# Public Policy and Decision-Analysis Methods: Development of the National Comprehensive Bicycle Program

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**The National Energy Conservation Policy Act of 1978 mandated that the U.S. Department of Transportation (DOT) conduct a study of the energy conservation potential of bicycling. One of the expressed objectives of the study was that a comprehensive bicycle transportation program be developed to address current obstacles to bicycle use. This paper describes and analyzes the approach taken to develop that program. The primary problem encountered in developing the program was that there are a multitude of obstacles to increased bicycle use and, similarly, a multitude of experts' opinions about which obstacles are the most important. To aid in gaining an overview of the issues and experts' opinions, a formal decision-analysis method called worth assessment was employed. During the application of worth assessment, experts organized problem issues into a hierarchy of program objectives and numerically evaluated the relative importance of those objectives for achieving increased bicycle use. A comprehensive bicycle program was then synthesized to respond to those objectives identified as most important. Difficulties were encountered in using the worth-assessment technique, e.g., determination of the level of detail for which discussion was appropriate, semantics problems, and a lack of consensus among experts on certain issues. However, through the use of worth assessment the following benefits were derived: (a) a comprehensive overview of the bicycling problem was synthesized, (b) experts throughout the country for the first time concurrently dealt with identical subject material to identify key obstacles to bicycling, and (c) DOT and Congress were given direction for policy priorities based on experts' quantitative rankings of issues.**

In the fall of 1978, Congress passed the National Energy Conservation Policy Act. Section 682 of that act deals with the potential energy conservation and other benefits of increased bicycle use in the United States. In that section Congress stipulated that obstacles to increased bicycle use be studied, that a target for commuting bicycle use be established, and that the U.S. Department of Transportation (DOT) "develop a comprehensive program to meet these goals."

DOT contracted with Mountain Bicyclists' Association (MBA) of Denver, Colorado, to complete the mandated study. Six months later, MBA produced a technical report detailing its findings for each assigned task as well as a recommended comprehensive program (1). DOT incorporated those findings into a report delivered to Congress on May 1, 1980 (2).

The tasks undertaken by MBA and DOT representatives were not easy. The charge to build a comprehensive program to attack obstacles to increased use was particularly intimidating, since in bicycling, as in any field, an array of obstacles and problems could be identified. These included unskilled riders, indifferent policymakers, defective products, poorly maintained facilities, and hateful motorists, to name just a few. In addition, almost everyone contacted had solutions for each problem (MBA developed a list of more than 500 individual strategies during this project). This situation required that the most important obstacles be identified and isolated and that a balanced program be built to address those obstacles. This paper examines and analyzes the approach used by the MBA project team to accomplish these ends.

## WORTH-ASSESSMENT METHOD

To develop an optimal comprehensive program, a systematic approach must be employed. Impact, Ltd., was commissioned by the MBA project staff to evaluate the applicability of decision theory techniques. Within this field there are numerous mathematical methods specifically designed to aid in the development of optimal strategies and allocate limited resources. Decision-analysis methods model the decision-making process, i.e., the mental process of defining and organizing objectives, determining their relative importance, and evaluating alternatives in terms of those objectives. (In the past, decision-analysis methods have been primarily used to evaluate complex alternatives; a classic example is site selection for nuclear power plants. In contrast, the bicycle study need was to generate a comprehensive program, which thus required a rather unique application of decision-analysis methods.)

After reviewing several candidate methods of varying complexity, Impact selected the worth-assessment method, which was developed by J.R. Miller for the U.S. Air Force Systems Command in 1967 (3). As applied, this method enabled the project team to organize the obstacles and factors that affect bicycle use into a logical framework, achieve a consensus of bicycle and institutional experts on the relative importance of each of those factors, statistically evaluate the level of agreement among the experts, and use this information to frame a comprehensive bicycle program.

## ORGANIZATION OF THE PROBLEM

As applied in the context of the DOT charter, the worth-assessment method was used primarily to develop a hierarchical structure to describe the bicycling problem (Figures 1-5). A primary objective was identified, which was then divided into four secondary objectives. Those objectives in turn were divided into criteria, and criteria were divided into subcriteria, etc. This process facilitated analysis of the problem at several levels of detail and allowed translation of general objectives into detailed criteria for analyzing problem solutions. An analysis of the evolution of that structure and its eventual use follows.

Organization of the myriad factors that influence bicycle use was accomplished by a panel of bicycling experts. During an intensive workshop, the panel, equipped with a list of previously identified obstacles, was guided through the worth-assessment process and produced a problem structure.

The first task of the workshop was to develop categories of the factors that influence bicycle use. The following list was drawn up:

1. Personal perceptions,
2. Environmental conditions,
3. Multimodal opportunities,
4. Bicycle and bicycle equipment design,
5. Support facilities,
6. Implementation considerations,
7. Behaviors,
8. Attitudes,
9. Personal skills,
10. Motor vehicle design, and
11. Institutional context.

For each of the categories the workshop participants, by means of a brainstorming exercise, identified obstacles or factors that influence each cate-

Figure 1. Worth-assessment structure: primary and secondary objectives.

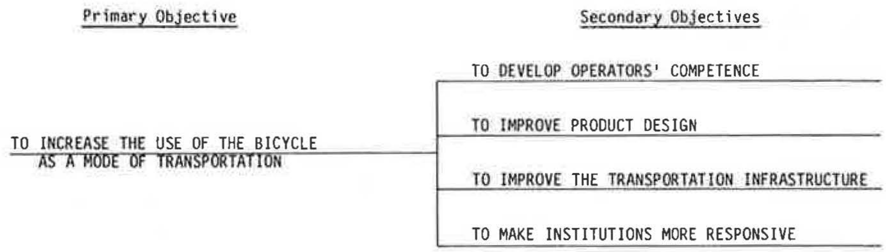



Figure 2. Worth-assessment structure: operators'-competence branch.

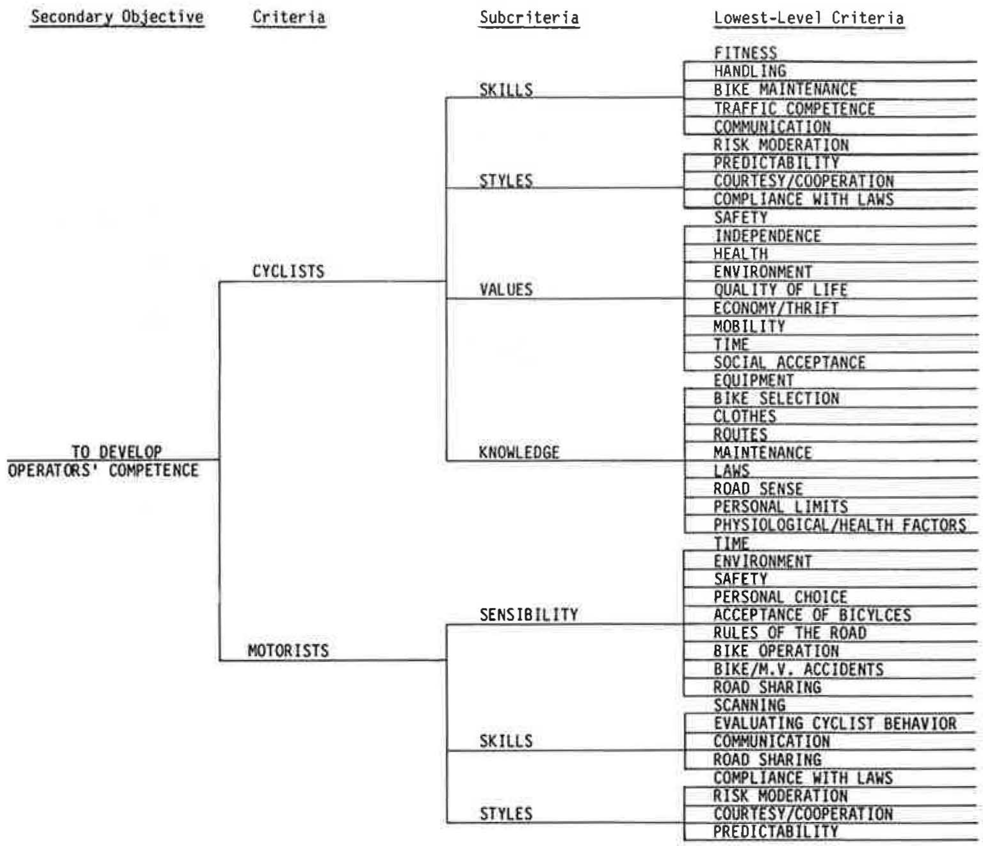



Figure 3. Worth-assessment structure: product-design branch.

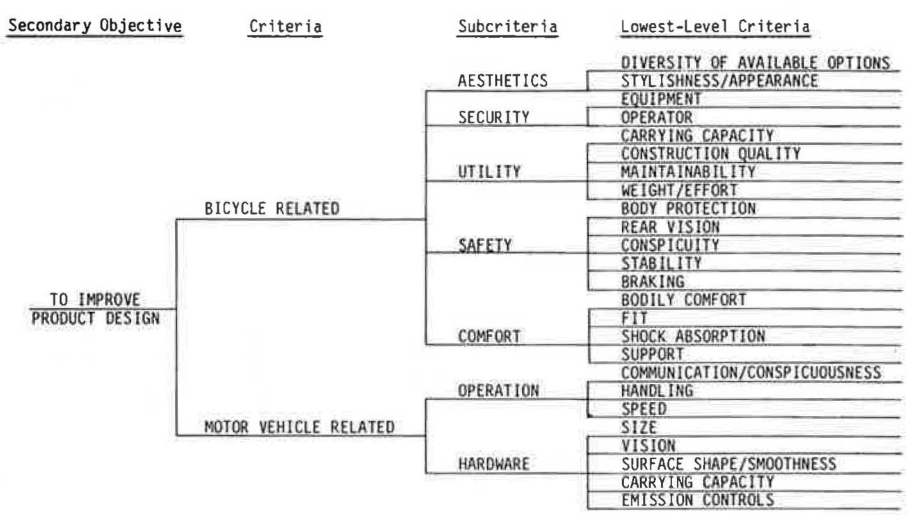


Figure 4. Worth-assessment structure: transportation-infrastructure branch.

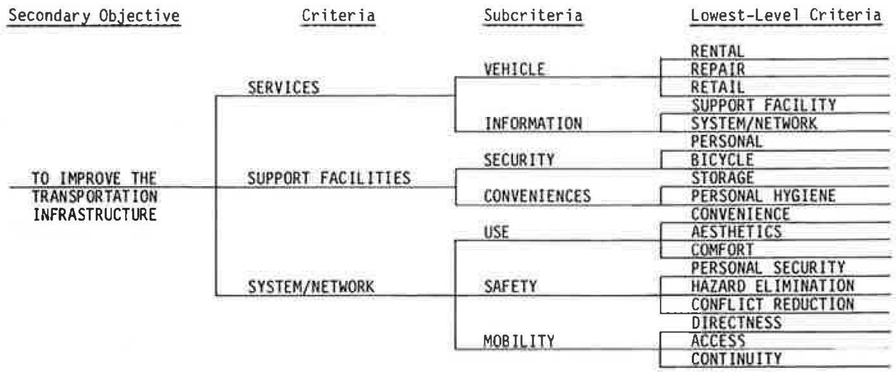



Figure 5. Worth-assessment structure: institutions branch.

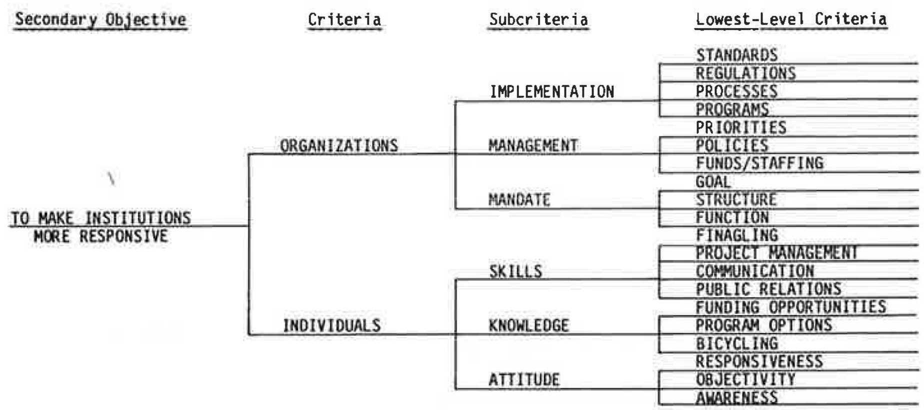
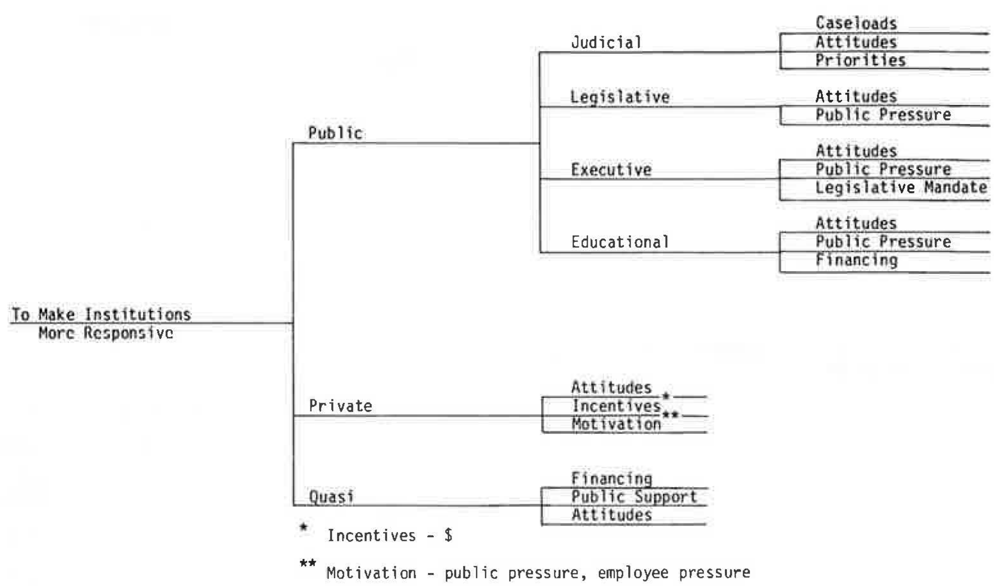



Figure 6. Preliminary hierarchical structure for institutions.




gory, for example, those for the category of environmental conditions: existing street; street design; street maintenance; land use patterns; weather and climate; air quality; topography; barriers; special facilities; bikeways; traffic level, speed, and type; continuity; roadway hazards; accidents; intermodal conflicts; signs and signals; distribution (time and geographical); and traffic control.

Participants were then separated into teams of two and assigned a group of categories that addressed similar subjects. Each team's charge was to translate its listed obstacles and factors into a hierarchy of objectives, which was to be combined with others to form the overall problem hierarchy. The process of developing the hierarchy was an iterative one that required input from all panel members before agreement was reached. An example of one of the interim hierarchies is presented in Figure 6.

The category listings and problem structures presented in Figures 1 through 6 provide excellent illustration of some of the difficulties experienced when attempting to structure a complex problem. Some of the problems experienced were as follows:

1. Problem specificity: One of the most difficult aspects is to determine an appropriate level of problem specificity. Through the development process, however, this problem resolves itself. For example, the tendency of the group that developed the structure in Figure 6 was to divide general categories into more specific parts, e.g., institutions were divided into public, private, and quasi-sectors. At the next hierarchy level, however, it became evident that those sectors had common problems, i.e., attitudes, priorities, financing, etc. In sequential iterations of the structure development, the three institutional distinctions were dropped and only the general attributes were included. This level of detail was deemed appropriate for specifying a national program.
2. Solution orientation: Another difficulty encountered was that experts often try to define problem factors in terms of a solution. In Figure 6 one of the problem attributes most often noted is public support or public pressure. Public support or pressure is a means to an end and was eventually generalized to the more-global expression "making institutions more responsive." Public pressure is only one alternative means for altering that responsiveness.
3. Semantics: Semantics difficulties are common to all definition exercises. Terms that have high emotional content present particular difficulty. One of the advantages of the worth-assessment approach is that a term used at one level is defined by the subsequent terms into which it is divided.

A comparison of the final worth-assessment hierarchy and the figures from which it was derived reveals that the group's initial category concepts were generally maintained, although the order was often altered. For example, "environmental conditions" proved to be an awkward term and was dropped in favor of "system network". As another example, it became easier to assign skills to several types of persons rather than to group persons under skills as was initially done.

The final structure was developed in the context of a specific application, development of a comprehensive national bicycle program. It is not claimed to be the only possible problem structure; another panel would have derived a different one. The point is that it is comprehensive--at some level all the obstacles to increased bicycle use that were identified are addressed.

There are some limitations to the structure and the method used to derive it. An assumption inherent in the structure is that of static conditions, i.e., that the economic conditions, political situation, people's values, etc., that existed when the structure was developed will continue to prevail. As a result, neither the dynamic interaction of the objectives nor the influence of exogenous factors is modeled. For example, improved institutional response may eventually result in an improved transportation infrastructure, and fuel availability and cost may alter perspectives. One must be aware of these limitations.

The worth-assessment method met the objectives of this application. The structure developed provides a concise overview of the problems that inhibit bicycle use in the United States today. The framework has been established so that, as conditions change, the structure can be altered accordingly.

As a final observation about the process leading to the structure, it was interesting to note the relative ease with which the operator-competence branch was developed and the relative difficulty encountered in formulating the institutional branch. This may have been due to the fact that the experts participating were primarily bicycle program experts.

## IDENTIFICATION OF CRITICAL OBJECTIVES

The next step toward developing a national program was to assess the relative importance of major objectives and criteria that influence bicycle use. The team's approach was to solicit opinion from recognized experts throughout the country. Those experts were divided into two classifications according to their expertise. Bicycle program experts (persons who have particular bicycling-related skills and who are involved in implementing bicycle programs) were asked to evaluate numerically the relative importance of issues that relate to operators' competence, product design, and the transportation infrastructure. Institutions experts (primarily administrators involved with bicycling at an institutional or policy level) were requested to evaluate institutional-response issues. Both groups were asked to evaluate the relative importance of the four secondary objectives. Workbooks that presented the overall problem structure and instructions for assigning numerical weights were sent to each expert.

The hierarchical worth-assessment approach allows one to systematically evaluate the relative importance of problem elements in a manageable fashion. Rather than having to address the entire problem at once, one addresses only one section of the structure at a time. For example, all decision makers were asked to consider initially only the relative importance of the four secondary objectives. Then institutions experts were asked to evaluate the criteria immediately underlying the objective "to make institutions more responsive," and bicycle experts were asked to consider criteria sets underlying the other secondary objectives. Experts were then asked to continue through their parts of the structure one discrete set at a time until all criteria sets were numerically evaluated.

Response to the workbook was mixed. Of the bicycle program experts, 75 percent completed their workbooks. One person declined to participate due to objections to the method. Of the institutions experts, 70 percent completed their workbooks at least in part, and two persons objected to the method. The primary objections focused on semantics. Considering the problems encountered in the workshop, this was not surprising.

For each objective or criterion, the mean (average) and SD (variability) of numerical values derived by experts were calculated. These values are presented in Figures 7-11. For each pair of numbers, the first value presented is the mean and the second is the SD, which indicates the variability of values submitted and therefore the degree of unanimity among the experts. For each group of associated criteria or objectives the sum of the mean values equals 1. Individual values can be interpreted as percentages that reflect the relative importance of each criterion in satisfying the more-global objective or criterion to which it relates.

Of particular interest was the comparison of bicycle program experts' assessments of the four secondary objectives with those of the institutions experts (Figure 7). These values are also compared in Table 1.

Bicycle program experts seem to agree that efforts to increase bicycle use should focus on opera-

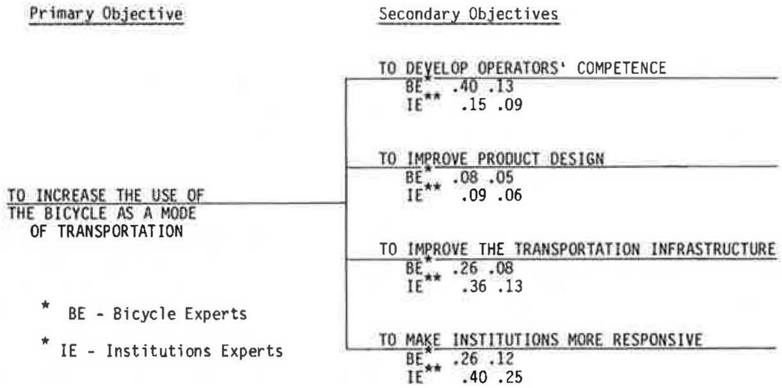



Figure 7. Experts' importance weights: secondary objectives.

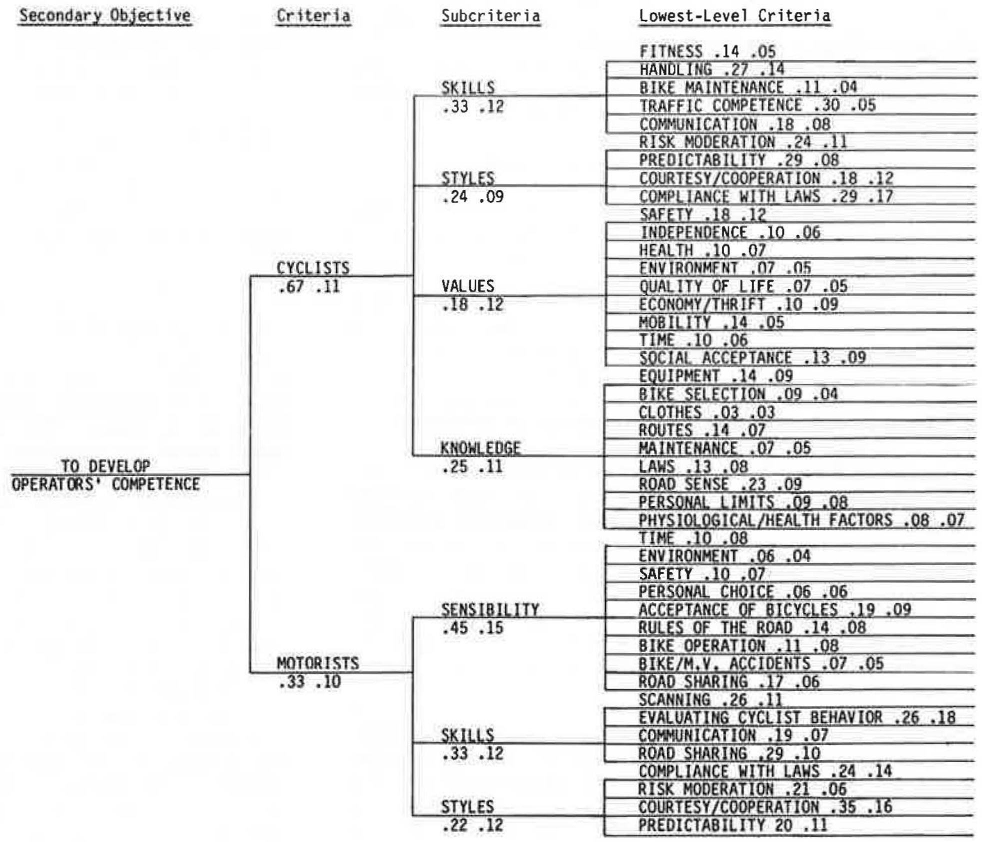



Figure 8. Experts' importance weights: operators'-competence branch.

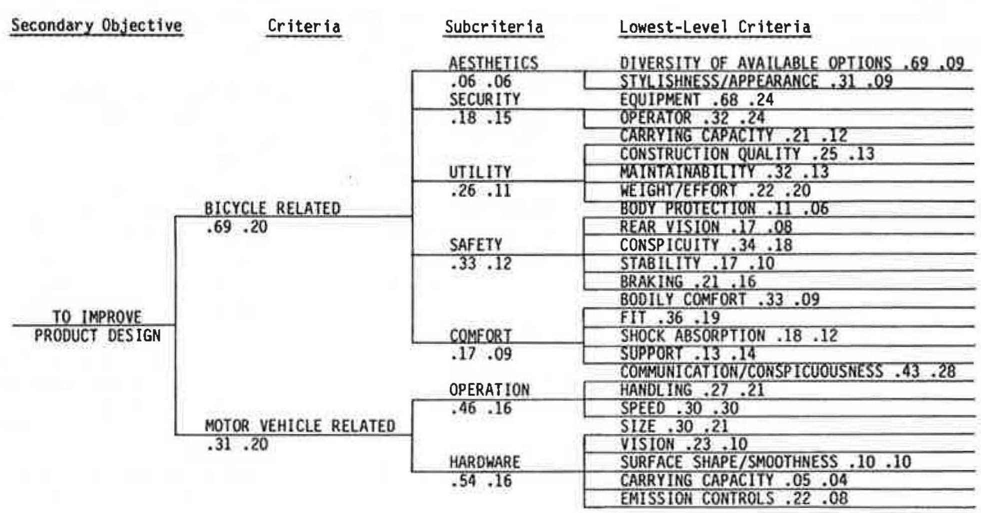



Figure 9. Experts' importance weights: product-design branch.

**Figure 10. Experts' importance weights: transportation-infrastructure branch.**

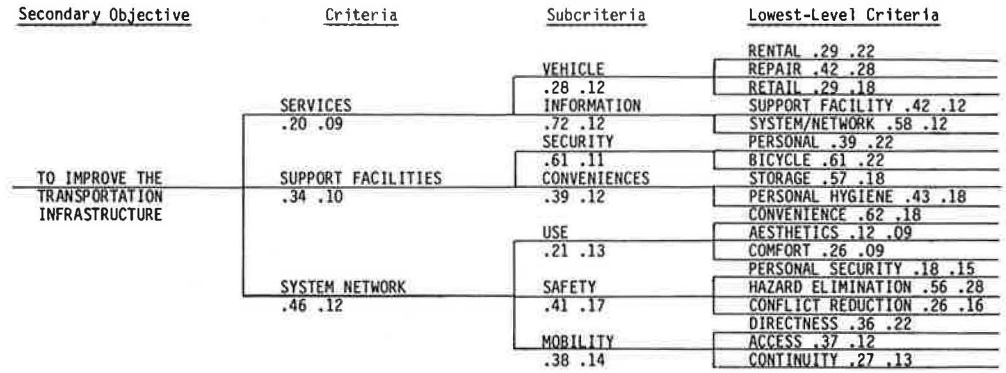



**Figure 11. Experts' importance weights: institutions branch.**

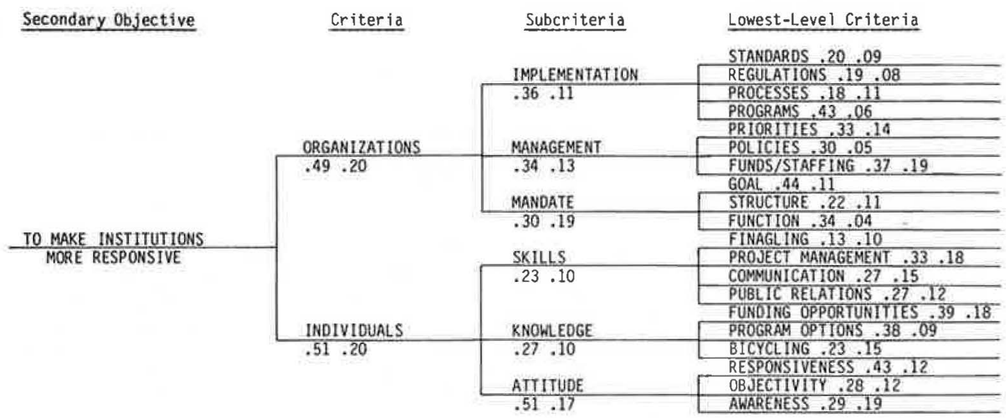



**Table 1. Comparison of secondary-objective importance weights.**

| Rank | Objective | Weight | SD |
|---|---|---|---|
| Bicycle Program Experts | | | |
| 1 | Operators' competence | 0.39 | 0.13 |
| 2 | Institutional response | 0.27 | 0.12 |
| 3 | Transportation infrastructure | 0.27 | 0.08 |
| 4 | Product design | 0.07 | 0.05 |
| Institutions Experts | | | |
| 1 | Institutional response | 0.38 | 0.25 |
| 2 | Transportation infrastructure | 0.38 | 0.15 |
| 3 | Operators' competence | 0.15 | 0.10 |
| 4 | Product design | 0.09 | 0.04 |

tor competence and that the secondary emphasis should be split equally between institutional response and transportation infrastructure. Product design is considered to be of negligible importance. In contrast, the institutions experts view institutional response as the major obstacle to increased use and rate operator competence a low third.

Possible interpretations are interesting. The results seem to support one of the obstacles to increased bicycle use often cited, i.e., that institutions experts do not really understand the bicycling problem and therefore often devote funds only to highly visible facility projects instead of to educational programs. On the other hand, it may be argued that the bicycle experts do not truly understand the importance of dealing within system constraints. For this study's purposes, MBA officials felt that bicycle program experts probably had a better overall perspective and chose to use their evaluations.

The experts' evaluations were used to identify the critical factors of the bicycling problem that should be addressed in the comprehensive national program. The detail that seemed appropriate for the formulation of a national bicycling program was that of the fourth structure level, subcriteria. Thus it was necessary to evaluate the importance of each subcriterion relative to the overall objective of increasing bicycle use. Each subcriterion's weighting factor was derived by calculating the product of the weights assigned to the secondary objective, the criterion, and the subcriterion itself along the path leading from the overall objective to that subcriterion.

Subcriteria are listed in Table 2 in order of descending importance as determined by the calculated importance weights (only the top 20 are listed). Again a "total-equals-one" percentage format was maintained. A natural division seemed to occur between the 19th and 20th criteria. Key aspects of the first 19 (as identified by the experts' weights) were chosen as priority items for the national bicycling program. Although these values indicate that the top-weighted criteria should receive greater emphasis than others, it was decided that, given the variability among the responses from bicycle-program and institutions experts and the general nature of the program, the 19 items would be accorded equal emphasis.

The decision to emphasize a broad range of policies represents a shift in DOT policy. Prior to this study, DOT had been concerned primarily with improving the transportation infrastructure. This study served to spur the department to pay more attention to questions of operator competence and institution responsiveness.

Table 2. Subcriteria importance weights.

| Rank | Objective and/or Criterion | Subcriterion | Weight |
|---|---|---|---|
| 1 | Cyclists | Skills | 0.088 |
| 2 | Institutions/individuals | Attitude | 0.068 |
| 3 | Cyclists | Knowledge | 0.067 |
| 4 | Cyclists | Styles | 0.064 |
| 5 | Motorists | Sensibility | 0.059 |
| 6 | Support facilities | Security | 0.054 |
| 7 | System/network | Safety | 0.049 |
| 8 | Cyclists | Values | 0.048 |
| 9 | Organizations | Implementation | 0.046 |
| 10 | System/network | Mobility | 0.045 |
| 11 | Organizations | Management | 0.043 |
| 12 | Motorists | Skills | 0.043 |
| 13 | Organizations | Mandate | 0.038 |
| 14 | Services | Information | 0.037 |
| 15 | Institutions/individuals | Knowledge | 0.035 |
| 16 | Support facilities | Conveniences | 0.034 |
| 17 | Institutions/individuals | Skills | 0.030 |
| 18 | Motorists | Styles | 0.029 |
| 19 | System/network | Use | 0.025 |
| 20 | Bicycle-related product design | Safety | 0.018 |

As a final note, the experts' SD values were evaluated in an attempt to interpret the significance of the demonstrated differences of opinions. Some possible interpretations are as follows:

1. Operator competence: The experts seem to be in general agreement on the important elements of improving operator competence at all levels of specificity. This indicates that operator-competence problems do not vary according to locale and are commonly encountered throughout the nation. Thus programs should easily cross geographical boundaries and be amenable to treatment at the federal level.
2. Transportation infrastructure: The experts were in fair agreement on critical elements when differentiating among general categories. However, as the criteria became more specific, less agreement was demonstrated. This may indicate that, in general, infrastructure improvements are needed in all communities but that the more-specific provisions of a program should be locality-specific.
3. Institutional responsiveness: Institutions experts did not generally agree on the critical elements. This may reflect the complexity of the problem and the difficulty encountered in defining it. The results may also support the concept that every institution has characteristics peculiar to it and therefore should be approached as a unique entity.

## CONCLUSIONS

Prior to the DOT-MBA study, promotion of increased bicycle use was characterized by a multitude of obstacles, varying experts' opinions, and a multitude of possible solutions. Now that this study has been completed, the federal government has an indication based on a survey of expert opinion of what tasks should be undertaken to increase bicycle use in the United States. Problem organization and acquisition of expert opinion were provided through the use of the decision-analysis method, worth assessment. The following benefits were derived from the use of worth assessment:

1. A comprehensive overview of the bicycling problem was synthesized,
2. Experts throughout the country for the first time concurrently dealt with identical subject material to identify the key obstacles inhibiting bicycling, and
3. DOT and Congress were given direction for policy priorities based on experts' quantitative rankings of issues. The result has been a shift in DOT bicycle policy.

Similar benefits could be realized through use of decision-analysis methods in developing local community bicycle programs or in other transportation policy fields.

## ACKNOWLEDGMENT

The research that formed the basis for this paper was sponsored by the U.S. Department of Transportation. The prime contractor for the project was Mountain Bicyclists' Association of Denver, Colorado. We would like to thank Katie Moran, Tom O'Hara, and Bill Wilkinson for their support and to acknowledge all the experts who gave their time to participate in the study.

# Discussion

Michael D. Everett

The study by Ryan and Schermerhorn attempts to identify the obstacles to increased bicycling for transportation in the United States as part of a congressional and DOT effort to increase bicycling to save energy. Unfortunately, the paper provides us few, if any, sound insights on the obstacles to bicycling or how to actually increase bicycling. The study uses a panel of experts to develop hypothesized obstacles to bicycling. This represents an exploratory research strategy appropriate when the investigators know little or nothing about a subject. But well-refereed replicable research and theory on the determinants of and obstacles to bicycling already existed and would have provided testable hypotheses. For example, we knew that costs, including time related to distance, constitute very important determinants in most modal choices. Articles had developed models that applied time costs and distance to explain lack of bicycling (4). Ryan and Schermerhorn virtually ignore time costs or distance as obstacles to bicycling.

Reasonably well-designed and implemented surveys consistently find that bicyclists and potential bicyclists consider motor vehicle traffic a major obstacle, and they state that separate facilities would increase their propensity to use the bicycle (5,6). Also, studies have confirmed the observed correlations between levels of traffic, separate facilities, and incidence of bicycle transportation (7,8). Finally, anyone familiar with the bicycle movement knows that some very strident voices have proclaimed lack of bicyclist competence to be an important obstacle to bicycling. Thus, the authors could have generated testable hypotheses without assembling an expensive panel survey. They then would have had time and resources to test the hypotheses.

For example, a serious study, even one done on a crash basis with limited funding, could have tested the already known hypotheses on the barriers to bicycling--costs (including time), lack of competence, and fear of traffic--by running correlations across communities. Even mail-back surveys could have obtained crude but usable data on incidence of bicycling, traffic conditions, infrastructure and facilities, existence of training programs, and distances of origins and destinations to calculate time costs. Collecting these data for communities that have perceived high rates of bicycling--Davis and Santa Barbara, California; Madison, Wisconsin; Eugene, Oregon; Tallahassee and Gainesville, Florida; Urbana, Illinois; and, to a much lesser extent, Northwest Washington, D.C., and Denver, Colorado--and similar communities that have little perceived bicycling would have provided data for useful multiple-regression analyses to test the various hypotheses.

Rather than testing well-known and for the most part well-developed hypotheses on the barriers to bicycling, this study at best tells us what bicycle program experts think constitute the obstacles to bicycling. But even here the study suffers from a number of methodological and factual shortcomings and distortions:

1. In Table 1 why does the study put transportation infrastructure after institutional response? The mean responses are equal and the infrastructure has a tighter SD. Changing these positions makes infrastructure look very important. But the paper never clearly defines infrastructure. Does it include separate facilities or just improvements to the road or some combination of factors?
2. Why does the study summarily throw out the opinions of the institutions experts, who, under the above logic, rank infrastructure first? Surely we cannot accept the reason stated in the paper that the major contractor, MBA, "felt bicycle program experts probably had a better overall perspective and chose to use their evaluations." Why should we not reason that institutions experts, who presumedly do not bicycle to work, more closely represent the mass of potential bicyclists whom we must attract to have any appreciable effect on energy use, air pollution, congestion, levels of exercise and health, or other important social variables? But why throw out either set unless we have a preconceived position we are trying to support?
3. How was the panel selected, what was their knowledge of the literature, and what were their bicycling experiences and tastes? The study tells us virtually nothing about the sample of experts. Remember, the panel of bicycle program experts apparently drew up the basic questionnaire, which was then sent out to institutions experts. In that questionnaire, facilities apparently were given a vague and low-ranking position, and costs, theoretically the most important determinant, were virtually ignored.
4. Were the bicycle experts really responding to the question, "What will increase bicycling" or were they also addressing the question, "What ought a good bicycling program to contain?" The problem with using practitioners to develop predictive models is that practitioners tend to become entrapped in their values and policies and may have less ability than more-detached observers to objectively predict events.
5. Why did the study fail to mention other readily available studies done on obstacles to bicycling and attempt to reconcile the conflicting conclusions? Were the authors aware of the other studies?

In conclusion, the present study tells us little about the determinants of bicycling. It does tell us that bicycle program experts (assuming the sample is representative) believe that education and bicyclist competence play or should play an important role in bicycle programs. Most bicycle analysts would probably agree with that conclusion and support responsible education, which also indicated the risks of bicycling, particularly for increasing safety. But wide gaps may exist between values and actual determinants of bicycling. Concentrating on values may cause us to miss some of the important hypothesized determinants such as distance and time costs. We need objective reviews of studies that have tested these determinants (7,8) and further testing, such as cross-community studies, if we want to understand the obstacles to and determinants of bicycling.

## Authors' Closure

We thank Everett for his comments and welcome the opportunity to respond. Feedback invariably indicates points that have been omitted and points that have been inadequately explained. In this case we appear to have been guilty of a few of the former and several of the latter.

Prior to responding to Everett's concerns point by point, a general comment should be made that apparently was not adequately explained in the paper. Although it was stated in the abstract and the introduction to the paper, we should have more clearly stressed the fact that our purpose in writing this paper was not to provide detail of bicycling problems nor the specifics of the DOT study. Our purpose was to present a methodology that had proved useful so that others could be aware of it and possibly adapt it for their use. The paper should be read in that context. For more details of the DOT study, the reader is referred to the report by Moran (1).

Everett's first comments criticize the use of a panel-of-experts approach. He implies that an alternative approach would have been what we term a basic research study. The choice of an approach was not ours but that of DOT. In general, the first step in a policymaking procedure is to determine whether adequate basic research has been conducted in the subject area. If so, experts are consulted who know the field and the studies to date and who help analyze and synthesize available information. If not, a basic research study is conducted. Then, once the study has been completed, the results should be synthesized with other study results by experts, so experts should be polled in either case. For this study DOT apparently concluded that sufficient basic research data were available and that expert appraisal and synthesis were needed. Expert surveys, however, are usually not very rigorous or explicitly comprehensive. The uniqueness of this study was that a large group of experts was systematically and objectively surveyed and the problem was comprehensively treated.

The second set of comments made by Everett deal with time and cost considerations. These comments make clear our failure to provide adequate study background information. As explained in the introduction, there were several study tasks, of which ours was one. During the obstacles-identification task, time and costs were identified as bicycle use determinants. However, DOT officials decided that policies that address these determinants were not within the purview of the study. Thus, the study was constrained in its scope. Time considerations were considered during the bicycle-use target development task through the use of a modal-split model.

Everett next returns to the theme of a basic research study as an alternative approach. This time his implication is that such a study would have been less demanding on limited time and resources. As discussed above, even if such a basic research study had been conducted, an experts-synthesis stage would still have been necessary. As it was, our study required only an initial meeting with a small group of experts and a mail-back workbook exercise in which some 50 experts were polled. All this was accomplished within less than three months. All of the testable hypotheses mentioned by Everett were explicitly or implicitly addressed. One can imagine the time, cost, and accuracy concerns associated with the kind of community sampling that he intimates as appropriate.

Everett continues with the observation that our study "at best tells us what bicycle program experts think constitute the obstacles to bicycling." We would amend this to read "the most important obstacles." Then the sentence would succinctly state the objective and achievement of the study.

In response to Everett's specific numbered comments,

1. He is correct about the ranking, although a better manner in which to present Table 1 would have been to assign both objectives a ranking of 2 and list the infrastructure objective first. Since the numerical ratings are listed, the impact of such a change would have been minor. As discussed in the organization of the problem section, hierarchy terms are provided definition by subsequent terms into which they are divided. This is true for the infrastructure term.
2. Everett raised a good point, which was a subject of debate at MBA. A counterargument was that if the masses understand themselves so well, why do we have so many expert psychoanalysts? Bicycle program experts are experts because they have studied the subject. DOT did keep this source of uncertainty in mind, however, when actually using the results to develop a program. As is discussed in the last part of the section on identification of critical objectives, "given the variability among bicycle program and institutions experts' responses," specific rankings were not used in formulating the program. Rather, experts' rankings were used as indicators, and the weaknesses of the survey, as exemplified by Everett's point, were known. Thus Everett's charge that we attempted to substantiate a preconceived notion is unwarranted and inaccurate.
3. As stated above, the purpose of the paper was to profile the methodology, not to present specifics. For more information on expert participants, readers are referred to the report by Moran (1). Also in this comment, Everett inaccurately characterizes the process used. As discussed in the paper, a small group of bicycle and institutions experts formulated an assessment structure, which was then used as the basis for the workbook sent to a larger group of bicycle and institutions experts.
4. Everett's implication is that persons heavily involved in a field cannot be objective. We agree to an extent but also realize the importance of insights that are provided through experience and involvement. Thus we always recommend that panel representatives differ in background, degree of involvement, and perspective. Then results are evaluated and used and the biases of the panel and limitations of the survey are known.
5. For a discussion of the studies reviewed during the objectives identification task, please refer to the task description and the bibliography in the report by Moran (1).

In conclusion, we again thank Everett for his comment and hope that our responses cause the paper to be better understood.

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# Bicycle Task Analysis: Development and Implications

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**Agreement as to what the critical tasks in bicycling are is essential to the development of valid bicycling educational programs. The bicycle task analysis (BTA) represents a significant first effort to describe what is involved in safe and efficient bicycle operation. In general, it follows the format of the motorcycle task analysis and the moped task analysis. A panel of 15 nationally recognized bicycling specialists reviewed the first draft of the BTA to check for inaccuracies, errors of omission, and organizational design. Following a complete revision of the first draft, the same review panel completed a criticality rating. This was a process by which specific tasks were rated in three categories: efficiency of operation, accident prevention, and accident severity. It is this criticality scoring that does the most to further one's understanding of what tasks are most important in bicycling for safe and efficient operation. The BTA provides a more reliable basis for developing a bicycling education program than that used by any existing bicycling curriculum.**

A task analysis is a complete description of the behaviors, knowledge, and skills necessary for the successful completion of a particular task. Task analyses have been written for automobile, motorcycle, and moped operation, and their most common use is in the development of instructional programs. The reason for this is that a task analysis breaks a gross skill, e.g., motorcycle operation, into its component parts (such as turning left and operating alongside parked vehicles) and also sequences the behaviors into teachable segments (e.g., approaches in center of lane, observes roadway for traffic, proceeds with turn, operates at reduced