The Delphi Method for Graduate Research

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Abstract

The Delphi method is an attractive method for graduate students completing masters and PhDlevel research. It is a flexible research technique that has been successfully used in our program atthe University of Calgary to explore new concepts within and outside of the information systemsbody of knowledge. The Delphi method is an iterative process to collect and distill the anony-mous judgments of experts using a series of data collection and analysis techniques interspersedwith feedback. The Delphi method is well suited as a research instrument when there is incom-plete knowledge about a problem or phenomenon; however it is not a method for all types of ISresearch questions. The Delphi method works especially well when the goal is to improve ourunderstanding of problems, opportunities, solutions, or to develop forecasts. In this paper, we pro-vide a brief background of the Classical Delphi followed by a presentation of how it has evolvedinto a flexible research method appropriate for a wide variety of IS research projects, such as de-termining the criteria for IS prototyping decisions, ranking technology management issues in newproduct development projects, and developing a descriptive framework of knowledge manipula-tion activities. To illustrate the method's flexibility, we summarize distinctive non-IS, IS, andgraduate studies Delphi research projects. We end by discussing what we have learned from usingthe Delphi method in our own research regarding this method's design factors and how it may beapplied to those conducting graduate studies research: i) methodological choices such as a quali-tative, quantitative or mixed methods approach; ii) initial question degree of focus whether it bebroad or narrowly focused; iii) expertise criteria such as technical knowledge and experience,capacity and willingness to participate, sufficient time, and communication skills; vi) number ofparticipants in the heterogeneous or homogeneous sample, v) number of Delphi rounds varyingfrom one to 6, vi) mode of interaction such as through email, online surveys or groupware, vii)methodological rigor and a research audit trail, viii) results analysis, ix) further verificationthrough triangulation or with another sample, and x) publishing of the results. We include an ex-tensivebibliographyandanappendixwithawid e-ranginglistofdissertationsthathaveusedthe

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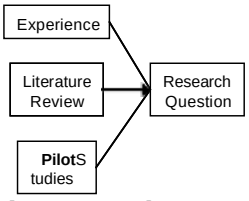
Introduction

It continues to be an exciting time to be a researcher in the information systems discipline; there seems to be a plethora of interesting and pressing research topics suitable for research at the mas- ters or PhD level. Researchers may want to look forward to see what will be the key information systems issues in a wireless world, the ethical dilemmas in social network analysis, and the les- sons early adopters learn. Practitioners may be interested in what others think about the strengths and weaknesses of an existing information system, or the effectiveness of a newly implemented information system. The

Delphi method can help to uncover data in these research directions.

The Delphi method is an iterative process used to collect and distill the judgments of experts us- ing a series of questionnaires interspersed with feedback. The questionnaires are designed to focus on problems, opportunities, solutions, or forecasts. Each subsequent questionnaire is developed based on the results of the previous questionnaire. The process stops when the research question is answered: for example, when consensus is reached, theoretical saturation is achieved, or when sufficient information has been exchanged. The Delphi method has its origins in the American business community, and has since been widely accepted throughout the world in many industry sectors including health care, defense, business, education, information technology, transportation and engineering.

The Delphi method's flexibility is evident in how it has been used. It is a method for structuring a group communication process to facilitate group problem solving and to structure models (Linstone & Turloff, 1975). The method can also be used as a judgment, decision-aiding or forecasting tool (Rowe & Wright, 1999), and can be applied to program planning and administration (Delbeq, Van de Ven, & Gustafson, 1975). The Delphi method can be used when there is incomplete knowledge about a problem or phenomena (Adler & Ziglio, 1996; Delbeq et al., 1975). The method can be applied to problems that do not lend themselves to precise analytical techniques but rather could benefit from the subjective judgments of individuals on a collective basis (Adler & Ziglio, 1996) and to focus their ollective human intelligence on the problem at hand (Linstone & Turloff, 1975). Also, the Delphi is used to investigate what does not yet exist



(Czinkota & Ronkainen, 1997; Halal, Kull, & Leffmann, 1997; Skulmoski & Hartman 2002). The Delphi method is a mature and a very adaptable research method used in many research arenas by re- searchers across the globe. To better understand its diversity in application, one needs to consider the origins of the Delphi method.

TheClassicalDelphi

The original Delphi method was developed by Norman Dalkey of the RAND Corporation in the1950's for a U.S. sponsored military project. Dalkey states that the goal of the project was "tosolicit expert opinion to the selection, from the point of view of a Soviet strategic planner, of anoptimal U.S. industrial target system and to the estimation of the number of A-bombs required toreduce the munitions output by a prescribed amount," (Dalkey & Helmer, 1963, p. 458). RoweandWright (1999)characterize theclassical Delphimethod byfour keyfeatures:

Anonymity of Delphi participants: allows the participants to freely express their opinionswithout undue social pressures to conform from others in the group. Decisions are evaluatedontheir merit, rather thanwho has proposedthe idea.

Iteration: allows the participants to refine their views in light of the progress of the group'sworkfromround to round.

Controlled feedback: informs the participants of the other participant's perspectives, and provides theopportunity forDelphi participantsto clarifyor changetheir views.

Statistical aggregation of group response: allows for a quantitative analysis and interpretationof data.

Some (Rowe & Wright, 1999) suggest that only those studies true to their origins that have thefour characteristics should be classified as Delphi studies, while others (Adler & Ziglio, 1996;Delbeq et al., 1975; Linstone & Turloff, 1975) show that the technique can be effectively modifiedtomeettheneedsofthegivenstudy.Perhapsadistinctionmightbemadebyusingtheterm*Classical* Delphi to describe a type of method that adheres to the characteristics of the originalDelphias summarized by Rowe and Wright (1999).

TypicalDelphiProcess

The Delphi process has been comprehensively reviewed elsewhere (Adler & Ziglio, 1996; Delbeqet al., 1975; Linstone & Turloff, 1975), and so we present only a brief overview of how we haveusedthe Delphi insomeof ourgraduatestudents'research projects(Figure 1).

Figure1:Three RoundDelphiProcess

Develop the Research Question - The research question is derived by a number of ways. Forexample, it might be co-developed by the student with the help of the supervisor, or the researcher's own industry experience often contributes to his interest in the research area. A reviewof the literature is also conducted, among other things, to determine if a theoretical gap exists.Often pilot studies are undertaken for numerous reasons: i) identify the problem, ii) conceptualizethe study, iii) design the study, iv) develop the sample, v) refine the research instrument, and, vi)develop andtest dataanalysis techniques(Prescott&Soeken,1989). Completinga pilotstudycan also help ascertain the relevance the research question has to industry; some supervisorsstronglyfavor applied rather theoreticalresearch.

Design the Research - After developing a feasible research question, we begin designing theresearch from a macro to a micro perspective. Typically we review different research methods(both qualitative and quantitative) and after considering the pros and cons of each, we select themost promising method(s) to help answer our research question. The researcher would select theDelphi method when he wants to collect the judgments of experts in a group decision making set-ting. Both qualitative and quantitative methods can be used in the Delphi process. The Delphimethod may be only one component of the research project; for example, the Delphi outputs maybeverified and generalized with a survey.

Research Sample - Selecting research participants is a critical component of Delphi researchsinceitistheirexpert opinions upon which the output of the Delphi is based (Ashton 1986; Bol-
ger & Wright 1994; Parente, Anderson, Myers, & O'Brien, 1994). There are four requirements for "expertise": i) knowledge and experience with the issues under investigation; ii) capacity and willingness to participate; iii) sufficient time to participate in the Delphi; and, iv) effective communication skills (Adler & Ziglio 1996). Since expert opinion is sought, a purposive sample is necessary where people are selected not to represent the general population, rather their expert ability to answer the research questions (Fink & Kosecoff 1985). The student may need some help from the supervisor to identify the initial group of experts but may use the "snowball" sam- pling technique to generate subsequent participants (Hartman & Baldwin, 1995; Mason, 1996).

Develop Delphi Round One Questionnaire - Care and attention needs to be devoted to develop- ing the initial broad question which is the focus of the Delphi because if respondents do not un- derstand the question, they may provide inappropriate answers and/or become frustrated(Delbeq et al., 1975). Sometimes, the purpose of the first round Delphi is to brainstorm (R. Schmidt, 1997).

Delphi Pilot Study - A pilot study is sometimes conducted with the goals of testing and adjusting the Delphi questionnaire to improve comprehension, and to work out any procedural prob- lems. The researcher may also pre-test each subsequent questionnaire. The Delphi pilot is espe- cially important for inexperienced researchers who may be overly ambitious regarding the scope of their research or underestimate the time it will take a Delphi research participant to fully re- spond to the Delphi survey.

Release and Analyse Round One Questionnaire - The questionnaires are distributed to the Del- phi participants, who complete and return them to the researcher. The results of Round One are then analysed according to the research paradigm (e.g. qualitative coding or statistical summariz- ing into medians plus upper and lower quartiles). Reality Maps can also be developed and shared with the Delphi participants. Reality Maps are graphical representations of the key constructs un- der investigation. They depict reality from the participant's perspective and often illustrate interactions, causes and effects, process flow, and other aspects of their reality. Reality Maps can greatly improve understanding and facilitate the emergence of collective intelligence in subsequent rounds about the topic under investigation (Lindstone & Turloff, 1975).

Develop Round Two Questionnaire - The Round One responses are the basis with which to develop the questions in the Round Two Questionnaire. Depending upon the research goals, the researcher may direct the focus of the research, or be directed by the opinions of the participants. If the purpose of Round One was to generate a list, then it is common to pare down that list in Round Two (R. Schmidt, 1997).

Release and Analyse Round Two Questionnaire - The Round Two Questionnaire is released to the

research participants and when completed, returned for analysis. However, the participants are first given the opportunity to verify that the Round One responses did indeed reflect their opin- ions and are given the opportunity to change or expand their Round One responses now that the other research participant's answers are shared with them. Ranking and rating the output of the first round is common (R. Schmidt, 1997). Continuous verification throughout the Delphi process is critical to improve the reliability of the results (Adler & Ziglio, 1996; Delbeq et al., 1975; Lin- stone & Turloff, 1975) and should be factored into the research design. Again, a similar process of analysis is often used in Round Two.

Develop Round Three Questionnaire - The Round Two responses are used to develop the Round Three Questionnaire with additional questions to verify the results, to understand the boundaries of the research, and to understand where these results can be extended. Typically, the questions become more focused on the specifics of the research at each round.

Release and Analyse Round Three Questionnaire - The final round of analysis is conducted following a similar process used to analyse the data in Rounds One and Two: use the appropriate technique for the question type (e.g. coding for open-ended, qualitative questions). Again, the research participants are given the opportunity to change their answers and to comment on the emerging and collective perspective of the research participants. The process stops if the research question is answered: for example, consensus is reached, theoretical saturation is achieved, or sufficient information has been exchanged.

Verify, Generalize and Document Research Results - The Delphi results are verified (usually continuously through the Delphi) and the extent the results can be generalized are also investi- gated. For PhD research conducted in our program, the Delphi results are often extended with a subsequent research phase such as interviews or surveys. The dissertation and thesis are sent to the National Library of Canada for their collection. These graduate students are also encouraged to publish their results in top tiered publications.

The "typical" Delphi process that we follow in the Project Management Specialization Pro- gramme is a general guide rather than a template. That is, we modify the process to best answer our research questions. For example, different types of questions (closed/open) and analysis (qualitative/quantitative) can be used in each round. In our program we have used a three round qualitative Delphi process to develop a complexity-based project classification system (Skulmoski & Hartman, 2002). Other three round Delphi research projects were undertaken to identify and describe project manager fears and frustrations (Hartman & Jugdev, 1998), to iden- tify the cost of mistrust in contracts (Zaghloul & Hartman, 2003) and to examine the fit between project manager leadership competencies and project characteristics (Krahn & Hartman, 2004). We have also used groupware technology to facilitate the Delphi method where only one round was required to achieve consensus regarding a new contracting process(Hartman & Baldwin, 1995). As groupware and distributed groupware become more widely available, the increase of single round Delphi studies may increase.

HowOthers HaveUsedt heDelphiM ethod

Many have examined a variety of studies that have used the Delphi method (Adler & Ziglio,1996; Linstone & Turloff, 1975; Rowe & Wright, 1999). The range of Delphi possibilities can beseen in Table 1. The Delphi has been used in research to develop, identify, forecast and to vali-date in a wide variety of research areas. While a three round Delphi is typical, single and doubleround Delphi studies have also been completed. Finally, the sample size varies in their studiesfrom 4 to 171 "experts". One quickly concludes that there is no "typical" Delphi; rather that themethodis modified to suitthe circumstances and research question.

DelphiMeth odFlexibilit yinIS/ITRes earch

IS/IT researchers have also used the

Delphi method. For example, the Delphi method has beenused to select IS projects (Peffers & Tuunanen, 2005), specify IS project requirements (Perez &Schueler, 1982), to determine the criteria for IS prototyping decisions (Doke & Swanson, 1995),rank technology management issues in new product development projects (Scott, 2000), and todevelop a descriptive framework of knowledge manipulation activities (Holsapple & Joshi,2002). The Delphi method was used at the InSITE 2005 conference to identify topics that shouldbe in an IT curriculum (Lunt et al., 2005). Next we will look at other IS projects that used theDelphi method in greater depth in order to both learn from the experiences of other researchers,and to display the flexibility of the method. Again, their focus, number of rounds and sample sizearevaried (Table 1).

Table1:DelphiMethodDiversity-PublishedResearch

NonIS/ITStudy	DelphiFocus	Rounds	SampleSize
Gustafson, Shukla, Delbecq, &Walster(1973)	Estimate almanac events to investi-gateDelphiaccuracy.	2	4
Hartman&Baldwin(1995)	Validateresearchoutcomes.	1	62
Czinkota&Ronkainen(1997)	Impact analysis of changes to theInternationalbusinessenvironme nt.	3	34
Kuo&Yu(1999)	Identify national park selection cri-teria.	1	28
Nambisanet al.(1999)	Develop a taxonomy of organiza-tionalmechanisms.	3	6
Lam,Petri,&Smith(2000)	Develop rules for a ceramic castingprocess.	3	3
Roberson, Collins, & Oreg(2005)	Examine and explain how recruit-ment message specificity influencesjob seeker attraction to organiza-tions.	2	171
IS/ITStudy	**DelphiFocus**	**Rounds**	**SampleSize**
Niederman, Brancheau, &Wetherbe,(1991)	Survey senior IS executives to de-termine the most critical IS issuesforthe1990s.	3	114,126 &104
Duncan(1995)	Identify and rank the critical ele-ments of IS infrastructure flexibil-ity.	2	21
Brancheau, Janz, & Wetherbe(1996)	Survey SIM members to determinethe most critical IS issues for thenearfuture.	3	78,87&76
Nambisanet al.(1999)	Develop a taxonomy of knowledgecreationmechanisms.	3	11
Scott(2000)	Rank technology management is-sues in new product developmentprojects	3	20

Wynekoop&Walz(2000)	Rank the most important characteristics of high performing IT personnel.	3	9
R. Schmidt, Lyytinen, Keil, &Cule(2001)	Identify and rank software development project risks: an internationalcomparativestudy.	3	Finland:13,13,&13 HongKong:11,11&9 USA21,21&9
Keil,Tiwana,&Bush(2002)	Rank software development projectrisks.	3	15,15&10
Brungs&Jamieson(2005)	Identify and rank computer forensicslegal issues.	3	11

The Delphi method has been used to develop a taxonomy of knowledge creation mechanisms(Nambisan,Agarwal,& Tanniru,1999).Theresearchersident ified19knowledgecreation

mechanismsintheliterature(e.g.ITjourna ls,vendordemonstrations,ITsteeringcom mittees,and user groups). They argue that deliberate organizational design in the form of mechanisms canfacilitate user IT innovation to the benefit of the organization. Using a 3 round Delphi with 11participants, the researchers populated a taxonomy of knowledge creation mechanisms. The par-ticipants were practicing IS managers from 6 organizations. They further verified the taxonomy ina field study using both the interview and survey methods. While this study is rigorous, we areunableto assess the "expertise" of the sample.

The increasing reach and range of computers into society has both positive and negative effects.One of the insidious aspects of this adoption is e-crime. The extraction and presentation of elec-tronic evidence in the courts form an important and new area of computer forensics. However,there are many emerging and difficult legal issues to address. The Delphi method was used by ateam of researchers to identify the principle legal issues facing the computer forensics disciplinewithin the Australian context (Brungs & Jamieson, 2005). A difficulty with this type of researchisthattheresofewrecognizedex pertsinthisfield.Ofthese30experts,11pa rticipatedinathreeround Delphi study. This heterogeneous sample comprised of three distinct groups: police, regulators and consultants. The sample identified 17 issues in a brainstorming session, then theyrankedand rated these in the Delphi.

Selecting, implementing and using an IT infrastructure is a critical process for organizations toachieve their organizational goals. This task is complicated when goals and priorities change. Aflexible IT infrastructure is therefore desirable. One researcher used the Delphi method to identifythe characteristics and metrics of a flexible IT infrastructure (Duncan, 1995). Duncan used a tworound Delphi (survey and discussion) to answer her research question. A homogeneous group of21 participants from the senior ranks of Fortune 500 companies participated. In the first Delphiround, the participants rated flexibility characteristics (e.g. compatibility rules for communicationnetworks, data and applications, management leadership in long term planning for applications,and interface standardization) that were identified in a literature review. Participants were alsoafforded the opportunity to add characteristics not on the initial list. In the second round, theydiscussed the round 1 results. The Delphi was followed by a round of interviews with a differentsamplefor verification and generalization purposes.

The Delphi method was used to investigate the traits and behaviors of top performing softwaredevelopers (Wynekoop & Walz, 2000). They extended a previous study that used the interviewmethod and choose the Delphi method because of its ability to achieve consensus; something thatwas absent among their interview sample. In this pilot study, nine participants (MBA students)were involved in a 3 round Delphi. She correctly identifies a limitation of her sample and alludesthatwhile theyhave software developmentexperience, theyarenotexperts.

ResearchershaveusedtheDelphitoidentifysoftwaredevelopmentprojectrisks(Keil etal.,2002; R. Schmidt et al., 2001). In the first study, the focus was on developing a list of commonrisk factors in three settings: Hong Kong, Finland and the United States (R. Schmidt et al., 2001).In the second study, the researchers investigated the differences of opinion regarding softwaredevelopment project risks between users and the project manager using risks identified in theSchmidt study (Keil et al., 2002). In the Schmidt study, participants from all three countries par-ticipated in a brainstorming session to identify software project risks. In the subsequent rounds,they were divided according to their country. In the second round, they pared down the list, and inthe final round, they ranked the risks. The researchers calculated the mean rank for each risk, andthe degreeofconsensuswithineachcountryusingKendall's W.ThisstudywasextendedbyKeil's research team using the same Delphi method (three rounds, 15 participants) and analysis toreconcileuser and projectmanager perceptions ofrisk.

Finally, the Delphi method has been used to forecast key issues in IS management. A 3 roundDelphi was used where the Society of Information Systems (SIM) members were asked to rank ISissues (Niederman et al., 1991). The remarkable aspect of this study is that of the 241 Delphi sur-veys that were distributed, 114, 126 and 104 surveys were returned and usable over the threerounds. A similar study six years later also used the Delphi and SIM members to rank 21 MISissues. Once again, the number of participants was high (but the response rate was lower) whereof the 217 surveys that were sent out, 78, 87 and 76 surveys were returned and usable over thethree rounds. There were significant changes in the rankings of the issues: for example, develop-ing an information architecture was ranked the number one issue in the first study and dropped inthe ranking in the second study to fourth place. The sixth ranked issue – building a responsive ITarchitecture – in the first studywas ranked as the top issue in the second study.A discussion ofthemovement in the rankings isabsent in the secondstudy.

The Delphi method has been used on different occasions in IS research. There is also wide vari-ance in the sample size. Both heterogeneous and homogeneous samples were used. The degree ofexpertise of the sample also varied. Some studies began with a predetermined list to rank and rate,while others generated the initial list through brainstorming. However, three round Delphis ap-pear to be favored. Some studies employed statistical treatment of data such as the Kendall *W*procedure. Most verifiedtheir researchwithanothermethod, andif they did nottheycautionedthe reader when interpreting the results. While it is a flexible method, it has not seen the degree ofuse as the survey method. We believe that the Delphi can be an effective and efficient methodappropriateforsomeISresearchif rigorousdesignconsiderationsarefollow edandimplemented.

TheDelphiMethodinDissertations

We see similar flexibility in the way the Delphi method was used in doctoral and masters researchprojects as before. Oddly, however, there are few research projects that have used the Delphimethod identified in the literature review. Instead other methods used in dissertation and thesisprojects such as surveys or interviews greatly outnumbered the Delphi. There are notable recentexceptionsincluding:
IdentifyingthecriticalsuccessfactorsforERPimplementationprojects(Carson,2005);
Developing a model of how technologies are developing and how they may fit with an organizationalstrategy(Gerdsri,2005);
ImprovingthequalityofITsecurity audits(Pieko,2005);
Identifyingthecriteriaformeasuringknowledgemanagementefforts(Anantatmula,2004);
IdentifyingwhythestrategiesforaDefenseDepartmentITprojectsucceededorfailed(Birdsall,2004); and,
Identifying emerging IT issues of the 21st century that affect public school board policies(Dahlby,2004).
These dissertations reveal the variety of research questions in IS that can be asked and subsequentlyanswered using the Delphimethod.
Approximately 40 dissertations and two theses that used the Delphi method were examined (SeeAppendix). Indeed, a search through the ProQuest Digital Dissertations database reveals at least280 dissertations and theses that used the Delphi method in their research. The majority of theresearch projects were from either education or healthcare. Beginning with the initial Delphiquestion(s) in round 1, they can be either broad or narrow. Many (Alexander, 2004; Christian,2003; Good, 1998) began with open questions in round 1 while some (Ayers, 1985; Friend, 2001;Menix,1997)used narrowquestions thatfocused on literaturederived content.

Sampling in these graduate student research projects also mirror other Delphi projects (See Ap-pendix). We continue to see great variability in the number of participants from 8 (Friend, 2001)to 345 (Lecklitner, 1984). Here, such a large number of research participants was in part due to aheterogeneous sample with six distinct sub-groups. Others also used heterogeneous samples(Cabaniss, 2001; Menix, 1997; Rosenbaum, 1985) while the majority relied upon homogeneoussamples. These were purposive samples developed with the snowball technique. Some generatedarandomsamplewithin these samples (Good, 1998;Laxton,2002: Wilke, 1982). The data collection processes for these student projects again are conventional. The number ofrounds is usually 3, while up to 5 were required (Kincaid, 2003) due to the increased difficulty ofgetting consensus from a heterogeneous sample. Not all large, heterogeneous samples requirednumerous rounds: Lecklitner (1984) used a sample of 345 consisting of 6 subgroups and requiredonly 2 rounds. He did not strive for consensus rather to understand what the subgroups thoughtabout his research questions. While some of the older studies used conventional mail (Cramer,1990; Lecklitner, 1984; Silverman, 1981), most used electronic mail. However, new technologies(e.g. Questionmark Perception) allow the researcher to put the Delphi questionnaire online whereresearch participants enter their answers. Such answers are in a digital format and then more eas-ily manipulated by the researcher. Some researchers (Cabaniss, 2001; Richards, 2000; V.Schmidt, 1995) used online surveys to collect their data. Finally, the data analysis in these pro-jects varied. Few researchers used purely qualitative analysis,(Kincaid, 2003; Watson, 1982) oth-ers quantitative,(Friend, 2001; Krebsbach, 1998; Shook, 1994; Silverman, 1981;Whittinghill,2000) while most began with qualitative followed by quantitative analysis of subsequent roundLikert-style questions (Friend, 2001; Good, 1998; Prestamo, 2000; Richards, 2000; Rosenbaum,1985). Thus, these graduate student research projects mirror the flexibility seen in other Delphiprojects.

DelphiMeth
odDesignCo
nsiderations

While the Delphi method is flexible and superficially simple, the researcher needs to take intoaccount many design considerations in order to successfully use the method. Poorly applied likeany other research method, the Delphi can yield suspect results. Having used and modified theDelphi method in many research projects in our program, we present some of our insights intoDelphimethod considerations.

MethodologicalChoices

While the Delphi is typically used as a quantitative technique (Rowe & Wright, 1999), a re-searcher can use qualitative techniques with the Delphi method. Qualitative research is interpre-tivist in the sense that the researcher is interested in how the social world is interpreted, under-stood and experienced; the researcher is flexible and sensitive to the social context within whichthe data was collected; and qualitative research is about producing holistic understandings of rich,contextual and detailed data (Mason, 1996). Qualitative research is also about engaging in con-versations with the research participants in a natural setting as opposed to research conducted in alaboratory (Creswell, 1994). The qualitative researcher attempts to make sense of or interpret thephenomena in terms of the meaning the participants place on them (Creswell, 1998). The Delphimethod is well suited to rigorously capture qualitative data. It may be seen as a structured processwithin which one uses qualitative, quantitative or mixed research methods. Such flexibility notonly affords the ability of the method to answer many research questions, but also can be wellmatchedto the abilities and aptitudes ofthe graduate student.

InitialQuestion– BroadorNarrow

There is a continuum representing the degree of focus or openness of the questionnaire questions.For example, the initial questions are typically broad, open-ended questions so as to widely castthe research net (Adler & Ziglio, 1996; Delbeq et al., 1975; Linstone & Turloff, 1975). Alterna-tively, the questions can be more focused and structured to guide the Delphi participants towardsa certain goal, all the while winnowing down the questions in subsequent rounds. By widely cast-ing the research net in the initial round, one is more likely to get a broader range of responsesthan if a narrow set of questions were to focus the collective intelligence of the research partici-pants. The tradeoff, however, is that more data is likely to be collected with broad, open-endedquestions requiring more time consuming analysis. Focused or broad questions, is a significantdecisionthat needs to be madeearlyinthe research design phase.

ExpertiseCriteria

The Delphi participants should meet four “expertise” requirements: i) knowledge and experiencewith the issues under investigation; ii) capacity and willingness to participate; iii) sufficient timeto participate in the Delphi; and, iv) effective communication skills (Adler & Ziglio, 1996). Com-mitment to participate in a multi-round Delphi can be inferred by the round-by-round responserate (Keil et al., 2002). It is our experience that those true experts in a field have great insight;unfortunately, they are often very busy and may not be able to participate fully. Engaging, con-cise, and well-written questions can often entice their participation. Those with marketing skillsoften excel at sample development and a high response rate. Often the student's supervisor is avaluableresource to colleagues who qualify as experts.

NumberofParticipants

A practical consideration facing the researcher is the sample size. While there are no hard and fastrules,a number of factors shouldbe considered:

- Heterogeneous or homogeneous sample: where the group is homogeneous, then a smallersample of between ten to fifteen people may yield sufficient results. However, if disparategroups are involved (e.g. an international study), then a larger sample will likely be requiredand several hundred people might participate(Delbeq et al., 1975). A word of caution needsto be extended to the new researcher: heterogeneous groups can greatly increase the com-plexity and difficulty of collecting data, reaching consensus, conducting analysis, and verify-ingresults.
- Decision quality/Delphi manageability tradeoff: there is a reduction in group error (or an in-crease in decision quality) as sample size increases. However, above a certain threshold,managing the Delphi process and analyzing the data becomes cumbersome in return formarginalbenefits.
- Internal or external verification: the larger the group, the more convincingly the results can besaid to be verified. However, a smaller sample might be used, with results verification con-ducted with follow-up research. For master theses, often a single Delphi study will often suf-fice; however, for a PhD dissertation, the Delphi is usually verified with a follow up study(e.g.interviews or survey).

There is a wide range in the sample size in these Delphi studies (Table 1 and Appendix). Onlythree Delphi participants formed the homogeneous sample to develop rules for ceramic castingprocess, presumably because such expertise is limited (Lam et al., 2000). Conversely, 45 partici-pantswereinvolvedfromthreecountries toidentify softwaredevelopmentrisks(R.Schmidt et

al., 2001). Potential sample size is positively related to the number of experts. One also needs tobe cognizant that the views of the sample participants may not be representative of a wider popu-lation (Brancheau et al., 1996) which impinges upon results generalization. Cautious interpreta-tion of results is recommended if the sample is small (Nambisan et al., 1999; Wynekoop & Walz,2000)and/orifthe participants' expertiseis suspect (Wynekoop& Walz,2000).

NumberofRounds

The number of rounds again is variable and dependent upon the purpose of the research. Delbecq,Van de Ven and Gustafson (1975) suggest that a two or three iteration Delphi is sufficient formostresearch.Ifgroupconsensusisdesirableandthesampleisheterogeneous,thenthreeormore rounds may be required. However, if the goal is to understand nuances (a goal in qualitativeresearch) and the sample is homogeneous, than fewer than three rounds may be sufficient to reachconsensus, theoretical saturation, or uncover sufficient information. Finally, as the number ofrounds increases and the effort required by Delphi participants, one often sees a fall in the re-sponserate (Alexander, 2004;Rosenbaum, 1985; Thomson,1985).

ModeofInteraction

There are different modes of Delphi interaction available to the researcher. Initially, the Delphisurveys were pen and paper-based, and often returned through the mail to the researcher (Cramer,1990; Lecklitner, 1984; Silverman, 1981). This is still an option to the researcher. However, withthe advent of electronic mail and personal networked computers, pen and paper-based Delphi'sare less common. Electronic mail affords many advantages to both researcher and Delphi partici-pant alike. Increasingly, experts have access to electronic mail. Perhaps the most significant bene-fit of electronic mail is the expediency provided by this mode of interaction. Quick turnaroundtimes help to keep enthusiasm alive and participation high. Another benefit of electronic mail isthat the raw data is already in a digital format which eliminates the tedious task of transcription.Hartman harnessed group networking technology to complete a one-round Delphi (Hartman &Baldwin, 1995). Finally, the internet allows new ways of group interaction which can be incorpo-rated into the Delphi process (Keil et al., 2002). Others used online surveys (Cabaniss, 2001;Richards, 2000; V. Schmidt, 1995). Thus, there are many different modes of interaction availabletothe Delphiresearcher.

MethodologicalRigor

As with any research, methodological rigor is a cornerstone of "good" research: sloppy researchproduces sloppy results. Rigor is critical to both quantitative (Creswell, 1994; Fowler, 1993) andqualitative research (Sadleowski, 1986). Rigor is improved when the researcher leaves an audittrail (Sadleowski, 1986). This is a clear decision trail of all key theoretical, methodological andanalyticaldecisionsmadeintheresearchfrombeginningtoend(Koch,1994).Audittrailshelptosubstantiate trustworthiness of the research (Rodgers & Cowles 1993). We recommend the re-searcher regularly use a journal that is dedicated to capturing this information. Thus, methodo-logicalrigorcan contributeto a successfulDelphi –qualitative orquantitative.

Results

The method of data analysis and results reporting are directly related to the type

of questions usedintheDelphiinstrument.Therefore, researchersneedtoapplyappropriate analysistechniques. ThepresentationofDelphiresultshasbeen morefullydiscussedelsewhere(Dalkey &Helmer,1963;Delbeqetal.,1975;Dietz, 1987;Linstone&Turloff,1975;R.Schmidt,1997).Somere-searchers include analysis of the results sorted according to areas of agreement and disagreement(Keilet al., 2002).

FurtherVerification

Many researchers cite as a limitation the difficulty generalizing the results to a wider populationdue to sample size (Hartman & Jugdev, 1998; R. Schmidt et al., 2001), their limited views or spe-cific agenda (Nambisan et al., 1999; Niederman et al., 1991), and their geographic location(Brancheau et al., 1996). Most researchers recommended further study to refine and verify theirresults (Keil et al., 2002; Nambisan et al., 1999; Wynekoop & Walz, 2000), to investigate relatedsets ofresearchquestions(Brancheauetal.,1996; Niedermanetal.,1991),toextendtheresultsto a similar sample, but from other geographical locations (Brungs & Jamieson, 2005) or to anentirely different sample (R. Schmidt et al., 2001). Verification studies can provide rich researchopportunitiesfor new researchers.

Publication

While some researchers include their Delphi instrument with their publication (Brancheau et al.,1996; Niederman et al., 1991), most do not. In order to tell good numbers from bad numbers, weneed to understand not only what was learned, but also how the researchers collected their data.Weneed to see theinstrument and key data(Glass,1997;Sawyer, 1997).

Conclusion

The Delphi method is a flexible research technique well suited when there is incomplete knowl-edge about phenomena. There are many rich research opportunities in the IS discipline that focuson problems, opportunities, solutions and forecasts. The Delphi method would be a suitable can-didate for such research projects. It is not just a quantitative method, but works very well in quali-tative research. We believe that this method is well suited to IS research because it is a fluid dis-cipline ripe for research. Like IS projects, no two Delphi studies are the same. There are manyvarieties of Delphi ranging from qualitative to quantitative, to mixed-method Delphi. While thereare many varieties of Delphi, common to all are design considerations that need to decided uponincluding sample composition, sample size, methodological orientation (qualitative and/or quanti-tative), the number of rounds, and mode of interaction. Considering these choices help to addrigor to the method. Increased rigor contributes to a successful Delphi and deeper understandingofthe IS discipline.

A final two points. First, the Delphi approach can be aggressively and creatively adapted to a par-ticular situation. Second, when adapting the approach, there is a need to balance validity with in-novation. In other words, the greater the departure from classical Delphi, the more likely it is thattheresearcher willwanttovalidatetheresults, bytriangulation,withanotherresearchapproach

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