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AUTHOR Tuscher, Leroy J.
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ABSTRACT

The purpose of the study was to provide "baseline" data for determining the feasibility of further investigation into the use of quantitive judgmental data in evaluating school programs for determining program budget allocations. The specific objectives were to: 1) Apply a Cost-Utility Model to a "real world" situation in a public secondary school; 2) Develop a technique for obtaining dollar values which represent program threshold cost; and 3) Measure the judgmental gap--the difference between dollars actually budgeted to competing programs and dollars recommended to be budgeted based on the output generated from the cost-utility analysis. The process of evaluating programs for purposes of resource allocation provided a process for coming to some concensus about the relative worth or value of these educational programs. The Cost-Utility Analysis procedure stimulated the collection of program cost data not previously available to the budget administrator, such a program threshold cost. The discrepancies between the recommended and actual program budget allocations were small enough to justify a more comprehensive application of the program evaluation and budget allocation process. (Author)

Final Report

Project No. 2-C-069
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LeRoy J. Tuscher
Lehigh University
524 Brodhead Avenue
Bethlehem, Pennsylvania 18015

AN EMPIRICAL STUDY OF THE APPLICATION OF A DECISION MAKING MODEL USING JUDGMENT IN THE ALLOCATION OF RESOURCES TO COMPETING EDUCATIONAL PROGRAMS

October 15, 1973

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education

National Center for Educational Research and Development
(Regional Research Program)

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The purpose of the study was to provide "baseline"data for determining the feasibility of further investigation into the use of quantitive judgmental data in evaluating school programs for determining program budget allocations. The specific objectives were to:

1. Apply a Cost-Utility Model to a "real world" situation in a public secondary school.

2. Develop a technique for obtaining dollar values which represent program threshold cost.

3. Measure the judgmental gap - the difference between dollars actually budgeted to competing programs and dollars recommended to be budgeted based on the output generated from the cost-utility analysis.

CONCLUSION

The process of evaluating programs for purposes of resource allocation provided a transparent process for coming to some concensus about the relative worth or value of these educational programs.

The Cost-Utility Analysis procedure stimulated the collection of program cost data not previously available to the budget administrator such as program threshold cost, which previously was unavailable although the project school district has had an operable PPBS accounting system for several years.

The discrepancies between the recommended and actual program budget allocations were small enough to justify a more comprehensive application of the program evaluation and budget allocation process.

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CHAPTER I

INTRODUCTION

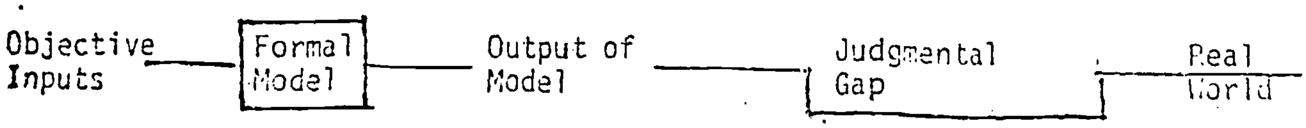
PROBLEM

A vast majority of the educational institutions across the nation are experiencing financial difficulties. There exists a severe limitation on the supply of public funds for education, while the demand for public expenditure for education appears virtually unlimited. Consequently, careful consideration must be given to the budgeting process. Cost-benefit and cost effectiveness techniques applied to educational expenditures have been suggested as useful methodologies in optimally allocating limited resources to maximize the return from the educational investment.

Levin and Shank (1970) describe cost-benefit analysis as "a measurement technique in which the total costs of a given program are compared with the probable total benefits." This technique in practice relies almost exclusively on quantifiable, tangible events, which limits benefits to be measured primarily in terms of cognitive achievement. In addition inputs and outputs are reduced to quantification in monetary terms. Cost effectiveness analysis is a variation of cost-benefit analysis with the exception that there is less emphasis on estimating dollar return on the educational resource investment and more on correlating alternative monetary allocation to achievement of specified goals. In this sense cost-effectiveness retains output in raw form without converting it to a dollar value. The results of this approach applied to education are often broad generalizations which are difficult to translate to specific programs at individual schools.

However appealing the above approaches may be theoretically, Kaufman (1967) has observed that "before cost-effectiveness and cost-benefit analysis can be used effectively, considerable refinement must be done with respect to the relationship between economic concepts and theory and the institutional (e.g., human, political and social patterns of behavior) framework surrounding education." Levitan (1969) has more than adequately demonstrated the real world considerations of Kaufman's observation by citing that while the Job Corp Program could be fully justified on equitable and moral grounds, the program was terribly vulnerable to profit and loss analysis. One might expect this type of vulnerability to occur frequently when considering expenditures for educational programs. A legitimate explanation is that both cost-benefit and cost-effectiveness analysis fail to consider explicitly the decision maker's judgment of program worth or value. That is, cost-benefit and cost-effectiveness models do not consider intangible, subjective feelings and hunches - both models rely on objective inputs, consequently there is a judgmental gap between the output of these models and the real world. Raiffa (1970) states, "This judgmental gap is often so wide that the analysis does not pass the threshold of relevance, consequently the analysis may be (and all too often is) general."

This phenomena may be depicted as follows:



Tuscher (1971) in an attempt to reduce the judgmental gap between model output and the real world developed a cost-utility model for optimally allocating resources among competing educational programs. Cost-utility analysis is quite similar to cost-effectiveness analysis with the major difference in that cost-utility analysis can consider both quantitative and qualitative determinants of program worth. That is, the decision maker takes into explicit consideration judgments of value when evaluating program utility.

This study is an empirical extension of research completed within the past two and one-half years in the area of cost-utility analysis. The result of which was the development of a mathematical model to evaluate education programs and allocate resources to competing programs based on the judgmental determination of program worth or value (utility).

This study as such is intended to provide "base line" data for further investigation into the use of judgment in the decision making process of allocating a constrained budget to competing educational programs. Appendix A provides the rationale and assumptions underlying the development of the cost-utility model.

OBJECTIVES

1. To apply the (Tuscher) Cost-Utility Model to a real world situation in a public secondary school.

2. To develop a technique for obtaining dollar values which represent program threshold costs. (Threshold cost is minimum dollar expenditure necessary to operate a program).

3. To measure the judgmental gap (the difference between dollars actually budgeted to competing programs and dollars recommended to be budgeted based upon the cost-utility model).

BUDGETING and RESOURCE ALLOCATION

"The quality of management exhibited in school districts throughout the United States is very uneven in terms of technical capabilities . . . One of the most common failure areas center around budgeting and financial administration."[1]

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[1] Merlin C. Duncan, "An Assessment of Accountability: The State of the Art." Educational Technology, Vol. 11 (January, 1971), P. 27.

Educational administrators, however, do not deserve full castigation for these failures. Granted that while some administrators have exhibited poor judgment in the allocation of scarce institutional resources, economists, social scientists and operations analysts have in more cases than not failed to present relevant models amenable to the resolution of the evaluation and budgeting problems experienced by the practicing administrator.

Kraft (1969) states: There is no great shortage of theoretical analysis in the field of cost-benefit and cost-effectiveness analysis, but that relevant empirical material is practically non-existent . . . the result is that, it has been impossible to test numerical hypotheses at the level of the school.

Charles Hitch (1967), Secretary McNamara's Secretary for Systems Analysis comments that:

> Economic analysis is concerned with the allocation of resources. Its basic tenet is to maximize the value the resources used. In business this reduces itself to maximizing profits, because both income and outgo are measured in the same units (dollars). In defense, and, generally, in the public sector <u>we lack a common valuation for objectives and resources.</u>[1] The result is that we have to use one of two weaker maxims: Maximize objectives for given resources, or minimize resources for given objectives.

Optimization decision-making theory has been used extensively by operations analysts in the development of resource allocation models. The concept is intuitively quite simple: Giver a mix of resources, allocate these resources to maximize some index which reflects the utility of some set of goals or objectives. Luce and Raiffa (1937) state this concept more formally as:

> Let X be a generic act in a given set F of feasible sets and let f(x) be a index associated with (appraising) X; then find X in F which yields the maximum (or minimum) index - i.e., f(x) is greater than or equal to f(x) for all X.

Utilizing optimization decision theory concepts, cost-utility analysis assumes either of two general formats:

1. For a specified level of utility the decision-maker seeks to choose from the set of F possible resource alternatives that mix which optimizes the given index of cost, f(x), i.e., which minimizes program costs for a specified level of utility, or

2. For a specified level of costs the decision-maker seeks to choose from the set F of possible resource alternatives that mix which optimizes the index of utility, f(x), i.e. which maximizes the utility for some fixed level of costs.

---

[1](Emphasis added).

Cost-effectiveness, cost-benefit and cost-utility methods have been suggested as a basis for decision-making in education by countless authors in the past decade. A comprehensive analysis of cost-effectiveness methods by Temkin (1970) reveals that:

> Firm theoretical bases for these studies are lacking. Theory in the domain of decision-making, should provide not only a basis for description and explanation, but explicit statements of assumptions underlying the proposed rationale or methodology.

Cost-benefit and cost-utility methods have fared no better in providing the educational decision maker with explicit statements of assumptions upon which the resource allocation model is based.

The educational decision-maker, when optimizing the allocation of resources to programs, is faced with alternative decision sets with respect to a proxmiate measure of the relationship between educational inputs and outputs. Considering the present state of the art, he may choose to characterize this relationship as one of cost versus indirect measurement of the attainment of program objectives, such as pupil-teacher ratios, dollar expenditure per pupil, etc., or he may decide to identify this relationship as one of costs versus some comprehensive measure of the attainment of program objectives, such as an approximate measure of program worth or value (utility).

Robert N. Anthony (1965) in Planning and Control Systems: A Framework for Analysis writes that every budgetary system comprises three processes, and that while these processes are not always distinguishable operationally they may be identified as follows:

> Planning involves the determination of objectives, the evaluation of actions and the authorization of select programs.
>
> Management involves the programming of approved goals into specific programs, the design of organizational units to carry out approved programs and the staffing of these units and the procurement of necessary resources.
>
> Control refers to the process of binding operating officials to the policies and plans set forth by their superiors.

Schick (1966) utilizing Anthony's conceptual framework in a longitudinal study of budgetary reform in the Federal Government observed that since 1920 these budgetary processes have singulary dominated budgetary practices. Schick notes that the control process predominated in the years from 1920 until 1935. Here the primary concern was to develop systems for expenditure control. Consequently, there followed a demand for trained accountants. The management process was dominate from 1935 until the early 1960's. During this era the management process received prime consideration along with the advent of performance contracting in governmental agencies - an interesting concept which has received considerable attention in American elementary and secondary education.[1]

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[1] "Performance Contracting," Phi Delta Kappan, Vol. 52, No. 7 (1971).

In the third and present era, the planning era, we see a major emphasis in the integration of budgeting and planning as typified by the introduction of PPB in all agencies of the federal government. The planning stage has been influenced by the following trends, Schick (1966):

a. Economic analysis has had an increasing role in shaping fiscal and budgetary policy.

b. New informational and decision-making techniques have enlarged the applicability of objective analysis to policy making.

c. A convergence has gradually occurred between the overall planning process and the budgetary process.

Kopff (1970) relates that the first trend, especially microanalysis, has been the major thrust responsible for cost-utility analysis. This analysis developed initially in efforts by welfare economists to generate a science of public finance. Kopff (1970, p. 72) states:

> Such a science of public finance, predicated on the principle of marginal utility, would furnish objective criteria for determining the optimal allocation of public funds amongst competing uses by appraising the marginal costs and the marginal benefits that would accrue from alternatives, thereby determining the combination which maximized utility.

The second trend, new informational and decision-making techniques, is exemplified by the electronic computer in what Helvey (1971) describes as The Age of Information, and the application of comparatively recent developments in statistical decision theory such as Fishburn's (1964, 1970) Value and Decision Theory and Utility for Decision Making and Chernoff's (1959) Elementary Decision Theory.

In his dissertation, Charles T. Nephew (1969), examined the fiscal allocation patterns of 119 school districts across ten states to determine and specify any functional relationship between resource inputs and educational outputs (quality). Nephew (1969, p. 61) concludes from his study that "money and the manner in which it is allocated to expenditure sub-categories does have an effect on school output even after the effect of socio-economic background has been accounted for." He further states:

> One can reasonably conclude that local school boards and their staffs must assign priorities to school objectives before allocating the available financial resources to specific categories within the school budget . . . across the board cuts or increases are not the answer.

The setting of priorities for budgeting to competing educational programs is not entirely an objective process. Quite the contrary, it is primarily a judgmental process.

LEVELS OF RESOURCE ALLOCATION

The budgeting process for a local educational agency may be conceptualized as a process of resource allocation reallocation progressing from the macro-organizational level to the micro-organizational level (see fig. 1.0).

The budget constraint at the district (macro) level is primarily determined by political events at the local, state and federal levels. These political events would be exemplified at the local level through bond issues, at the state level through subsidies and the federal government through federal revenue-sharing.

The process by which the freely allocatable portion of the K dollar budget (see fig. 1.0) is allocated to individual buildings or schools is not of primary concern for this study, but only as this process provides a constrained budget for the individual school. It should suffice to say that this can be done in most cases simply on a per pupil dollar allocation formula.

At the third level we are given a constrained budget of k_{ij} dollars to be distributed in some manner to j programs within school i. The basic questions to be answered at this level is "what do we value in education" and how should we allocate the constrained budget so as to maximize some measure of total program worth, i.e., how should we budget the k_{ij} dollars to the competing programs within school i to maximize the total worth (utility) of the j programs?

The allocation of funds to specific programs by the process suggested for level three budgeting provides a budget constraint of k_{ijk} dollars for each of the j programs. At this level we are not so concerned with the value (utility) of a program per se, but given a constrained budget of k_{ijk} dollars for program j, what is the most "effective" mix of resources or the "best" alternative solution to satisfy that program's objectives.

School personnel are continually faced with situations which involve choosing a candidate solution from competing alternatives. Choosing among competing alternatives is essentially a decision process. The nature of the decision process implies a futuristic orientation, one of anticipating consequences of acting on the decision alternatives. Since the educational decision maker must and does make a final choice, it seems apparent that in some way the administrator or teacher must weigh the anticipated consequences against some factors (criteria) to reach a final overriding value assessment that determines his choice. The argument is of course that the decision process involves a high degree of uncertainty and that values and personal judgment play an important part in arriving at an educational budget allocation decision.

A. LEVEL 3 BUDGETING PROCESS (MODEL I)

Model I is referenced from the basic value decision model (see fig. 2.0). In Model I the a_i are programs such as math, science, English, social studies, etc. in which the utility of program i is the sum of weighted utilities across the k criteria. That is $U_i = \sum_k U_{ik} W_k$.

Level #	Accountability Level (Personnel)	Budget Allocation Level	Paradigm	Level of Competition	Constrained Budget
1.	Superintendent of Schools	District	District	District competes with other social institutions or agencies for the tax dollar	$K
2.	Building	School level	School 1, School 2, School 3	Schools within district compete for "fair share" of district constrained budget.	k_i $\sum_i k^i = K$
3.	Dept. Chairman or Area coordinator	Program Level	Program 1 Program 2 ⋮ Program j	Programs within school compete for "fair share" of school constrained budget.	k_{ij} $\sum_j k_{ij} = k_i$
4.	Individual Teacher	Resource Level	Supplies & Materials A/V Textbook etc. Program P_j	Resources and/or alternatives compete within programs for "fair share" of program constrained budget.	K_{ijk} $\sum_k K_{ijk} = k_{ij}$

Fig. 1.0 - Budget Allocation Reallocation

The process of allocating expenditures to educational programs to maximize the composite total utility (total program worth) can begin once the programs have been evaluated and the constrained budget and individual program threshold costs have been determined. An interactive computer program has been written which can be used by the decision maker to evaluate programs and allocate expenditures to programs which will maximize total program worth. The algorithm to maximize total program worth is based on optimization theory using the Lagrange Multiplier Technique and recursion methods.

In order to allocate limited resources among competing programs based on the utility of these programs, it is necessary first to establish a functional relationship between the utility of a program and the cost of each program at various levels of cost. The utility of a program is defined as a real valued number which expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective. It is assumed that the evaluator's judgment or preference takes into consideration both qualitative and quantitative factors. The amount of money or resources allocated to a given program will depend on the degree to which that program satisfies a given set of criteria or objectives. It is observed from the above discussion that utility is a function of level of expenditure and some set of criteria or objectives.

A number of relationships between utility and level of expenditure become immediately obvious, which will enable us to determine a relatively good approximation of the cost-utility curve, and subsequently a functional relationship between program expenditure and program utility. These relationships or underlying assumptions are:

1. A program allocated zero resources has zero utility for any set of criteria or objectives.

2. The utility of a program increases as it's level of expenditure increases.

3. There is a minimum level of program expenditure (threshold level) which must be allocated to a given program if it is to operate at all. Corresponding to this threshold level of program expenditure is a minimum level of acceptable utility. A utility value below this level implies a non-operable level of program expenditure.

4. The utility of a program does not increase indefinitely as it is allocated greater and greater expenditure levels. This seems to be a reasonable assumption. For example, it is very doubtful that if teachers salaries were doubled, the value or worth (utility) of the program would also double. This is, beyond the threshold level of utility the marginal utility decreases as the expenditure level increases. In an economic context this assumption means that small allocations lead to essentially zero returns, while large ones have a saturation effect, the "law of diminishing returns."

RESOURCE ALLOCATION (MODEL I)

The results of the previous sections have provided a functional relationship between the utility, $U_i(x_i)$, and the level of expenditure, x_i, for any program i, i - 1, 2, . . . L. That is, given Program Threshold cost, C_i, i = 1, 2, . . . L, and the corresponding values $U_i(x_i)$, i = 1, 2, . . ., L derived by methods outlined in the evaluation model, it is assumed that $U_i(x_i)$ and x_i are functionally related by the logrithmic function:

$$U_i(x_i) = U_i e^{-\beta_i/x_i}, \text{ where } \beta_i = 2C_i$$

The problem now is to find the values x_i, i = 1, 2, . . . L. constrained by N dollars allocated amongst L programs such that $\sum_{i=1}^{L} x_i = N$ and the sum, $\sum_{i=1}^{L} U_i(x_i)$, is maximized, i.e.,

$$\text{MAX:} \quad \sum_{i=1}^{L} U_i(x_i) \qquad (1)$$

$$\text{S.T.:} \quad N \qquad (2)$$

For example, consider the case where L = 2. By the method of Lagrange multipliers, a general method for finding an extreme value (maximum or minimum) of a function subject to one or more constraints,

$$F(x_i, x_2, \lambda) = \sum_{i=1}^{2} U_i e^{-\beta_i/x_i} + \lambda\left(\sum_{i=1}^{2} x_i - N\right).$$

Sample output from the expenditure allocation algorithm would appear as follows:

Program	Expenditure	Utility
Math	\$10,200	18.7
Science	9,800	16.4
English	8,300	9.3
Social Studies	8,700	10.6
Total	\$37,000	55.0

LEVEL 4 BUDGETING PROCESS (MODEL II)

After the budget constraints for programs within a school are determined, the decision maker is faced with choosing the "best" mix of alternative resources consistent with some identified decision criteria.

In this situation we are concerned with identifying an objective function which combines information concerning the utility of outcomes (see fig. 3.0) and the probability of outcomes (see fig. 4.0) into an estimate of expected utility, assuming the decision role is to maximize expected utility.

ALTERNATIVES

	a_1	a_2		a_j	
C_1	$U(C_1)_1$	$U(C_1)_2$		$U(C_1)_j$	
C_2	$U(C_2)_1$	$U(C_2)_2$	$U(C_i)_j$ = utility of C_i given a_j $U(C_1)_j$ . . . C_{ij}	$U(C_2)_j$	
C_i	$U(C_i)_1$	$U(C_i)_2$		$U(C_i)_j$	

Fig. 3.0 Matrix of Utility Function $U(C_i)_j$

ALTERNATIVES

Criteria

	a_1	a_2		a_j	
C_1	$f(C_1)_1$	$f(C_1)_2$		$f(C_1)_j$	
C_2	$f(C_2)_1$	$f(C_2)_2$		$f(C_2)_j$	
			$f(C_i)_j = f(C_i a_j)$ = estimated probability density function of C_i given a_j		
C_i	$f(C_i)_1$	$f(C_i)_2$		$f(C_i)_j$	

Fig. 4.0 Matrix of Outcome Estimates $f(C_i)_j$

The objective function then becomes:

$$U_j = U \; u(C_i)_j, \; f(C_i)_j$$

where U_j = expected utility associated with alternative a_j

U = functional notation

$U(C_i)_j$ = set of utility estimates

$f(C_i)_j$ = probability density function of criteria estimates

let U_{ij} = the expected utility of C_i given a_j

If C_i is measured on a continuous scale then

$$U_{ij} = \int_{-\infty}^{\infty} U(C_i)_j \; f(C_i)_j \, dC_i$$

and then assuming that the criteria are valuewise independent the expected utility of alternative a_j becomes:

$$U_j = \sum_i \int_{-\infty}^{\infty} U(C_i)_j \; f(C_i)_u \; dC_i.$$

The decision rule is then to choose that alternative which has the greatest expected utility. Model II is related only to a general scheme for allocating educational resources, and is not an intregal part of this investigation.

CHAPTER II

PROCEDURES

I. DESCRIPTION OF ACTIVITIES

This research investigation was undertaken in cooperation with administrative staff and teaching personnel at Pennsbury High School. The Pennsbury School District, located just outside Philadelphia, was one of six school districts in the state of Pennsylvania selected to participate with the Fels Institute of Local and State Government in the development of an Educational PPB System (1965). Consequently, the Pennsbury School District is currently operating with a program accounting system under which each school maintains some autonomy for allocating instructional expenditures by programs. The research activities reported herein were conducted at Pennsbury High School utilizing an approach referred to as Cost-Utility Analysis. Appendix A delineates the rationale and underlying assumptions inherent in the procedures as described in this chapter.

The Cost-Utility Model required that programs competing for resource expenditures be specified along with a set of decision criteria by which the relative value or worth of each program was judged by each of the decision-makers. Subsequently numerical measures (utilities) were assigned to each of the cells in the program - criteria matrix. That is, the decision-makers assigned values to program-criteria combinations. The values assigned represented the potential value or worth of each program with respect to satisfying the specified program criteria (see fig. 5.0)

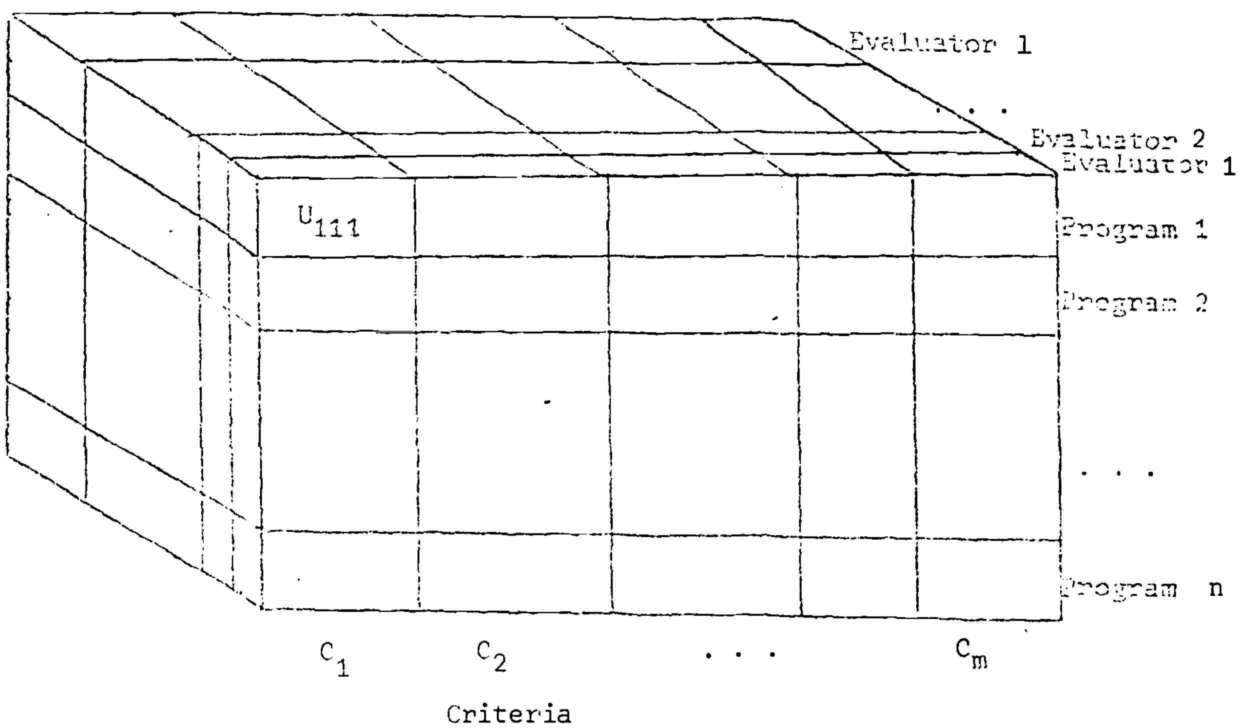


Fig. 5.0

In addition to the above requirements the decision-makers were required to assign relative weights to the criteria identified in the program-criteria matrix.

The numerical values assigned to the cells in the program-criteria matrix were checked for consistency with the decision-maker's judgments by using the Churchman-Ackoff approximate measure of value or worth (see Appendix A, pages A7 - A9).

The activities described above concluded the first part on the program evaluation part of the budgeting process. Before the expenditure allocation process began the constrained budget, program constrained maximum and threshold cost of each program were determined. The constrained budget is the dollar expenditure allocation given to Pennsbury High School by the district office to be allocated among the competing educational programs operating at Pennsbury High School. The program threshold cost is the minimum dollar expenditure required to maintain the current operating program at a status quo level. Any expenditure greater than the threshold cost would mean that the program is experiencing growth in a value-added sense. The program constrained maximum is the dollar value above which a specified program cannot effectively utilize its resources.

The process of allocating expenditures to educational programs to maximize the composite total utility (total program worth) began after the programs had been evaluated and the constrained budget and individual program program threshold costs had been determined. An interactive computer program was utilized to aggregate evaluation data and generate allocation expenditures to programs. The algorithm to maximize total program worth is based on optimization theory using the Lagrange Multiplier Method and recursion methods developed by Newton (for a complete explanation see Appendix A, pages A10 - A13).

II. PROCEDURES

Step 1 - Meet and Discuss Operational Plans

The project director met with administrative personnel of Pennsbury High School during late September, 1972, to discuss and schedule the research activities for the ensuing year. The research activities and time schedule for completing these activities were coordinated to interface with the budget preparation calendar of the Pennsbury School District (see Appendix B for activities and time schedule).

Step 2 - Determine Programs

Programs identified for inclusion in the investigation were selected on the basis of the following practical criteria:

1. Total instructional expenditures in the sub-categories of textbooks, supplies and audio/visual aids for all programs selected should account for at least 75% of total program expenditure as determined from past program expenditure allocations.

2. Only programs whose chairman has agreed to participate will be included in study.

Consistent with the above decision criteria the following programs were selected:

1. Business Education
2. English
3. Language
4. Mathematics
5. Social Studies
6. Science

Step 3 - Identify Decision-Makers

The decision-makers in this study are defined to be:

1. Curriculum chairmen of programs selected for study.
2. Building budget administrator.

Since the curriculum chairmen are in reality competing for a "fair share" of the constrained budget, it is reasonable to assume that their judgment may be biased in favor of their own program. To adjust for the possible bias each program was represented by a single decision-maker, the program chairman. The building budget administrator was included as a decision-maker because he had the responsibility and authority for resource allocation decisions at the building level.

Step 4 - Determine Criteria

The decision-makers met, discussed and defined the criteria upon which the program allocation decisions should be based. The relative worth or value of a program was determined by the degree to which each program was judged to have the potential to contribute to the satisfaction of these predetermined criteria. Each program was then budgeted monies according to its aggregated program worth. The following criteria and accompanying definitions represent a consensus of the decision-makers of those considerations deemed to be important in the program budget allocation decision:

Relevance	The degree to which a program satisfied the social cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.

Step 5 - Assigning Relative Weights to Criteria

The basis for assigning weights to each of the criteria rests with the assumption that the criteria are considered to vary in importance as they relate to budget allocation decision. Each decision maker weighted the criteria according to the following procedures:

1. Rank order the criteria
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representation of your judgment using Churchman-Ackoff Approximate Measure of Value (see Appendix A).

RANK	CRITERIA	IMPORTANCE
1		
2		
3		
4		
5		

EXAMPLE:

1. Rank Order Criteria	Need	40	2. Assign Values Consistent with rank order
	Generality	30	
	Relevance	15	
	Assimilation	10	3. Check for inconsistency
	Urgency	5	

The criteria weights were determined by averaging the importance scores over all evaluators for each criteria and then normalizing the averaged scores. The procedure utilized by the decision makers is detailed in Appendix C.

Step 6 - Determine Budget Constraint,

Program threshold costs and program constrained maximums.

The budget constraint is the dollar expenditure allocated to Pennsbury High School by the district office to be reallocated among the six competing educational programs within the instructional sub-category, textbooks.*

Program threshold cost is the minimum dollar expenditure required to maintain the current program at the status quo level. Any expenditure greater than the threshold cost would mean that the program is experiencing growth in a value-added sense.

Program threshold costs were determined by first examining budget allocation patterns and approved program budget requests in the textbook category during the two previous years (see Appendix D). This historical data provided a baseline from which to zero in on the projected program threshold costs required for this study.

By examining the approved budget requests during the previous year, the budget administrator was able to identify for each program the approved list of textbooks and resource materials. Working from this approved list of textbook and resource materials, the program threshold costs were determined by summing the cost incurred for textbook and materials replacement and the cost for obtaining additional textbooks and materials based on any increase in projected program enrollment. The threshold dollar figure is a guaranteed or minimum level of expenditure allocated to a given program.

Program constrained maximum is a dollar value greater than or equal to the program threshold cost. It is the dollar value above which a specified program cannot effectively utilize its resources.

This value was subjectively determined by the budget administrator. It was determined in part by comparing for each program the previous year's approved budget against demands to exceed that budget allocation.

Step 7 - Assigning Numerical Values (Utilities) to Program-Criteria Matrix.

Each decision-maker evaluated all programs against each criteria according to the following procedure (see Appendix E):

Assign values to each cell of the Program-Criterion Matrices on the last page according to the following:

1. Rank order the program alternatives for the first criterion.
2. Assign a number between 0 and 100 to each program alternative, such that these numbers are consistent with 1.
3. Check for inconsistency between your judgments and the numerical representation of your judgments.

---

*The intent of the original investigated was to use all three of the instructional sub-categories; however, district budgeting policy prohibited the lumping of funds across categories for the resource allocation process. Subsequently, that sub-category which accounted for the largest percentage of the total of all three sub-categories was used in the investigation.

EXAMPLE:

	Relevance		
	English	90	
1. Rank order programs	Social Studies	75	2. Assign Values Consistent with rank order
	Science	70	
	Mathematics	60	

3. Check for inconsistency, if inconsistent, adjust numerical values to obtain consistency with your judgment.

Inconsistency was determined by utilizing the Church-Ackoff procedure for obtaining an approximate measure of worth or value. A composite program-criteria matrix was obtained by averaging score values for each cell across all decision makers. This composite matrix was used to obtain a single measure of program worth by summing the weighted averages for each program.

Step 8 - Optimize Budget Allocations

(see Appendix A, pages A10 - A13)

Step 9 - Determine Judgmental Gap

The judgmental gap was operationally defined to be the difference between dollars actually budgeted to the six competing programs and the dollars recommended to be budgeted based upon the cost-utility model in the instructional sub-category - textbook.

CHAPTER III

RESULTS

The primary purpose of this study was to provide "baseline" data for determining the feasibility of further investigation into the use of quantifying judgment in the decision making process. The specific objectives were to:

1. Apply a Cost-Utility Model to a "real world" situation in a public secondary school.

2. Develop a technique for obtaining dollar values which represent program threshold cost.

3. Measure the judgmental gap - the difference between dollars actually budgeted to competing programs and dollars recommended to be budgeted based on the output generated from the cost-utility analysis.

<u>Objective 1 - Results</u>

The data required as input for the computer generated outcomes were obtained by the procedures delineated in steps two through eight in Chapter II. That is, six programs, Business Education, English, Language, Mathematics, Social Studies and Science were evaluated against the following five criteria (see Appendix F): Relevance, Generality, Assimilation, Urgengy and Need by each of the seven decision makers. In addition the criteria were weighted and the program threshold costs, program constrained maximum and budget constraint were determined (see Appendix D). These data were fed into the computer with the following results being generated:

```
EDUCATIONAL PROGRAM EVALUATION AND BUDGET ALLOCATION

WANT INSTRUCTIONS?
---?YES

THIS PROGRAM ALLOWS UP TO 20 EVALUATORS TO EVALUATE EDUCATIONAL PROGRAMS


ON THE BASIS OF GIVEN CRITERIA AND OBJECTIVES.  UP TO 12 PROGRAMS
AND 12 CRITERIA MAY BE SPECIFIED.

THE USER IS THEN ALLOWED TO WEIGHT THE DIFFERENT CRITERIA,
```

```
NAME YOUR PROGRAMS AND THEN TYPE '*'
---?ENG,SOCST,MATH,SCI,BUSED,LANG *

NAME YOUR CRITERIA AND THEN TYPE '*'
---?REL,GEN,NEED,ASSM,URG*

WILL THE FIRST EVALUATOR PLEASE SIGN IN.
---?CORBETT

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
    ENG        ---?95
    SOCST      ---?80
    MATH       ---?60
    SCI        ---?65
    BUSED      ---?55
    LANG       ---?55

GEN
    ENG        ---?90
    SOCST      ---?75
    MATH       ---?55
    SCI        ---?60
    BUSED      ---?45
    LANG       ---?50

NEED
    ENG        ---?80
    SOCST      ---?75
    MATH       ---?65
    SCI        ---?70
    BUSED      ---?55
    LANG       ---?60

ASSM
    ENG        ---?90
    SOCST      ---?85
    MATH       ---?70
    SCI        ---?80
    BUSED      ---?65
    LANG       ---?60

URG
    ENG        ---?80
    SOCST      ---?75
    MATH       ---?65
    SCI        ---?70
    BUSED      ---?55
    LANG       ---?60

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

```
WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO


WILL THE NEXT EVALUATOR PLEASE SIGN IN.
(TYPE '*' TO TERMINATE THE EVALUATION PROCEDURE.)
---?HOLLIHAN

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
     ENG          ---?95
     SOCST        ---?100
     MATH         ---?80
     SCI          ---?75
     BUSED        ---?60
     LANG         ---?55

GEN
     ENG          ---?100
     SOCST        ---?90
     MATH         ---?65
     SCI          ---?85
     BUSED        ---?50
     LANG         ---?70

NEED
     ENG          ---?60
     SOCST        ---?100
     MATH         ---?70
     SCI          ---?80
     BUSED        ---?90
     LANG         ---?50

ASSM
     ENG          ---?90
     SOCST        ---?95
     MATH         ---?65
     SCI          ---?60
     BUSED        ---?100
     LANG         ---?70

URG
     ENG          ---?75
     SOCST        ---?80
     MATH         ---?55
     SCI          ---?100
     BUSED        ---?95
     LANG         ---?60

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

```
WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO


WILL THE NEXT EVALUATOR PLEASE SIGN IN.
(TYPE '*' TO TERMINATE THE EVALUATION PROCEDURE.)
---?BACHMAN

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
     ENG          ---?100
     SOCST        ---?90
     MATH         ---?70
     SCI          ---?75
     BUSED        ---?80
     LANG         ---?50

GEN
     ENG          ---?100
     SOCST        ---?70
     MATH         ---?95
     SCI          ---?90
     BUSED        ---?80
     LANG         ---?60

NEED
     ENG          ---?100
     SOCST        ---?65
     MATH         ---?90
     SCI          ---?85
     BUSED        ---?70
     LANG         ---?75

ASSM
     ENG          ---?70
     SOCST        ---?85
     MATH         ---?75
     SCI          ---?100
     BUSED        ---?60
     LANG         ---?65

URG
     ENG          ---?90
     SOCST        ---?100
     MATH         ---?65
     SCI          ---?80
     BUSED        ---?70
     LANG         ---?75

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

```
WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO


WILL THE NEXT EVALUATOR PLEASE SIGN IN.
(TYPE '*' TO TERMINATE THE EVALUATION PROCEDURE.)
---?WILLING

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
    ENG         ---?100
    SOCST       ---?95
    MATH        ---?80
    SCI         ---?85
    BUSED       ---?35
    LANG        ---?30

GEN
    ENG         ---?100
    SOCST       ---?60
    MATH        ---?90
    SCI         ---?85
    BUSED       ---?10
    LANG        ---?20

NEED
    ENG         ---?60
    SOCST       ---?70
    MATH        ---?50
    SCI         ---?100
    BUSED       ---?30
    LANG        ---?40

ASSM
    ENG         ---?50
    SOCST       ---?30
    MATH        ---?20
    SCI         ---?100
    BUSED       ---?40
    LANG        ---?30

URG
    ENG         ---?70
    SOCST       ---?80
    MATH        ---?40
    SCI         ---?100
    BUSED       ---?60
    LANG        ---?50

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

```
WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO


WILL THE NEXT EVALUATOR PLEASE SIGN IN.
(TYPE '*' TO TERMINATE THE EVALUATION PROCEDURE.)
---?DOUGHERTY

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
     ENG        ---?90
     SOCST      ---?86
     MATH       ---?80
     SCI        ---?50
     BUSED      ---?100
     LANG       ---?25

GEN
     ENG        ---?100
     SOCST      ---?80
     MATH       ---?95
     SCI        ---?20
     BUSED      ---?15
     LANG       ---?25

NEED
     ENG        ---?95
     SOCST      ---?90
     MATH       ---?80
     SCI        ---?20
     BUSED      ---?15
     LANG       ---?25

ASSM
     ENG        ---?50
     SOCST      ---?80
     MATH       ---?85
     SCI        ---?95
     BUSED      ---?100
     LANG       ---?25

URG
     ENG        ---?100
     SOCST      ---?50
     MATH       ---?95
     SCI        ---?25
     BUSED      ---?90
     LANG       ---?10

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

```
WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO


WILL THE NEXT EVALUATOR PLEASE SIGN IN.
(TYPE '*' TO TERMINATE THE EVALUATION PROCEDURE.)
---?COBB

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
    ENG         ---?100
    SOCST       ---?95
    MATH        ---?10
    SCI         ---?30
    BUSED       ---?90
    LANG        ---?75

GEN
    ENG         ---?100
    SOCST       ---?50
    MATH        ---?20
    SCI         ---?10
    BUSED       ---?40
    LANG        ---?30

NEED
    ENG         ---?100
    SOCST       ---?40
    MATH        ---?10
    SCI         ---?20
    BUSED       ---?50
    LANG        ---?30

ASSM
    ENG         ---?100
    SOCST       ---?30
    MATH        ---?10
    SCI         ---?20
    BUSED       ---?50
    LANG        ---?40

URG
    ENG         ---?100
    SOCST       ---?40
    MATH        ---?10
    SCI         ---?20
    BUSED       ---?50
    LANG        ---?30

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

```
WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO


WILL THE NEXT EVALUATOR PLEASE SIGN IN.
(TYPE '*' TO TERMINATE THE EVALUATION PROCEDURE.)
---?DUANE

YOU WILL BE ASKED TO ASSIGN A UTILITY (0 TO 100) TO EACH PROGRAM
BASED ON EACH OF THE CRITERIA.

REL
     ENG          ---?100
     SOCST        ---?95
     MATH         ---?85
     SCI          ---?80
     BUSED        ---?70
     LANG         ---?60

GEN
     ENG          ---?100
     SOCST        ---?95
     MATH         ---?90
     SCI          ---?85
     BUSED        ---?80
     LANG         ---?70

NEED
     ENG          ---?100
     SOCST        ---?75
     MATH         ---?50
     SCI          ---?95
     BUSED        ---?70
     LANG         ---?40

ASSM
     ENG          ---?50
     SOCST        ---?60
     MATH         ---?70
     SCI          ---?100
     BUSED        ---?95
     LANG         ---?70

URG
     ENG          ---?100
     SOCST        ---?75
     MATH         ---?85
     SCI          ---?90
     BUSED        ---?80
     LANG         ---?60

WANT TO CHECK YOUR UTILITY ASSIGNMENTS FOR CONSISTENCY,
USING THE CHURCHMAN-ACKOFF PROCEDURE?
---?NO
```

WANT A PRINTOUT OF YOUR INDIVIDUAL EVALUATION MATRIX?
---?NO

WANT THE COMPOSITE EVALUATION MATRIX?
---?YES

	REL	GEN	NEED	ASSM
ENG	86.25	98.75	86.88	68.75
SOCST	92.00	76.87	73.75	71.88
MATH	68.75	75.00	58.13	58.13
SCI	67.50	65.00	70.63	81.88
BUSED	70.00	50.00	62.50	75.63
LANG	51.25	49.38	45.00	55.00

	URG
ENG	89.38
SOCST	70.00
MATH	62.50
SCI	71.88
BUSED	72.50
LANG	50.63

WANT THE STANDARD DEVIATION MATRIX?
---?YES

	REL	GEN	NEED	ASSM
ENG	29.02	3.31	16.76	20.27
SOCST	5.96	15.40	16.54	19.52
MATH	23.55	25.00	22.90	25.61
SCI	17.50	30.21	30.56	26.92
BUSED	19.20	26.53	21.51	22.97
LANG	15.36	20.07	15.21	19.20

	URG
ENG	11.84
SOCST	17.85
MATH	25.98
SCI	29.99
BUSED	15.41
LANG	19.44

ASSIGN A WEIGHTING FACTOR BETWEEN 0 AND 100 TO EACH CRITERION
AS THE NAME OF THE CRITERION IS PRINTED OUT.

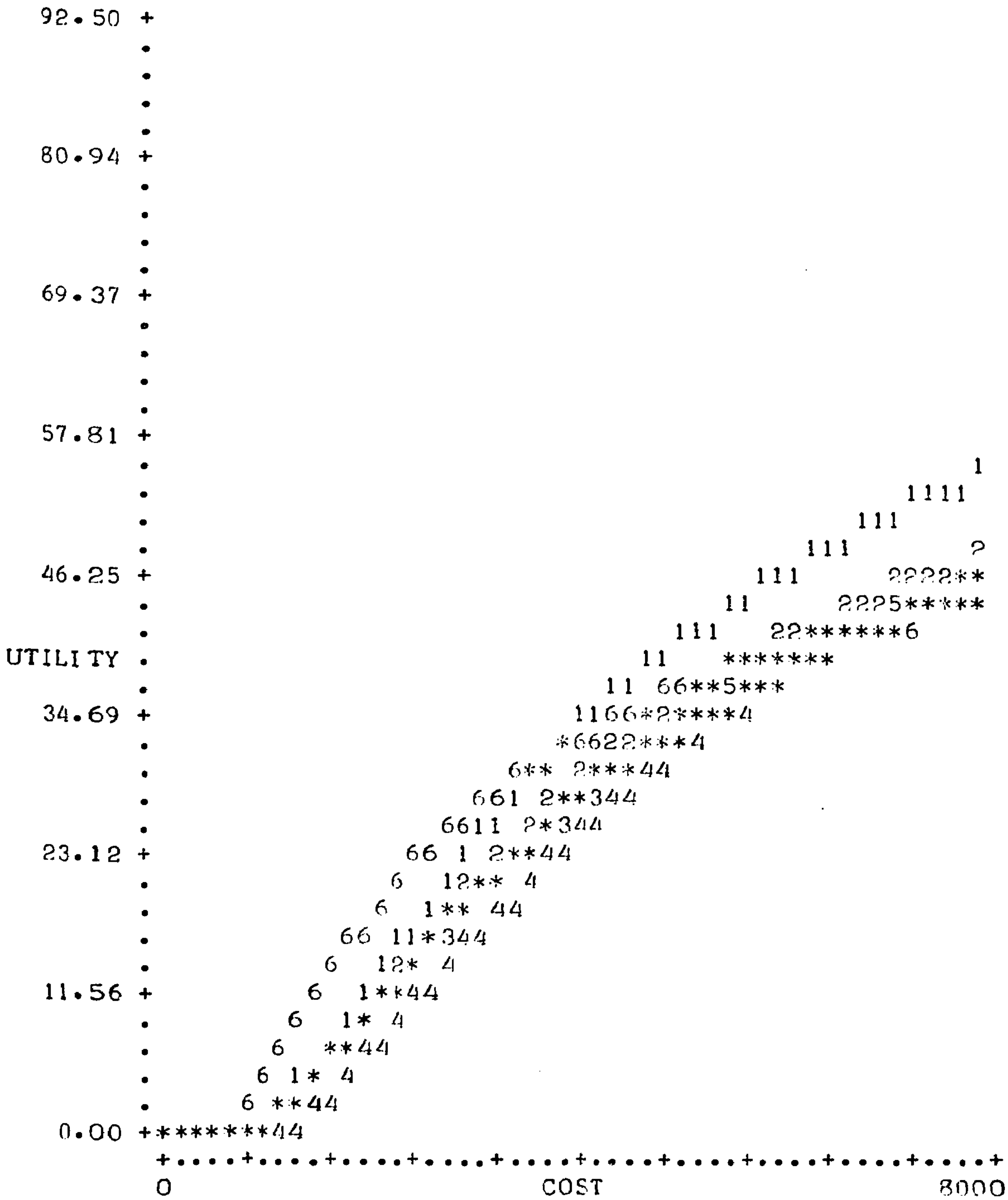
REL ---?28
GEN ---?23
NEED ---?22
ASSM ---?15
URG ---?12

PROGRAM	UTILITY
ENG	92.50
SOCST	81.15
MATH	76.20
SCI	88.65
BUSED	77.25
LANG	60.90

```
ENTER THE THRESHOLD COST (IN DOLLARS) OF EACH PROGRAM
AS THE NAME OF THE PROGRAM IS PRINTED OUT.


ENG         ---?2000
SOCST       ---?2000
MATH        ---?2000
SCI         ---?2500
BUSED       ---?2000
LANG        ---?1200

ENTER THE CONSTRAINED MAXIMUM (IN DOLLARS) FOR EACH PROGRAM
AS THE NAME OF THE PROGRAM IS PRINTED OUT.
(A ZERO VALUE WILL CAUSE THE PROGRAM TO BE OMITTED
FROM THE OPTIMIZATION)


ENG         ---?5000
SOCST       ---?4000
MATH        ---?3000
SCI         ---?5000
BUSED       ---?4000
LANG        ---?1200

YOUR CONSTRAINED MAXIMUM IS LESS THAN OR EQUAL TO
THE THRESHOLD COST FOR THIS PROGRAM.
PLEASE RETYPE THE CONSTRAINED MAXIMUM FOR LANG
---?2000
```

```
WANT A PLOT OF ONE OR MORE OF THE COST-UTILITY CURVES?
---?YES

SPECIFY THE PROGRAMS FOR WHICH YOU WANT THE COST-UTILITY CURVES PLOTTED

AND THEN TYPE '*'.
---?ENG,SOCST,MATH,SCI,PUSED,LANG*

ENTER THE MAXIMUM COST TO BE PLOTTED.
(THIS DEFINES THE RIGHT END-POINT OF THE X-AXIS.)
---?7500


  92.50 +
        .
        .
        .
        .
  80.94 +
        .
        .
        .
        .
  69.37 +
        .
        .
        .
        .
  57.81 +
        .
        .                                                           11
        .                                                        111
        .                                                    1111
  46.25 +                                                 111       222
        .                                               11       2222***
        .                                            111      22******6
UTILITY .                                          11    *******
        .                                        11 66*******4
  34.69 +                                      1*66*2*****4
        .                                    **6 22****44
        .                                  6*   2****44
        .                               66*1 2**344
        .                             66 1 2** 44
  23.12 +                            6 112** 44
        .                          66 1 ** 44
        .                        66  12*344
        .                       6  11** 4
        .                      6  12* 44
  11.56 +                     6  1**44
        .                   66  ** 4
        .                  6  1**44
        .                 6  **44
        .                6 ***4
   0.00 +*********4
         +....+....+....+....+....+....+....+....+....+....+
         0                       COST                    7500
```

```
SPECIFY THE PROGRAMS FOR WHICH YOU WANT THE COST-UTILITY CURVES PLOTTED

AND THEN TYPE '*'.
---?ENG,SOCST,MATH,SCI,BUSED,LANG*

ENTER THE MAXIMUM COST TO BE PLOTTED.
(THIS DEFINES THE RIGHT END-POINT OF THE X-AXIS.)
---?8000
```



```
WANT ANOTHER PLOT?
---?NO

ENTER THE BUDGET CONSTRAINT.
---?22000


OPTIMAL BUDGET ALLOCATION

PROGRAM            COST    UTILITY

ENG              4634.17      39.0
SOCST            4000.00      29.9        CONSTRAINED MAXIMUM
MATH             3000.00      20.1        CONSTRAINED MAXIMUM
SCI              4456.57      28.9
BUSED            3909.25      27.8
LANG             2000.00      18.3        CONSTRAINED MAXIMUM

TOTAL           22000.00     163.9

SELECT AN OPTION OR TYPE 'HELP'
---?STOP
```

Objective 2 - Results

Program threshold cost was defined as the minimum dollar expenditure required to maintain a program at the current operational level. Any expenditure greated than the threshold level would imply that the program is experiencing growth in a value-added sense.

The procedures for obtaining the approximate dollar value representing program threshold levels are discussed under Procedures - Step 6 in Chapter II.

Objective 3 - Results

Objective three was concerned with measuring the discrepancy between dollars actually budgeted to competing programs and dollars reocmmended to be budgeted based on the output generated from the cost-utility analysis (see Table 1.0).

Program Budget Discrepancy

Program	Recommended (Dollars)	Actual (Dollars)	Discrepancy (Dollars)
English	4,634.17	4,500.00	134.17
Social Studies	4,000.00	4,000.00	0
Mathematics	3,000.00	2,500.00	500.00
Science	4,456.57	4,500.00	43.43
Business Education	3,909.25	3,500.00	409.25
Language	2,000.00	1,500.00	500.00
Totals	22,000.00	20,500.00	

Table 1.0

The budget constraint utilized in the cost-utility analysis was $22,000.00, while the budget constraint for actual expenditures wes $20,500.00. This discrepancy of $1,500.00 evolved as a result of the budget administrator allocating $1,500 from the $22,000 to a contingency category after the program budgets had been determined using the cost-utility approach.

CHAPTER IV

Summary and Conclusions

Summary

The study reported herein, as previously indicated, was experimental in nature. The purpose of the study was to provide "baseline" data for determining the feasibility of further investigation into the use of quantitative judgmental data in evaluating school programs for determining program budget allocations.

The Cost-Utility Analysis involved essentially two interrelated processes; program evaluation and program budget allocations. The primary function of the evaluation process was to derive a single valued numerical measure of the asymptotic level of program worth (utility) based on the judgment of preference or worth by several evaluators. Each evaluator rated on a continuous scale from 0 to 100 every program with respect to each of the given criteria. After each evaluator had assigned a value which represented the intensity of program worth to all program-criteria alternatives, his ratings were checked for internal consistency using the Churchman-Ackoff approximate measure of value. If the judgments and ratings were inconsistent, then the evaluator adjusted his ratings to conform to his judgment.

The resource allocation process utilized the composite program utility values derived from the evaluation process, the established program threshold costs and the program constrained maximums to generate optimal program expenditure levels which maximized the utility or worth of all programs.

Conclusion

The process of evaluating programs for purposes of resource allocation provides a transparent process for involving all persons of the school community in coming to some concensus about the relative worth or value of these educational programs.

The Cost-Utility Analysis procedure stimulated the collection of program cost data not previously available to the budget administrator such as program threshold cost, which previously was unavailable although the project school district has had an operable PPBS accounting system for several years.

The discrepancies between the recommended and actual program budget allocations were small enough to justify a more comprehensive application of the program evaluation and budget allocation process.

The procedures and model utilized in this investigation can be categorized as a judgment-based decision system. Fundamental to the decision system, but not directly demonstrable, are two implied axioms:

1. Judgments in a decision system should be fragmented into its least complex elements. This permits judgments to occur at the single element level with the opportunity to allocate judgment responsibility among decision makers.

2. Decision makers can make explicit preference and value judgments. This being contingent upon appropriate scaling techniques and proper training.

The question of validating judgment based decision systems must inevitably be approached. Validation in the classical sense consists of demonstrating the coherence between the output of a system, in this case program budget allocation determined through a cost-utility analysis, and the comparable output of some other system considered to be valid. Here the valid system may be assumed to be the budget administrator. This would appear to be the case in considering a measure of the judgmental gap between the output of the two comparable systems. This would be a valid approach provided the goal of the system was to reproduce the budget administrator's program allocation decisions. To some extent this has been an important consideration in testing th feasibility of the cost-utility analysis study. The importance of the cost-utility analysis is not simply that the results of the two comparable systems are essentially the same, but that the process caused more value to accrue and bear on the final outcome than if the outcome were solely or primarily determined by the budget administrator.

In another sense the system must of its own right be self-validating provided the preference or value judgments can be considered "true values." It is this problem of systems validation in the non-classical sense which needs to be more thoroughly studied and researched.

In conclusion, the Cost-Utility Analysis Process is a transparent process by which programs are evaluated and resources distributed to programs. It can provide school districts with a potentially powerful communication vehicle. Human judgment has prevailed in assessing program worth and in the determination of basic costs. Judgment is what both education and science are all about. The purpose of both these endeavors, as has been the purpose of this study, is the refinement and improvement of human judgment. Judgment lies at the very heart of effective professional decision making. Rejection of the use of judgment for assessing educational outcomes will result in failure to consider the most important aspects of a school's educational goals and objectives.

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APPENDIX A

PROCEDURES

Appendix A is divided in two parts. The first part will consider the theoretical development of the evaluation-resource allocation model, which will serve to allocate limited resources among competing educational programs based on the maximization of total program utility given a budget constraint. More formally this may be stated as:

$$\text{Max} \sum_{i=1}^{L} U_i(x_i),\quad U_i(x_i) = \text{Utility of program } i \text{ at expenditure level } x_i.\ i = 1, 2, \ldots, L.$$

Subject to: N, Budget constraint.

The second part will consider the design of a computerized man-machine system, which can be utilized to facilitate the application of the evaluation-resource allocation model.

Evaluation Model

In order to allocate limited resources among competing programs based on the utility of these programs, it is necessary first to establish a functional relationship between the utility of a program and the cost of each program at various levels of cost. The utility of a program is defined as a real valued number which expresses an evaluator's judgement of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective. It is assumed that the evaluator's judgement or preference takes into consideration both qualitative and quantitative factors.[1] The amount of money or resources allocated to a given program will depend on the degree to which that program satisfies a given set of criteria or objectives. It is observed from the above discussion that utility is a function of level of expenditure and some set of criteria or objectives.

A number of relationships between utility and level of expenditure become immediately obvious, which will enable us to determine a relatively good approximation of the cost-utility curve, and subsequently a functional relationship between program expenditure and program utility. These relationships or underlying assumptions are:

1. A program allocated zero resources has zero utility for any set of criteria or objectives.

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[1] Frank W. Banghart, Educational Systems Analysis (Toronto, Ontario: The Macmillan Company, 1969), p. 208.

2. The utility of a program increases as it's level of expenditure increases.

3. There is a minimum level of program expenditure (threshold level) which must be allocated to a given program if it is to operate at all. Corresponding to this threshold level of program expenditure is a minimum level of acceptable utility. A utility value below this level implies a non-operable level of program expenditure.

4. The utility of a program does not increase indefinitely as it is allocated greater and greater expenditure levels. This seems to be a reasonable assumption. For example, it is very doubtful that if teachers salaries were doubled, the value or worth (utility) of the program would also double. That is, beyond the threshold level of utility the marginal utility decreases as the expenditure level increases. In an economic context this assumption means that small allocations lead to essentially zero returns, while large ones have a saturation effect, the "law of diminishing returns."

It follows from the above assumptions that the cost-utility curve passes through the origin of two dimensional space; lies entirely in the first quadrant; and is asymtotic to some maximum level of utility. The S-shaped curve in figure 7 satisfies all of the above assumptions. By an S-shaped function, we shall mean a non-decreasing function $U(x)$, which is convex in $(0,C_i)$, concave in (C_i,∞) and which is continuous at $x = 0$ and at $x = C_i$. It is also assumed that $U(C) = 0$.

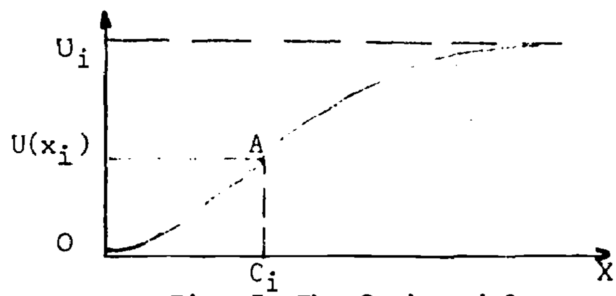

Fig. 7. The S-shaped Curve

Assumption four states that beyond the threshold level of utility, $U(x_i)$, the marginal utility decreases as program expenditure increases. Since the S-shaped curve has an inflection point, A, above which the marginal utility decreases as expenditure increases, let us assign the coordinates of point $A(C_i, U(x_i))$, where C_i is the threshold level of program expenditure and $U(x_i)$ is the threshold level of program utility.

The rationale for assuming that the threshold level of program expenditure falls on the inflection point, A, of the program cost-utility curve follows from economic theory (see figure 7.1).

Figure 7.1(a) represents the typical program cost-utility curve with the inflection point at A. Figure 7.1(b) shows both the marginal utility (MU) and average cost (AC) curve. The MU curve will intersect the AC curve at its maximum value, E. Point C is the point on the cost-utility curve in which the marginal utility per unit cost is so small as to warrant no further finding. Points B and C in Figure 7.1(a) divide the cost-utility curve into three sections, I, II and III. It is observed that the rational decision maker will not operate in either section I or section III, but in section II. In section I, AC is increasing to its maximum. That is, the AC per unit utility is at its highest. In section III the AC is decreasing slowly and then increasing, while the MU per unit cost is approaching zero. The per unit cost produces negligible added utility. The best trade off between average cost and total utility lies in section II.[1]

Now since point A lies just outside and approaches the rational allocation area II, it seems a reasonable assumption that the threshold cost, C_i, be the abscissa of point A.

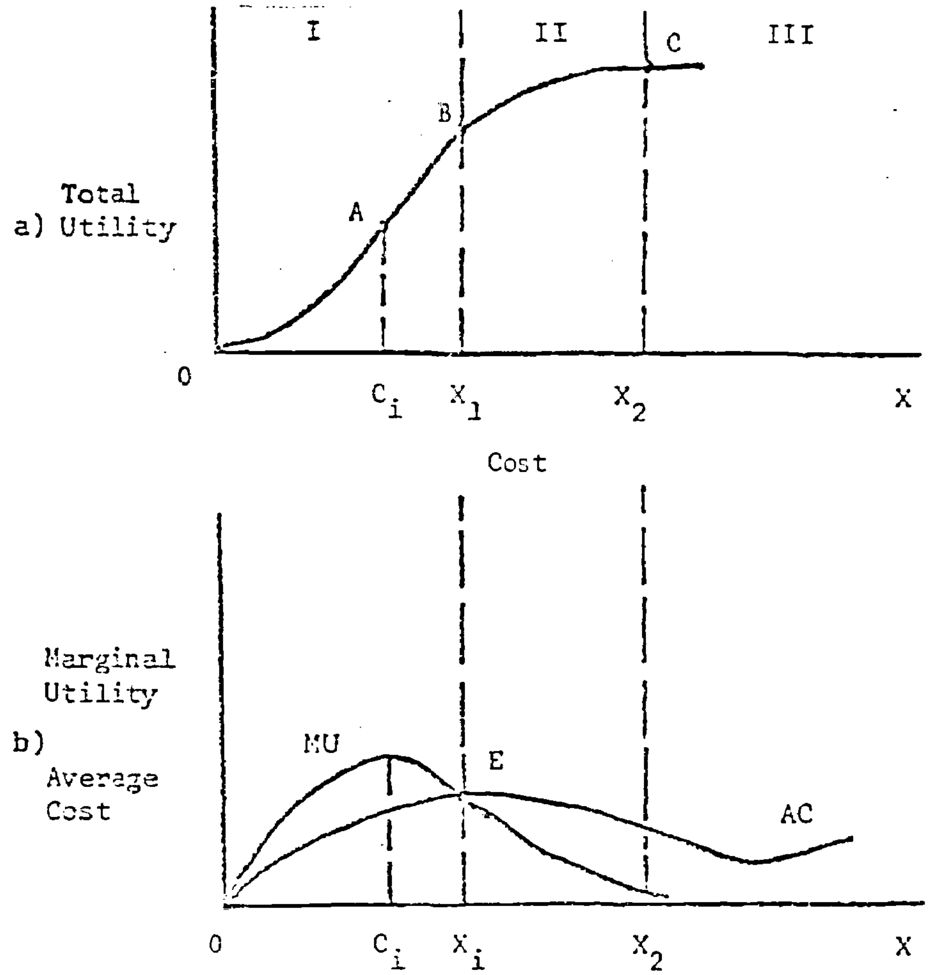

Fig. 7.1. The Relationship Between Student Demand and Threshold Level of Expenditure for Program i

[1]Richard H. Leftwich, The Price System and Resource Allocation (New York: Holt, Rinehart and Winston, 1966), pp. 113-115.

The logarithmic (reciprocal transformation) function gives a very good approximation to the underlying assumptions and S-shaped curve depicted in figure 7. The functional relationship between utility and cost then is as follows (see figure 8).

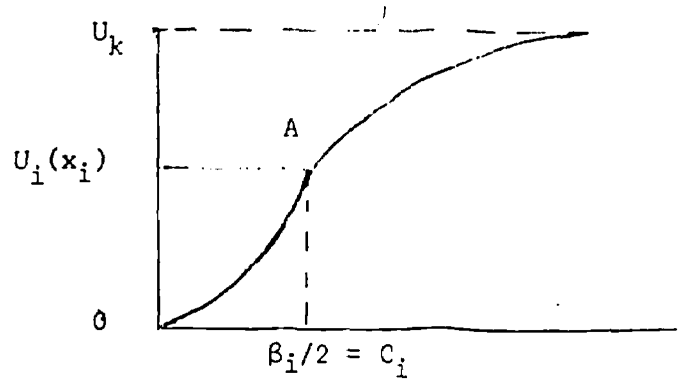

Fig. 8. A Functional Relationship Between Cost and Utility

$U_i(x_i) = U_i e^{\beta_i/x_i}$ = Utility of program i at expenditure level X_i. $i = 1, 2, \ldots, m$. $C_i = x_i = N$.

$\beta_i = 2C_i$, where C_i is the threshold level of expenditure for program i.

U_i = asymptotic level of program worth or value for program i.

$A(C_i, U(x_i))$ = the inflection point on the cost-utility curve.

Aggregating additive utilities

As stated earlier the utility of a program is a function of some set of criteria or objectives. Most allocation decisions will be based on such multi-criteria situations. The problem is one of evaluation. That is, how to obtain single valued comparisons of the utilities of program alternatives when each utility must take into account the contributions of several criteria or objectives. Additive utility theories offer one possible approach to this problem. For example, suppose program utility is a function of the following four criteria; Relevance, Generality, Assimilation and Urgency. Relevance is defined as the degree to which a program has the potential to satisfy the social and cultural goals and objectives of the institution. Generality and Assimilation are economic factors which assess the interrelatedness of all programs. Generality is the degree to which the outputs of a given program are utilized by the other programs, while Assimilation is the degree to which a program utilizes the outputs of the other programs. Urgency is a political criterion which gives explicit recognition to pressure groups in the budgeting process. Now consider the evaluation matrix in figure 9.

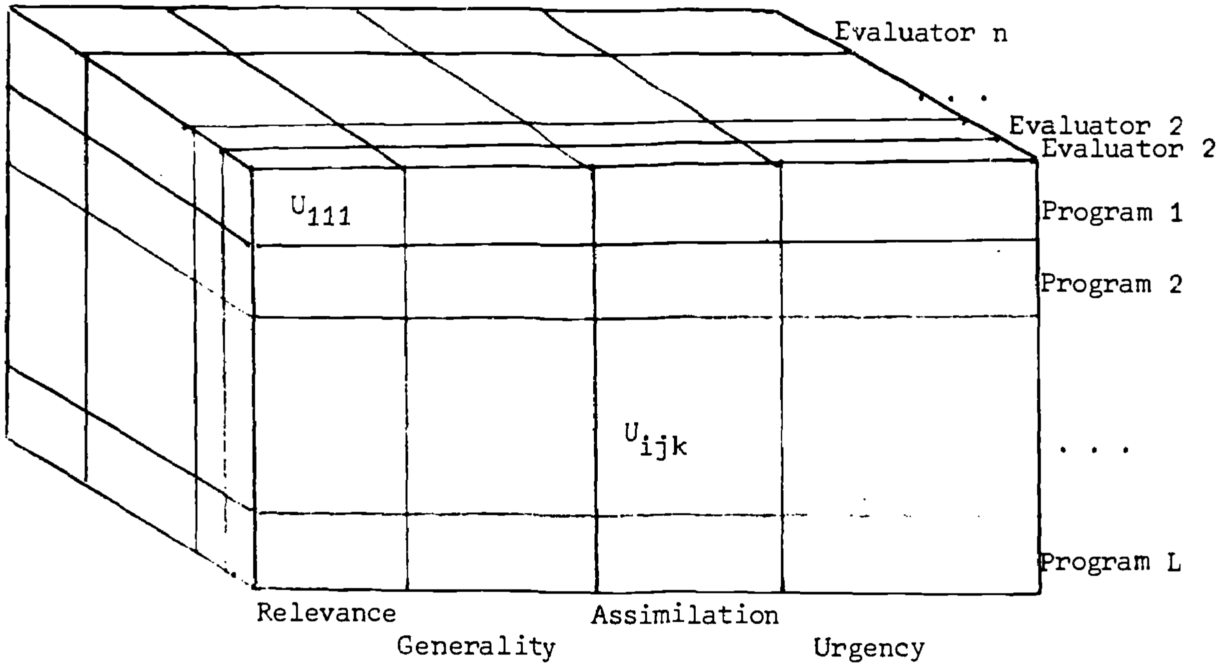

Fig. 9. The Evaluation Matrix

U_i = Asymptotic level of program worth or value.

i = Program
j = Criterion of evaluation
k = Evaluator
L = Number of programs
m = Number of criteria
n = Number of evaluators
w_j = Weight given to criterion j

$$\sum_{j=1}^{m} w_j = 1.$$

For any two programs in a set of alternative programs, if the first program is evaluated to be of greater worth with respect to a given criteria than the second program, then the utility of the first program is greater than the utility of the second program. This follows from Theorem 1:[1]

> A number, U(x), can be assigned to each x in X so that if x and y are in X, then
>
> $$x \quad y \quad \text{iff} \quad U(x) \stackrel{<}{=} U(y).$$

Theorem 1 permits one to go back and forth between judgements of worth or value and utilities, where utility was defined previously to be

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[1] Fishburn, "Utility Theory," p. 344.

a real valued number. This implies that the entries, U_{ijk}, in the evaluation matrix are real valued numbers whose magnitude determines the relative worth of the alternative programs with respect to a given criterion. That is,

U_{ijk} = Utility assigned to criterion j in program i by evaluator k.

If we assume the interpersonal comparability of utility for $n \geq 2$, then

$\sum_{k=1}^{n} U_{ijk}/n$ = Utility assigned to criterion j for program i by n evaluators.

By Theorem 2A, which states:[1]

$$x \quad y \quad \text{iff} \quad \sum_{i=1}^{n} w_i v_i(x_i) \leq \sum_{i=1}^{n} w_i v_i(y_i),$$

it follows that:

1. $\sum_{k=1}^{n} (U_{ijk}/n)w_j$ = Weighted utility assigned to criterion j for program i.

2. $\sum_{j=1}^{m} \sum_{k=1}^{n} (U_{ijk}/n)w_j = U_i$ = Asymptotic level of value or worth for program i.

A methodology has thus been established by which to obtain single valued comparisons of the utility of program alternatives when each utility is an amalgamation of multi-criteria. In addition a rank ordering of program alternatives has been established (Ordinal Utility). This procedure would suffice if we were interested only in selecting that program judged to have the greatest asymptotic level of program utility. This is however, not the case when we are interested in decisions by which to allocate scarce resources among competing educational programs. The resource allocation problem requires at least an interval scaling of program utilities with respect to the given set of criteria or objectives (Cardinal Utility).

An interval scale can be obtained by first assigning an arbitrary point of origin, which shall be designated "0", and an arbitrary unit of measure. The range of the interval scale will arbitrarily have 100 units.

Estimating Additive Utilities

Program evaluation involves the assigning of utilities to program alternatives. These quantitative measures represent the relative worth of program alternatives with respect to a given criterion or objective.

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[1] Fishburn, "Utility Theory," pp. 346-347.

What is required is an efficient and logically consistent methodology for estimating these assigned utilities. Fishburn has classified under four aspects the bases for selecting methodologies for estimating additive utilities.[1] The methodologies for estimating utilities with multi-dimensional criteria in the present evaluation model will consider the following aspects:

1. Non-probabilistic estimation methods.

2. Estimation methods which consider the preference-indifference relation.

3. Estimation methods which evaluate factors (criteria) singly and independent of each other.

4. Estimation methods which consider the levels of each criterion or objective to be continuous.

Prior to assigning individual utilities to program alternatives, decisions must be made which identify and specify programs and criterion to be included in the evaluation matrix as well as the weighting of the criteria and the identification of the evaluators. It is also necessary to determine the threshold levels of program expenditure for each program identified in the evaluation matrix and the budget constraint, N.

The development of this evaluation-resource allocation model will not be concerned with either the specific identification of programs and criteria or the selection of evaluators to be included in the evaluation model. It is suggested that these decisions will be peculiar to a given institution and will be taken as inputs into the evaluation model. Similarly, the threshold levels of program expenditure, C_i, will be assumed as input for the evaluation-resource allocation model.

Once the programs and evaluators have been identified and the threshold levels of program expenditure have been determined, decisions must be made as to which criteria will be included in the evaluation phase. If a single evaluator is involved, he simply identifies the criteria for evaluation and the relative importance (weight) assigned to each criteria. If the selection of criteria and the assigning of weights to criteria are a group decision, the Delphi methodology may be employed to obtain group concensus.[2] Assuming the criteria and weights have been satisfactorily established, each decision maker is now required to establish the relative utility of all programs for each criteria. Each individual decision maker proceeds in the following manner:

1. The first procedural step is to have each individual decision maker rank order the program alternatives against each criteria.

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[1]Fishburn, "Methods of Estimating Additive Utilities," pp. 436-439.

[2]Pill, op.cit., pp. 57-60.

2. Next each individual is asked to assign a number (utility) to each program alternative for each criteria between 0 and 100, such that these numbers are consistent with step one. Step 1 and step 2 may be combined by eliminating step 1 and directly assigning a utility to each program alternative and criteria. It is however, probably easier to assign utilities once the programs are ordered with respect to a given criterion.

3. The third and final step is to check the logical consistency of judgements of worth and value and the numerical representations of these judgements. If there are inconsistencies, then the appropriate utilities are changed to accommodate the appropriate judgement. The methodology judged most suitable for step 3 is the Churchman-Ackoff approximate measure of value.

For example, suppose the following utilities have been assigned to four programs considering only the criterion of Relevance. Assume also the threshold levels of program expenditure had been determined prior to assigning these utilities (see table 1).

INITIAL PROGRAM-CRITERION MATRIX

Criterion	Relevance
Program 1	50
Program 2	10
Program 3	60
Program 4	40

Table 1.

First, the programs are ordered from most relevant to least relevant. The order may be determined from either step 1 or by ordering the numbers in the cells from largest to smallest. It is observed that the programs are ordered with respect to relevance as P_3, P_1, P_4, P_2. Now determine which is more relevant, P_3 or the combination of P_1, P_4, and P_2. If P_3 is more relevant, then the utility assigned to P_3 should be greater than the sum of the utilities assigned to P_1, P_4, and P_2. It is observed that we have an inconsistency since 60 is less than 50+10+40 = 100. Consequently, the utilities for P_1, P_4 and P_2 must be adjusted to conform to the given judgement while maintaining the relative magnitude of their utilities. An appropriate change might be to let $P_1 = 25$, $P_4 = 20$ and $P_2 = 10$. Now the assigned utilities conform with the a priori judegment.

That is, 60 is greater than 25+20+10 = 55.

If on the other hand the combination of P_2, P_4, and P_1 is judged more relevant than P_3, the numbers assigned as in table 1 are consistent since 60 is less than 100. But the check for consistency is not complete. The following test for inconsistency must also be applied.

1. Determine which is more relevant P_3 or P_1 and P_4. Suppose P_1 and P_4 are preferred to P_3. It is seen that the numbers assigned are consistent since 90 is greater than 60. If P_3 was judged more relevant then an adjustment in the assigned utilities must be made.

2. Determine which is more relevant P_1 or P_4 and P_2. Suppose P_4 and P_2. $P_4 + P_2 = 20 + 10$ equals 30 is greater than 25, hence the utilities assigned are consistent.

In summary, suppose the following judgements had been made:

1. $P_1 + P_4 + P_2$ more relevant than P_3.

   Check for consistency:

   Is 50 + 40 + 10 greater than 60? Yes, consistent.

2. $P_1 + P_4$ more relevant than P_3.

   Check for consistency:

   Is 50 + 40 greater than 60? Yes, consistent.

3. $P_4 + P_2$ more relevant than P_1.

   Check for consistency:

   Is 40 + 10 greater than 50? No.

   Change $P_2 = 20$.

FINAL PROGRAM-CRITERION MATRIX

Criterion	Relevance
Program 1	50
Program 2	20
Program 3	60
Program 4	40

Table 2.

Resource Allocation Model

The results of the previous sections have provided a functional relationship between the utility, $U_i(x_i)$, and the level of expenditure, x_i, for an program i, i = 1, 2, . . . L. That is, given C_i, i = 1, 2, . . ., L, and the corresponding values $U_i(x_i)$, i = 1, 2, . . ., L derived by methods outlined in the evaluation model, it is assumed that $U_i(x_i)$ and x_i are functionally related by the logrithmic function.

$$U_i(x_i) = U_i e^{-\beta_i/x_i}.$$

The problem now is to find the values x_i, i = 1, 2, . . .L, constrained by N dollars allocated amongst L programs such that

$\sum_{i=1}^{L} x_i = N$ and the sum, $\sum_{i=1}^{L} U_i(x_i)$, is maximized, i.e.,

$$\text{MAX:} \quad \sum_{i=1}^{L} U_i(x_i) \tag{1}$$

$$\text{S.T.:} \quad N \tag{2}$$

or more completely:

$$\text{MAX:} \quad \sum_{i=1}^{L} U_i e^{-\beta_i/x_i} \tag{3}$$

$$\text{S.T.:} \quad \sum_{i=1}^{L} x_i = N \tag{4}$$

For example, consider the case where L = 1. By the method of Lagrange multipliers, a general method for finding an extreme value (maximum or minimum) of a function subject to one or more constraints.

$$F(x \quad F(x_1,x_2,\lambda), = \sum_{i=1}^{2} U_i e^{-\beta_i/x_i} + \lambda\left(\sum_{i=1}^{2} x_i - N\right).$$ [1]

That is, the objective function, $\sum_{i=1}^{2} U_i(x_i)$ equal $\sum_{i=1}^{2} U_i e^{-i/x_i}$,

and the constraint function, $\sum_{i=1}^{2} x_i$ equal N, are written as a single function, F, using the Lagrange multiplier, λ. The values x_1 and x_2 are then found by finding the global maximum on $F(x_1, x_2, \lambda)$. This is

[1]Samuel B. Richmond, Operations Research for Management Decisions (New York: The Ronald Press Co., 1968), pp. 112-122.

done by taking the partial derivative of F with respect to x_1, x_2, and λ; setting the partial derivatives equal to zero and solving for x_1 and x_2, i.e.,

$$F = \sum_{i=1}^{2} U_i e^{-i/x_i} + \lambda\left(\sum_{i=1}^{2} x_i - N\right), \text{ for } i = 1, 2. \text{ and}$$

$$C_i \leqq x_i \leqq N.$$

Taking the partial derivative of F with respect to x_1, x_2 and λ, we get

$$\frac{\partial F}{\partial x_i} = \frac{\partial}{\partial x_i} \; u_i e^{-\beta_i/x_i} + \lambda = 0.$$

$$= -U_i e^{-\beta_i/x_i}\{-\beta_i/x_u^2\} + \lambda = 0$$

$$= \beta_i/x_u^2 \; U_i e^{-\beta_i/x_i} + \lambda = 0.$$

For i = 1,

$$\frac{\partial F}{\partial x_1} = \beta_1/x_1^2 \; U_1 e^{-\beta_i/x_1} + \lambda = 0. \qquad (5)$$

For i = 2,

$$\frac{\partial F}{\partial x_2} = \beta_2/x_2^2 \; U_2 e^{-\beta_2/x_2} + \lambda = 0, \qquad (6)$$

For λ,

$$\frac{\partial F}{\partial \lambda} + x_1 + x_2 = N \qquad (7)$$

Equations (5), (6), and (7) are respectively equivalent to equations (8), (9) and (10).

$$\beta_1/x_1^2 \; U_1 e^{-\beta_1/x_1} = -\lambda, \qquad (8)$$

$$\beta_2/x_2^2 \; U_2 e^{-\beta_2/x_2} = -\lambda \text{ and} \qquad (9)$$

$$x_1 + x_2 = N \qquad (10)$$

Solving the three equations, (8), (9), and (10), simultaneously, we get

$$\left[\beta_1/(N-x_2)^2\right] U_1 e^{-\beta_1/(x_1-N)} = \left[\beta_1/x_2^2\right] U_2 e^{-\beta_1/x_2}, \tag{11}$$

but this is simply equivalent to

$$\frac{dU_1}{dx_1} = \frac{dU_2}{dx_2}. \tag{12}$$

That is, $\sum_{i=1}^{2} U_i(x_i)$ is maximized when the first derivative of U_1 with respect to x_1 is equal to the first derivative of U_2 with respect to x_2 and $x_1 + x_2$ equal N. This can be interpreted geometrically as follows (see figures 10a and 10b). Consider the cost-utility curves for two programs, P_1 and P_2, figure 10a. In figure 10b, line L, is moved up or down until a + b = N, the budget constraint. It is observed that

$$\frac{du_1}{dx_1} = \frac{du_2}{dx_2} \quad \text{at points A and B.}$$

Consequently, a dollars should be allocated to program P_1 and b dollars should be allocated to program P_2.

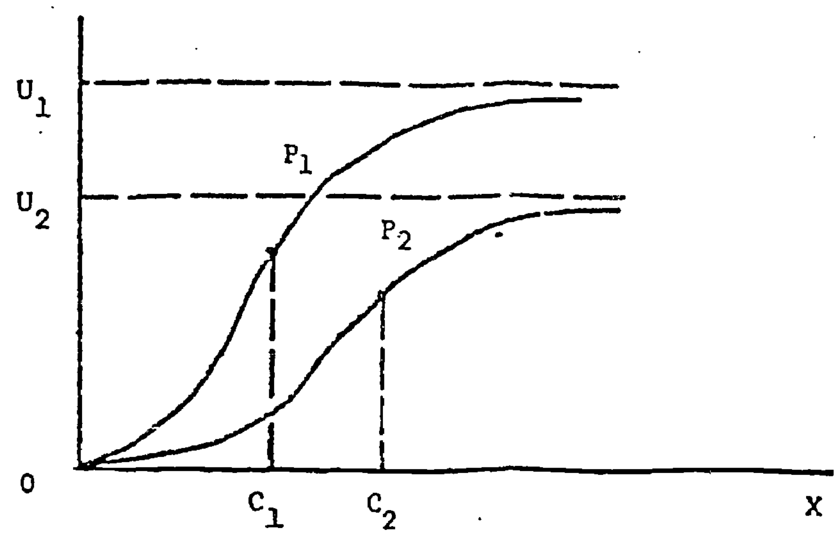

Figure 10a. Program cost-utility curves

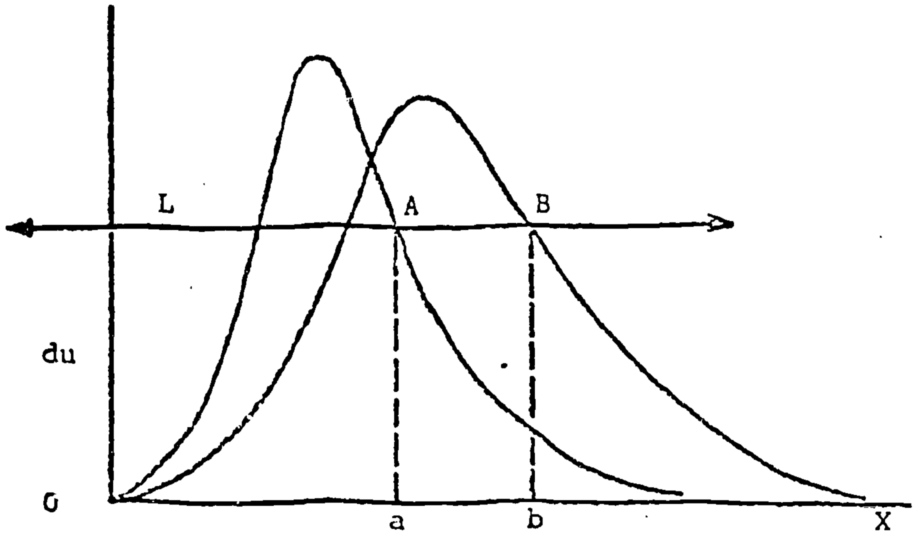

Figure 10b. First Derivative curves of cost-utility functions

Although the optimal solution was derived for only two programs, the theory extends to L programs. In this case the optimal solution will occur when the following two conditions are simultaneously met:

$$\frac{du_1}{dx_1} = \frac{du_2}{dx_2} = \ldots = \frac{du_l}{dx_.}, \text{ for} \qquad (13)$$

$$x_1 + x_2 + \ldots + x_l = N \qquad (14)$$

The technique for optimizing total program utility with the given cost constraints as previously developed assumes that the $\frac{du_i}{dx_i}$ exist such that for i = 1, 2, . . ., L, conditions (13) and (14) can be satisfied. It is observed, however, that situations will occur in which it is impossible to satisfy both (13) and (14). When this incongruity does occur, the procedure is to fund that program i which has the minimum maximum first derivative at its threshold level of program expenditure; subtract C_i from N and maximize total program utility for the remaining L - 1 programs subject to (N - C_i) dollars. For example, suppose we initiate the following optimization problem:

$$\text{MAX: } \sum_{i=1}^{L} U_i(x_i) \text{ for } i = 1, 2, \ldots, L \qquad (15)$$

$$\text{S.T.: } \sum_{i=1}^{L} x_i = N. \qquad (16)$$

If the conditions imposed on the problem are such that (15) and (16) cannot simultaneously be satisfied, then fund that program i whose cost-utility curve has the smallest maximum marginal utility at a level of C_i dollars and proceed as follows:

$$\text{MAX:} \quad \sum_{i-1}^{L-1} U_i(x_i), \text{ for } i = 1, 2, \ldots, L-1 \qquad (17)$$

$$\text{S.T.:} \quad \sum_{i-1}^{L-1} x_i = (N - C_i) \qquad (18)$$

This procedure is iterated until both of the conditions for optimization can be simultaneously satisfied..

This concludes the theoretical considerations for the evaluation-resource allocation model with the exception that there is not an analytic solution to equations (13) and (14), which will provide us with the optimal allocations x_i, $i = 1, 2, \ldots, L$. This, however, is not a serious restriction as the values x_i, may be obtained by recursive methods.[1]

System Design

The entire process of program evaluation and resource-allocation is computerized to allow the decision maker(s) to interact via machine to quickly determine the values of the decision variables. The following subroutines have been programmed to meet the above objective.

Program

The Program subroutine enables the user to enter by name the programs to be evaluated. The maximum number of programs that can be named is 12.

Criteria

This subroutine permits the user to enter by name the criteria against which the program alternatives will be evaluated. The maximum number of criteria that can be named is 12.

Evaluate

The Evaluate subroutine allows each evaluator to enter his assigned utility rating for each criterion for as many programs as will require budgeting. Each of the evaluator's ratings are checked for logical consistency against his preferred judgement using the Churchman-Ackoff method of approximating measures of value. The maximum number of evaluators per routine is 20.

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[1]Ralph H. Pennington, Introductory Computer Methods and Numerical Analysis (Toronto, Ontario: The Macmillan Co., 1970), p, 286.

Weight

The Weight subroutine permits the user to weight each criterion such that the sum of the weights of all criteria is equal to 1. If the user does not wish to weight criteria, it is assumed that all criteria have equal weight.

Threshold

This subroutine requires that the user enter a value, C_i, for each program. C_i is the threshold ecpenditure for program i.

Plot

The Plot subroutine allows the user to print out on terminal a plot of the cost-utility curves for as many programs as desired. The cost-utility curves may be plotted individually or collectively.

Constraint

This subroutine requires the user to specify the budget constraint, N, which will be utilized to maximize total program utility.

Matrix

The Matrix subroutine gives a printout of the optimal expenditures to be budgeted to each program and a corresponding value of program utility. The subroutine also gives a value which represents total program utility. This value is found by summing over the individual utilities which correspond to the budgeted level of expenditure.

Maximum

This subroutine allows the user to place a maximum value on the amount of dollars allocated to any of the named programs.

Restart

The Restart subroutine clears all existing storage units and permits the user to start anew the evaluation-resource allocation process.

Stop

This subroutine allows the user to exit from the evaluation-resource allocation program.

The evaluation-resource allocation on-line system is programmed to allow maximum flexibility for determining the values of the decision output variables. The initial run through the system is linear with the exception of the two printout options, Matrix and Plot. After the initial run, the user has the option of choosing any one of the twelve subroutines contained in the program in order to change any of the systems variables (see Flow diagram of evaluation-resource allocation system on the following page).

Having derived the optimal budget allocations which maximize total program utility, post optimal sensitivity analysis may be performed by calling any of the input subroutines (Weight, Threshold or Constraint); changing the value(s) of the input variables and observing the new optimal program budget allocations.

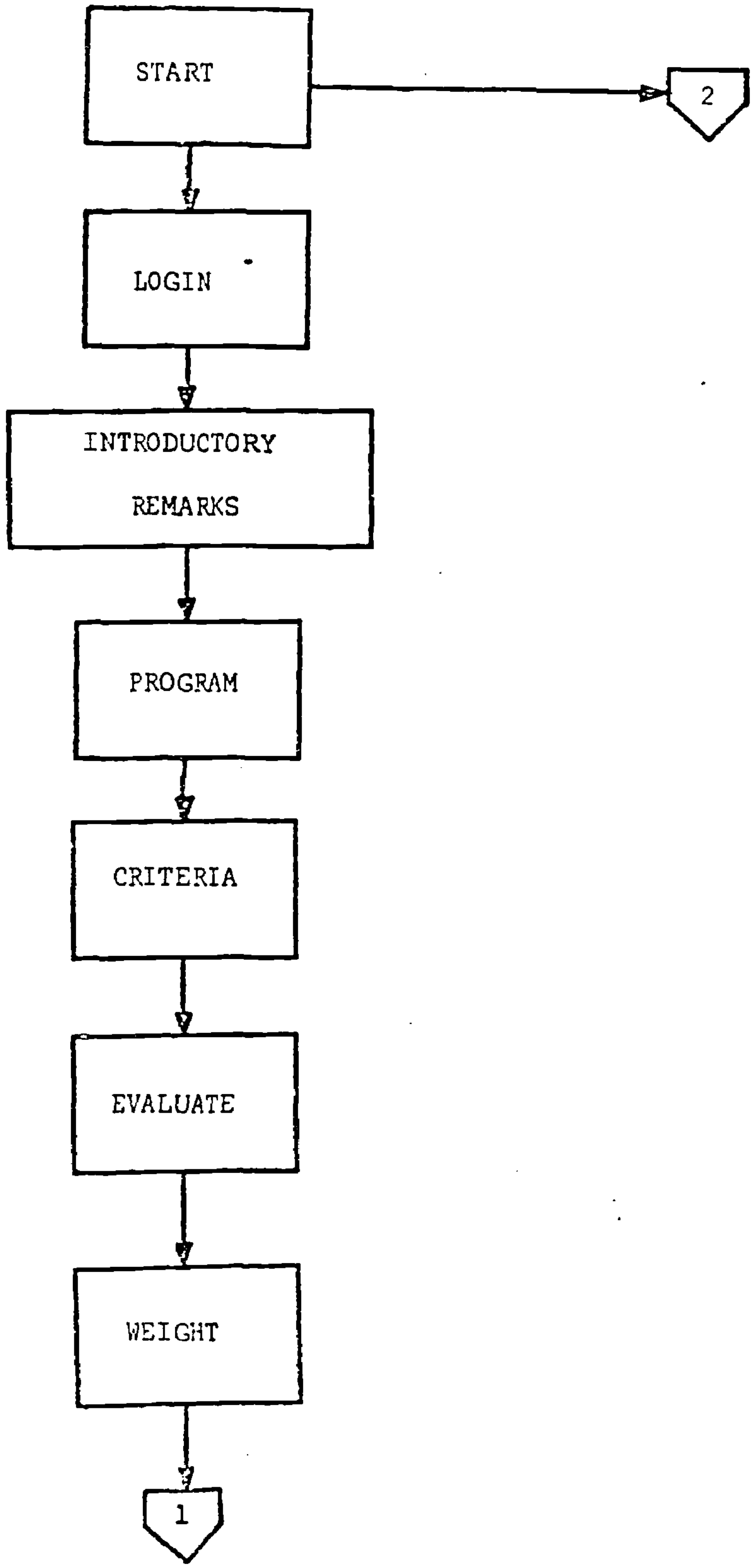

Fig. 11. Flow for Program Evaluation and Budget Allocation

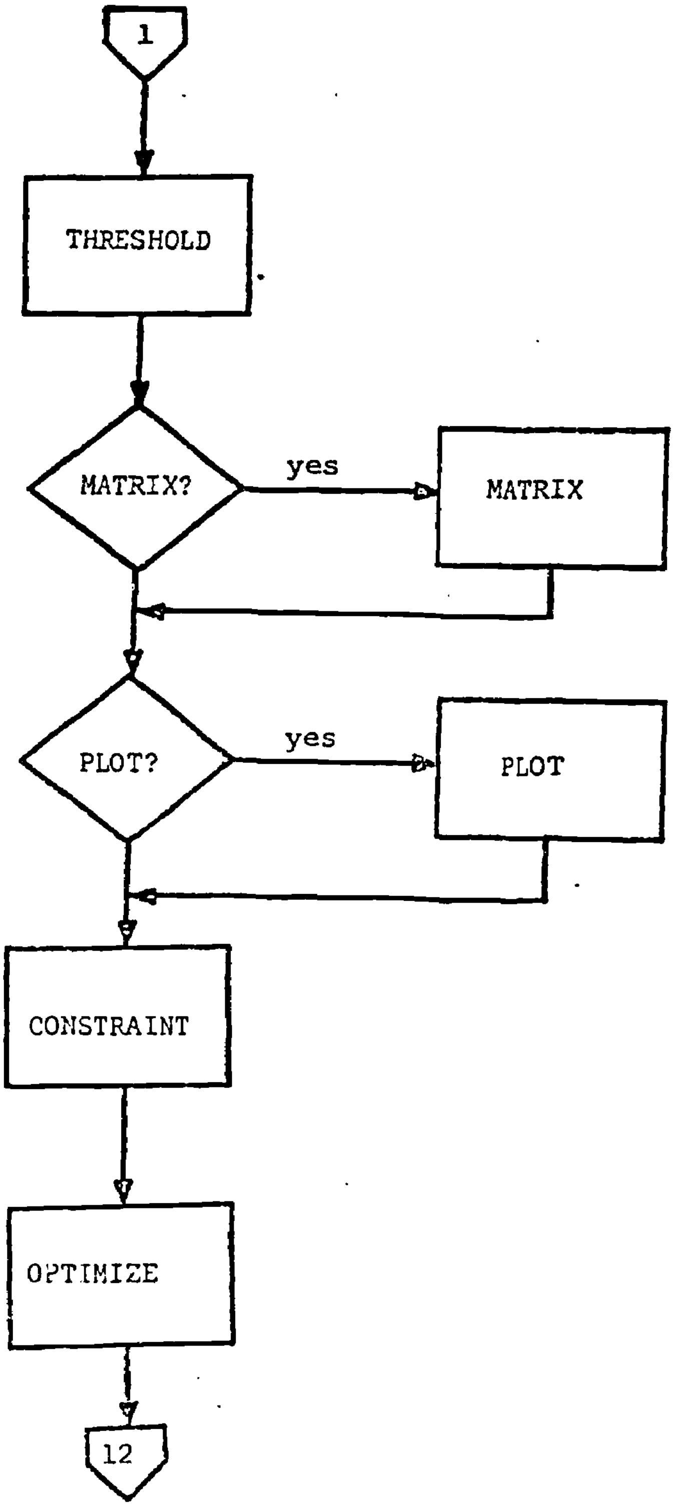

Fig. 11. Continued

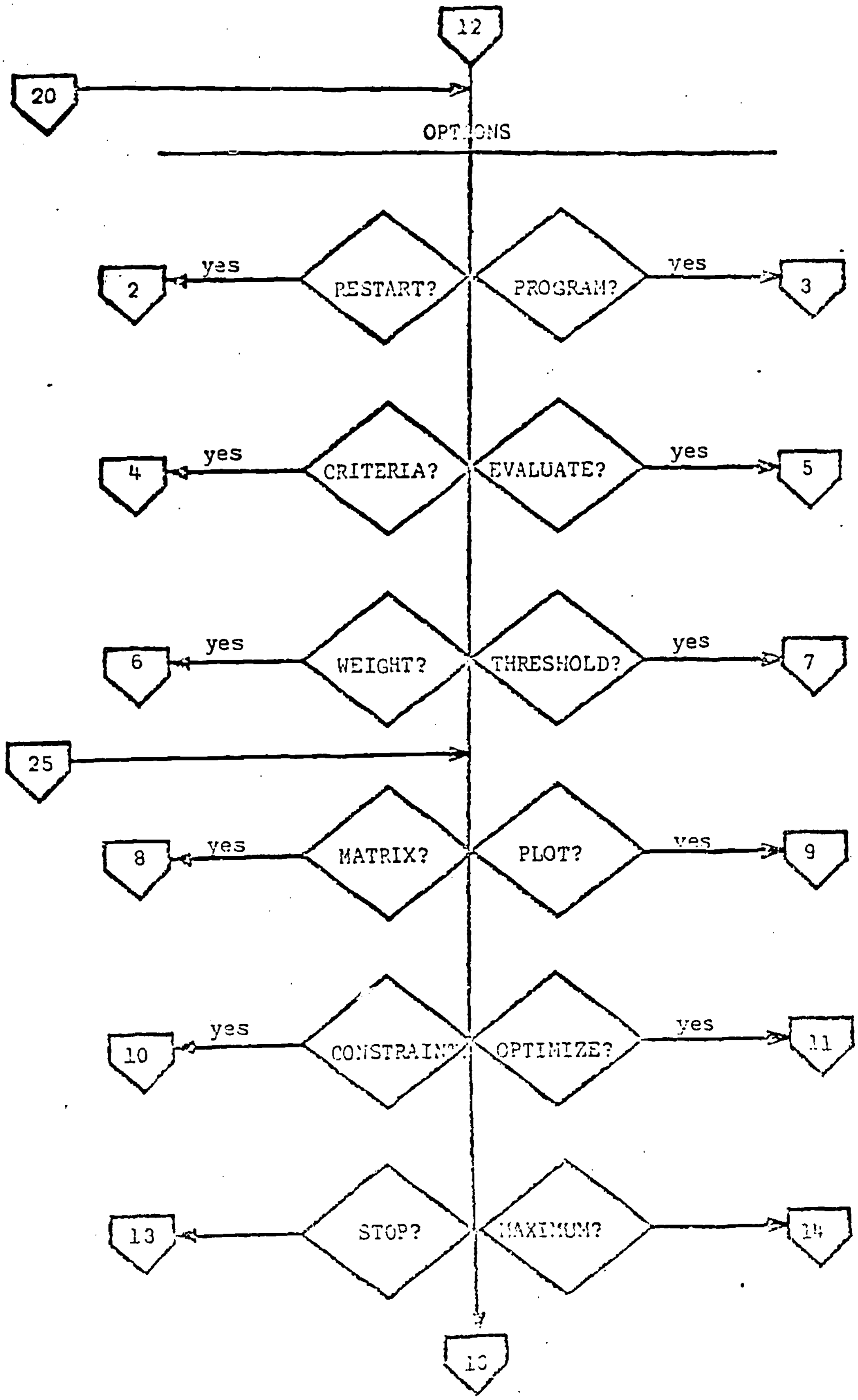

Fig. 11. Continued

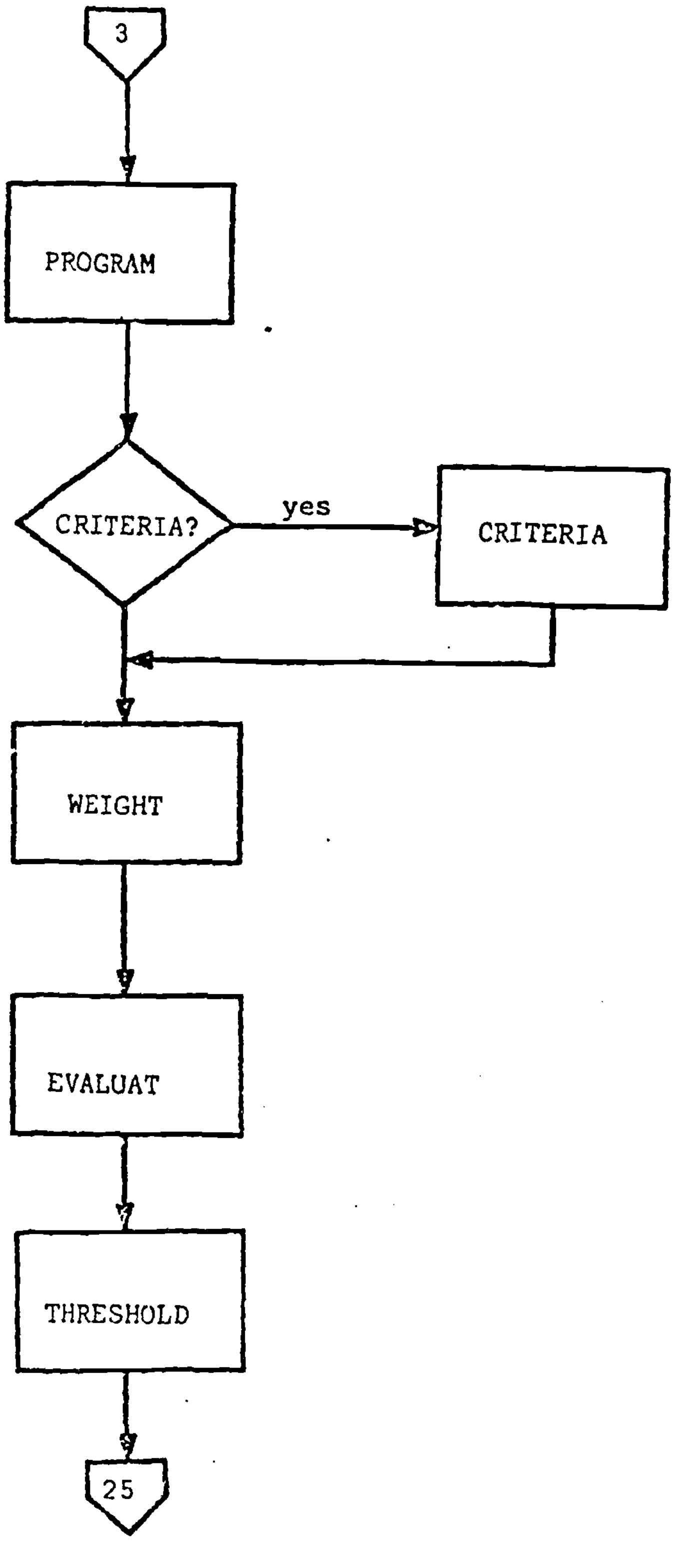

Fig. 11. Continued

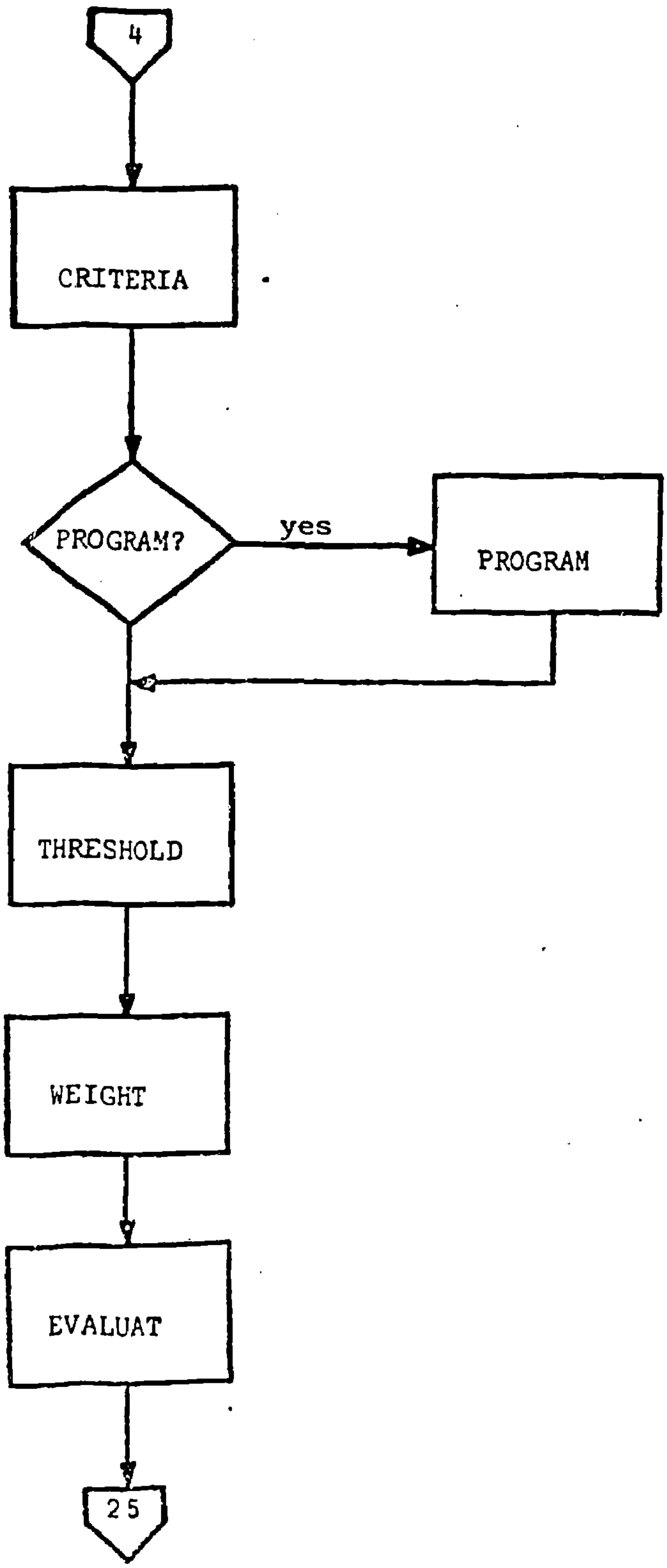

Fig. 11. Continued

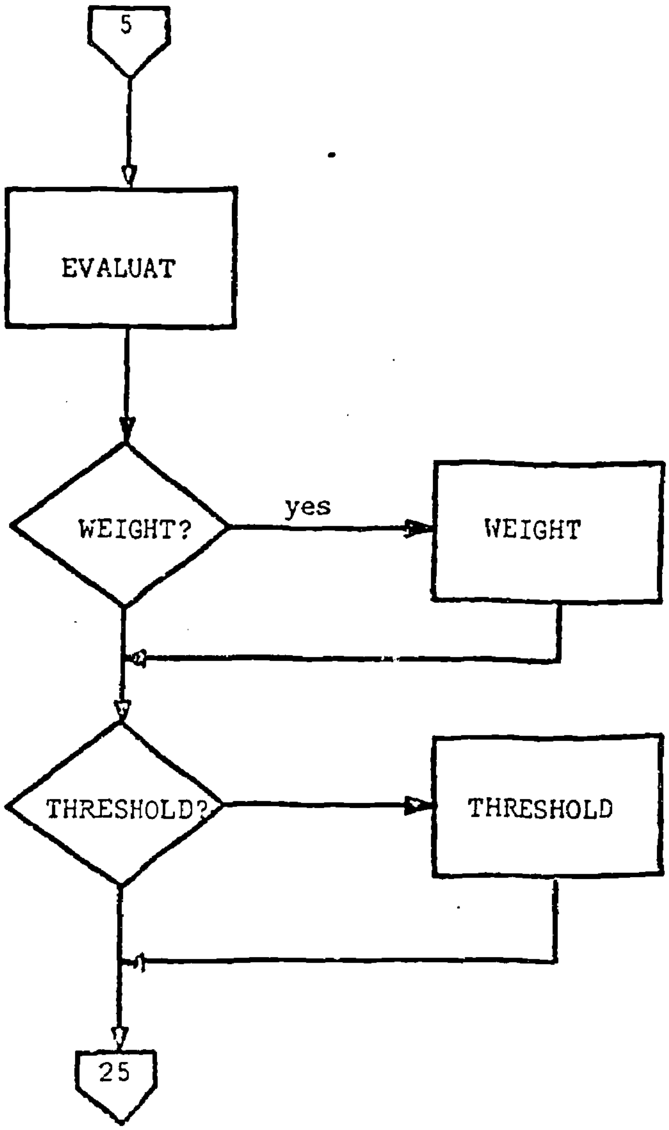

Fig. 11. Continued

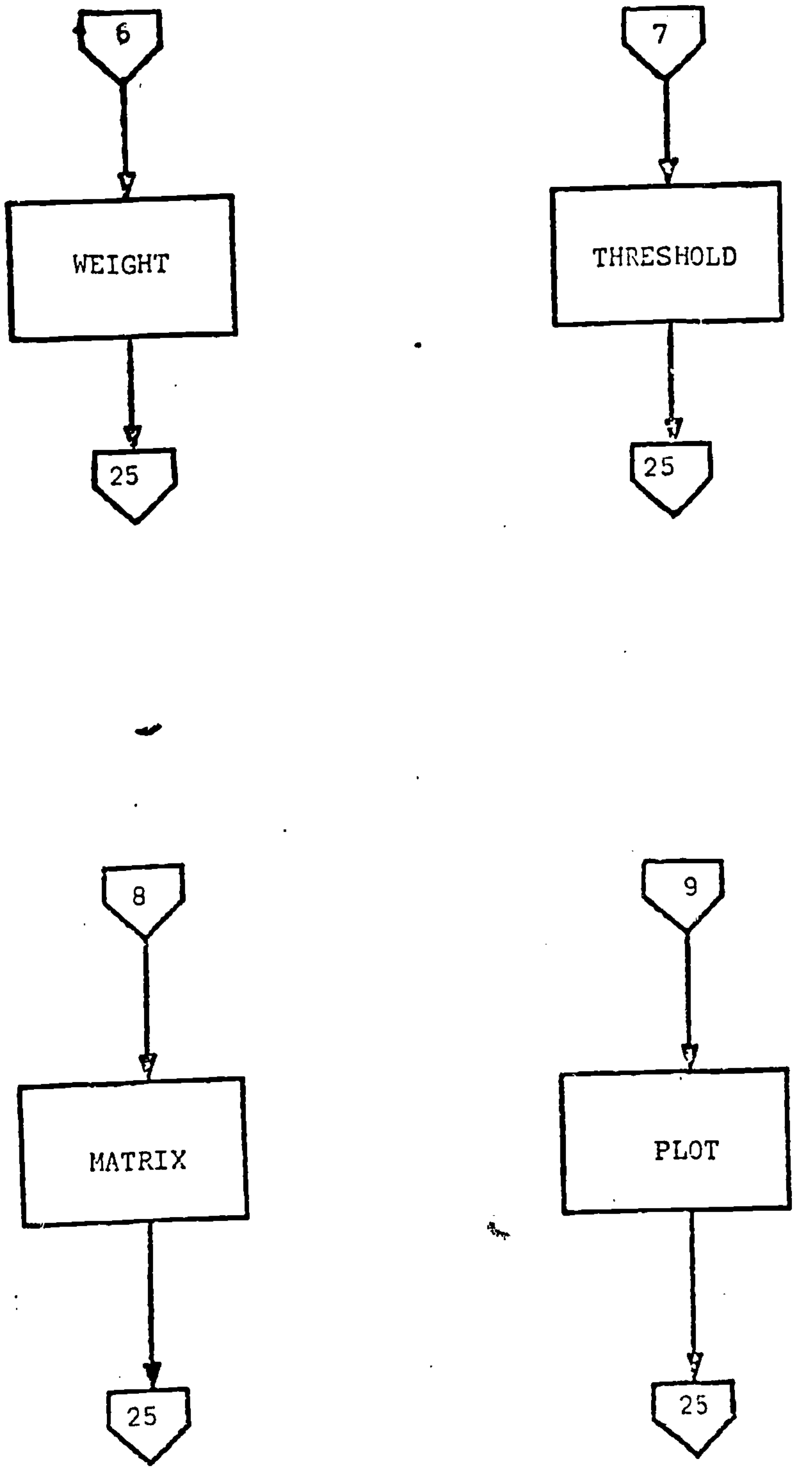

Fig. 11. Continued

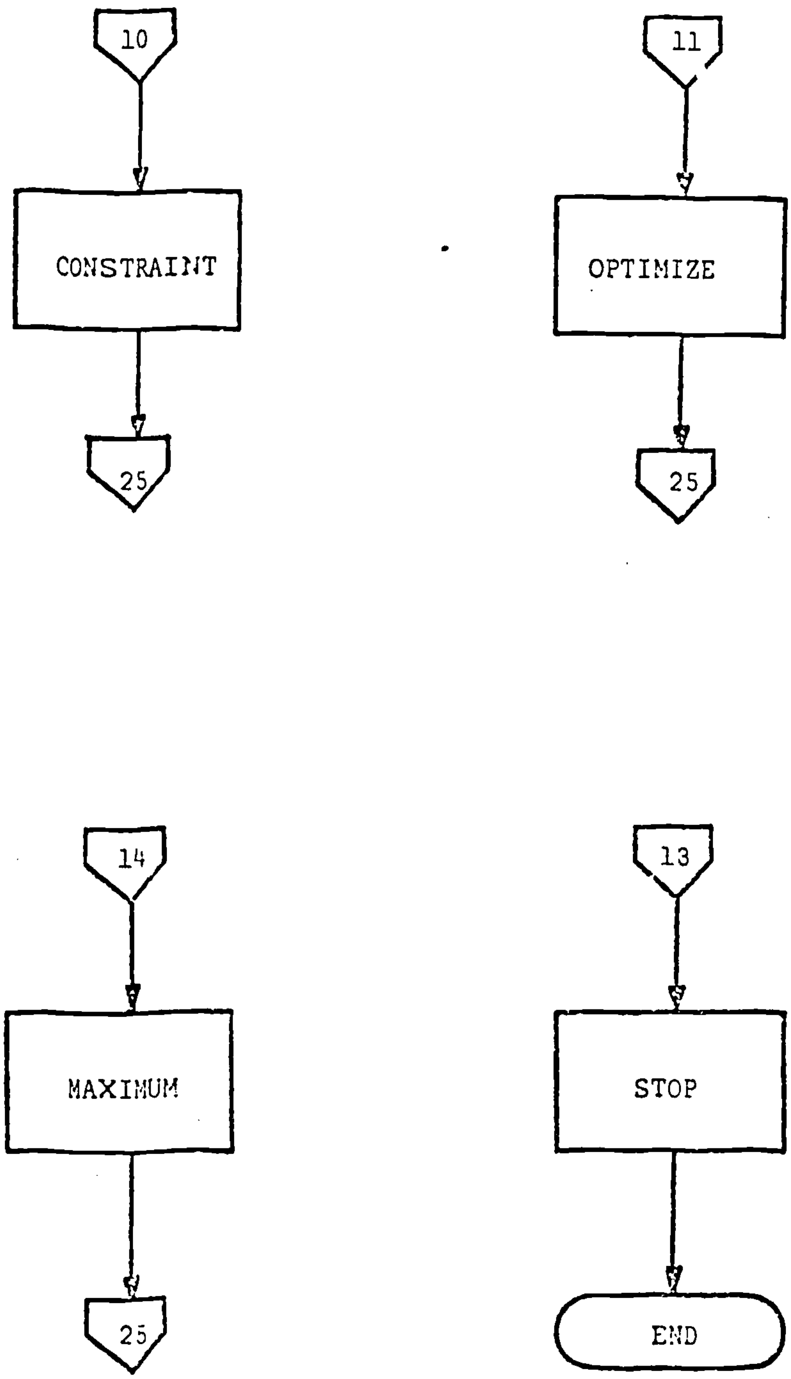

Fig. 11. Continued

APPENDIX B

ACTIVITIES AND TIME SCHEDULE

Activity	Starting Time	Completion Time
1. Meet and discuss operational plans with principal and assistant principal of Pennsbury High School	September 1, 1972	September 15, 1972
2. Make arrangements for installation of a computer terminal at Pennsbury High School	September 1, 1972	September 30, 1972
3. Determine programs	September 16, 1972	September 30, 1972
4. Determine criteria	October 1, 1972	October 15, 1972
5. Determine individual program threshold costs	October 1, 1972	October 31, 1972
6. Make arrangements to tie in with the Lehigh University Computer Network	October 1, 1972	October 31, 1972
7. Assign relative weights to criteria	October 16, 1972	October 31, 1972
8. Determine constrained budget	November 1, 1972	November 15, 1972
9. Have decision-makers assign numerical values to program criteria matrix	November 16, 1972	November 30, 1972
10. Submit data to interactive computer terminal to obtain recommended program expenditure allocations for ensuing year	January 6, 1973	February 25, 1973
11. Have budget administrator determine actual program budget allocation for ensuing year	February 26, 1973	March 15, 1973
12. Determine degree of judgmental gap	March 16, 1973	March 31, 1973

APPENDIX C

ASSIGNING CRITERION WEIGHTS

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district-

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recongition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1		
2		
3		
4		
5		

EXAMPLE:

1. Rank order Criteria

Need	40
Generality	30
Relevance	15
Assimilation	10
Urgency	5

2. Assign values consistent with rank order.

3. Check for inconsistency.

APPENDIX D

All Instructional Categories
(Supplies, Textbooks, Audio Visual Aids)

Program	71-72	72-73	Average
English	4858.27	5412.36	5135.31
Social Studies	5857.57	9635.60	7746.58
Mathematics	1023.11	2006.46	1514.78
Science	8681.13	10,597.76	9639.44
Business Education	6104.20	4615.04	5359.68
Language	1422.54	908.52	1165.53

Instructional Sub-Category
(Textbooks)

Program	*71-72	Enrollment	**73-74	Enrollment
English	3535.10	2438	2000	2384
Social Studies	5559.00	2180	2000	2406
Mathematics	2006.43	1413	2000	1327
Science	4843.40	1275	2500	1420
Business Education	3537.75	1335	2000	1335
Language	908.52	804	1200	658

* Dollar figure represents threshold cost and program growth

** Dollar figure represents threshold cost.

APPENDIX E

ASSIGNING PROGRAM - CRITERION VALUES

We will assume for the purpose of this exercise, that six programs; Business Education, English, Language, Mathematics, Science and Social Studies are to be evaluated against the five criteria; Relevance, Generality, Assimilation, Urgency and Need.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.
Threshold Cost	The minimum level of program expenditure which must be allocated to a given program if it is to operate at all.
Constrained Maximum Maximum	The dollar-value, above which, a specified program cannot effectively utilize its resources.

Program Evaluation Exercise

Assign values to each cell of the Program-Criterion Matrices on the last page according to the following procedure:

(1) Rank order the program alternatives for the first criterion.
(2) Assign a number between 0 and 100 to each program alternative, such that these numbers are consistent with (1).
(3) Check for inconsistency between your judgments and the numerical representation of your judgments.

EXAMPLE:

		Relevance	
	English	90	
1. Rank order programs	Social Studies	75	2. Assign values consistent with rank order
	Science	70	
	Mathematics	60	
			3. Check for inconsistency

PROGRAM - CRITERION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1		
2		
3		
4		
5		
6		

GENERALITY

RANK	PROGRAM	UTILITY
1		
2		
3		
4		
5		
6		

ASSIMILATION

RANK	PROGRAM	UTILITY
1		
2		
3		
4		
5		
6		

URGENCY

RANK	PROGRAM	UTILITY
1		
2		
3		
4		
5		
6		

NEED

RANK	PROGRAM	UTILITY
1		
2		
3		
4		
5		
6		

CURRICULUM CHAIRMAN (ENG.)
PROGRAM - CRITERION MATRIX

APPENDIX F

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	95
2	SOCIAL STUDIES	80
3	SCIENCE	65
4	MATH	60
5	LANGUAGE	55
6	BUSINESS EDUCATION	55

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	90
2	SOCIAL STUDIES	75
3	SCIENCE	60
4	MATH	55
5	LANGUAGE	50
6	BUSINESS EDUCATION	45

ASSIMILATION

RANK	PROGRAM	UTILITY
1	ENGLISH	90
2	SOCIAL STUDIES	85
3	SCIENCE	80
4	MATH	70
5	BUSINESS EDUCATION	65
6	LANGUAGE	60

URGENCY

RANK	PROGRAM	UTILITY
1	ENGLISH	80
2	SOCIAL STUDIES	75
3	SCIENCE	70
4	MATH	65
5	LANGUAGE	60
6	BUSINESS EDUCATION	55

NEED

RANK	PROGRAM	UTILITY
1	ENGLISH	80
2	SOCIAL STUDIES	75
3	SCIENCE	70
4	MATH	65
5	LANGUAGE	60
6	BUSINESS EDUCATION	55

CURRICULUM CHAIRMAN (S.S.)
PROGRAM - CRITERION MATRIX.

RELEVANCE

RANK	PROGRAM	UTILITY
1	SOCIAL STUDIES	100
2	ENGLISH	95
3	MATH	80
4	SCIENCE	75
5	BUSINESS EDUCATION	60
6	LANGUAGE	55

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	90
3	SCIENCE	85
4	LANGUAGE	70
5	MATH	65
6	BUSINESS EDUCATION	50

ASSIMILATION

RANK	PROGRAM	UTILITY
1	BUSINESS	100
2	SOCIAL STUDIES	95
3	ENGLISH	90
4	LANGUAGE	70
5	MATH	65
6	SCIENCE	60

URGENCY

RANK	PROGRAM	UTILITY
1	SCIENCE	100
2	BUSINESS EDUCATION	95
3	SOCIAL STUDIES	80
4	ENGLISH	75
5	LANGUAGE	60
6	MATH	55

NEED

RANK	PROGRAM	UTILITY
1	SOCIAL STUDIES	100
2	BUSINESS EDUCATION	90
3	SCIENCE	80
4	MATH	70
5	ENGLISH	60
6	LANGUAGE	50

CURRICULUM CHAIRMAN (M)
PROGRAM - CRITERION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	90
3	BUSINESS EDUCATION	80
4	SCIENCE	75
5	MATH	70
6	LANGUAGE	50

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	MATH	95
3	SCIENCE	90
4	BUSINESS EDUCATION	80
5	SOCIAL STUDIES	70
6	LANGUAGE	60

ASSIMILATION

RANK	PROGRAM	UTILITY
1	SCIENCE	100
2	SOCIAL STUDIES	85
3	MATH	75
4	ENGLISH	70
5	LANGUAGE	65
6	BUSINESS EDUCATION	60

URGENCY

RANK	PROGRAM	UTILITY
1	SOCIAL STUDIES	100
2	ENGLISH	90
3	SCIENCE	80
4	LANGUAGE	75
5	BUSINESS EDUCATION	70
6	MATH	65

NEED

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	MATH	90
3	SCIENCE	85
4	LANGUAGE	75
5	BUSINESS EDUCATION	70
6	SOCIAL STUDIES	65

CURRICULUM CHAIRMAN (SCI.)
PROGRAM - CRITERION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	95
3	SCIENCE	85
4	MATH	80
5	BUSINESS EDUCATION	35
6	LANGUAGE	30

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	MATH	90
3	SCIENCE	85
4	SOCIAL STUDIES	60
5	LANGUAGE	20
6	BUSINESS EDUCATION	10

ASSIMILATION

RANK	PROGRAM	UTILITY
1	SCIENCE	100
2	SOCIAL STUDIES	80
3	ENGLISH	50
4	BUSINESS EDUCATION	40
5	LANGUAGE	30
6	MATH	20

URGENCY

RANK	PROGRAM	UTILITY
1	SCIENCE	100
2	SOCIAL STUDIES	80
3	ENGLISH	70
4	BUSINESS EDUCATION	60
5	LANGUAGE	50
6	MATH	40

NEED

RANK	PROGRAM	UTILITY
1	SCIENCE	100
2	BUSINESS EDUCATION	80
3	SOCIAL STUDIES	70
4	ENGLISH	60
5	MATH	50
6	LANGUAGE	40

COORDINATOR (B.E.)
PROGRAM - CRITERION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	BUSINESS EDUCATION	100
2	ENGLISH	90
3	SOCIAL STUDIES	85
4	MATH	80
5	SCIENCE	50
6	LANGUAGE	25

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	MATH	95
3	SOCIAL STUDIES	80
4	LANGUAGE	25
5	SCIENCE	20
6	BUSINESS EDUCATION	15

ASSIMILATION

RANK	PROGRAM	UTILITY
1	BUSINESS EDUCATION	100
2	SCIENCE	95
3	MATH	85
4	SOCIAL STUDIES	80
5	ENGLISH	50
6	LANGUAGE	25

URGENCY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	MATH	95
3	BUSINESS	90
4	SOCIAL STUDIES	50
5	SCIENCE	25
6	LANGUAGE	10

NEED

RANK	PROGRAM	UTILITY
1	BUSINESS EDUCATION	100
2	ENGLISH	95
3	SOCIAL STUDIES	90
4	MATH	80
5	SCIENCE	50
6	LANGUAGE	25

COORDINATOR (LANG.)
PROGRAM - CRITERION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	95
3	BUSINESS EDUCATION	90
4	LANGUAGE	75
5	SCIENCE	30
6	MATH	10

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	50
3	BUSINESS EDUCATION	40
4	LANGUAGE	30
5	MATH	20
6	SCIENCE	10

ASSIMILATION

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	BUSINESS EDUCATION	50
3	LANGUAGE	40
4	SOCIAL STUDIES	30
5	SCIENCE	20
6	MATH	10

URGENCY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	BUSINESS EDUCATION	50
3	SOCIAL STUDIES	40
4	LANGUAGE	30
5	SCIENCE	20
6	MATH	10

NEED

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	BUSINESS EDUCATION	50
3	SOCIAL STUDIES	40
4	LANGUAGE	30
5	SCIENCE	20
6	MATH	10

ASSISTANT PRINCIPAL (SCI.) BUDGET
PROGRAM - CRITERION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	95
3	MATH	85
4	SCIENCE	80
5	BUSINESS EDUCATION	70
6	LANGUAGE	60

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SOCIAL STUDIES	95
3	MATH	90
4	SCIENCE	85
5	BUSINESS EDUCATION	80
6	LANGUAGE	70

ASSIMILATION

RANK	PROGRAM	UTILITY
1	SCIENCE	100
2	BUSINESS EDUCATION	95
3	LANGUAGE	80
4	MATH	70
5	SOCIAL STUDIES	60
6	ENGLISH	50

URGENCY

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SCIENCE	90
3	MATH	85
4	BUSINESS EDUCATION	80
5	SOCIAL STUDIES	75
6	LANGUAGE	60

NEED

RANK	PROGRAM	UTILITY
1	ENGLISH	100
2	SCIENCE	95
3	SOCIAL STUDIES	75
4	BUSINESS EDUCATION	70
5	MATH	50
6	LANGUAGE	40

PROGRAM - CRITERION MATRIX
COMPOSITE EVALUATION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	86.25
2	SOCIAL STUDIES	92.00
3	MATH	68.75
4	SCIENCE	67.50
5	BUSINESS EDUCATION	70.00
6	LANGUAGE	51.25

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	98.75
2	SOCIAL STUDIES	76.87
3	MATH	75.00
4	SCIENCE	65.00
5	BUSINESS EDUCATION	50.00
6	LANGUAGE	49.38

ASSIMILATION

RANK	PROGRAM	UTILITY
1	ENGLISH	68.75
2	SOCIAL STUDIES	71.88
3	MATH	58.13
4	SCIENCE	81.88
5	BUSINESS EDUCATION	75.63
6	LANGUAGE	55.00

URGENCY

RANK	PROGRAM	UTILITY
1	ENGLISH	89.38
2	SOCIAL STUDIES	70.00
3	MATH	62.50
4	SCIENCE	71.88
5	BUSINESS EDUCATION	72.50
6	LANGUAGE	50.63

NEED

RANK	PROGRAM	UTILITY
1	ENGLISH	86.88
2	SOCIAL STUDIES	73.75
3	MATH	58.13
4	SCIENCE	70.63
5	BUSINESS EDUCATION	62.50
6	LANGUAGE	45.00

PROGRAM - CRITERION MATRIX
STANDARD DEVIATION MATRIX

RELEVANCE

RANK	PROGRAM	UTILITY
1	ENGLISH	29.02
2	SOCIAL STUDIES	5.96
3	MATH	23.55
4	SCIENCE	17.50
5	BUSINESS EDUCATION	19.20
6	LANGUAGE	15.36

GENERALITY

RANK	PROGRAM	UTILITY
1	ENGLISH	3.31
2	SOCIAL STUDIES	15.40
3	MATH	25.00
4	SCIENCE	30.21
5	BUSINESS EDUCATION	26.58
6	LANGUAGE	20.07

ASSIMILATION

RANK	PROGRAM	UTILITY
1	ENGLISH	20.27
2	SOCIAL STUDIES	19.52
3	MATH	25.61
4	SCIENCE	26.92
5	BUSINESS EDUCATION	22.97
6	LANGUAGE	19.20

URGENCY

RANK	PROGRAM	UTILITY
1	ENGLISH	11.84
2	SOCIAL STUDIES	17.85
3	MATH	25.98
4	SCIENCE	29.99
5	BUSINESS EDUCATION	15.41
6	LANGUAGE	19.44

NEED

RANK	PROGRAM	UTILITY
1	ENGLSIH	16.76
2	SOCIAL STUDIES	16.54
3	MATH	22.90
4	SCIENCE	30.56
5	BUSINESS EDUCATION	21.51
6	LANGUAGE	15.21

ASSISTANT PRINCIPAL (SCIENCE) BUDGET

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	GENERALITY	35
2	ASSIMILATION	30
3	RELEVANCE	20
4	NEED	10
5	URGENCY	5

EXAMPLE:

1. Rank order Criteria

Need	40
Generality	30
Relevance	15
Assimilation	10
Urgency	5

2. Assign Values Consistent with rank order

3. Check for inconsistency.

CURRICULUM CHAIRMAN (S.S.)

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	GENERALITY	35
2	ASSIMILATION	30
3	NEED	20
4	RELEVANCE	10
5	URGENCY	5

EXAMPLE:

1. Rank order Criteria

Need	40
Generality	30
Relevance	15
Assimilation	10
Urgency	5

2. Assign Values Consistent with rank order
3. Check for inconsistency.

CURRICULUM CHAIRMAN (SCI.)

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	NEED	35
2	RELEVANCE	30
3	URGENCY	20
4	GENERALITY	10
5	ASSIMILATION	5

EXAMPLE:

1. Rank order Criteria

Need	40
Generality	30
Relevance	15
Assimilation	10
Urgency	5

2. Assign Values Consistent with rank order

3. Check for in-

CURRICULUM CHAIRMAN (M)

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	RELEVANCE	35
2	GENERALITY	25
3	ASSIMILATION	25
4	URGENCY	10
5	NEED	5

EXAMPLE:

1. Rank order Criteria

Need	40
Generality	30
Relevance	15
Assimilation	10
Urgency	5

2. Assign Values Consistent with rank order

3. Ch[illegible]

COORDINATOR (F.L.)

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	NEED	40
2	RELEVANCE	30
3	URGENCY	15
4	GENERALITY	10
5	ASSIMILATION	5

EXAMPLE:

1. Rank order Criteria

Need	40	
Generality	30	
Relevance	15	
Assimilation	10	

2. Assign Values Consistent with rank order

CURRICULUM CHAIRMAN (ENG.)

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	GENERALITY	35
2	RELEVANCE	30
3	NEED	15
4	ASSIMILATION	[illegible]
5	URGENCY	5

EXAMPLE:

1. Rank order Criteria — Need 40 [illegible]
2. Assign Val[illegible] Consis[illegible]

COORDINATOR (B.E.)

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA	UTILITY
1	RELEVANCE	60
2	NEED	15
3	GENERALITY	10
4	ASSIMILATION	10
5	URGENCY	5

EXAMPLE:

1. Rank order   Need   10   [illegible]

COMPOSITE

We will assume for the purpose of this exercise that the following criteria; relevance, generality, assimilation, urgency and need, are to be evaluated against the major objectives of the school district.

DEFINITION:

Relevance	The degree to which a program satisfies the social and cultural goals and objectives of the institution.
Generality	The degree to which the outputs of a given program are utilized by the other programs.
Assimilation	The degree to which a program utilizes the outputs of all other programs.
Urgency	The degree to which an evaluator wishes to give explicit recognition to pressure groups in the budgeting process with respect to a given program.
Need	The degree to which an evaluator wishes to emphasize a higher priority because of special circumstances.
Utility	A real valued number that expresses an evaluator's judgment of the degree to which a given program has the potential to contribute to the satisfaction of some stated criterion or objective.

CRITERIA EVALUATION EXERCISES:

1. Rank order the criteria.
2. Assign a number between 0 and 100 to each criterion, so that these numbers are consistent with your rank order. The sum total not to exceed 100.
3. Check for inconsistencies between your judgments and the numerical representatives of your judgment.

RANK	CRITERIA		UTILITY
1	RELEVANCE	27.7	28
2	GENERALITY	22.7	23
3	NEED	22.2	22
4	ASSIMILATION	15.5	15
5	URGENCY	11.6	12

EXAMPLE:

1. Rank order Criteria

Need	40
Generality	30
Relevance	15
Assimilation	10
Urgency	5

2. Assign Values Consistent with rank order
3. Check for inconsistency.