

Delphi

PREREQUISITE TOOLS

None.

USAGE

PURPOSE

The Delphi is a group process technique for eliciting, collating, and generally directing informed (expert) judgment towards a consensus on a particular topic.

USES

The Delphi may be used in:

- 1) Establishing goals and their priorities.
- 2) Identifying the dimensions and the attributes of a problem.
- 3) Providing forecasts (e.g., identifying future developments and their effects).
- 4) Clarifying positions and delineating differences between group members.
- 5) Gathering information from a group whose members do not meet face-to-face (either by choice or practicality) and wish to retain their anonymity.

SHORT DESCRIPTION

The Delphi is a method whereby individuals are allowed to focus on and debate issues anonymously. The

study is typically conducted by mail through several rounds of questionnaires (QTN, page 19). The results of each round are collected, collated, and analyzed by a design team. Based on this analysis, questions for the subsequent round are developed. The Delphi generally promotes convergence of opinions, although it may provide the basis for disagreement.

ADVANTAGES

- 1) The anonymity provided by the Delphi precludes some undesirable aspects of face-to-face communication, such as dominance by certain personalities and inhibition of expression.
- 2) A Delphi participant may respond with opinions which more truly represent his or her feelings.
- 3) Individuals who may not otherwise afford the time required for a group meeting may participate.
- 4) With the Delphi, a large heterogeneous group can participate on an equal basis.
- 5) The Delphi is obviously useful when the respondents are geographically scattered.

LIMITATIONS

- 1) The Delphi is precluded when there is a limited time available to aggregate participants' judgments, because of the delay in gathering and assimilating responses.
- 2) The Delphi should not be used with individuals who have difficulty reading or expressing themselves in written communication.

3) High participant interest and commitment is assumed or the quantity and quality of responses decreases with successive rounds.

4) Desirable features of a group meeting, such as instant communication and intellectual stimulation, are compromised.

REQUIRED RESOURCES

LEVEL OF EFFORT

The design team will have to spend a significant amount of time designing questionnaires and analyzing completed questionnaires. Integration between the decision maker and Delphi design team is necessary to ensure that the goals or requirements of the decision maker are understood by the design team.

SKILL LEVEL

The design team must be able to establish unbiased questionnaire designs which relate the Delphi exercise to its purpose (see QTN, page 19). The feedback of comments and reactions to the respondents should be succinct and representative without reflecting the bias of the design team. Members of the design team who are knowledgeable in the subject matter greatly facilitate this crucial process.

TIME REQUIRED

Approximately six weeks are required to complete a Delphi exercise which consists of four rounds of questionnaires (see figure 1). Since eight days are allowed for each set of responses (including three days for *dunning*), the Delphi requires only about two weeks of actual effort.

The continual motivation of the respondents is important in order to get a quick response and good return percentage. Consequently, the design team needs to minimize the delay between receipt of questionnaires and transmittal of the next one to participants. Analysis of the returned questionnaires and design of the subsequent questionnaires should begin immediately rather than waiting until the expected return for each round.

DESCRIPTION OF TOOL

DEFINITIONS

1) *Dunning* is the process of recontacting participants who have failed to return their questionnaires.

2) A *target group* is a set of persons with certain common characteristics, e.g., all experts possessing knowledge about a particular problem, or farmers with land in the same river basin.

REQUIRED INPUTS

Since Delphi is a tool to aid decision making, it will be most effective if the decision maker is involved throughout the process.

Respondents should be considered who:

- 1) Have special experience or knowledge to share;
- 2) Represent a cross-section of opinions; and
- 3) Can be motivated to participate.

The size of the design team will vary from two to five, in direct proportion to the size of the respondent group. Delbecq, et al. (1975) found that, in their experience, 30 well-chosen respondents were sufficient: few additional ideas were generated by having more participants. About 15% of the selected participants will decline.

For the questionnaire to communicate successfully, the questions should:

- 1) Be as short as possible.
- 2) Be adapted to the language most familiar to the respondent's area of expertise (e.g., health or education).
- 3) Elicit useful responses at the level of abstraction required (i.e., general vs. specific).

TOOL OUTPUT

The output of the Delphi exercise will generally be a convergence of opinion.

One type of output may be a frequency distribution or histogram of forecasts (see HIS, page 131). For example, the respondents may estimate what the legal minimum wage should be for the country of Temasek in 1980 in order to ensure adequate housing and food for citizens. The frequency distribution graph in figure 2 indicates that an interval of \$75 to \$100 was favored by most respondents as the desirable minimum wage. It also shows that a great majority of the respondents would not set a minimum wage below \$75. The mean and standard deviation may be computed for the responses and added to the graph (HIS, page 131).

Another type of output is the ranking of responses to a particular question. For example, the respondents may list the problems they perceive in the health field. The output is a vote on the importance of the problems.

METHOD OF USE

GENERAL PROCEDURE

Delbecq, et al. (1975) recommend that the following steps be followed in designing and implementing a Delphi exercise. This procedure is only one way in which a Delphi exercise may be carried out. The number of rounds of

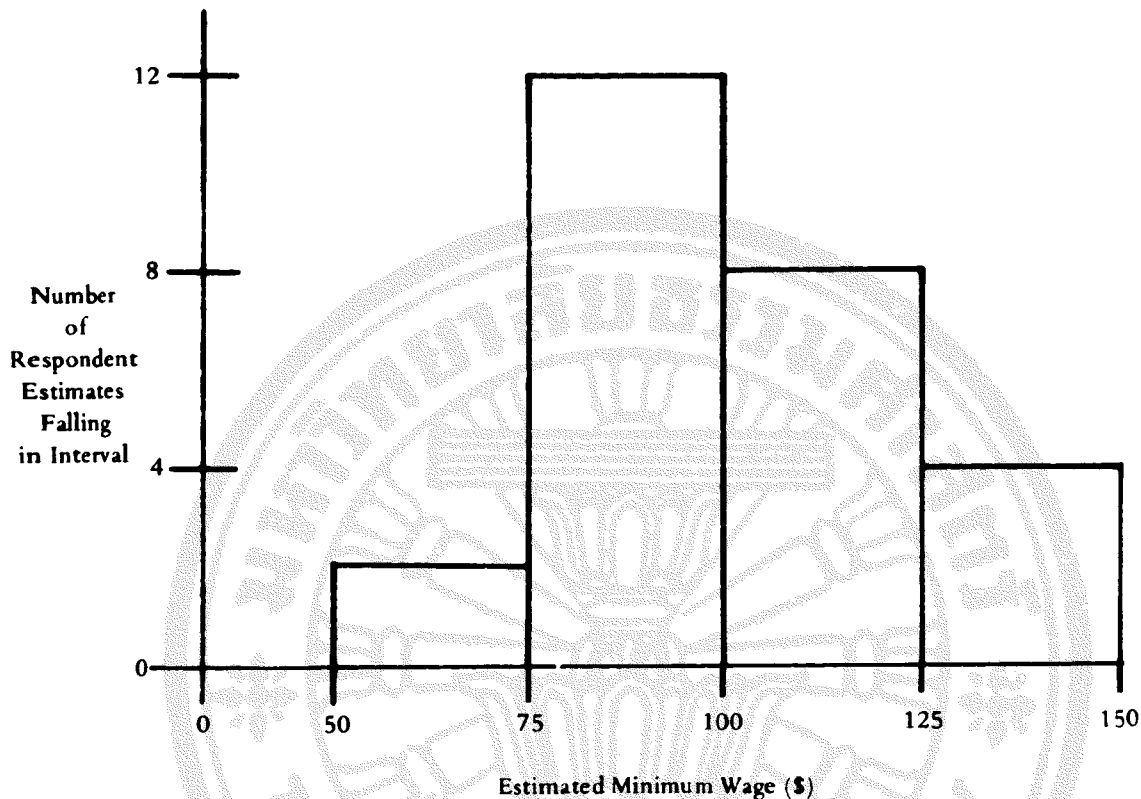
FIGURE 1
Schedule for Delphi

Activities	Minimum Time Required	
1. Develop problem statement	½ day	} one day
2. Select respondents	½ day	
3. Contact respondents	2 days	
4. Develop questionnaire #1 and test	½ day	
5. Type and send out	1 day	
6. Response time	5 days	
7. Dunning time (if used)	3 days	
8. Analysis of questionnaire #1	½ day	} two days
9. Develop questionnaire #2 and test	½ day	
10. Type and send out	1 day	
11. Response time	5 days	
12. Dunning time (if used)	3 days	
13. Analysis of questionnaire #2	½ day	} two days
14. Develop questionnaire #3 and test	½ day	
15. Type and send out	1 day	
16. Response time	5 days	
17. Dunning time (if used)	3 days	
18. Analysis of questionnaire #3	½ day	} two days
19. Develop questionnaire #4 and test	½ day	
20. Type and send out	1 day	
21. Response time	5 days	
22. Dunning time (if used)	3 days	
23. Analysis of questionnaire #4	1 day	
24. Prepare report	1 day	
25. Type report and send out	1 day	
26. Prepare respondents' report	½ day	
27. Type report and send out	1 day	

The minimum time is 47 days, allowing 8 days (including dunning) for each response.

SOURCE: Andre Delbecq et al., *Group Techniques for Program Planning: A Guide to Nominal Group and Delphi* (Chicago, Ill.: Scott Foresman, 1975), p. 87.

FIGURE 2
Frequency Distribution of Estimates of Minimum Wage



questionnaires, the types of questions, the responses required, and the analyses performed will vary depending on the type of application and the actual situation.

1. Determine the basis for a Delphi.

- 1.1 A statement of objectives or problems is developed by the decision maker in cooperation with the rest of the design team.
- 1.2 Target groups of respondents (e.g., agricultural economists, engineers, planners, etc. in an agricultural development exercise) are generated by the design team. Names of potential respondents are then identified.
- 1.3 Telephone or personal contact is made with the potential respondent. The respondent is informed of the objectives of the Delphi, the nature of the respondent group, the obligations involved, how long the Delphi will take, how the Delphi works, and how his or her participation will be mutually advantageous. The safeguards on anonymity may be explained.

2. Design questionnaire #1.

- 2.1 The initial task of the respondents is generally to generate a list of items. Examples of such

items would be barriers to delivery of services, perceived problems, or potential developments.

- 2.2 The design team formulates questions which are consistent with the statement of objectives (see Questionnaires, QTN, page 19).
- 2.3 A short cover letter outlines the task and reiterates the agreement reached in the initial contact with the respondent in step 1.

3. Solicit responses for questionnaire #1.

- 3.1 If possible, the questionnaire is pretested to ensure that questions are not misinterpreted. The group may be composed of several typical respondents from the Delphi group.
- 3.2 The questionnaire and cover letter are distributed to all respondents. Return of the completed questionnaires should be prearranged (e.g., by enclosing self-addressed stamped envelopes).
- 3.3 If sufficient questionnaires are not returned by the specified date, dunning, or carefully composed reminders, should be directed to the Delphi group. A response rate of 85% is usually considered acceptable.

4. Analyze questionnaire #1.

- 4.1 Responses are copied and cut into slips so that each member of the design team has a set for each question. For example, for the question, "What agricultural developments do you foresee for Temasek in the next 15 years?" the slips may read "more effective fertilizers," "lining of irrigation ditches with concrete," etc.
- 4.2 Each member sorts the response items for all questions into stacks representing similar responses to a question. The stacks are then labeled, e.g., for agricultural development, "Irrigation," "Education," "Technology."
- 4.3 A member of the team reads his stack of labels. Through group discussion, the design team agrees upon categories of responses.
- 4.4 Response slips are reordered according to the category labels. Obvious duplications are eliminated, and closely related items are combined. Statements expressing the resulting items within each stack are formulated. The result of this effort constitutes the list of items for questionnaire #2.

5. Design questionnaire #2.

- 5.1 Questionnaire #2 should help respondents understand, clarify, criticize, and support items identified in questionnaire #1.
- 5.2 Several things may be asked of the respondent. He may be asked to forecast when a development may take place or if the items identify potential future developments. He may be asked to identify what impacts such a development might have, or he may be asked to vote on the items. The respondent is encouraged to provide comments, e.g., he may state why he thinks a problem is important.
- 5.3 If the respondent is to vote on the items, the rank-order procedure may be used (see Nominal Group Technique, NGT, page 14).

6. Solicit responses for questionnaire #2.

Repeat step 3, including pretest and dunning (if necessary).

7. Analyze questionnaire #2.

- 7.1 The comments for each item are placed in stacks (see step 4) to be summarized and communicated to the respondent in questionnaire #3.
- 7.2 If voting has taken place, the results are aggregated and the items are ranked according to

their votes. If quantitative forecasts have been made, a frequency distribution is constructed (see figure 2) and distributed to the respondents in the next questionnaire (see Histograms, HIS, page 131).

- 7.3 The responses are reviewed to see if they are useful in achieving the objectives set up in step 1. If necessary, the next questionnaire can be altered by encouraging a different kind of comment or by making responses more specific.

8. Design questionnaire #3.

- 8.1 This questionnaire aims to explore disagreements identified in questionnaire #2.
- 8.2 The results of step 7—the ranking of the items, the aggregated forecasts, and the summarized comments—are given to the respondents.
- 8.3 The cover letter informs the respondents that they should react to any questions and criticisms and should lobby for or against items they feel strongly about.

9. Solicit responses for questionnaire #3.

Repeat step 3, though a pretest is seldom necessary.

10. Analyze questionnaire #3.

The design team reviews the reactions to the comments and summarizes them in a procedure similar to that outlined in step 4.

11. Design questionnaire #4 (optional).

- 11.1 This is a final attempt towards consensus.
- 11.2 Questionnaire #4 is similar to #3 except that it also provides a summary of respondents' reactions.
- 11.3 The respondents consider the final reactions and are asked to provide a vote or quantitative forecast similar to that indicated in questionnaire #2.

12. Solicit responses to questionnaire #4 (optional).

Repeat step 3, omitting the pretest.

13. Analyze questionnaire #4 (optional).

The rankings are totaled for each item to identify its importance. Where forecasts were made, final frequency distributions are constructed.

14. Closure.

The participants are informed of the results to provide a sense of closure.

EXAMPLE

In dealing with a country's economy, the decision maker determines that continued inflation is a major problem. To combat the problem, he must identify the factors causing inflation and its effects. Target groups may be economists, corporation heads, consumer advocates, trade union leaders, and agricultural experts.

Questionnaire #1 asks, "What are the factors which may contribute to inflation over the next five years?" The respondents answer by listing several items they feel are important:

- Increase price of oil
- Strengthen border defenses
- Shortage of rice

Questionnaire #2 lists all the responses, and each respondent provides comments and votes by giving each item a numerical value which corresponds to the importance of that item.

Item	Vote	Comments
Increase price of oil	3	If new sources of oil are found, price increase may be less
Strengthen defenses on border	0	High likelihood of military aid from another country
Shortage of rice	4	Import prices and number of tons of rice imported will increase

The responses for questionnaire #2 are analyzed. The votes are aggregated and comments are summarized. Questionnaire #3 asks for reactions to the aggregated votes and comments. One respondent's reaction may be:

Item	Vote	Comment	Reaction
Strengthen defenses on border	153	High likelihood of military aid from another country	The other country failed to support our country last year despite previous pledges

Questionnaire #4 then circulates all reactions and asks for a final vote.

THEORY

A number of theoretical arguments have been made to support the claim that the Delphi method is superior to conventional uses of groups in problem solving or forecasting. In 1964, Gordon and Helmer laid the foundations for the Delphi. Delbecq, et al. (1975) compared the characteristics and performances of interacting, nominal, and Delphi groups. Dalkey (1969) provided empirical arguments for the relative accuracy of Delphi estimates compared to individual or face-to-face group estimates.

BIBLIOGRAPHY

Dalkey, N. "An Experimental Study of Group Opinion." *Futures* 1 (June 1969): 282-88.

Delbecq, Andre; van de Ven, Andrew; and Gustafson, David. *Group Techniques for Program Planning: A Guide to Nominal Group and Delphi*. Chicago, Ill.: Scott Foresman, 1975.

Gordon, Theodore J., and Helmer, Olaf. *Report on a Long-Range Forecasting Study*. Rand Paper P-2982. Santa Monica, Calif.: Rand Corporation, September 1964.

Helmer, Olaf; Gordon, Theodore J.; Enzer, Selwyn; de Brigard, Raul; and Rochber, Richard. *Development of Long-Range Forecasting Methods for Connecticut: A Summary*. IFF Report R-5. Middletown, Conn.: The Institute for the Future, September 1969.

Martino, Joseph P. *Technological Forecasting for Decisionmaking*. New York: American Elsevier, 1972, pp. 18-64.