program in state and region

1)_____, 2)_____, 3)_____

low medium high

E. COST-EFFECTIVENESS

EA) Average costs per student FYE

1)_____, 2)_____, 3)_____, 4)_____, 5)_____

over $8000 $7-8000 $6-7000 $5-6000 under $5000

EB) Average number of doctorates produced per year per tenure track FTE faculty

1)_____, 2)_____, 3)_____, 4)_____, 5)_____

0-.30 .30-.80 .80-1.50 1.50-2.00 over 2

EC) Average number of MEds produced per year per tenure track FTE faculty

1)_____, 2)_____, 3)_____, 4)_____, 5)_____

0-.30 .30-1.00 1.00-2.00 2.00-4.00 over 4

ED) Average number of BA/BSs produced per year per tenure track FTE faculty

1)_____, 2)_____, 3)_____, 4)_____, 5)_____

0-.50 .50-2.00 2.00-4.00 4.00-10 over 10

EE) FYE students per tenure track FTE faculty

1)_____, 2)_____, 3)_____, 4)_____, 5)_____

0-5 5-8 8-12 12-16 over 16

Table 3: Calculating Final Utility Weights of Alternative Resource Reallocation Requests

Attributes	Normalized Importance Weight [1]	x	Utility Ratio [2]	Alternative #9 Adjusted Performance [3]	=	Alternative #9 Weighted Utility [4]	Alternative #1 Adjusted Performance [3]	=	Alternative #1 Weighted Utility [4]	• • •	Alternative #2 Adjusted Performance [3]	=	Alternative #2 Weighted Utility [4]	• • •	Alternative #3 Adjusted Performance [3]	=	Alternative #3 Weighted Utility [4]
AA	0.07		25.00	4		7.00	4		7.00		0		0.00		0		0
AB	0.07		50.00	2		7.00	2		7.00		0		0.00		0		0
AC	0.05		50.00	2		5.00	2		5.00		0		0.00		0		0
AD	0.07		50.00	2		7.00	2		7.00		2		7.00		1		3.5
AE	0.03		50.00	1		1.50	2		3.00		1		1.50		0		0
BA	0.07		50.00	2		7.00	2		7.00		2		7.00		0		0
BB	0.07		50.00	2		7.00	2		7.00		2		7.00		0		0
BC	0.04		50.00	2		4.00	1		2.00		0		0.00		0		0
BD	0.05		50.00	1		2.50	2		5.00		1		2.50		0		0
CA	0.07		33.33	3		7.00	1		2.33		2		4.67		0		0
CB	0.07		50.00	1		3.50	1		3.50		2		7.00		0		0
DA	0.06		50.00	2		6.00	2		6.00		1		3.00		1		3
EA	0.07		25.00	3		5.25	2		3.50		2		3.50		2		3.5
EB	0.07		25.00	2		3.50	4		7.00		0		0.00		0		0
EC	0.04		25.00	0		0.00	0		0.00		3		3.00		1		1
ED	0.03		25.00	3		2.25	0		0.00		2		1.50		2		1.5
EE	0.07		25.00	3		5.25	2		3.50		2		3.50		2		3.5
Total Weighted Utility Values:						80.75			75.83				51.17				16.00

Notes:

[1] Normalized importance weights represent proportional weight of each individual attribute multiplied by the proportional weight of its corresponding criteria.

[2] Utility ratio represents the units of utility awarded to each unit of adjusted performance.

[3] Adjusted performance of attributes represents the actual raw score of the alternative minus the minimum plausible performance level, for those cases where more is better. For those cases where a lower score on performance is better, the adjusted performance measure represents the maximum plausible score minus the actual raw score.

[4] Weighted utility is the product of multiplying the normalized importance weight times the utility ratio times the adjusted performance.

Table 4: Ranking of Allocation Requests

Department/Program Allocation Request Package	Ranking by Total Weighted Utility
#9	81
#1	76
#16	74
#15	61
#4	57
#14	54
#2	51
#12	48
#6	48
#5	46
#7	44
#8	30
#13	30
#11	26
#10	17
#3	16

Figure 1: Transformation of Measurable Attribute into Utility Values (Utility Box for Attribute AA)