The Rank-Based Expected Value Method of Plan Evaluation

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•THIS paper is concerned with the application of a new method of plan evaluation, the rank-based expected value method, to land use transportation plans in urban and regional contexts. The methodology is new in its application to urban plan evaluation, but it has been used for a number of years in corporate long-range planning.

The plan evaluation problem may be simply stated. Given a set of alternate plans, plan evaluation is concerned with the selection of one of the alternate plans that best fulfills the objectives of the planning project. Plan evaluation, by its very definition, assumes that a number of alternative plans have already been synthesized, and that these plans have been screened to eliminate plans that are infeasible because of certain defined constraints in the planning objectives.

Although the method to be discussed is applicable to the entire field of urban and regional planning, it is probably most useful in the evaluation of a land-use plan. The facility plans that are based on the land-use plan may also be evaluated with the rank-based expected value method, but the benefits are not as pronounced as they are in land-use planning. Generally, land-use plans are more difficult to evaluate than facility plans since the objectives of such plans are more qualitative in nature. In the usual case, then, it is expected that the method would be applied either to the land-use plan or to a comprehensive set of land-use and facility plans as part of an urban master plan.

PROBLEMS IN PLAN EVALUATION

The traditional approach to plan evaluation is the benefit-cost method. Benefit-cost evaluation involves a tabulation of all the benefits and costs of the project followed by a comparison of the sum total of all the benefits and costs in order to arrive at an estimate of the value of the project. Although in a theoretical sense the benefit-cost method would seem to provide a satisfactory solution to most plan evaluation problems, in practice it suffers from the following difficulties:

1. It is quite difficult to evaluate intangible benefits. The estimation of the intangible benefits can often distort the whole value estimation process.
2. The expense of obtaining all of the benefit and cost data needed to apply the benefit and cost method is often prohibitive.
3. Benefit-cost analysis is not easily related to indirect costs of related projects or programs.
4. It is difficult to allow for various uncertainties of implementation in benefit-cost analysis.

If another method is to represent an improvement over benefit-cost analysis, it must overcome, to some degree at least, the difficulties listed. What is really needed is a method that would handle intangible benefits and indirect costs with less data collection and analysis effort.

RANK-BASED EXPECTED VALUE METHOD

The rank-based expected value method is quite simple in both concept and application. Application of the method involves the following steps:

1. The rank ordering of plan objectives;
2. The rank ordering of plans under each objective; and
3. The estimation and assignment of a probability of implementation for each of the plan alternatives.

The philosophy of rank ordering relates to the concept that intangible benefits and costs are easier to rank in preference order than they are to assign a scalar benefit or cost value. The concept of rank ordering is proposed to overcome the difficulties of scalar estimation inherent in the intangible benefits and the indirect costs of planning

Plan	Specified Development Objective	Balanced Allocation of Land	Natural Resource Conservation	Facility Costs	Plan Value, V $V = p \Sigma (n_1m_1 + n_2m_2 + n_0m_0$
		Rank Order Value of Objective n = 2	Rank Order Value of Objective n = 3	Rank Order Value of Objective n = 1	
		Rank Order Value of Plan, m	Rank Order Value of Plan, m	Rank Order Value of Plan, m	
1	Probability of Implementation p = 0.6	3	1	3	0.6 [(2 x 3) + (3 x 1) + (1 x 3)] = 7.2
2	Probability of Implementation p = 0.5	2	2	1	0.5 [(2 x 2) + (3 x 2) + (1 x 1)] = 5.5
3	Probability of Implementation p = 0.9	1	3	2	0.9 [(2 x 1) + (3 x 3) + (1 x 2)] = 11.7

Figure 1. Theoretical application of the method.

projects. The probability of implementation concept is designed to introduce the aspect of uncertainty into plan evaluation.

The detailed methodology of the rank-based expected value method may be understood from a more detailed description of the sequence of activities:

1. All objectives, n in number, are ranked in order of importance and assigned values of n, n minus 1, n minus 2, . . ., to n minus (n - 1) in descending rank order.
2. The alternative plans, m in number, are ranked under each of the specific land-use development objectives and assigned a value of m, m minus 1, m minus 2, . . ., to m minus (m - 1) in descending rank order.
3. A probability, p, of implementation is assigned to each of the plans being ranked.
4. The value, V, of each alternative plan is then determined by summing the products of n times m times p for each of the specific development objectives:

$$V = p \Sigma (n_1m_1 + n_2m_2 + \ldots + n_nm_n)$$

The matrix table shown in Figure 1 illustrates a simple theoretical application of the method for three specific development objectives. In the hypothetical plan evaluation shown in the table, Plan 3 would be selected as that plan which best meets the development objectives.

HISTORICAL DEVELOPMENT

The development of the rank-based expected value method is best understood in terms of its application in the business arena, since it was first developed for application to corporate planning in a large multi-product manufacturing firm.

It was applied to that top management level of problems usually designated as corporate strategy. Corporate strategy involves the selection of new products in new markets and the modification of old products and markets to establish a continuing dynamic product-market portfolio for a business. In its corporate application, the development of such a strategy involves the screening of a large number of alternatives for feasibility prior to the direct application of the rank-based expected value method. After this initial screening, the corporate objectives are ranked, the plan alternatives are ranked, probability of implementation is estimated, and each of the plan alternatives are then evaluated as described in the foregoing urban planning application.

The similarities of corporate and urban planning are many. Like urban planning, corporate planning must deal with intangibles. Long-range profitability is not the only goal of most business firms, and even long-range profitability, since it is not possible

to obtain precise estimates of future revenues and costs, is really best evaluated as an intangible itself. There are, in addition, many social, political, and legal constraints on a firm that must be treated as intangible objectives. Corporate planning is also fraught with uncertainty. Most product and market ventures are doomed to failure, so it is vital to introduce the concept of probability of the implementation into any methodology of corporate plan evaluation. Although the concept of probability of implementation is somewhat different in the corporate and urban planning functions, it must be dealt with in a direct and straightforward manner in both.

APPLICATION OF THE RANK-BASED EXPECTED VALUE METHOD IN THE SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

The potential and problems of the rank-based expected value method are better understood from an application in a specific plan evaluation project. This method was applied to the evaluation of the land use-transportation plans developed by the Southeastern Wisconsin Regional Planning Commission.

In this application, the first set of problems related to a clarification of the meaning of objectives and standards. Urban planning objectives often tend to be vague, overlapping, and even irrelevant. To relate the method to actual objectives and their resulting design standards entails a need for discipline in the precise definition of each plan objective and standard. To avoid semantic difficulties, the following definitions used in southeastern Wisconsin will be assumed:

Objective: A goal or end toward the attainment of which plans are directed.
Standard: A criterion used as a basis of comparison to determine the adequacy of plan proposals to attain objectives.

Further confusion in the definition of planning objectives results from the indiscriminate mixing of different levels of objectives as they affect the preparation of regional plans. Some planning objectives are important only at the level of regional plans, others affect planning at the community level, while still others are important only at the neighborhood level. To eliminate this source of confusion, a hierarchy of objectives and standards was classified in southeastern Wisconsin. This made it possible to utilize only those objectives and standards that applied for a particular level of plan evaluation.

The procedure used in applying the method was basically the method previously described with some modification. The plan evaluation activities involved were the following:

1. Each of the three plans was evaluated for each of the design standards and, since each design standard applied to only one objective, the ranking of the plans under each objective was determined from the composite ranking of the plans for the design standards of the objective.
2. Each of the three objectives was ranked as described previously.
3. The probability of implementation of each plan was estimated.
4. The value of each plan was calculated as previously described.
5. The plan with the highest plan value was selected for recommendation by the planning staff.

The response of both the planning staff and the Commission members to the rank-based expected value method was quite favorable. The staff found it a useful tool in clarifying the objectives and design standards and for introducing a discipline of thought into the plan evaluation process without the need for extensive benefit and cost data analysis. Criticisms of the method revolved primarily about the concept of probability of implementation.

It is apparent from the evaluation plan values shown in Figure 2 that the probability of implementation is an important factor in plan selection. The Satellite City Plan would have ranked higher if it were not for the low likelihood of implementing this plan. Although some philosophical problems of the purpose of planning are introduced by this probability concept, most members of the staff and Commission agreed that this concept was quite crucial in plan selection in southeastern Wisconsin.

Plan	Major Group Objective	Provide for a Balanced Allocation of Land[a]	Provide for an Appropriate Spatial Distribution of Land Uses[a]	Meet the Design Requirements of the Major Land Uses[a]	Plan Value
		Rank Order of Group Objective = 3	Rank Order of Group Objective = 2	Rank Order of Group Objective = 1	
		Rank Order Value of Plan[b]	Rank Order Value of Plan[b]	Rank Order Value of Plan[b]	
Controlled Existing Trend	Probability of Implementation = 0.6	2	3	1	7.8
Corridor	Probability of Implementation = 0.3	1	2	2	2.7
Satellite City	Probability of Implementation = 0.1	3	1	3	1.4

[a]Includes the objectives listed under this group in Appendix Table A-31, SEWRPC Planning Report No. 7, Vol. 2.
[b]Based on the rank order value as shown in Appendix Table A-29, SEWRPC Planning Report No. 7, Vol. 2.

Source: SEWRPC

Figure 2. Land-use plan selection criteria.

There is little question that further development of the rank-based expected value method is necessary before it could be applied on a wide scale. The most important need is for the development of computer programs and techniques for sensitivity analysis. Confidence in the method would be increased if it were possible to obtain easily some of the sensitive values at which the plan selected would change. By determining these sensitive points, the planner could better evaluate whether his information is sufficient to recommend the plan suggested by the method. Personnel at the consulting engineering firm of Consoer, Townsend in Chicago have been applying the method in this manner. In an application of the method to the evaluation of alternative route locations, a number of sensitivity analyses were performed to develop confidence in the route location that was recommended. Documentation of this application is not yet available but is expected in the near future.

Although the rank-based expected value method is not offered as a panacea to all problems of urban plan evaluation, it is believed that the method provides a contribution to a difficult aspect of urban and regional planning.

Discussion

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•PLAN evaluation involves the examination and analysis of alternative plans to select the plan that best satisfies the goals and objectives of the study area. The technique employed in the plan evaluation phase of a transportation planning program should be the object of much concern, early in the planning process. Each study area should subscribe to a comprehensive plan evaluation technique that will assist plan selection and, most important of all, insure implementation.

Two papers have been presented that describe techniques for plan evaluation. Both papers point out a real problem that exists in the transportation planning process today, and they are attempts to provide solutions to the problem. The problem pointed out is that, while very sophisticated techniques are available to inventory, analyze, and forecast travel patterns, land use, and socioeconomic activity in developing a transportation-land use plan, the same sophistication is not available to evaluate plan alternatives to insure the selection of the best plan and its implementation.

THE RANK-BASED EXPECTED VALUE METHOD OF PLAN EVALUATION

Mr. Schlager's paper deals with a form of plan evaluation that is new to urban planning, but that has been used before in industry. Basically he has sought to provide a practical means of communicating the advantages and disadvantages of a set of alternative land-use and transportation plans to seek the selection of the best plan.

The paper points out the fact that the common practice of cost-benefit analyses cannot take all factors into account because of the difficulty of quantifying intangible criteria. The author proposes a simple ranking of alternative plans with regard to the manner in which they meet a ranked set of regional planning objectives. In other words, through necessary contact with technical and policy decision-makers, the area's planning objectives are ranked according to a consensus of preference, and then each plan is ranked according to its ability to meet each goal or objective. With this approach, much is accomplished to insure the implementation of the selected plan because the people of the area have been involved in the decision-making process.

Further, the author has added a factor to the decision-making process called the "probability of implementation" which tends to temper "optimistic or unrealistic" plans with an appropriate air of certainty. Many times, worthwhile projects have not been constructed for lack of funds, inadequate promotion, inadequate technical justification, or because their benefits were diffused by unrealistic projects.

Therefore, the technical and policy sessions that were held to identify goals and standards and alternate transportation and land-use plans, to rank goals and objectives in order of preference, and to rank plans according to their ability to satisfy specific goals or objectives were invaluable. This procedure should do much to provide a dynamic and successful transportation planning process in the southeastern Wisconsin area.

SYSTEMS EVALUATION: AN APPROACH BASED ON COMMUNITY STRUCTURE AND VALUES

The paper by Messrs Schimpeler and Grecco is an approach directed toward the same problem. However, the techniques for ranking the regional goals and objectives and determining the effectiveness of the various plan alternatives were developed through the application of decision-making theory and operations research that has been the subject of considerable attention over the past 15 years, mostly in industry.

This paper, like Mr. Schlager's, proposes extensive contact with technical and policy decision-makers in establishing statements of goals and objectives and ranking these statements in order of a consensus of preference. Through ranking and/or rating techniques, a utility value is determined relative to the importance of each goal to the region. The professional staff then determines the effectiveness of each alternative plan in satisfying each goal and objective. Total plan effectiveness is then measured for each plan through a decision model by summing all products of each plan effectiveness value times the utility value for each regional goal or objective.

Schimpeler and Grecco also point to the use of this technique in capital programming and route location studies. An approach similar to this has been used in the Akron Metropolitan Area Transportation Study program to solve a route location problem, and the City of Akron is considering a similar technique in capital investment programming.

The authors suggests that additional research will be required in the development of a succinct, comprehensive, well-defined statement of regional goals and objectives. Statements of general goals do not work because it is impossible to draw definite distinctions between how various plans affect them, much less attempt to rank them in order of preference, because all seem equal.

Most important, however, once a goals statement is defined, is the establishment of measuring devices for each goal or objective so that the effect of each plan can be compared objectively. The various interpretations of goals must be understood and agreed upon by all concerned in the planning process. And, finally, the professional task force that evaluates the effectiveness of each plan must be composed of a good cross section of the professional disciplines required to develop the plan.

SUMMARY

The success of any transportation planning process in the country can be measured in very simple terms by answering the question: "Is the plan being implemented?" In other words, are the transportation facilities recommended by the plan being constructed on schedule and have the development policies set forth in the plan been used to guide development and growth in the urban area?

Many factors will determine whether or not a plan will be implemented, but probably the most significant factor will be how the plan was presented and accepted. Were the proper decision-makers in the region made part of the plan development and evaluation process? If they were not, they may feel that the plan is impractical or not well-founded and, therefore, will not work toward its implementation.

An objective for any study staff, in order to insure plan implementation, is to establish a good channel of communication with the policy-makers in the area. In this business, this can only be achieved by talking at the level of the policy-maker who is not necessarily concerned with gravity models, modal splits, O-D surveys, all-or-nothing traffic assignment, capacity restraints, and the rest of the technical jargon. He is more concerned with his transportation needs and the implications of various solutions to those needs. If a staff can show the policy-maker his needs and related improvement costs and involve him in the methodology of measuring how alternate solutions to his needs satisfy the various criteria in selecting the best alternate, then that study will be successful.

In effect, the policy-maker must understand the plan evaluation procedure. Further, the policy-maker must be given an active part in the development of and application of the plan evaluation procedure to determine the best transportation-land use plan for the region.