URBAN PUBLIC TRANSPORTATION GOAL DETERMINATION: A RESEARCH APPROACH

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Urban problems such as energy shortages, congestion, and increasing highway costs are prompting communities to reassess the need for public transportation. A solution can be achieved if citizens are encouraged to rely less on the automobile and more on public modes for intracommunity travel. However, achieving user shifts in mode preferences is not easy because of the automobile's popularity. Consequently, if public transportation is to realize its potential, effective planning is essential, and it must begin with the setting of appropriate goals for community transportation services. Among the complexities that add to the difficulty of setting goals are the differing needs of existing and potential user groups, the variety of transportation service alternatives, community role structure, environmental constraints, and limited resources. A promising approach to setting community transportation goals is the policy Delphi method. Through this technique information is collected independently from various individuals and groups concerning future events and policy issues. Opinions and information are gathered without the participants' having to interact. Moreover, feedback of information from other participants is provided to each Delphi panel member. The paper examines the community transportation goal-setting task in the context of a complete transportation planning process. Major attention is given to applying the policy Delphi method to generating community transportation goal information and assessing the extent of agreement among policy makers.

●DESIGN of new and improved urban public transportation systems will be a major community responsibility in the decades ahead because of gasoline shortages, traffic congestion, and rapidly increasing highway costs. These problems can be reduced if public transportation services are properly planned and implemented such that consumers are encouraged to rely less on private automobiles. Nevertheless, achieving this shift in preferences is a difficult and complex task. Some experts have speculated that, as long as gasoline is available to consumers, it is doubtful whether drivers will change to public transportation (1). Consequently, to achieve any shift in transportation mode preferences will require effective planning that must begin with the setting of and agreement on appropriate goals for a given community.

Goals are quantitative and qualitative guidelines for use in focusing and directing public transportation planning efforts. Determination of goals in urban communities presents a complex challenge because of differing needs of existing and potential user groups, transportation service alternatives, community role structure, environmental constraints, and resource limitations. Yet effective transportation planning cannot be accomplished unless operational goals and action priorities are established. Typically, when goals are specified at all, they focus on system efficiency and tend to neglect needs of various user groups and the role of public transportation in solving community problems.

Our point of view toward public transportation encompasses various service alternatives such as conventional bus and rail fixed-route, fixed-schedule systems, car and bus pooling, taxicabs, and demand-responsive systems (e.g., dial-a-bus and shopper minibuses). The goal-setting process should consider all feasible system alternatives

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in a particular urban community. Because of the wide variation of factors that influence public transportation from one city to another, goal determination should be community specific. Of course, to the extent that federal and state public transportation policies (e.g., funding support) influence local planning, they should be recognized in the goal-setting process.

One promising approach to the urban public transportation goal-setting process is the Delphi method of independently collecting and analyzing information from relevant groups on uncertain future events and policy issues. The unique characteristics of transportation goal setting at the community level match well with the advantages and requirements of the Delphi procedure. Accordingly, our purpose is to examine how the Delphi approach can be used to generate information for the public transportation goal-setting process. The nature and scope of public transportation goal setting are outlined, and major goal areas are identified and discussed. A methodology for determining goals is presented that uses the Delphi method as a systematic approach to identifying goals, obtaining community feedback, assessing conflicts among individuals and groups, and obtaining a consensus from those involved in the public transportation decision-making process.

GOAL-SETTING TASK

Goal Setting in the Planning Process

Goal setting is only one element in an integrated planning process. Planning, implementation, and control of urban public transportation systems involve six major phases of activity:

1. Community inventory or audit—The community characteristics that may influence (or constrain) public transportation must be identified. This includes travel origin-destination analysis, geographical patterns, land use, residential and employment distribution, and other factors.

2. Determination of community goals—Goals provide a set of guidelines (including priorities) on the role and importance of public transportation within which the overall planning process should be accomplished.

3. Identification of feasible transportation system alternatives—The purpose of this phase is to identify relevant public transportation system options for various community groups (e.g., senior citizens, school children, commuters).

4. Selection of operational objectives—At this stage, operational (measurable) objectives should be set regarding specific public transportation needs. Objectives should be set for each citizen group (market target) to be served and should be consistent with overall community goals (stage 2).

5. Design and testing of systems—Next strategies must be formulated and tested (if appropriate) to achieve objectives for each market target including new and revised transportation systems, organizational design, and other management and operational decisions.

6. Implementation, evaluation, and control systems—Here plans are executed, results are evaluated, and necessary modifications are made over time to bring actual results as close as possible to desired results.

Prior Work in Goal Determination

Various approaches to public transportation policy planning are discussed in the literature, and broad categories of goals and objectives are mentioned; nevertheless, little attention has been paid to actual methods of goal setting. Part of the difficulty in developing specific transportation goals and objectives has been due to the political nature of the planning process, lack of priorities, and the problem of developing

accurate forecasts of future needs.

Engelen and Stuart acknowledge the importance of developing explicit goals and objectives while realizing the problems in establishing approaches for identifying, stratifying, measuring, and analyzing the relative importance of different goals to various interest groups (2). They recommend several specific development goals for urban transportation systems as guidelines for beginning community value research. Ellis (3) indicates several problems inherent in the transportation planning process including (a) assessment of the impact of a transportation program on various individuals and groups, (b) measurement of the change in community values over time, (c) use of abstract values in the planning process, and (d) the inflexibility of the hierarchical transportation process. Ellis recommends that the planner assist the political process in achieving a consensus rather than merely presenting alternatives. Other writers such as Hossack and Hocking (4) and Douglas (5) also recognize similar problem areas and offer a variety of planning models to develop transportation objectives. However, these models are more useful in carrying out the planning process after the general goals have been set. Hauser and Cameron discuss, within a regional transportation concept, the need to ascertain goals from various community leaders and planning agencies as a means of placing an objective, measurable bound on the problem definition (6). They suggest using an interdisciplinary team to integrate specialized disciplines into the planning process.

An excellent review of several transportation forecasting techniques is provided by McDaniel (7). He points out that transportation planning is concerned primarily with societal decisions, a fact that is not realized by most long-range forecasts. He reasons that forecasting of this nature can best be done by people outside of the transportation profession. The professional is viewed as an enabler rather than a forecaster. Thus a technique such as the Delphi might well be more revealing if panel participants were made up of generalists from a transportation point of view.

Although some attention has been given to determination of public transportation goals, few systematic approaches have been recommended for accomplishing the task. There is, nevertheless, a clear acknowledgment of the need for specification of goals to guide the public transportation planning process.

Factors Influencing Goal Determination

Three groups of factors normally influence the determination of public transportation goals in a particular community: community problems, transportation needs of various citizen groups, and system effectiveness and efficiency. These areas are shown in Figure 1 along with the specific factors in each of the three groups. In general, goals should result from needs of citizens in the community and the problems that public transportation can help solve. Desired system effectiveness and efficiency influence the extent to which contributions can be made to these needs and problems. The three areas are, of course, closely interrelated. For example, a community that desires to provide transportation to senior citizens as a public service must decide, based on both benefits and costs, the extent to which these needs should be met.

Who Should Set Goals?

The question of who should determine goals is difficult to answer because of the variations that exist in community role structure. Moreover, a variety of points of view, preferences, and motivations are present. An individual may respond differently, for example, as a commuter, taxpayer, businessman, and real estate investor. His or her preferences concerning appropriate community goals may vary depending on his or her point of view (e.g., commuter versus real estate investor). Also, some individuals and groups that are influential in the community are not members of the formal power structure. Although these problems exist, decisions concerning goals must be made. Thus, it is essential that those responsible for goal determination develop effective

mechanisms for collecting and analyzing information from various individuals, groups, and organizations in the community.

In many cases, elected officials function as the goal-setting group for the community. They represent the citizens and are influenced in varying degrees by individuals and organized groups. Moreover, they typically have developed formal and informal information channels to make them aware (at least in general terms) of community needs, problems, conflicts, and opportunities. Yet, because these information systems are probably not adequate, consideration should be given to improving information flows to public officials from various individuals and groups in the community concerning public transportation goals. In this regard an interesting proposal has been made for a citizen information system using technology to extend citizen and government dialogues (8). Charnes et al. offer useful guidelines concerning information requirements for urban systems (9). Improvement in information flows represents a major challenge if information needed for planning is to be effectively generated.

Figure 2 shows the goal-setting process in public transportation planning with elected officials as the focal point. Information and influence flow from individuals and groups in the community to the elected officials. Decision makers also may be influenced by federal and state government policies and guidelines, particularly when financial support is sought from these sources. If a transportation planning unit or other group involved in public transportation planning exists in the community (e.g., transit authority, transit operator, planning commission), elected officials may receive information and recommendations from these sources. Based on these inputs, elected officials are viewed as responsible for goal formation. Their role in this process seems appropriate since they will frequently determine whether or not public transportation plans are to be implemented.

How public officials function in the goal-setting role varies from community to community. The description of the goal-setting process shown in Figure 2 is sufficiently flexible to include various approaches within this general framework. For example, the transportation planning unit might be charged with formulating goals to be approved by all or certain elected officials (e.g., mayor or city council or both). In this case, the relative position of the elected officials and transportation planning unit boxes in Figure 2 would be interchanged.

DELPHI TECHNIQUE

The Delphi technique is a systematic method for soliciting opinions individually from a group of people, combining responses, and feeding the information back to participants for use in reassessing their opinions. This process continues for two or more rounds until some degree of consensus is reached. An extensive bibliography and discussion of the methodology and applications are provided by Turoff (10). The Delphi method has been applied mainly to forecasting technological change and, to a lesser extent, to corporate planning. Specific uses include projected developments in medicine, department store personnel requirements, forecasts of information processing technology, public affairs forecasting, and industry trends.

The Delphi procedure provides an alternative to group discussion as a way of obtaining a consensus on some future estimate. Use of the Delphi removes direct interpersonal interaction and confrontation characteristic of committee and organized group activities. It encourages individual thinking and, at the same time, provides an external stimulus (via feedback) to participants. Because individuals can analyze a problem, issue, or future event and can provide estimates or answers in private, many behavioral aspects of group deliberation are avoided. Members of a Delphi panel working independently are more likely to be candid in their responses. Group pressures are not present, and subordinates are less likely to feel a need to echo responses of superiors. Using a multistage approach of two or more rounds allows panel participants to modify answers given in one round in a subsequent round. They avoid going on record as would be the case in a group meeting and thus are more likely to modify initial estimates of uncertain events or preferences. Also, the use of multiple rounds

Figure 1. Factors that influence determination of public transportation goals in the community.
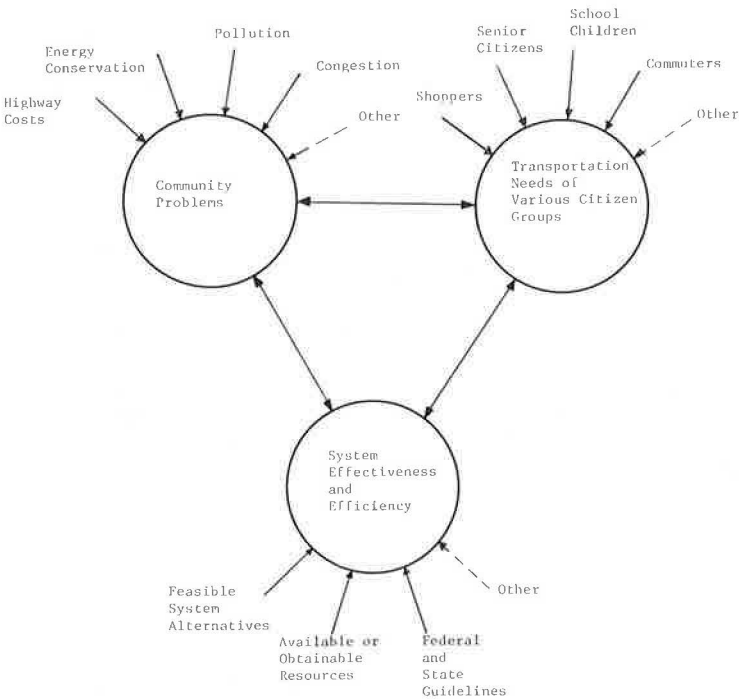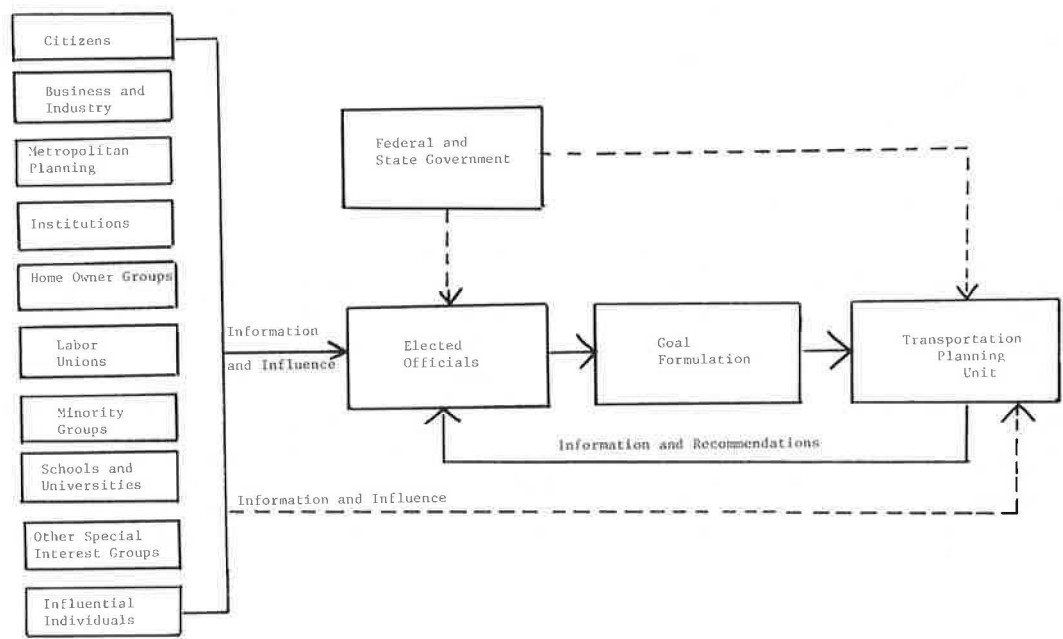

Figure 2. Public transportation goal-setting process.

provides an opportunity for more gradual development of a preference, opinion, or estimate as compared to a one-shot approach. Although the accuracy of Delphi estimates is difficult to evaluate (particularly in regard to policy issues), where testing has been possible Delphi results have been shown to to be more accurate than other forecasting methods when historical data are not available (12). These advantages are particularly relevant to overcoming some of the problems in establishing public transportation goals.

Application to Policy Areas

Use of Delphi procedures has largely been centered on forecasting future events or their probabilities of occurrence. A limited number of applications have been made in the policy area (10). Delphi procedures have been used by Oak Ridge National Laboratories to derive weights for indexes of land use with a high potential for future land use. A policy application concerning commercial land use development is discussed by Schneider (11). Inasmuch as goal determination for urban public transportation is a type of policy formulation, the Delphi methodology also appears quite promising for this use. Public transportation goal development typically involves the consolidation of different points of view.

Issues and Problem Areas

Although the Delphi procedure has significant advantages, there are also problem areas that should be recognized by those considering use of the approach. According to Turoff (10), several relevant questions that should be considered by designers, participants, and users relate to selection and briefing of the panel, type and content of information feedback after each round, assessing the accuracy of Delphi-generated information, and use and interpretation of results.

Many of these questions must be addressed in the initial design effort. Their importance varies by application. Because Delphi information is subjective, judgments must be made. For example, should responses of panel members be weighted to reflect each participant's expertise? Perhaps most important, the potential user of Delphi should recognize that the method is deceptively simple. The designer and user must consider all relevant implications if Delphi results are to be properly integrated into the decision-making process.

DELPHI GOALS STUDY APPROACH

The first task in a Delphi goals study is the selection of a design team who will be responsible for planning, implementing, and analyzing the results of the study. The major stages in a Delphi goals study are shown in Figure 3. Building on prior work in goal determination, the design team must define the scope of the study and identify appropriate goal areas for study (Figure 1). Analysis of the community's role structure as related to public transportation will be helpful in guiding selection of the Delphi panel. Concurrently, a questionnaire should be designed for use in soliciting opinions from panel members. With these tasks complete, the first round of responses can be obtained, analyzed, and fed back to participants for their use in the second round of responses. This process continues through two or more rounds until responses concerning community goals stabilize. A more detailed discussion of the major elements in the study approach follows.

Design Team

People from various professional areas can contribute knowledge and experience that

are useful in urban public transportation planning. Transportation involves and influences government, business, other institutions, and citizens. The planning task requires engineering and management skills, understanding of government and legal processes, and knowledge of land use and other aspects of urban planning. Based on the importance of considering different points of view and using various professional capabilities, the following design team was used in a pilot test of the Delphi procedure for generating public transportation goal information in an urban community:

1. Professional civil engineer with extensive experience in public transportation system design and operation,
2. Business administration professor with experience as a businessman and as a management consultant,
3. Sociologist with extensive research experience in urban communities,
4. Geographer with technical expertise in urban geography and demographics,
5. Political scientist with experience in the state and community where the pilot study was conducted, and
6. Professional urban planner with extensive planning experience.

A multidisciplinary team like this can facilitate the design of a goals Delphi by providing various points of view concerning public transportation goal development. This group proved invaluable, not only in study design, but also in analysis and interpretation of the information generated. For example, the design team must have a clear understanding of the community role structure to aid in identifying the Delphi panel. Much of the detailed design work can be accomplished by two or three individuals, providing the other members of the team assess the approach and provide suggestions for improving it.

Selection of Panel Participants

The logical role of elected officials as a goal-setting body has been discussed. Although this group may appropriately accomplish the task or alternatively respond to recommendations from the transportation planning unit, a question remains on how information should be assembled for public transportation goal analysis. Different levels of role structures relevant to public transportation issues and policies are shown in Figure 4.

Consideration should be given to soliciting information from one or more of these levels. Various alternatives exist for assembling goal information (Figure 5). For example, a representative sample of citizens could be surveyed on goal preferences. Also, the sample of citizens could serve as Delphi panel members. The resulting information could be analyzed by the planning unit and used as a basis for developing recommendations for review by elected officials. Alternatively, results of a citizen survey could be reviewed by elected officials; they subsequently could serve as a Delphi panel for developing goal preference information. As shown in Figure 5, other combinations of information from different role structure levels could be used depending on the assessed need for goal preference information in a particular community. Selection of appropriate sources (role structure levels) of goal information in a given community should consider (a) extent of citizens' concern and interest in public transportation, (b) indicated desire for involvement in transportation planning by representatives of various groups and organizations, (c) public officials' experience with public transportation issues and problems, and (d) extent of perceived controversy in the community concerning the role and scope of public transportation. Because of the energy crisis, public transportation has become significantly more visible in many communities because of its possible role in helping to conserve energy and reduce travel costs. This will likely place increased importance on obtaining goal information from various sources in the community.

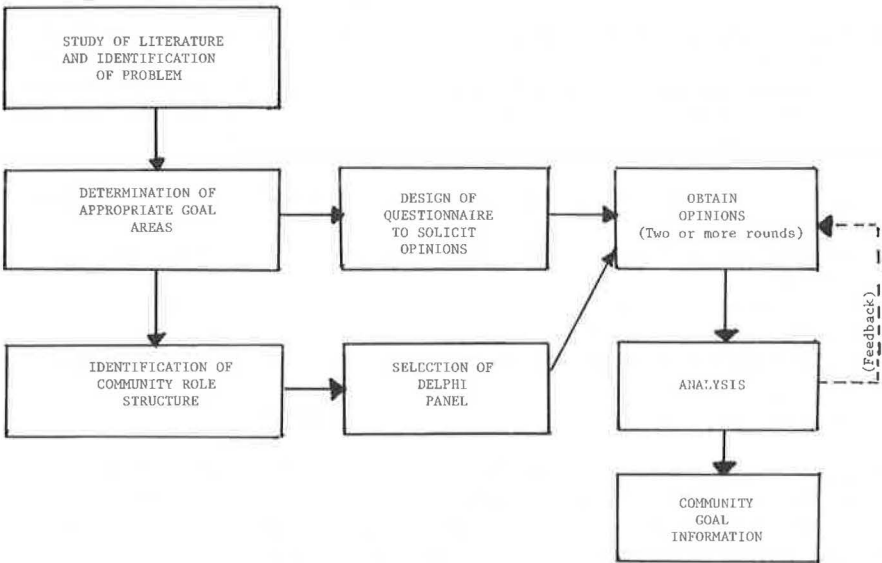**Figure 3. Stages in Delphi study to determine urban public transportation goals.**

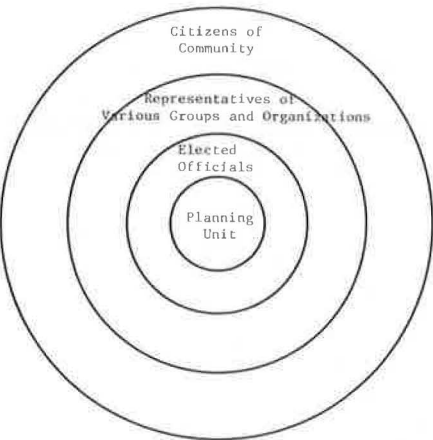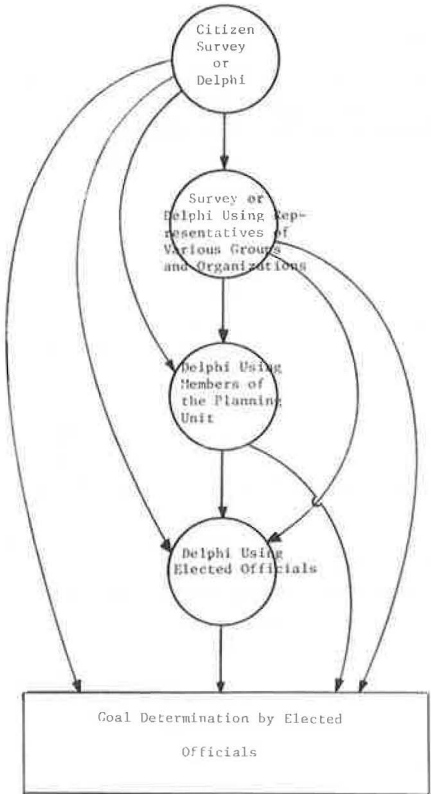**Figure 4. Community role structure for public transportation goal determination.**

Figure 5. Alternative approaches to assembling information by elected officials for goal determination.

Questionnaire Design

The format of the questionnaire used to obtain responses from panel members can vary from highly structured (forced choice) to open-ended questions. In either, the range of questions asked should be sufficiently comprehensive to cover all relevant goal areas. With a structured format, fewer rounds are needed to reach a stable response level; for an open-ended questionnaire, typically more revisions in the original questionnaire are needed. Alternatively, the responses to nonstructured questions would probably not be gleaned through forced-choice questions. Both formats can be used in a single questionnaire. For example, where all possible responses are uncertain, open-ended questions can be used. In the pilot study using the three general goal areas discussed earlier (community problems, transportation needs of various citizen groups, and system effectiveness), a comprehensive structured questionnaire was developed and pretested by the design team. Provision was also made for respondents to ask questions and to add areas that they believed should be covered in the study. An example question from each of the three goal areas is shown in Figure 6. Also shown are open categories allowing participants to add questions.

Implementation and Analysis

It is important that panel participants be briefed on the nature and purpose of a Delphi study. This can be accomplished through written instructions in combination with a personal visit with each participant on the first round by a member of the design team. Subsequent rounds could be handled by mail. Other approaches to orientation are possible depending on the group involved, participants, geographic location, nature of the study, and related considerations. These include detailed written instructions sent by mail, telephone briefing of respondents, and group briefings (providing there is no reason to withhold the identity of participants).

So that each participant can assess group responses as an input to his or her answers in subsequent rounds, some type of summary must be provided. This can take the form of high, low, and median values for each question; a frequency count for each response category of a question; percentile breakdowns; or other appropriate summary statistics depending on the type of question. A percentile or frequency breakdown may be preferable in terms of giving participants as much information as possible about group response. In cases where open-ended questions are asked, responses can be listed for review by respondents.

The time span of a goals Delphi can be several weeks if three or four rounds are used along with feedback of summary responses on each round. Follow-up will typically be necessary when questionnaires are mailed to speed up response and to eliminate nonresponse. Even though participants in our pilot study were highly cooperative, several weeks elapsed before the completion of only two rounds.

Results

It should be emphasized that the primary role of the Delphi panel in the public transportation goal determination process should be to provide information to those responsible for setting goals rather than to establish the final goal. This is particularly true when the Delphi is used to obtain goal preferences from various levels in the community. In cases where the Delphi is used by public officials to assemble information on their own goals preferences (rather than to try to achieve the same objective through group meetings), they will ultimately need to meet as a group to resolve issues in areas where lack of a consensus is obtained. One advocate (10, p. 153) of the usefulness of the policy Delphi has observed that it

Figure 6. Examples of questions included in a transportation goals Delphi questionnaire.

CITIZEN'S TRANSPORTATION NEEDS AREA

Any family totally dependent upon public transportation in the community should have services available to travel to and from:

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Schools	1	2	3	4	5
Place of employment	1	2	3	4	5
Recreation and entertainment facilities	1	2	3	4	5
Shopping facilities	1	2	3	4	5
Health care facilities	1	2	3	4	5
Religious facilities	1	2	3	4	5
Community organizations	1	2	3	4	5
Other:					
_____	1	2	3	4	5
_____	1	2	3	4	5

EFFECTIVENESS AND EFFICIENCY AREA

How do you feel the public transportation system should be financed on a continuing basis? (Please answer all three questions below.)

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Totally by fares	1	2	3	4	5
Low nominal fares with partial subsidy	1	2	3	4	5
Free to rider--total subsidy	1	2	3	4	5

COMMUNITY PROBLEMS

Do you feel that public transportation could be used to help solve problems in the following areas?

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Reducing automobile pollution	1	2	3	4	5
Reducing traffic congestion	1	2	3	4	5
Reducing gasoline use	1	2	3	4	5
Reducing traffic accident rate	1	2	3	4	5
Reducing noise level	1	2	3	4	5
Improvement of strip development patterns	1	2	3	4	5
Improvement of parking conditions	1	2	3	4	5

Can you think of other problem areas which should be included?

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

... is not in any way a substitute for studies, analyses, staff work, or the committee. It is merely an organized method for correlating views and information pertaining to a specific policy area and for allowing the respondents representing such views and information the opportunity to react to and assess differing viewpoints.

The results of a goals Delphi may not reflect a consensus in all goal areas. For example, it is unlikely that all elected officials will agree on how public transportation should be financed (e.g., fares, partial subsidy, or total subsidy). Yet, by providing each panel member with summary responses of the group, a given respondent is aware of the preferences and opinions of others. Information that indicates the lack of a consensus can be valuable to those responsible for planning public transportation.

IMPLICATIONS AND SUMMARY

The following implications for the potential user of a goals Delphi are based on observations of those who have used the Delphi method to generate policy information and on our own experience.

1. There may be a tendency on policy issues for respondents (particularly elected officials) to answer in terms of what they think is politically appropriate, although this should be less prevalent in the Delphi process than, for example, in an official's public statement. Also, in applications where information is obtained from other levels (e.g., citizens, groups, and individuals), elected officials may find this information useful in strengthening their position or may find that it causes them to shift their position.

2. The potential problem of changes over time in opinions and preferences of Delphi participants should be recognized. Unlike forecasting applications, goal preferences may change over a shorter time span because of environmental changes or inclusion of different people in the community power structure (e.g., newly elected officials). For example, the energy crisis no doubt has significantly influenced goal preferences regarding public transportation. Because of the possibility of changes over time, goal information should be collected at least every few years.

3. The question of who should set community public transportation goals at the community level is not resolved, although a rationale in support of elected officials' fulfilling this role has been offered. This issue deserves further study and analysis.

4. The effectiveness of the information systems of elected officials should be assessed. A two-stage Delphi study involving, for example, representatives from community groups and organizations in stage 1 and elected officials in stage 2 should be tested to assess the influence of such goal information on elected officials.

5. A particularly complex question related to public transportation goal development in many communities is that of geographical governmental boundaries. For example, in our pilot study, some of the goal areas in which lack of agreement existed apparently occurred because the panel was made up of city and county officials. The Delphi application discussed by Schneider (11) involved representation from two central business districts plus a third group with no possible geographical bias; participants were organized into three subpanels. A Delphi approach can be a very effective means of identifying controversial goal areas between different levels of government.

The many advantages of the Delphi method for collecting goal information outweigh the possible limitations. Nevertheless, the implications related to the nature of a policy application and the specific characteristics of the public transportation area should be recognized. Preliminary tests of the approach have been sufficiently encouraging that further applications should be undertaken. Effective mechanisms for aiding the goal determination process in public transportation are critically needed. Delphi offers a promising contribution to this methodological gap.

ACKNOWLEDGMENT

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