Methods for Distilling IS Key Issues Using a Delphi Approach

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Abstract

This paper describes two methods for distilling key issues from Delphi survey data. The approach taken in this work is perhaps best described as methodological action research. The research team found little in the literature describing the Delphi method that provided substantive guidance when confronted with major research design concerns in the context of IS key issues studies. The concerns in this study stemmed largely from the need to deal with unstructured responses from a heterogeneous survey population. The topics covered in this paper are a partial record of efforts to develop effective methods for addressing such concerns. The two methods described for coding survey responses were the use of a rules-based approach of coding to a predefined framework and an open coding approach in which coding categories are developed from the data themselves. A method of synthesising the results from multiple coding rounds was then described and summarised.

Keywords

IS Research Methodologies, IS Research Issues, Qualitative Data Analysis

INTRODUCTION

During the past thirty years Information Technology/Information Systems (IT/IS) has played an influential role in organizations. The rapidly changing character of information systems demands an ongoing assessment of major issues in the IS field. The IS literature in the last twenty years contain several excellent studies of the relative importance of IS issues (e.g., Deans, Karwan, Goslar and Toyne 1991; Watson and Brancheau 1991; Watson, Kelly, Galliers and Brancheau 1997). Eight of the more influential of these studies have used the Delphi method to survey the perceptions of IS executives (i.e., Dickson and Nechis 1984; Brancheau and Wetherbe 1987; Watson 1989; Niederman, Brancheau and Wetherbe 1991; Dexter et al. 1993; Pervan 1993; Brancheau, Janz and Wetherbe 1996; Dekleve and Zupancic 1996). Similarities among these major IS studies include the following: (1) a sample list of issues is provided; (2) a heterogeneous respondent group is surveyed; (3) 3-4 consensus rounds are applied; (4) a 10-point item scale is used; (5) reasonable consensus is achieved; and (6) a final list of 20-30 issues is summarized. Watson and Brancheau (1991) recommend that use of the Delphi method is appropriate for comparing and contrasting findings across similar studies, and that doing so contributes to a cumulative IS management discipline. Despite the use of a common method, comparison across "issues" studies is difficult due to the different ways in which the Delphi method has been applied.

Although there appears to be agreement among researchers and practitioners on the advantages of the Delphi method, considerable variance is possible in Delphi method design and implementation (Linstone and Turoff 1975; Delbecq, Van de Ven and Gustafson 1986). In particular, variations in the administration of Delphi-type studies have revolved around the following issues:

- respondent group targeted
- alternative mechanisms for communicating with respondents
- anonymity of the respondent group members
- use of either open-ended or structured questions to elicit responses
- appropriate number of survey rounds
- number of items carried over to subsequent surveys
- procedures used to synthesize responses into a summary list of issues

The strengths and weaknesses of the Delphi method in the context of IS key issues studies have been addressed previously (Chang and Gable 2000; Chang, Gable, Smythe, Timbrell forthcoming). Despite the background literature concerning the application of the Delphi method to IS key issues studies, the actual step-by-step processes for generating a comprehensive and meaningful set of major IS issues from diverse survey responses has not been adequately reported. Researchers contemplating the use of a Delphi approach are confronted with a range of methodological issues and find little in the literature to guide their choices with respect to data analysis. For example: How to deal with a large amount of non-numerical, unstructured, and rich data? How to select between alternative coding/indexing systems? How to ensure those issues identified accurately reflect the respondents' intentions? How computer tools can be used to manage textual data to support the process of qualitative concept building, typology construction, and theory development? Whether to use methods such as the Nominal Group Technique?

The following is typical of discussion, in published papers, on the process employed to consolidate first round responses of a Delphi survey:

> *This first round resulted in eighteen pages of issues and trends. In most instances, respondents provided ratings for an issue or trend heading, and then added substantial comments that elaborated on that dimension. Based on these replies, the research council devised issue categories into which the various comments were grouped. In addition, predicted changes were linked with specific corporate responses. This consolidation of comments served to eliminate overlaps, and made the wealth of information more amenable for evaluation and discussion in the subsequent rounds. (Czinkota and Ronkainen 1997)*

Researchers engaged in conducting Delphi surveys would be well served by greater clarity in the processes that are used to transform the raw responses from first-round Delphi questionnaires into the consolidated issues that typically comprise second round questionnaires. For studies that use a relatively small number of respondents who generate responses around a small set of well-defined constructs, this process can be rather trivial. Other studies, perhaps using less homogeneous respondent groups and/or more open-ended initial questions, may generate extensive lists of loosely related responses, the sorting and classifying of which can be a highly ambiguous task. The objective of this paper is to illuminate some of the data analysis concerns encountered in applying the Delphi method for IS key issues studies.

The paper describes two approaches to developing a set of key issues from responses to a Delphi survey. The two approaches are described in the next section, followed by a comparison of the strengths and weaknesses of each. The paper concludes with a discussion of the lessons learned from this exercise.

DISTILLING ISSUES IN A DELPHI STUDY

The Research Problem

Throughout this paper are included references to, and examples from, a recent Delphi study. This reference study was a Delphi-type survey conducted within five agencies of an Australian State government. These agencies had each been involved in implementing Enterprise Resources Planning (ERP) systems, specifically the SAP Financials modules. The purpose of the research was to identify, and determine the relative importance of, major ERP lifecycle issues from the perspectives of the key participants. The ERP lifecycle of implementation, management, and support is an extensive and ongoing experience. The pre-implementation, implementation, and post implementation stages continue throughout the lifetime of the ERP as it evolves with the organization (Dailey 1998). The three key participants, vendors, implementation partners, and user organizations must continuously make difficult judgments on major issues in relation to ERP lifecycle support (Davenport 1998, Gable et al. 1998).

To qualify for participation in the Delphi study the respondents were required to have had close involvement with SAP Financials within their agency during development and/or in using the system in an operational capacity. The first round of the survey occurred relatively soon after the system had gone into production in each of the agencies. Respondents were asked: "What do you consider have been the major issues in implementing, managing and/or supporting the SAP Financials lifecycle in your organization?"

The first round of the survey resulted in 274 issues being identified from 61 non-anonymous respondents. The text of the responses ranged from terse statements (i.e. "Resource hungry."; "SAP security is complex and resource intensive to maintain.") to detailed descriptions of perceived issues (i.e. "Navigation of the system is particularly difficult for infrequent users compounded by menu titles that, in a number of cases, are not indicative of their data content."; "While some skill transfer occurred between the implementation partner and the departmental staff not enough planning was put into maintaining a highly skilled and knowledgeable SAP team to support the system.").

The data analysis complexities in this study stemmed from two main sources. First, in order to get broad coverage of the ERP lifecycle management issues, the respondent group was intentionally diverse. The respondent group included managers involved with the project, internal IS personnel, personnel from the external implementation partners, agency personnel involved with the development, and user groups. Second, in order to yield issues across the full ERP lifecycle implementation, management, and support, the initial survey question was deliberately general in scope. Responses to the first round of the survey were consequently diverse, making data analysis more complex than is the case for simpler Delphi studies. The research team found little in the extant Delphi literature to direct the data synthesis efforts.

A typical response to dealing with complexity is to impose some form of structure. Three methods considered for providing structure to the issues in the reference study were – structuring the problem, structuring the analysis, and structuring the process. Structuring the problem refers to breaking the problem up into manageable tasks. Structuring the analysis refers to selecting a suitable framework for analysis and imposing the structure provided by that framework. Structuring the process refers to selecting a methodology that prescribes specific

steps to follow in conducting the analysis. The tasks, frameworks, and processes considered are described in the following sections.

The Qualitative Research Literature

The qualitative research literature can serve as a guide to coping with the types of coding issues that confront Delphi method researchers. Qualitative data analysis concerns data that is non-numeric, generally unstructured, and often rich in perceptions. The concept, however, is attributed different meanings in different contexts of research. Not only does the nature of the data vary (responses to open-ended questions, narrative field notes, interview transcripts, personal diaries, public documents, etc.) but so too do the strategies employed by researchers in the analysis of these data. The choice of strategy may be driven by research objectives, the nature of the data themselves, and the epistemological frameworks that influence the research generally (Tesch, 1991). Although researchers are never free from bias, they can converge on the meaning of text through immersion (Ramm, 1970; Lacity and Janson, 1994). Through the iterative process of reading and interpreting text material, a better understanding of the respondent's intentions can be built (Gadamer, 1977; Gadamer, 1985; Husserl, 1985; Winograd and Flores, 1986). Because Delphi studies are predicated on grouping like responses, one of the core activities is the determination of the meaning that lies behind each survey response. The responses to a Delphi survey can range from simple rankings of alternatives where the list is supplied by the researchers, to lengthy and complex narrative responses, depending on the research design. Although the former types of response are generally easily dealt with, the latter present more significant difficulties and clearly fall within the domain of qualitative methods. The techniques described in this paper are targeted at the more complex types of textual responses.

There are many traditions in qualitative data analysis, but most fit within one of two broad categories: holistic or atomistic (Willis and Jost, 1999). Atomistic approaches generally involve breaking the data down into segments, adding codes to the data segments, and then looking at relationships between the codes. Holistic approaches, on the other hand, tend to leave the data intact and emphasize that meaning must be derived for a contextual reading of the data rather than the extraction of data segments for detailed analysis. The choice of one approach over the other is typically determined by the research objectives. The two approaches and their major points in Willis and Jost (1999) are summarised in Table 1.

	Atomistic/Empirical	Holistic/Interpretive
Codes are	Facts that lead to theories Logically, objectively derived	Efforts to make meaning Tentative, emergent, theory-laden
Codes are created	Before data analysis	As you go along
Codes can be used to	Test hypotheses derived from existing/emerging theories	Build understanding
Hypotheses are	Empirically testable statements	Tentative, imprecise conjectures

Table 2: Two approaches to using code-and-retrieve data analysis methods

Perspectives on the strengths and weaknesses of the two approaches, and on the circumstances in which each approach might be most appropriate, are varied and often run to the heart of the philosophy of science. The positivist school of MIS researchers has (until relatively recently) tended to avoid qualitative research. Where qualitative research has been done, however, it has

been more of the atomistic type, relying on traditional concepts of validity and reliability. Researchers more in the subjectivist tradition, on the other hand, have readily adopted qualitative data as evidence and have also tended to embrace the more holistic approaches. The question of whether the differences are ones of philosophy or of fit between research questions and research methods (or some combination of the two) is an important one, but one that is beyond the scope of this paper. Interested readers are directed to the many excellent reference works (e.g., Gadamer, 1985; Lacity and Janson, 1994) both on the philosophical issues and on qualitative analysis more specifically.

Coding Method #1 – Fitting the Data to a Framework

The first coding method employed a predefined framework to structure the responses. This approach is in the tradition of atomistic styles of qualitative analysis but its use in this context is revelatory rather than for hypothesis testing (although post hoc hypothesis testing is possible). The coding scheme drew upon the MIT Management for the 1990s Framework (Scott Morton 1991). This framework views an organization's performance as being contingent on the appropriate fit of six key factors: external environment, strategy, structure, technology, management processes, and individual skills & roles (Figure 1). Although the original purpose of the framework was to understand the impact of IT on organizations, it was selected for this research to serve as a conceptual map - a means of categorizing issues and examining possible relationships between them. This particular model was chosen because it purported to represent the organisational impacts of IT deployment and because it had been used in an earlier single pilot case study of ERP implementation (Niehus et al 1998).

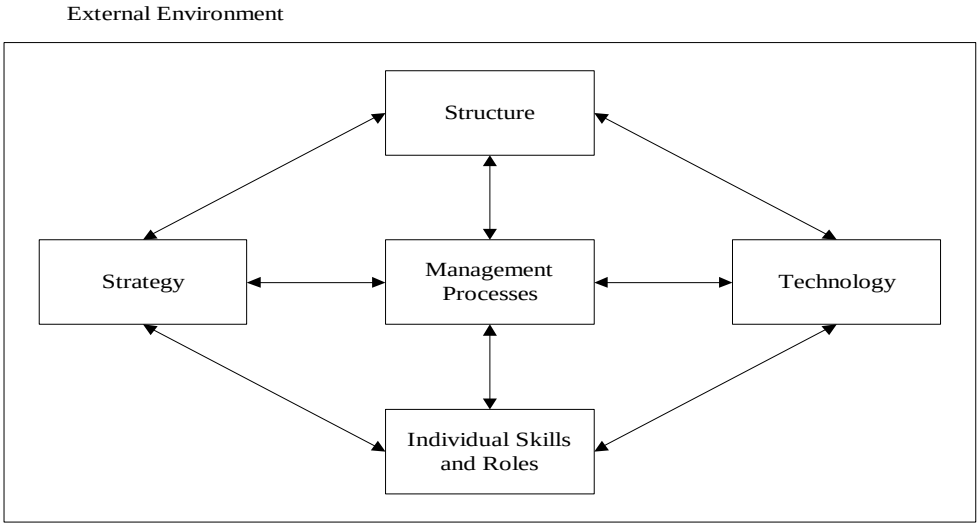

Figure 1: MIT90s framework (Scott-Morton 1991, 1994)

The first step in using any predefined framework is to ensure the constructs in the model are well defined. Preliminary coding rules were then determined for each of the constructs to facilitate coding the responses. A simple coding database application was also developed to expedite the coding, storage, and reporting of results. The approach to coding used for this study differed from that usually described in qualitative research methods. Rather than attaching labels (that represent constructs) to responses according to specified coding rules, the coding rules themselves were attached to the responses. This process was developed with a view to allowing multiple frameworks to be fitted to the response data - by coding rules to responses, and then mapping the rules to the constructs in whatever framework was of interest. The preliminary rules were modified and supplemented in the coding of a randomly selected sample

of responses. Ten rules were sufficient to code these responses to the six constructs in the model. After coding this first sample the groupings of responses should be evaluated for content validity to ensure that the coding rules capture the meaning of the constructs. Concerns about coding reliability can be dealt with by using multiple coders or a test-retest approach.

In the subsequent coding of the holdout sample of responses, no additions or modifications to the coding rules were necessary. An example of a rule for coding to the technology construct was:

> *The issue relates to the characteristics and direct costs and benefits (both real and anticipated) of designing, acquiring, deploying, using, or disposing of a particular technology (e.g. technique, machine, software, etc.).*

The first round of coding resulted in the vast majority of responses coding to the *Technology* category. This problem illustrates the requisite variety problems associated with coding to a predefined framework. The ability to represent the diversity of issues within a coding sample is limited by the variety in the framework itself. Few, if any, models are sufficiently detailed to capture the richness of the responses to a broad IS survey. For the coding to facilitate a meaningful analysis the constructs must be further broken down into a hierarchy of subconstructs. A candidate model for such a coding scheme might resemble the familiar MISQ keyword classification scheme (Barki et al. 1993) that presents areas of IS interest at several levels of detail.

The benefits of coding to a predefined framework are substantial. The categorisation of issues is grounded in the theory that underlies the reference framework. Category definitions are therefore less arbitrary than might otherwise be the case. The categorisation scheme is independent of the study in question, increasing the extent to which propositions made from the data are generalisable to other domains. The framework may also be applied to data from several surveys, permitting comparison of findings across studies.

Coding Method #2 – Open Coding

The second coding method described uses the data themselves to define the coding categories. This form of coding is in the tradition of the holistic/interpretive methods described earlier. When coding responses by this method the process begins with no predefined categories. The relevant categories emerge from the meaning attributed to the responses by the researchers. The determination of categories is therefore much more subjective than the first coding method described above.

A manual procedure was adopted because spatial characteristics of the coding procedure appeared to ease the coding task. That is, the researchers were more easily able to perform the task when they could visually identify the categories of responses. This preference may have been idiosyncratic to the researchers involved. A card was printed for each issue showing the text of the issue, the detailed description provided by the respondent, and an identification number. The cards were randomized before the first round of sorting.

The first round procedure for sorting involved selecting a card, reading the issue and the description on that card, and placing the card into a category. Category selection was determined by the meaning of the issue as described on each card. Groups of ‘like’ issues were formed and these were developed into categories as the sorting process continued. As new cards were examined, the nature of some of the groupings was amended slightly to accommodate new issues. There were no formal rules for resolving whether an issue fell into one grouping or another; the distinctions were based solely on the text of the issues as they appeared on each card. Examples of the categories after this first round were *knowledge management*, *cost/benefit*, and *operational deficiencies*. The first round of coding produced 12

categories with a good distribution of responses across categories (range of 7-67 responses per category).

When all of the cards had been placed into groups, the cards in each grouping were examined once more for the meaning represented by the groups, and the groups were then given preliminary labels. In the second round of sorting, each of the groups from the first round was examined in turn. For each group the cards were again examined and sorted into 'like' groups. Subgroups for most of the initial groups were quite easily determined with several issues being clearly alike, and different from other issues in that group. As for the first round, the groupings were again examined and appropriate labels attached. As no groups were suggestive of third-level groupings the sort procedure ended with the second round. The groups of issues were inspected a final time and minor revisions made where appropriate. Examples of the second-level categories within the knowledge management category were: *insufficient resources and effort put into developing in-house knowledge*; *difficult to retain people with SAP skills due to market pressure to leave*; and *training provided was inadequate and did not cover the diversity of circumstances encountered in normal daily operations.* The number of final categories totaled 38 (range of 1-33 responses per category). The coding of responses to groups were then entered into the project database. Using a variation of the Nominal Group Technique, the validity of the categories was tested by having a panel of experts (senior representatives from Government agencies) examine the issues and allocate them to categories of their choosing. The coding results from the researchers and the panel members were then compared, differences evaluated, and changes made where appropriate.

The benefits of using a holdout sample for these data diminished from the first to the second round of coding. Because some of the minor classifications only contained two or three responses, some new categories were defined from the holdout sample data. A more appropriate method of determining reliability for the open coding procedure is to use a two-step procedure. First have multiple coders work through the open coding procedure described above and then compare the results from each coder and resolve the differences. The second step is to conduct additional rounds of coding, following the procedure described in method #1 above, using the categories determined in the first round of open coding as prespecified constructs and checking for reliability using an appropriate statistic (e.g. Cronbach's α or Cohen's κ).

The major strength of the open coding approach is that this form of coding is data driven - the categories so formed reflect the range of issues that were collected as data rather than some pre-defined scheme. Unlike the first method described above, the open coding approach is extensible to any number of distinct categories. Because the categories are determined from the data themselves, respondents should easily comprehend them when the second round of the Delphi survey is implemented. A corresponding weakness of this method is that, because the coding scheme is specific to a set of data, it may not be generalisable to other data sets. Because there is no theory underlying the categories it is more difficult to identify the relationships that may exist between them.

SYNTHESIS

Researchers need not commit to the exclusive use of a single coding scheme. Some research contexts may benefit from employing multiple coding schemes. In the reference study the purpose was to develop a deep understanding of the perceptions that prevailed in a particular context. Because it referred to a continuous process (the ERP lifecycle implementation, management, and support) there was an expectation that threads of explanation might emerge from the data analysis that extended from system development through implementation to operational use. Multiple coding schemes were examined because the research team believed that no single scheme was likely to illuminate the complexity of the key issues and the

relationships that might exist between them. The use of multiple coding schemes introduced the additional complexity of reconciling the results of each. Reconciliation was necessary because the Delphi approach called for a single set of key issues for distribution in the second round of the survey. A method of synthesising the results from multiple coding rounds was then summarised below in Figure 2.

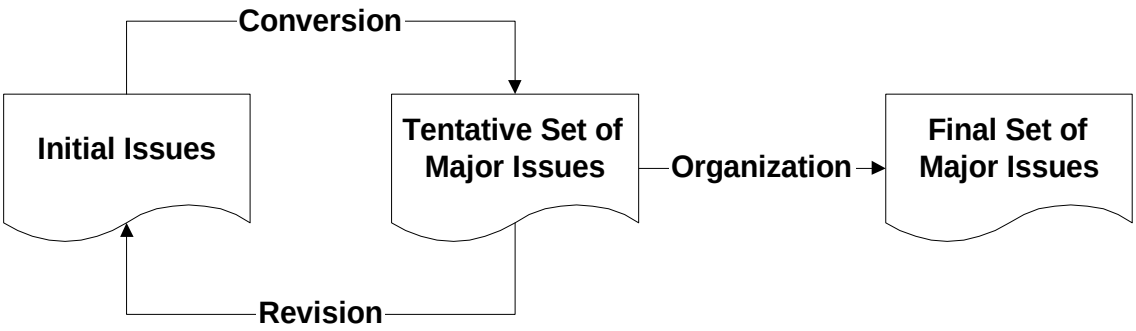

Figure 2: Overview of the issue synthesis process

A simple method for reconciling the disparate set of issues is to employ a combination of 'vertical' and 'horizontal' analysis approaches (Davies 1991). The vertical approach describes an individual researcher's focus on his/her own data analysis effort. Multiple researchers work concurrently on the same data to produce several sets of analyses, each researcher continuing to an intuitively determined depth. In the reference study the vertical analysis produced several different preliminary sets of issues, each from a different coding scheme. The second step of horizontal analysis involves comparing and mapping across different sets of tentative issues, with emphasis on developing a consolidated master set of key issues (Figure 3). Researchers may find it beneficial to involve individuals from the survey population in the horizontal analysis phase. In the reference study it was determined that key senior personnel in the government agencies could provide valuable insight into the key issues, and particularly the relationships between them. For studies of this type it is generally beneficial to have a panel, composed of the domain experts and members of the research team, work through the sets of issues together rather than separately to exploit their joint understandings of the domain. At this stage of the research the analysis of data is particularly subjective. Because a Delphi approach was being employed, however, the panel's perceptions of the issues and their interrelationships could be validated in subsequent rounds of the survey.

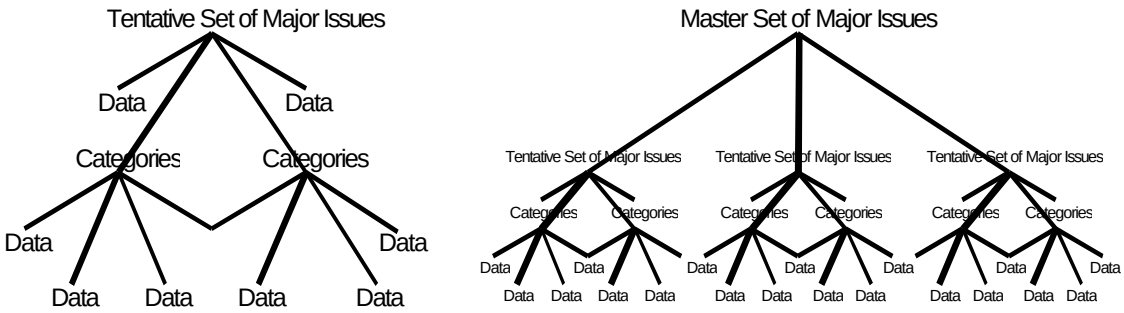

Figure 3: Vertical analysis (left) and the consolidation of horizontal analysis (right)

CONCLUSIONS

This paper has described two methods for distilling IS key issues from Delphi survey data. The approach taken in this work is perhaps best described as methodological action research. The research team found little in the literature describing the Delphi method that provided substantive guidance when confronted with major research design concerns in the context of IS key issues studies. The concerns in this study stemmed largely from the need to deal with unstructured responses from a heterogeneous survey population. The topics covered in this paper are a partial record of efforts to develop effective methods for addressing such concerns. The two methods described for coding survey responses were the use of a rules-based approach of coding to a predefined framework and an open coding approach in which coding categories are developed from the data themselves. Following feedback from the expert panel, and because of its flexibility, the open coding method was adopted for further rounds of this Delphi Study. The results of the methodological action research effort to date are summarised below in Table 2.

Tasks	Who involved
• Distil a structured set of preliminary issues from the individual raw issues using either a predefined coding scheme or an open coding approach. o Code the responses o Apply appropriate checks for validity and reliability o Revise as necessary	Research team members
• Examine the resulting structured set of preliminary issues and attempt to understand the interrelationships between categories o Contrast and compare the results of alternative coding methods o Combine and map the researchers' results into a coherent master set of issues	Review panel
• Seek confirmation of the resulting master set of issues	Review panel
• Finalize the master set of issues	Research team

Table 4: Summary of the approach suggested by the reference study

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