

## **Malleable Delphi: Delphi Research Technique, its Evolution, and Business Applications**

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*The objective of this article is to characterize the evolution of Delphi Technique from its origin at the Rand Corporation in the 1950's to its use today. The implementation of Delphi methodology has evolved and has been continuously "reborn" to meet new research challenges. Twenty-five Delphi studies were examined. I focused on twelve studies that I could learn the most from in terms of methodology changes. Changes included moving from paper surveys to the use of computers, use of the Internet, Web site based surveys, and computer databases for analyzing data with statistical software tools. This article brings focus to a powerful research tool that can be used very cost effectively in business and business education research by an individual researcher.*

**Field of Research:** Business Education Research Methods

### **1. Introduction**

The Delphi technique was developed by the Rand Corporation to "obtain the most reliable consensus of opinions of a group of experts by a series of intensive questionnaires interspersed with controlled opinion feedback" (Dalkey & Helmer, 1963, p. 458). The Delphi technique project was originally funded by the U.S. Air Force for strategic defense purposes. These included long-range forecasting in the area of national defense. The methodology did not find its way into public use until 1964 when Gordon and Helmer (as cited in Linstone & Turoff, 1975) first described the technique in a Rand Corporation paper. Linstone and Turoff mentioned that early implementation of Delphi studies focused on long-range trend forecasting and were conducted by monitor teams using paper questionnaires.

Thousands of Delphi technique studies have been successfully completed since the method was first implemented in the 1950's (Linstone & Turoff, 1975). According to Griffin (2005), even though group process is more time consuming than individual decision making, it often proves more effective to base a decision on a consensus reached in a group process. Delphi has been used successfully in "forecasting technological breakthroughs at Boeing, market potential for new products at General Motors, research and development patterns at Eli Lilly, and future economic conditions by the US government" (Griffin, 2005, p. 292).

As Internet technology has advanced, Delphi methodology appears to have taken new forms. The Internet has greatly improved ease of communication between the participants and the researcher. The use of efficient communication is of key importance in Delphi studies. Delphi technique has evolved from the use of mailed paper surveys to online surveys, high speed Internet communications, and computer-based data processing and analysis of results. In this case study of

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Delphi's evolution, my challenge was to examine how Delphi has been adapted to technology and how its use has been made more efficient. I identify how it has become a more powerful research tool easily useable by individual researchers rather than requiring a team effort.

### **1.1 Research Question**

Has Delphi methodology evolved and if so how has it evolved? This study will identify changes that may have taken place over its years of implementation.

### **1.2 Organization**

The remainder of this paper includes a literature review that discusses Delphi methodology, its attributes, benefits of use, and its applications. The methodology section describes how this study was implemented and is followed by a discussion of the findings and conclusions.

## **2. Literature Review**

Linstone and Turoff (1975) postulate that Delphi methodology is a structured communication process. Delphi iterations result in a common reality that is elaborated and modified by succeeding rounds of subjective and negotiated thoughts. Repeating the questions and their continued analysis adds to their reliability (Alexander & Serfass, 1999). According to Mitroff and Turoff (as cited in Linstone & Turoff, 1975), Delphi can be thought to be a system of inquiry seeking pragmatic truths. Another view of Delphi inquiries by Scheele (as cited in Linstone & Turoff, 1975) is that Delphi is a process of reality construction.

According to Alexander and Serfass (1999), Delphi is a multi-step structured process for reaching an expert consensus that can be thought of as a jury of experts. They add that Delphi has been beneficial in providing a communication process to enable a group of subject-matter experts to reach consensus about answers to complex problems. Delphi is based on the group dynamics notion that a number of minds addressing a question usually leads to more informed answers. Structure is enhanced by iterating pre-designed survey questionnaires through a number of survey rounds to objectify agreement of the resulting consensus. Delphi allows the participants to remain anonymous; and by so doing, encourages them to express themselves freely. Each round of questions are analyzed, revised, and reissued for additional rounds of refinement.

Although Delphi was first used for forecasting, Linstone and Turoff (1975) suggest it has many other applications. They argue that it is not the specific application that determines suitability of Delphi as much as it is the need for an expert group communication process. A number of considerations may lead one to apply Delphi as the appropriate research methodology. If a question is not readily dealt with analytically, but can be addressed collectively with expert consensus, it may be appropriate for a Delphi approach. Other situations where Delphi may be suitable include when a group of experts cannot easily be brought together into a focus group for a long period of time, when more participants are needed than can easily interact

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face-to-face, or when face-to-face meetings are too costly (Linstone & Turoff, 1975). The Delphi technique is appropriate and can be productive in surveying experts to bring focus to unstructured issues (Alexander & Serfass, 1999).

Adler and Ziglio (1996) argue that a Delphi advantage is its ability to systematically access a wide pool of knowledge and experience. Delphi is appropriate and recommended for implementation when the only source of information is the informed judgment of experts who are physically distant from each other, cannot afford to give up time for extended meetings, and budgets cannot afford extensive travel costs. Adler and Ziglio suggest that Delphi can be used as a tool to support informed decision-making, particularly when decision-makers are facing uncertainty. In this case, Delphi allows the exploration of the problem and consideration of alternate solutions. Adler and Ziglio (1996) state “the results of proper applications of the Delphi method can greatly assist policy makers to improve creativity in their decision-making when accurate information is unavailable” (p. 8). Delphi offers anonymous, asynchronous communication and supports equal weighting of responses. It typically starts with an exploratory pilot round of open-ended questions.

### 3. Methodology and Research Design

The purpose of this qualitative study was to identify and document the evolution of Delphi research methodology. This paper was developed as a result of an extensive review of Delphi research studies prior to developing my own Delphi study. I wanted to make use of the most up-to-date, approved adaptations of the technique. Delphi research studies were examined to identify differences that were implemented by various researchers. I reviewed Delphi implementations that were different from one another in significant ways and examined the methodology content of each study.

Case methods may “be useful for investigating how an individual or program changes over time, perhaps as the result of certain circumstances or interventions” (Leedy & Ormrod, 2005, p. 135). In this case, I collected data from numerous research studies that included use of the Delphi technique. This data consisted of Delphi-based dissertations and other research studies. I began data analysis during data collection as I examined twenty-five Delphi studies. I was looking for examples of modifications of the methodology. From the twenty-five studies I examined, I identified twelve that were representative of changes in methodology. Patterns of change were identified that support the evolution of the methodology.

### 4. Discussion of Findings

The feasibility of using Delphi methodology is related to the commitment and time required to make the Delphi communications process work effectively and the feasibility of properly selecting a purposive panel of experts to obtain the information of interest. In recent years, a number of methods have been used to make the Delphi technique more feasible to individual researchers. Feasibility often comes down to whether or not one researcher can accomplish a meaningful Delphi study in a reasonable time frame of one year or less.

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### ***4.1 Delphi Research Conference Method***

Delphi conference methodology has replaced the monitor team by using computers (Linstone & Turoff, 1975). Now, Internet communications and Web sites are used to expedite the Delphi process. In this type of implementation, participants communicate via the Internet and access survey questionnaires via a Web site. The responses are saved in a database on a server. Using descriptive statistics, the mean, median, mode, standard deviations, and interquartile ranges can be analyzed and results reported after each round of questions. Using a data analysis application, researchers are able to analyze responses to the questions electronically and report the consensus information quickly. The Delphi Conference method reduces delays previously associated with summarizing each round of data. In the most structured form of Delphi, communications are defined in terms of a specific item-based Likert scale questionnaire. This approach has the added advantage of essentially creating a real-time communication system by reducing the analysis and turn-a-round time between Delphi rounds (Linstone & Turoff, 1975).

### ***4.2 Delphi Use in Education Research***

A Delphi study was used to “determine the common functions, knowledge and skills which hospital education directors would need to perform their job adequately in the 1980’s” (Rossman & Eldredge, 1982, p. 4). The second purpose was to identify most suitable approaches in conveying important knowledge and skills. The population sample included 253 members of the American Society of Health, Manpower, Education, and Training (Rossman & Eldredge, 1982). Of the 253 members, 127 completed all four rounds of questionnaires. The first-round questionnaire was open-ended; the second round listed first-round item responses and asked participants to prioritize them on a five-point rating scale. The third questionnaire presented the modal consensus for each item and asked participants to join the consensus or list reasons for dissenting. The fourth questionnaire solicited most suitable learning experiences for acquiring the most important knowledge and skills.

This study concluded that high emphasis should be given to preparation for future technical innovations. Improvement of diplomacy skills was also advised to integrate the organization educational and institutional goals including attitudinal and behavior change processes. It was recommended that training methods be designed to teach the needed knowledge and skills. It was felt they should be practical, based on internships, and other on-the-job experiences. A modified Delphi methodology was used in which respondents, who were not willing to join the consensus in the third-round questionnaire, were asked to list reasons for dissenting. The fourth and final questionnaire created an added value by asking the participants to suggest learning experiences they felt would be useful in acquiring the information recommended in the study’s conclusions.

Rossman and Carey (1973) used a variation of the Delphi technique to gain knowledge of the learning needs of teachers and administrators in adult learning centers. This study was a departure from conventional Delphi methodology in that all of the participating experts were attending the same two-day conference held at the University of Massachusetts.

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Cho (2004) successfully completed a Delphi-based dissertation to develop a model for improving the productivity of asynchronous virtual teams. In this case, the objective was to find a construct for supporting idea generation. Delphi surveys were used to achieve consensus. This study resulted in the notion that a value of Delphi is related to assuring equal participation of the panel members and minimizing the blocking of ideas.

In the above examples, Likert scale survey questionnaires were used to structure and expedite the Delphi consensus process. The examples all had as a goal the development of a model, construct, or framework. They were reasonably successful in using Delphi in a non-forecasting mode to derive answers to complex questions regarding good practice models in business education. The above-noted studies are indicative of the evolution of Delphi from a futures forecasting tool into a methodology for providing answers to specific, complex, and often unstructured questions. More recently, Delphi studies have been used to develop expert consensus about questions other than forecasting and computers have been implemented to evaluate participant responses (Topper 2006).

### ***4.3 Delphi Use in Leadership Research***

Martin (2002) completed a Delphi study to identify the attributes and best practices of college and university presidents and senior leaders. This study included a panel of 18 expert participants and was completed in three stages. The first stage was content analysis of feedback reports from six institutions. It was followed by two rounds of Delphi surveys. Although the first stage of content analysis was laborious, the feasibility of completing this study in a reasonable time frame was enhanced by the fact that the two Delphi survey rounds were expedited by using Likert scale questions to structure the responses. Data collection was electronic via e-mail and a Web site.

Sheridan (2005) conducted a Delphi study that was used to develop a model of intercultural leadership competencies for U.S. business leaders. This study identified that leadership is a universal concept with a cultural perspective, that culture is a misunderstood construct within organizations, and that leaders must balance commercial and cultural concerns. Three rounds of data collection were used to identify interpersonal, intrapersonal, and cultural competencies. Participants numbered 26 and in the interest of research efficiency and feasibility, survey questionnaires were Web-based and accessed via the Internet. In this research, a pilot study was conducted with seven experts, who responded to eight open-ended questions that were made available via the Web site. The researcher created second and third round questionnaires made available to the participants via the Internet. This study led to a recommendation that U.S. business leaders should develop a global mindset, world knowledge, and multicultural interpersonal skills.

### ***4.4 Delphi Use in Professional Development Research***

Josephine Gibson (1998) used the Delphi technique to identify content and context of professional development needs of nurses. In this case, the purpose was to

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develop a specific definition of good practice content in nurse education. A Delphi survey was carried out with a panel of 28 participants using three rounds of questionnaires. Previous studies had used up to 50 participants. The lower number of participants reduced the handling and processing time but still provided a successful outcome. Gibson (1998) reasoned that a wide range of content could be managed by devising a structured survey instrument to easily prioritize responses. The introduction of Likert scale questionnaires to structure responses expedited the consensus, provided a more time efficient Delphi process, and made Delphi more feasible for use by one researcher. Round 1 included five open-ended questions. Round 2 consisted of a structured survey for rating the importance of items identified in the content analysis of round one replies. The third round was used to verify the consensus viewpoint about the most important development needs. It identified a consensus of training needs that were put into practice.

### ***4.5 Delphi Use in Business Succession Planning Research***

Topper (2006) asked a panel of experts to reach a consensus definition of best practices in succession planning in privately controlled businesses. This Delphi study resulted in a good practice model for succession planning. Thirty-seven experts participated in three rounds of surveys that were administered electronically in conjunction with a secure Web site. The initial phase of this research used five human resource professionals to evaluate the survey instrument. It was followed with a pilot test that included a group of ten individuals, who were or had been executives from privately controlled business firms. Three Delphi rounds were then conducted electronically using multiple-choice demographic questions and Likert scale questions to reach a consensus of items of greatest importance in the practice of succession planning. The results of this consensus process led to identifying and favorably rating 21 best practices. Based on these practices, a decision model was developed to assist in improving business continuity and longevity in the face of succession challenges. The use of structured questionnaires, the Internet, and a Web site made it feasible for the researcher to complete this study of succession planning in a reasonable time frame.

### ***4.6 Two-Round Delphi Study Applications Become Popular***

White and Russell (1995) conducted a two-round Delphi in an attempt to discover essential elements in supervisory systems. The researchers argued that a third round would be a duplicate of the second round, except that panelists would have been shown the results of the second round. In a third round, panelists are asked to reconsider their second round responses in full awareness of the entire panel's data. By concluding after Round 2, the potential to bias the Round 3 data based on imagined pressure to conform to the norm is avoided.

Edwards (2001) provided a good example of the conference form of Delphi that can be feasibly conducted by an individual researcher. Expert participants were reduced to nine and the rounds of questionnaires were reduced to two. This is a more recent notion that fewer participants do not necessarily reduce the validity of the results. A third round does not add much new knowledge, is time consuming, and costly. This modified Delphi methodology appears very feasible for doctoral dissertations, where

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the researcher is working alone. Round 1 consisted of an open-ended questionnaire that asked the panel to provide up to five variables in each of seven categories. The round-two questionnaire was developed by the researcher from the responses to Round 1. It was presented back to the participants in the form of a five-point Likert type survey. Participants were asked to rate the scale of importance of each item. Descriptive statistics were calculated and variables with a high level of consensus were retained and became the basis for developing a good practice guideline. The Likert scale survey used in Round 2 established an expert consensus and obviated a need for a third round. This two-round Delphi approach further supports feasibility of use by a single researcher. In this case, the second round question format was highly structured. Edwards' timeline required only six months to collect and analyze data and 89 pages to document.

Brill, Bishop, and Walker (2006) used a two-round Web-based Delphi to identify competencies for effective project management. The experts were project managers with more than 20 years experience. In Round 1, participants were asked to identify project management success factors. The panel identified 78 trainable competencies. In Round 2, 42 of the 78 competencies were judged very important. This study is a good example of using the first round as a brainstorming pilot and the second round to reach a consensus of important variables.

In support of two-round Delphi applications, it can be argued that showing participants the results of Round 2 and then asking them to reconsider their prior responses in a third round puts an undesirable pressure on deviant panel members to conform to the most popular responses and may bias the results. Regarding three-round studies, Clayton (as cited in Bulger, 2004) asserts that consensus may be achieved due to pressure to conform to other participant responses rather than through thoughtful reconsideration of their own responses. Identifying important variables with high consensus in Round 2 eliminates the influence of pressure to conform that may arise in Round 3 when participants are asked to reconsider their votes based on the Round 2 responses of their peers.

In 2007, the author completed a study using Delphi methodology. The purpose of the study was to reach a consensus in identifying important elements of critical thinking in management. Delphi research methodology was used to enable the collection and analysis of key elements identified by a panel of experts. After completing two distinct survey rounds, the Delphi panel of 20 experts reached a consensus about elements that constitute a best practices model of critical thinking in management. Both survey rounds were conducted via an Internet link to a secure survey Web site. The first survey was a pilot round of open-ended questions that allowed the participants to brainstorm/explore the topic. The second survey reached a consensus of 167 elements that were rated very important or important. The research question "What do experts believe are important elements in a model of critical thinking in management?" was satisfied by the elements that were identified.

## 5. Conclusion, Validity, and Limitations

The argument that a conference form of Delphi study is feasible for serious research is supported by its success in Delphi studies evaluated in this paper. The more

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recently modified forms of Delphi implementations have reduced the number of expert participants to as few as ten, used highly structured questionnaires where possible, and reduced the number of survey rounds to as few as two. Recent studies use electronic means for surveying and collecting data, provide a central Web site and the Internet for enhancing the communication process, and use commercially available survey application software to develop and host the surveys. These modifications support the feasibility of using Delphi for dissertations and other individual researcher studies.

Delphi conference methodology uses computer systems and Internet communications to replace the monitor teams. Web sites have been added to expedite the research process. Now, participants log into a Web site to answer survey questions. Responses are saved in a database on a server where they can be analyzed using computer-based statistical software tools. Besides forecasting future events, Delphi has been used in prioritizing qualities, attributes, and best practices of leaders; discovering intercultural leadership competencies; professional development needs; business succession planning; and modeling. Based on this case study, Delphi research methodology appears to be quite malleable (Rossman, personal communication, December 13, 2007).

Validity of this case study is based on the convergence (triangulation) of the data (Leedy & Ormrod, 2005). Numerous Delphi studies supported the convergence of results reported in this article. Results are limited to differences in Delphi methodology that were found in the research studies I examined. Other Delphi research studies exist and other methodology changes may be found by examining these additional studies. Another researcher may look at other Delphi studies and come to different conclusions.

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