

The Delphi as a Job Analysis Tool

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Abstract. The objective of this project was to revalidate a course of instruction. Traditional approaches, methodologies and resources for validating instruction were considered. Technical documentation was reviewed and subject matter experts were consulted. The findings indicated a discrepancy between the existing instruction and the needs and goals of the training population. This scenario is probably familiar to many instructional designers, however, the approach selected to redesign the course is probably not. Job and task analysis (JTA) methods are amply described in the instructional development literature. These methods include documentation review, observations of the workplace, interviews of incumbents and subject matter experts and various kinds of surveys. The methods work well in areas where the job is well defined and stable and where changes in job requirements are predictable.

Recently I was charged with the responsibility of analyzing a course of study for preparation of commanding officers (COs) for the Navy's submarine force. As I gathered information relevant to the course, I began to realize that a discrepancy existed between the content of the present course and the training needs of the prospective submarine commanding officer. The existing course was a combination of portions of other technician training courses in the various technical job areas of the ship. As a result, the course was more detailed than was necessary in some aspects, and in others, omitted information and skills which would be appropriate and necessary for the CO. Therefore, a method capable of assessing needed information, appropriate level of instructional detail, and best method of presen-

tation was required. Due to the nature of the CO's job, an assessment of future command needs based on current thought and reflection, was also required. The demands which would be placed on the schedule and workload of the CO prohibited using a group or committee information gathering process (Finch & Crunkelton, 1979; Adams, 1975). However, information from the CO incumbents was essential as they had first-hand experience about the information, skills, forms, and presentation styles required for the course. An approach which would provide for future forecasting needs and which would allow for participation without travel and time expense was indicated. Such an approach was the Delphi Process.

The Delphi Procedure

Review of the Literature

Weatherman and Swenson (1980) describe the Delphi technique as a sequence of related procedures for eliciting and refining information and opinions obtained from a group. As a process of sequential individual interrogations centered around a questionnaire which is interspersed with both information and opinions, the Delphi capitalizes on the concept that "several heads are better than one" in arriving at subjective conjectures about the future (Dalkey & Helmer, 1963). "Experts . . . will make conjectures based upon rational judgment and shared information rather than merely guessing, and will separate hope from likelihood in the process (Dalkey & Helmer, 1963, p.9)."

The term "expert" can be applied to anyone who can contribute relevant information and opinions. However, according to literature generated by the Rand Corporation (Dalkey, 1969) and further supported by Pill (1971), the term "expert" generally refers to "highly educated and experienced specialists in particular subject disciplines" (p. 6). Implicit in this context, the Delphi pro-

cedure could be employed in almost any social situation to gain meaningful information concerning opinions about events—past, present, or future—and then quantifying and ordering that subjective information. Pill (1971) stated with respect to the question of utilization of the procedure in a decision-making process: "Perhaps the first step in being able to make reasonable decisions about the future, is to understand the present, and by implication the past" (p. 7).

Dalkey (1969) describes the Delphi procedure as having three desirable features: anonymity, controlled feedback, and statistical group response. The feature of anonymity is established through the use of questionnaires or other impersonal communications channels such as computers. This feature reduces the effect of dominant individuals. Irrelevant information is reduced through controlled feedback—conducting the exercise in a sequence of rounds between which a summary of the results of the previous round are communicated to the participants. Statistical group response is a device to assure that the opinion of each group member is reflected in the final response. The use of statistical definition of the group response is a means of reducing group pressure for conformity. However, at the end of the exercise there still may be a significant appeal in individual opinions. Based on this analysis, the Delphi procedure would serve as a basis for eliciting responses needed to quantify information and opinions, which would serve as a basis for further decision-making or analysis.

The Delphi process has been used in the field of training education. Weaver (1971) and Winstead & Hobson (1971) describe the use of the process in establishing educational priorities and institutional goals, and in forecasting the future for planning purposes. Finch and Crunkelton (1979) view the Delphi as a useful tool when curriculum planners

desire to reach consensus regarding the content of a particular curriculum. They offer the technique as useful in enabling experts to speculate individually and then reach consensus regarding the content necessary to prepare workers, even in areas where no workers presently exist. Lester and West (1979) describe the use of the Delphi technique to identify and classify the critical tasks of the educational information specialist. The Delphi process appeared to be appropriate for validating the Navy CO course content.

Method

A group of 14 active submarine commanding officers who would participate in the Delphi process, was identified through nomination and selection by the Navy Command, based upon their patrol and command experience. Prior to constructing a questionnaire suitable for the process, a series of three planning interview meetings were held with several former commanding officers (not part of above sample) for the purposes of identifying overall major areas of concern which would be offered as possible starting points for round one of

the Delphi process.

Round one of the Delphi process requested the participants to reflect on their experiences as commanding officers and comment on the appropriateness of topics suggested for inclusion in the course. The participants were also requested to suggest all of the possible topics which should be included in the course. Additional requested information included the level of detail at which the topic should be taught, the most appropriate presentation methods for each topic, and the rationale for the choices. Figure 1 presents the format for the round one Delphi instrument.

The participants were given one week in which to respond. They were specifically asked to consider their experiences in deciding topics for inclusion and exclusion. As a result of the data analysis, 36 topic areas were identified for inclusion in the course. The data indicated a dichotomy of opinion as to appropriate level of detail for certain technical topics. This was a predictable outcome. The rationale for choice of level of detail would become important data in round two. These data were

summarized and compiled into a round two instrument.

In round two of the Delphi process, each of the 14 participants was requested to review his initial responses to each topic. The participants' original instruments (round one) were copied and returned to them with their round two instruments. They were then requested to review the group responses to each topic. Each participant was then requested to react to the group's response and to his original response with respect to each of the variables (Include, Not Include, Emphasis, and Method of Instruction). Each participant was also requested to review the additional topics suggested and to support all of his remarks with a current rationale. Figure 2 represents the format for the Delphi round two questionnaire.

As a result of round two of the Delphi process, the same 36 topic areas were identified for inclusion with reactions indicating an increased consensus for each topic area across each of the variables. These data were then compiled for round three—the final round of the Delphi process.

<p><u>List I (Emphasis)</u></p> <ul style="list-style-type: none"> a. Concepts b. General Overview c. Block Diagram d. Detailed Theory e. Procedural Discipline f. General Operating Guidelines g. Sequential Operation h. Effect of Casualties i. Information Flow Path j. Organizational Responsibilities k. Maintenance Policy l. Black Box Functions m. Scheduling n. Detailed Operating Procedures o. Detailed Maintenance Procedures p. Security q. Safety r. Other _____ 	<p><u>List II (Teaching Methodology)</u></p> <ul style="list-style-type: none"> 1. Lecture 2. Self-Study 3. Guided Seminar 4. Group Study 5. Demonstration 6. Lab Drill 7. Other _____
<p><u>SAMPLE</u></p> <p>1. EM Log</p> <p>Include <input checked="" type="checkbox"/> Not include <input type="checkbox"/></p> <p>Emphasis <u>h, i, k</u></p> <p>Method of Instr. <u>1</u></p>	
<p><u>All PCO/PXO should be familiar with the EM log and use of its output. SSBN unique applications of the log should be emphasized.</u></p>	

Figure 1. Delphi Round 1 Questionnaire Item.

In round three of the process, the participants were again requested to review their round two responses to each topic area as well as the group responses to that topic area. They were again re-

quested to react to both the group responses as well as their responses for each topic with respect to each of the variables and to support their choices with a rationale. In each case a rationale

was requested whether or not changes were made in their choices. Figure 3 represents the format for Delphi round three.

The results of round three were tabulated. At the conclusion of round three, two respondents changed their responses to the technical topic areas and conformed to the majority of the group, thus indicating a need for only an overview presentation on the topic. Data which resulted were then analyzed in order to produce an outline of the curriculum as suggested by the participants.

Results

As a result of this three-round Delphi process, the revised course contained 36 topic areas. Each topic area was identified with appropriate emphasis and teaching methodology. The revised course reflected a less detailed equipment knowledge emphasis and a more conceptual overview of equipment systems. The revised course also emphasized concentration in areas of departmental administration previously not covered. The previous course was developed largely from technical documentation and information provided by technicians, rather than from information provided by actual job incumbents. The Delphi process provided this input. The Delphi process has now become a standard practice for course definition and validation in the Navy submarine training program.

Discussion

The Delphi process has proven to be a useful tool for job analysis. As employed in this case, the Delphi process provides a means for course validation, a useful exercise often overlooked in many training organizations.

Participants in this process indicated a desire to participate again in the future. The Delphi methodology enabled me to gather data from critical participants without the burden of time, travel and expense. It also provided a means of fostering group thinking without pressure from peers and superior officers.

The Delphi methodology provided a means of obtaining information from knowledgeable people who are currently performing the job under study. This group can most adequately predict those skills and areas of knowledge which will be necessary in the foreseeable future. The process also permitted time and an appropriate atmosphere for each participant to reflect on the responses of his

1. Strategic Weapons System (SSBN)

Based on a response from 13 CO/XO incumbents the following information has been produced.

To include 13
Not to include 0

The number of incumbents indicating preference for emphasis of instruction for each choice in List I is recorded to the left of the choice. The preference for teaching methodology is indicated to the left of the respective numerical designation in List II.

List I (Emphasis)	List II (Teaching Methodology)
4 a. Concepts	12 1. Lecture
10 b. General Overview	3 2. Self-Study
7 c. Block Diagram	2 3. Guided Seminar
1 d. Detailed Theory	0 4. Group Study
4 e. Procedural Discipline	3 5. Demonstration
6 f. General Operating Guidelines	3 6. Lab Drill
3 g. Sequential Operation	0 7. Other _____
9 h. Effect of Casualties	
2 i. Information Flow Path	
0 j. Organizational Responsibilities	
3 k. Maintenance Policy	
1 l. Black Box Functions	
1 m. Scheduling	
2 n. Detailed Operating Procedures	
2 o. Detailed Maintenance Procedures	
4 p. Security	
4 q. Safety	
0 r. Other _____	

The results offered by some of the respondents are as follows:

- Needs to know overall system and interrelationships of basic building blocks such as sub-systems, components, maintenance, scheduling and casualty procedures (8 respondents)

Please review your response to item #1 in light of the above information. You may maintain your original position or change it. In either case, please provide justification for your action. Below is a space and format provided for your next response.

List I (Emphasis)	List II (Testing Methodology)
a. Concepts	1. Lecture
b. General Overview	2. Self-Study
c. Block Diagram	3. Guided Seminar
d. Detailed Theory	4. Group Study
e. Procedural Discipline	5. Demonstration
f. General Operating Guidelines	6. Lab Drill
g. Sequential Operation	7. Other _____
h. Effect of Casualties	
i. Information Flow Path	
j. Organizational Responsibilities	
k. Maintenance Policy	
l. Black Box Functions	
m. Scheduling	
n. Detailed Operating Procedures	
o. Detailed Maintenance Procedures	
p. Security	
q. Safety	
r. Other _____	

SAMPLE

- EM Log

Include Not include _____

Emphasis h, i, k

Method of Instr. 1

All COO/PRO should be familiar with the EM log and use of its output. SSBN unique applications of the log should be emphasized.

Figure 2. Delphi Round 2 Questionnaire Item.

1. EM LOG

To include 12
 Not to include 1

List I (Emphasis)

- 5 a. Concepts
- 12 b. General Overview
- 0 c. Block Diagram
- 1 d. Detailed Theory
- 0 e. Procedural Discipline
- 0 f. General Operating Guidelines
- 0 g. Sequential Operation
- 0 h. Effect of Casualties
- 0 i. Information Flow Path
- 0 j. Organizational Responsibilities
- 1 k. Maintenance Policy
- 0 l. Black Box Functions
- 0 m. Scheduling
- 0 n. Detailed Operating Procedures
- 0 o. Detailed Maintenance Procedures
- 1 p. Security
- 0 q. Safety
- 0 r. Other _____

List II (Teaching Methodology)

- 12 1. Lecture
- 1 2. Self-Study
- 0 3. Guided Seminar
- 1 4. Group Study
- 0 5. Demonstration
- 0 6. Lab Drill
- 0 7. Other _____

Include	Not Include	Emphasis	Teaching Method	Responses
<u>✓</u>	_____	<u>b</u>	<u>1</u>	Describe use of EM Log output (2 respondents).
<u>✓</u>	_____	<u>b</u>	<u>4</u>	Emphasis SSBN unique applications (1 respondent).

Remarks/Justification

Agree that an overview of SSBN unique applications should be included; however, subject does not require "emphasis."

Figure 3. Delphi Round 3 Questionnaire Item.

peers. Above all, the Delphi process was accepted by the community whom it was to serve as a process which yielded a relevant and technically accurate training product.

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