COMPUTER SUPPORT INTERACTIONS: VERIFYING A PROCESS MODEL OF PROBLEM TRAJECTORY IN AN INFORMATION TECHNOLOGY SUPPORT ENVIRONMENT

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Observations in the information technology (IT) support environment and generalizations from the literature regarding problem resolution behavior indicate that computer support staff seldom store reusable solution information effectively for IT problems. A comprehensive model of the processes encompassing problem arrival and assessment, expertise selection, problem resolution, and solution recording has not been available to facilitate research in this domain. This investigation employed the findings from a qualitative pilot study of IT support staff information behaviors to develop and explicate a detailed model of problem trajectory. Based on a model from clinical studies, this model encompassed a trajectory scheme that included the communication media, characteristics of the problem, decision points in the problem resolution process, and knowledge creation in the form of solution storage.

The research design included the administration of an extensive scenario-based online survey to a purposive sample of IT support staff at a medium-sized state-supported university, with additional respondents from online communities of IT support managers and call-tracking software developers. The investigator analyzed 109 completed surveys and conducted email interviews of a stratified nonrandom sample of survey respondents to evaluate the suitability of the model. The investigation employed mixed methods including descriptive statistics, effects size analysis, and content

analysis to interpret the results and verify the sufficiency of the problem trajectory model.

The study found that expertise selection relied on the factors of credibility, responsibility, and responsiveness. Respondents referred severe new problems for resolution and recorded formal solutions more often than other types of problems, whereas they retained moderate recurring problems for resolution and seldom recorded those solutions. Work experience above and below the 5-year mark affected decisions to retain, refer, or defer problems, as well as solution storage and broadcasting behaviors. The veracity of the problem trajectory model was verified and it was found to be an appropriate tool and explanatory device for research in the IT domain.

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CHAPTER 1

INTRODUCTION

This dissertation contains a report of descriptive research into the problem solving and solution recording behaviors of information technology (IT) workers in several different work settings. This investigation extended a qualitative pilot study from 2001, described in Appendix A, in which I studied a single work site in detail and formulated a model of the observed information behaviors. For the current study, I developed a much more detailed model of the problem resolution behavior of IT support staff and explored it across a larger sample from a wider variety of workplaces. This chapter presents background on problem resolution processes in the IT environment, the specific problems this study addressed and why they are important, and an overview of the research approach and methods. The chapter includes the delimitations and limitations of the study, and definitions of essential or unusual terminology. I have organized the remainder of the dissertation into conventional chapters for the literature review, methodology, results, and discussion and conclusions.

Background

The salient activity of information technology (IT) workers is the acquisition of knowledge about their automated systems that will enable them to deploy reliable installations of hardware, software, and data, and in the event of failures to those systems, to resolve the problems expeditiously and prevent them in the future. These workers and their managers measure success in terms of the availability of reliable information systems for their users, and in their ability to minimize the downtime experienced through either system failures or emergency maintenance. At every level, the response to an information system problem is usually immediate and intently focused on achieving a restoration of service. The process for organizational learning, the retention of information about the solution to a problem that would be necessary to speed future responses or stimulate system changes to prevent future problems, is often much less clear. Many IT organizations appear to specialize in reactive procedures and never advance to the stage of proactive problem prevention. Typically, these institutions have not made it a priority to store solution information about recurring problems and make it available to their entire IT staff, and consequently there are neither efficient means for recalling prior solutions nor are there any coherent processes for implementing permanent solutions to known issues.

According to the latest Gartner report on IT management process maturity levels from their December 2005 poll (Curtis, 2006), 40% of IT organizations are still at maturity Level 1, reactive.[1] This is an improvement since their 2004 poll that saw 57% at Level 1, but because this is a poll taken from 759 attendees at a data center conference, the better funded and organized IT organizations were probably overrepresented. Even with that population, 2% of the respondents reported that their IT organizations were still at maturity Level 0, chaotic. It seems reasonable to assume that more than half of all IT organizations are in fact still operating at IT management

[1] From *Conference polling indicates improvement in IT management process maturity*, by D. Curtis, 2006, Gartner Report G00138514, Stamford, CT: Gartner, Inc. Copyright 2006 by Gartner, Inc. Used by permission.

process maturity levels of chaotic or reactive. In many of these cases, it is in all probability a failure to store solutions and known issue information and make them available for reuse that is preventing the IT organization from moving forward to maturity Level 2, proactive.

Any IT support environment contains a multitude of people solving problems with IT systems, many of which are repetitive and should be logical candidates for encoding into explicit knowledge for reuse. The linkage between problem solving and solution recording in an IT support workplace would appear to be obvious, with the latter logically following the former as a matter of standard practice. The reality appears to be far different. A number of studies into the behavior of computer support help desks and customer call centers indicated that solution recording following problem resolution is often the exception rather than the rule, and the findings of the pilot study confirmed that supposition. At times, the decision to record solution information depends primarily on the consultant’s projection of its possible future use (Ackerman & Halverson, 2004). At other times, shortcomings in the problem-tracking information systems available to the IT support staff members influence their choice of whether to record or retain any new knowledge. In some circumstances, it is the lack of any incentives to store knowledge that obstructs the solution recording process (Ackerman & Malone, 1990; Huber, 1990; Von Krogh, Ichijo, & Nonaka, 2000).

In the specific computer support environment investigated during the pilot study for this research project, more than 95,500 trouble tickets had been resolved since the system came on line in 1998, along with more than 13,500 change requests. Trouble tickets, also known as incident reports or help desk cases, are reports of problems with existing IT systems or services. Change requests are not normally problems, but requests to add new services, change existing ones, or to install new systems or software. Change requests often require the same sort of handling that is required for trouble tickets. In sharp contrast to the number of trouble tickets in the system, only 105 records had been stored in the integrated solution-recording module since 1998, and most of those originated with only a few individuals. That is approximately one formal solution entered for every 625 trouble tickets that have been resolved in the system. Even those are gone now, removed after becoming obsolete in 2003 when the campus dropped dial-up support. Based on the lack of success with the built-in solution recording features, the institution began the limited implementation of another knowledge base solution in the second half of 2005, and by the first part of 2006, it contained about 50 solutions. Almost all of those solutions came directly from existing help desk frequently asked questions (FAQs), and no one has added any new items since then. Without the resolution of several technical issues and a concerted effort to promote the new system and train IT staff to use it effectively, it is unlikely that it will be any more successful than the previous one.

Based on the pilot study observations, the IT staff members may at best record a terse portion of the solution in a trouble ticket work log, but more likely, they will simply enter the word “fixed” or “done” instead, leaving no clue as to how the problem was resolved. Other IT staff members have recorded an unknown number of more complete solutions in this manner before closing the tickets, but that does not necessarily make them available to other IT support staff. No effective tools are available for efficiently searching those work logs and reviewing the results, so the recorded solutions that do exist have little realistic potential for reuse. Even the individual who entered the solution may have problems locating and retrieving it months later. The automated retrieval of solutions within the current application depends entirely on a categorization match between the classification of the new problem and that of the solution. In practice, this has proven to be virtually unusable because each solution can only have a single classification, and there are more than 1,400 category-type-item classifications for problems.

When the same or a similar problem appears again, whoever takes the call must start at the very beginning, looking for the solution someone else found earlier that now is lost. Even the person or group who originally solved the problem will have to reconstruct the solution from memory, a process that can take just as much time and effort to accomplish as the original problem resolution did. Those who resolved the problem the first time will remember the act, but will not usually remember the details of the solution, so when the problem reoccurs they must discover the same or another solution all over again. If every problem with information technology were unique, this practice would not be a problem. Unfortunately, until improvements or corrections to hardware or software change the underlying technology in a system, the existing problems will remain and reoccur. The inefficiency of this method of IT problem solving should be obvious, but a viable course of action to improve it is not.

Denied a place for easy storage and efficient retrieval of solution information, the IT support staff at this site has had to turn to other storage devices. One of the pilot study findings was that the help desk consultants were routinely storing solution information in their personal and shared electronic mailboxes. This method of retaining solutions required the least amount of effort on their part, and the knowledge stored there was searchable from the email client software for up to six months; after 180 days, that particular mail system permanently deletes all non-archived mail items. One can only guess at how much useful solution information ultimately has been lost because of this practice.

Problem Statement

For a variety of reasons, the people working as information technology (IT) support staff who spend their time resolving problems of every possible kind are seldom able to transform their solutions into reusable knowledge. In many cases, they expend considerable effort in creative or collaborative problem solving, the results of which they only apply to resolve the problem at hand. Because the recording or sharing of solutions is merely an optional follow-up step to problem resolution, an afterthought, in many cases IT staff members omit it. Instead of storing this information in a reusable form or sharing it, they consign the solution to personal memory or forget it completely. Even when some sort of storage or broadcast does take place, IT staffers frequently communicate it in only the most transient of media and it never becomes a part of the organization’s explicit memory. The solution storage process is not taking place, and intellectual capital is lost over time or as IT staffers change positions or organizations. Organizational learning is not taking place as it should, and everyone involved wastes time, energy, and resources.

The underlying problems with the solution storage dilemma may lie in the number of participants and the convolution of steps and actions that are often required to solve complex issues with information systems. Other factors such as problem criticality and work experience may also have a direct bearing on the failure to create knowledge. During the pilot study it became apparent that the problem trajectory, or its complete path from arrival to resolution, had an influence on the final decision of whether to store a solution. In light of this observation, any attempt to determine when IT staff members will create and store knowledge must begin by following the pathway of problem trajectory. The main problem that this study attempts to address is that no complete picture of the entire problem trajectory and its component processes exists in a form suitable for application to IT environments. One of the products of the pilot study was a rudimentary model of the problem resolution and solution recording process. This study endeavored to explicate that model further with detail added from pilot study observations and from the literature, and then to verify its completeness within the typical problem scenario situations encountered by IT support staffers in their daily work environments.

Based on observations in the environment under study and generalizations from the IT problem resolution, knowledge management, and knowledge creation literature, it is clear that the systematic recording of organizational knowledge about solutions to

IT infrastructure problems seldom takes place as it should. To better understand where the knowledge creation process is breaking down, researchers in this area need a comprehensive model of the entire problem resolution process, from the initial notification of the problem to the final disposition of information about the solution that was applied to resolve it. To address this problem systematically, investigators need to know which situational factors within the model and what characteristics of individual IT staff members appear to influence the decisions to store solution information in a manner that facilitates its reuse by other IT support staff.

Purpose of the Study

The purpose of this study was to investigate the problem resolution and solution recording behavior of IT support staff members when faced with different types of information system problems that arrived by various communications media, and covered the full range of variations in criticality, scope, frequency, and other factors. This study further explored some of the most interesting information behavior that I observed during a qualitative field study of customer support operations, the pilot study described in Appendix A, to include the expertise selection and problem resolution processes. The intent of that study was to identify the various factors that affected how IT support staff members resolved incidents, including how they identified the problems and found solutions, and what conditions had to be present before they would record or share those solutions. I was able to develop a basic process model of help desk or computer support interactions from the observations of that study, but it was limited to the very specific environment of a single IT support help desk.

A primary goal for the current investigation was to expand the details of the help desk interaction model (Appendix B, Figure B1) developed during the pilot study into a much more in-depth and comprehensive model of IT problem trajectory, and then to verify the completeness of the new model with a population that performs those processes on a regular basis. To be useful in a more generally applicable form, the model would have to account for all of the factors and decisions that are included in this process across many different IT settings, so the extremely heterogeneous IT environment of a university was considered to be an appropriate research context. An additional goal of this study was to determine whether the work experience of IT support staff members played a significant part in determining their solution recording behavior. A tangential goal of the investigation was to continue trying to identify where the process of knowledge management was breaking down in the local environment, such that the IT support staffers were not properly recording or sharing the solutions to IT problems.

An overall objective of this study was to confirm and verify the suitability and stability of a proposed model of problem trajectory. This model encompassed the comprehensive but much more generic model of trajectory developed by Glaser and Strauss (1968) for their medical ethnographic studies, and applied it to the information technology support arena. I developed a well-elaborated, phased model from the observations and findings of the pilot study, supplemented by my domain knowledge of

IT support processes and the available literature. I designed the study to confirm the phases of the trajectory scheme, the component variables, the range of possible values for each variable, and their interactions with each other and their environment by using a larger sample than that observed during the pilot study. As a collateral benefit, the results of this inquiry could also inform the design and employment of knowledge management tools at the site under study, where I have been working on a knowledge base project for several years.

Significance of the Study

This study contributed to a better understanding of the information behavior of IT support staff members, who synthesize or reuse knowledge in their daily tasks of solving computer problems for their customers. In some cases, they actually record that knowledge for future use. The area of IT support operations has become increasingly critical to the success or failure of businesses and organizations of every size and kind, but management still views it as a reactive cost center that can do more harm than good when not properly administered. The extent to which knowledge about solutions is developed, used to resolve immediate problems, and then retained for use to solve future problems is a good measure of IT organizational effectiveness as described by Curtis (2006). It is the proactive use of that knowledge to prevent problems and improve the infrastructure that enables an IT organization to move past management process maturity Level 1, reactive, and reach the proactive stage at Level 2. When the IT support staff does not retain or share the knowledge gained during the process of problem resolution in some fashion, they will expend a similar level of effort to find the same or another solution the next time that the same problem occurs. This inefficiency drives up the costs of IT support and works against any efforts to avoid future costs through proactive measures. It also has a detrimental effect on the services provided to IT system users in the organization, driving costs even higher due to lost worker productivity.

The most significant contribution of this study was to verify the components of a comprehensive model of the problem resolution and solution recording process in an information technology environment, and to document the relationships between some of the key components based on situational responses from people who actually do this type of work on a daily or recurring basis. This model of problem trajectory contains much greater detail than has been employed in earlier research efforts, and should prove useful as a basis for designing future research into the dynamics of problem solving in IT workplaces. This investigation also identified those parts of the process for which improvements in practices or adjustments to managerial emphases may have the highest payoff for solution knowledge creation. In addition, this study provided details about how the information behaviors of IT support staff members change with experience, and what the implications of that progression could be for the practice of knowledge management.

Theoretical Perspective

As the principal researcher, I conducted the pilot study within the same theoretical frameworks of organizational memory, distributed cognition, and trajectory that Ackerman and Halverson have used to inform their own research (Ackerman & Halverson, 1998, 1999, 2000, 2004). This investigation drew on those same theoretical models, but used a much more detailed model of problem trajectory that I derived from the results of the pilot study. I was also able to draw on more recent work in knowledge management theory, especially that of knowledge creation.

As reported in Appendix A, the pilot study made extensive use of the various facets of organizational memory theory, including distributed intelligence and intelligent artifacts (Pea, 1993), the locus of organizational memory (Walsh & Ungson, 1991), expertise networks (Ackerman, 1998; McDonald & Ackerman, 1998), and referral or boundary spanning (Ackerman & Halverson 1999; Metoyer-Duran, 1993). One part of the pilot study attempted to investigate the role of incentives in the creation of knowledge, guided by theory from many sources (Ackerman & Malone, 1990; Davenport & Prusak, 1998; Huber, 1990; Orlikowski, 1992; Von Krogh et al., 2000). The study also used the theory of distributed cognition (Hutchins, 1991, 1995) to better understand and map the decision processes that involved multiple people and information systems. A theoretical model of trajectory (Ackerman & Halverson 1999; Hutchins, 1995; A.L. Strauss 1993) served to explain both the successive effects of actions over time, and the anticipated outcome of each situational phase.

During the pilot study, I used all of these theoretical perspectives at some point to explain or understand the information behaviors and actions observed during the investigation. The research project reported here drew on that wide theoretical base and included more recent developments in distributed cognition theory (Hollan, Hutchins, & Kirsh, 2000; Pea, 2004), expertise (Ackerman, Pipek, & Wulf, 2003; Ehrlich, 2003), knowledge creation (Choo, 2006; Von Krogh et al., 2000), knowledge management systems (Halverson, Erickson, & Ackerman, 2004), and organizational memory (Ackerman & Halverson, 2004; Halverson & Ackerman, 2003).

Research Approach

This study was conducted within the paradigm of modern pragmatic investigation (Howe, 1988), employing a mixture of quantitative and qualitative methods (Tashakkori & Teddlie, 1998), including descriptive survey research, selective semi-structured email interviews, and artifact inspection. The investigation attempted to verify the completeness of a proposed model, and as a result employed research questions that asked *how* various factors affected problem resolution and solution recording behavior. According to Blaikie (2000), the answers to *how* questions must be built on the answers to *what* and *why* questions, and he stated that although all four research strategies, inductive, deductive, abductive, and retroductive, claim to be able to answer *how* questions, "In some cases, a combination of strategies might be an advantage" (p. 122). That line of reasoning recommended the use of mixed methods to obtain answers to the research questions in this study.

This investigation was also an extension of an earlier qualitative field study into organizational memory processes, situated in a computing center help desk at the same site. The inspiration for that pilot study came from a series of reports of investigations into information behavior in call centers and help desks that appeared in several publications by Ackerman and Halverson (1998, 1999, 2000, 2004). The investigation reported here, the pilot study that preceded it, the studies by Ackerman and Halverson, and related studies with other researchers have all made use of mixed methods and exploratory procedures to extend our understanding of this particular type of information behavior in the workplace.

Research Questions

I derived the research questions for this study from the conclusions of the pilot study, which had recommended further exploration of several different areas within the context of organizational memory in an IT support environment. I formulated one broad research question into problem trajectory, along with four subordinate questions to help guide the analysis through all five phases of that process. I also selected a second question with a much narrower scope for the study, addressing the possible effects of work experience. These research questions are:

1) How do the factors of problem trajectory, in particular, criticality, scope, and frequency of occurrence, affect the problem resolution and solution recording behaviors of IT support staff?
2) How does experience in the workplace affect the problem resolution and solution recording behavior of IT support staff?

The first research question, investigating the factors of problem trajectory, incorporated most of the variables in the problem resolution process that I had actually observed during the pilot study. This question made use of a detailed model of problem trajectory to structure the research, a model developed from the pilot study findings and extended using the literature. I defined four subordinate questions to ensure that the investigation would explore every aspect of the research question during the analytical process. I explain these four questions in detail in Chapter 2, elaborating on the process of developing the research questions from prior research literature. Specifically, I intended to examine consultant information behavior for the effects of the communications media in which problems arrive, the factors considered during the phases of problem assessment, expertise selection, and problem resolution, as well as the criteria for solution recording. The research design for this question was exploratory, and it was my intent to identify and enumerate the factors selected for the model of problem trajectory and to gain a better understanding of their interactions.

The second research question addressed a very specific finding of the pilot study, the observation that there seemed to be a relationship between the work experience of computer support consultants and their solution recording behavior. The differences observed within a very small sample of consultants, ranging from part-time workers with less than a year on the job to full-time staff with more than four years of experience, were contradictory and could have significant implications for knowledge management practices in high turnover environments. My intention in the research design for this question was to identify any associations between the self-reported work experience and the solution recording behavior of the members of an IT support staff. In Chapter 2, I present a more detailed explanation of each research question, within the context of existing literature and previous studies.

Delimitations and Limitations of the Study

This study primarily investigated problem resolution and knowledge creation behavior within a discrete information technology support community at a medium-sized, state-supported university in Texas. This community consists of both centralized and distributed computer support groups that operate independently of one another due to organizational structures but coordinate many of their activities. One of the unifying factors is an enterprise call-tracking system, the Remedy® Action Request System® (BMC Software, Inc., Houston, TX, http://www.bmc.com). Remedy has been in general use since 1998, providing tools for recording, tracking, and referring problem reports within this community. It also contains the means for recording and retrieving solution information. The community numbers more than 350 full-time and part-time staff members, of which approximately 280 have full user permissions on the call-tracking system. When I opened the first survey on the University's Zope QSurvey server for data collection on April 18, 2006, exactly 283 individuals composed the original sample for the study. This number fluctuated during the study as IT staff members departed or were hired into the various support organizations. To obtain data from external organizations for comparison, and to increase the number of responses, I extended the survey to three other IT support communities using the commercial SurveyMonkey.com site on May 23, 2006. Two of these were the EDUCAUSE community groups for User Services and for Distributed Technology Support, consisting of IT managers and senior staff at many other educational institutions in the United States. The other was the ARSLIST listserv, an international community of more than

1,800 Remedy system administrators and developers who work primarily with call tracking and solution recording systems and their users.

Even though the study had a starting sample of almost 300 possible respondents, this sample size did not provide a group large enough for statistical proofs of causality. The actual sample obtained was far smaller at 109 respondents with completed surveys, some from quite different populations. The results are therefore not directly generalizable to other IT organizations, in particular to organizations outside higher education, but they could be transferable to other, similar populations. Because this project was limited to descriptive research, the model of problem trajectory was verified and described but was not validated using empirical methods. That step will have to wait for a later study using a much larger sample from a more widespread population.

Definitions of Terms

Information technology (IT) support staff: staff members who support both the customers and the information systems used in an organizational environment. This broadly defined term includes computer support consultants within the context of the overall IT support organization. It covers a broad range of workers, from database administrators to telephone repair technicians. The terminology used in this document includes *IT staff* for the general group or organization, *IT staffer* for an individual, and *IT staffers* for more than one individual.

Computer support consultants: IT support staff members who normally provide first-line support to end user customers within the context of a help desk, hotline, or other type of customer service call center. The pilot study focused primarily on this portion of the IT staff population. The terminology used in this document to refer specifically to help desk staff as observed during the pilot study includes *consultant* or *consultants*.

Computer support problems: any problem with accessing or using the information technology systems in an organizational environment. The problems include difficulties with desktop computer hardware or software, communication networks, user authentication or access, or any centralized information systems that people need to use to accomplish their work or academic activities.

Boundary objects: Discrete records or parcels of information created to transmit meaning between individuals or groups, in the present or across time. A trouble ticket is the most comprehensive type of boundary object used in an IT problem solving process, whereas an email message or thread of messages is probably the most common type used. Star (1989) described boundary objects in some detail.

EDUCAUSE: The nonprofit association of higher education institutions and industries that promotes the intelligent use of information technology. Two parallel organizations, the Interuniversity Communications Council, Inc., (trade name Educom, formed in 1964) and the College and University Systems Exchange (CAUSE, formed in 1962, incorporated in 1971), combined in June 1998 to form EDUCAUSE. (EDUCAUSE home page, 2006)

CHAPTER 2

LITERATURE REVIEW

The literature supporting this investigation is largely theoretical or conceptual, as there is a dearth of pertinent empirical studies on the specific topics under study. First, I will discuss the search for relevant literature in general terms. Next, I have provided a brief synopsis of each theoretical concept or model found in the literature and used in the research design, with their primary source citations. Then I cover the literature and concepts supporting the model of problem trajectory in depth, as these are a central part of the research design. Finally, I explain each of the research questions in detail, within the context of the available theoretical and empirical literature.

The Search for Relevant Literature

The best way to trace the existing literature on information technology problem solving, problem trajectory and solution recording is to follow Mark Ackerman's research into call center interactions and related topics. The reference lists of his many papers covered thirteen years of continual research in this area and included numerous collaborations with other researchers. These lists constituted an indispensable guide to the topical and theoretical literature. During the conduct of the original pilot study for this investigation in 2000-2001, I prepared an extensive citation map to almost everything that Ackerman had cited, from his works and the works that he cited to the salient theoretical papers that appeared in most of the reference lists. I updated these citations to reflect newer publications when writing the final report for the pilot study, and again when preparing for this study. I supplemented the citation analysis with online searches of both the topics and the authors to locate newer or related materials. This area of investigation has remained somewhat of a niche for more than a decade, with the same researchers involved in extending the topical area.

The literature for knowledge management and knowledge creation was outside the realm of Ackerman's writings, and I first investigated it through online searching. Search terms that included *knowledge*, *creation*, and *support* in various Boolean combinations found a manageable number of relevant books and papers while ignoring the vast number of knowledge management materials, many of which are not of a scholarly nature. Citation analysis of the key papers and texts in this area, beginning with Nonaka (1991), revealed a useful amount of literature on knowledge creation theory. The dissertation by Oh (2002) is the only empirical work I found that actually investigated knowledge creation in a manner relevant to this study. Other search terms that proved useful were *expertise* and *referral*, as well as *network* and *help desk*. *Solution recording* turned out to be much too narrow a concept, as virtually nothing appears in writing specifically about it. Ackerman's call center investigations in fact contained the best descriptions of it available, but with the more general terminology of boundary objects applied to the records created to store problem resolution information.

Investigations into Information Technology Problem Solving Behavior

A number of recent studies into the practices of IT support help desks and call centers have focused on areas of interest related to this research project. Studies by Mark Ackerman and several other researchers have used distributed cognition theory (Hutchins, 1995) as a conceptual framework to explore the organizational memory processes observed within information centers (Ackerman & Halverson, 1998, 1999, 2000, 2004; Ackerman & Mandel, 1995, 1999; Halverson & Ackerman, 2003; Halverson, Erickson, & Ackerman, 2004; McDonald & Ackerman, 1998). Their research documented the many ways that information is stored in distributed memories consisting of human memory, artifacts, or processes within a problem-solving context. These studies explored the difficulties encountered when information in organizational memory must be located, retrieved, and recontextualized for use in the current situation. The pilot study also revealed some of the problems associated with capturing solution information for reuse, and decontextualizing it from the original situation for storage in knowledge repositories or boundary objects.

Researchers in this topical area have found it helpful to apply the concept of anticipated trajectory (A. L. Strauss, 1993) to their study of the decisions concerning whether or how solution information would be stored for future use (Ackerman & Halverson, 1999, 2000, 2004). In addition to investigating the creation and use of explicit solution information, many of these studies looked at the process of locating and obtaining implicit information or expertise from other support personnel (Ackerman, 1993, 1994, 1996, 1998; Ackerman & McDonald, 1996; Ackerman & Malone, 1990; Ackerman & Palen, 1996; McDonald & Ackerman, 1998, 2000). In the next section, I explain each of the theoretical approaches used in this body of research in general terms, followed by the concepts that are central to the research questions.

Theoretical Literature

Organizational Memory

The theoretical grounding of the concept of organizational memory had its early roots in March and Simon's seminal book, *Organizations* (1958). These authors suggested that standard operating procedures represent a common form of organizational memory. The best discussion of all aspects of organizational memory theory appeared in Walsh and Ungson's comprehensive review of the literature (1991). For the pilot study design, I used their construct of the locus of organizational memory (Walsh & Ungson, 1991, p. 62) to structure my inquiry into the locations in which knowledge could be both stored and retrieved. This construct included all of the elements of who, what, when, where, how, and why, described in terms of where they would be stored in organizational information "bins," and is illustrated in Appendix B, Figure B2. My pilot study focused primarily on Phase 1 of Walsh and Ungson's recommended research issues: "assessing the structure of organizational memory" (p. 82). The current research study moved firmly into Phase 2: "parsing the information acquisition, retention, and retrieval processes" (p. 82).

Distributed Cognition and Distributed Intelligence

In their review of organizational memory, Walsh and Ungson (1991) described a model of distributed memory for organizational information, and traced the concept of supra-individual knowledge sharing back to the beginning of the 20th century, to sociologists such as Durkheim and Fleck. These concepts remained limited to the storage of information by groups of individuals, who could collectively remember much more about a particular event than any one member of the group. Hutchins (1991, 1995), a cognitive science researcher studying workgroup processes for solving problems, developed a similar theory while observing shipboard navigation teams. His distributed cognition theory went well beyond mere memory storage to describe how groups of people, aided by procedures, devices, and artifacts, were able to store and process large amounts of disparate and dynamic information, make sense of it individually and collectively, and then solve complex problems.

Hutchins' theoretical model combined the concepts of social distribution of work, information processing, language structures, and intelligent artifacts. It provided insight into how work teams accomplished complicated tasks, avoiding confirmation bias by employing a division of labor, buffering artifacts, distributed memory, and group intelligence. Various investigators have applied this theoretical framework successfully to research environments ranging from aircraft cockpits to call centers because it explains how people offload short-term memory to artifacts and retrieve it later to make decisions, usually in a workgroup setting. People use this process, which Hollan et al. (2000) called external scaffolding, wherever they interact with their environment to accomplish complex cognitive tasks.

Taking a slightly different approach, Pea (1993) developed the concept of distributed intelligence to explain how knowledge is a socially constructed phenomenon. Pea described distributed intelligence within the literature of educational technology and cognition rather than in the literature of organizational theory or information systems. He considered intelligence to extend beyond the scope of one or more humans because of a process of distribution, specifically by its embodiment in tools, symbolic diagrams, or computer interfaces that carry explicit memory about a particular process. Pea specifically wanted to separate the concept of distributed cognition from the artifacts that it frequently uses "because people, not designed objects, 'do' cognition" (p. 50). He expanded on the idea of intelligent tools or artifacts as affordances that carry the capability to perform a specific function within their design. His description of designed artifacts as mediators of human activity that are able to carry meaning between contexts served to enrich the theory of socially distributed cognition by providing a more detailed explanation of the roles that tools play.

Pea (1993) pointed out that a tool which was designed as an affordance to one activity can often be adapted to serve as an affordance to other activities, some quite different from the originally intended purpose. One can apply this idea directly to knowledge creation, in which one redefines a solution from one context with additional categorical or metadata affordances to become a solution in a completely different context. One of his most recent works (Pea, 2004) also looked at scaffolding, a technique for creating artifacts to offload cognitive processing. This is an old concept in educational cognition, with its roots in Vygotsky's sociocultural theories from 1934. As noted earlier, Hollan et al. (2000) also used the concept of external scaffolding in their discussion of distributed cognition theory to describe the actions people take to simplify their cognitive tasks. After comparing the explanations of Pea to those of Hutchins and of Walsh and Ungson, I have concluded that the concept of distributed intelligence is in fact an integral part of distributed cognition. When incorporated into any model of distributed cognition, it serves to explain the nonhuman components better.

During the pilot study, I was able to use distributed cognition theory to help explain how multiple actors, using several different information sources and communications systems, accomplished problem resolution. Because the originators of this theory designed it to deal with processes that take place over time, or that have a trajectory in which earlier events affect the conditions of later events, it was particularly suitable for investigating problem resolution processes that often took days or even weeks to complete. In the investigation reported here, I used distributed cognition theory to frame the scenarios for the survey instrument, to develop the questions for the interviews, in considering the need to inspect any information artifacts, and to help guide all of the data analysis processes.

Knowledge Management and Knowledge Creation

Knowledge management appears to be organizational memory reformulated for the popular press to make the business books bestseller list. Knowledge management theory grew out of the collision between organization theory, information system design, and the information explosion brought on by the advent of the Internet and corporate intranets. It arose in the context of improving the technological support for decision-making, and its roots extend to organizational interpretation (Weick & Daft, 1983), organizational sense-making (Weick, 1995), and organizational learning (Duncan & Weiss, 1979; Senge, 1990). Knowledge management has been widely popularized in the business press, with a cornucopia of formulaic how-to books appearing over the last decade. It remains an elusive goal, in part because it means very different things in diverse types of organizations, and in part because so many of its processes are neither visible nor explicit. Instead, they exist only as embodied within the individuals and the social contexts of the organization.

Knowledge creation theory has emerged more recently, introduced by Nonaka (1991, 1994) and popularized in Nonaka and Takeuchi (1995). Their spiral model of organizational knowledge creation has been widely used in subsequent research. It bridges the gaps between tacit and explicit knowledge, as well as individual and organizational knowledge, and explains the process of creating new knowledge. During the pilot study, I defined solution storage as the knowledge creation activity of interest, and focused on the role of incentives for creating that knowledge. The importance of providing viable incentives in order for knowledge creation to be successful has been noted in Ackerman (2000), Ackerman and Malone (1990), Davenport and Prusak (1998), Huber (1990), Orlikowski (1992), and Von Krogh et al. (2000). A significant finding during the pilot study was that most of the help desk consultants perceived no incentives whatsoever for creating solutions in a general knowledge base, although most of them had techniques for retaining solutions for their personal use. No policies were in place that directed them to do so or specified where to store them, nor was there any reward structure if they did store solutions. This study continued the exploration of knowledge creation processes in an IT support environment, using the same narrow definition of knowledge creation as solution storage, but it did not investigate the highly subjective area of incentives due to their dependency on organizational culture (Orlikowski, 1992).

Expertise Networks

The concept of an expertise network is yet another fundamental building block of organizational memory. Because people are the only viable repository for implicit knowledge (Polanyi, 1966), every organization needs a method for locating and accessing that knowledge. Ackerman and his colleagues have heavily investigated this aspect of organizational memory, but the roots of their research extend back to Allen's technological gatekeeper studies (1977). Metoyer-Duran (1993) described these gatekeepers as filling a *boundary-spanning role* (p. 115) to connect consultants or customers to experts, answers, or other referral networks – either internal or external. Ackerman (1998) and McDonald and Ackerman (1998) called these sources of access to information expertise *concierges*: individuals who played a crucial role in locating expertise inside or from outside the organization. The concept of expertise networks is directly applicable to IT support operations, especially those of help desks and call centers, whose raison d'être is to locate the appropriate knowledge with which to solve customer problems.

Ackerman and Halverson (1999) stated that the social dynamics of referral in which someone either must seek an answer from the internal expertise network or from outside their organization, have more influence on network use than any technical issues. Several of the research questions in the pilot study looked at the social issues and the supporting technology for expertise networks, drawing on Ackerman's (1998) statement that "Information technology can support organizational memory in two ways, either by making recorded knowledge retrievable, or by making individuals with knowledge accessible" (p. 205). This investigation continued to probe that area of organizational memory, expanding the study population from the help desk staff to most of the approximately 350 IT support staff at the research site. Although help desk consultants operated as the lowest level of technological gatekeepers, acting as direct information intermediaries for the customers, the second- and third-tier support staff normally resided somewhere within the various expertise networks. They provided the actual expertise, either technical knowledge or solutions to problems, or access to the experts who knew the answers in any given area. I incorporated these second- and third-tier support staff into the research design by including them in the survey population and in the subsequent interview process.

Defining the Research Questions from Prior Research Literature

Several theoretical concepts, such as distributed cognition and knowledge creation, were central to the research questions for this study. The literature describes each of these concepts in considerable detail, and most of the researchers in the field of organizational memory have a clear understanding of them. A less familiar concept was that of *trajectory*, although researchers in the health care domain apply it frequently. This concept deserved a more detailed explanation of the theoretical model that is available in the literature, and how that model has been adapted to this particular inquiry. In the case of problem trajectory, a specific application of trajectory to the information technology domain, I used the pilot study results to extend the general model of trajectory from its medical roots to one that more accurately described the problem resolution processes used within the IT support arena of practice.

The Concept of Problem Trajectory

In their call center research, Ackerman and Halverson (1999) took the concept of trajectory originally used by Barney Glaser and Anselm Strauss (1968) in medical sociology research and applied it to the anticipated use of information within organizational memory. They also drew on the concept of developmental or career trajectory described in Hutchins (1995, pp. 263-4), calling it the "trajectory of past experience" (Ackerman & Halverson, p. 9). These concepts of trajectory proved useful in understanding individual learning, organizational learning, and problem solving. Trajectory models have been particularly helpful in understanding how people select some knowledge for retention and discard the rest. Ackerman and Halverson stated, "The incentives for keeping memory follow the developmental trajectory, the assumed trajectory, and its projected consequences" (p. 9). Stated another way, the trajectory is the difference between knowledge that was created for a unique circumstance and knowledge that appears to be applicable to multiple situations now and in the future. It is anticipated trajectory, the application of a person's projection of possible future use for new information, which determines knowledge retention. The only solution information that people are likely to record in a knowledge system is that which they have concluded has some potential for future reuse.

A review of the original clinical trajectory model used by Glaser and Strauss (1968) is necessary in order to understand how Ackerman and Halverson (1999) applied it to the trajectory of information use. It originated as a core category in some of Glaser and Strauss' (1967) pioneering grounded theory research and became the central theme of their monograph *Time for dying* (1968) with chapters devoted to each phase. Figure 1 displays a diagram of their original model of trajectory as appeared in one of Strauss' later books. As depicted in this diagram, each phase consists of an identical set of five sequential elements, with the last element in each phase feeding directly into the first element of the subsequent phase. A phase begins with conditions, moves through interactions, and progresses using various strategies and tactics until it produces a set of consequences. These consequences become a fundamental part of the set of conditions that defines the next phase of the trajectory scheme. Over time, Strauss continued to expand and refine the concept of trajectory in his publications on social science research and grounded theory.

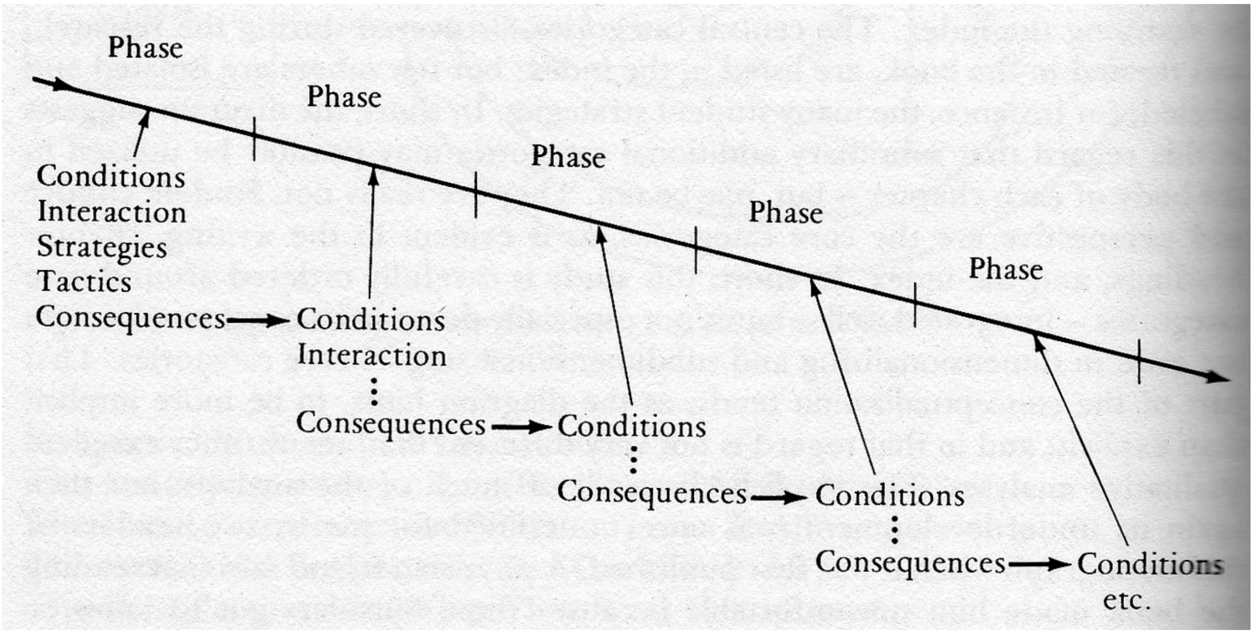

Figure 1. A diagram of Glaser and Strauss's original concept of trajectory, depicting the elements of each phase and the interactions between them. From *Qualitative analysis for social scientists* by A. L. Strauss, 1987, Cambridge, NY: Cambridge University Press. Copyright 1987 by Cambridge University Press. Reprinted with permission.

Anselm Strauss (1993) further explained the concept of trajectory in his book *Continual permutations of action*. He described trajectory as "the course of any experienced phenomenon as it evolves over time," and "the actions and interactions contributing to its evolution" (p. 55). He and Barney Glaser developed the concept of trajectory during research conducted within the framework of the University of Chicago's school of interactionist sociology, and the pragmatist philosophical theory of action (p. 3). They formulated and applied it while engaged in qualitative research in the context of hospitals and medical facilities, where the trajectory of a patient's condition and treatment was a well-established concept. The components of their model as elaborated in Strauss (1993) appear in Table 1.

Table 1

Subordinate Concepts of Trajectory

Subordinate Concept	Description of Subordinate Concept
Trajectory phasing	The investigator's concept of phases: the changes in interaction that occur sequentially, over time, around the phenomenon as it progresses.
Trajectory projection	The visualization of an expected course of interaction that participants use to shape their decisions and actions.
Trajectory scheme	The conscious plan to manipulate interactions as needed in order to follow the trajectory projection.
Arc of action	The investigator's concept of past actions and interactions within the trajectory scheme, in retrospect from the present.
Reciprocal impact	The potential for consequences of interaction to become, in turn, the conditions for the subsequent interactions.
Trajectory management	The process by which the actors performing within the trajectory scheme mold the course of the phenomenon.

Note. The concepts and descriptions in this table were summarized and paraphrased from much more detailed explanations presented in *Continual permutations of action* by A. L. Strauss, 1993, New York: Aldine de Gruyter.

In Anselm Strauss' 1993 description of trajectory, a second set of biographical components paralleled the first and described each concept in terms of the actors involved rather than the phenomenon (p. 57). Ackerman did not apply these during his investigation, and I did not attempt to apply them in this study.

Ackerman and Halverson published their first paper together on organizational memory research in 1998, based on an ethnographic study of a telephone hotline group. In their 1998 paper, distributed cognition was the key theoretical framework for analysis, but they did not mention the concept of trajectory. They published additional papers on the same research in 1999, 2000, and 2004, each in more detail, and each one of them made use of the concept of trajectory to explain the potential for future use of the information in a call record. In contrast, their 1998 article did not cite or use Strauss' trajectory model or even Hutchins' developmental trajectory from his 1995 book that they had used as a primer for distributed cognition. Their subsequent papers all contain an entire section on trajectory, in which they describe the path of a complete event. I quoted from that material at the beginning of this section, and in the next, I will describe the essential definition and explanation of trajectory as they applied it to their research.

In their usage, trajectory was the description of the probable path of an event, the path one anticipates that the event is most likely to follow. Experience directly affected the expectation of the same event in the present or future. In the case of the call record, Ackerman and Halverson (2004) tried to explain how one call record would be detailed and easy to recontextualize and reuse and another would be so brief that it was not usable without contacting the author directly. They concluded that the agent who created the record had determined that the problem was an individual problem with a very low chance of recurrence and that the trajectory of future use was so unlikely that she had skimped on the information included in the record. The result was that because of her mistake in projecting the trajectory for a specific problem, the agent did not adequately code a reusable organizational memory fragment in an explicit record. As a result, this record was not useful later without the added step of reconstructing the original transaction from implicit, human memory. In this study, Ackerman and Halverson also described the subsequent creation of a new call record that another agent then escalated to a different support group for resolution, a group that did not like to get escalations. The second agent constructed it carefully, providing detailed information in order to facilitate recontextualization by the receiving group. This agent also took pains to include details that would serve to justify their action in routing it to the other group. In this case, the trajectory of the event was that an agent created a new call record and immediately reused it as a boundary object to transmit the problem to another group. The call center agent made her implicit understanding of the problem explicit in the call record, and then referred it to the benefits group for resolution. In this case, the agent handled the preparation of a new call record very differently than the previous agent because the trajectory of expected use and projected consequences were also very different.

Problem Trajectory Phases

I have taken my interpretation of the clinical trajectory model described by Glaser and Strauss (1968) in Appendix B, Figure B3, plus the event trajectory models described by Hutchins (1995) and Ackerman and Halverson (1999, 2000, 2004), and have laid out a problem trajectory model based on observations and analysis from the pilot study. The help desk interaction model contained elements of problem trajectory but did not depict the entire process. Based on that model and other findings from the pilot study observations, I developed a diagram of the complete life cycle of an information technology problem. As stated in A. L. Strauss (1993), "trajectory phasing represents the researcher's conceptualization of phases, in accordance with changes in the interaction occurring over time 'around' the phenomenon as it evolves. Analytically, these phases are properties of the sequence of interactions" (p. 54). I superimposed five logical phases over that portion of the problem life cycle that pertained directly to IT support activities. These were Phase 1 Problem Arrival, Phase 2 Problem Assessment, Phase 3 Expertise Selection, Phase 4 Problem Resolution, and Phase 5 Solution recording. As depicted in Figure 2, these five phases overlaid on the problem life cycle make up the complete trajectory of a problem as it occurs in an IT support environment. Once I had established the trajectory phases, it was possible to begin developing a problem trajectory model and scheme from the component categories and derived variables for each of the phases.

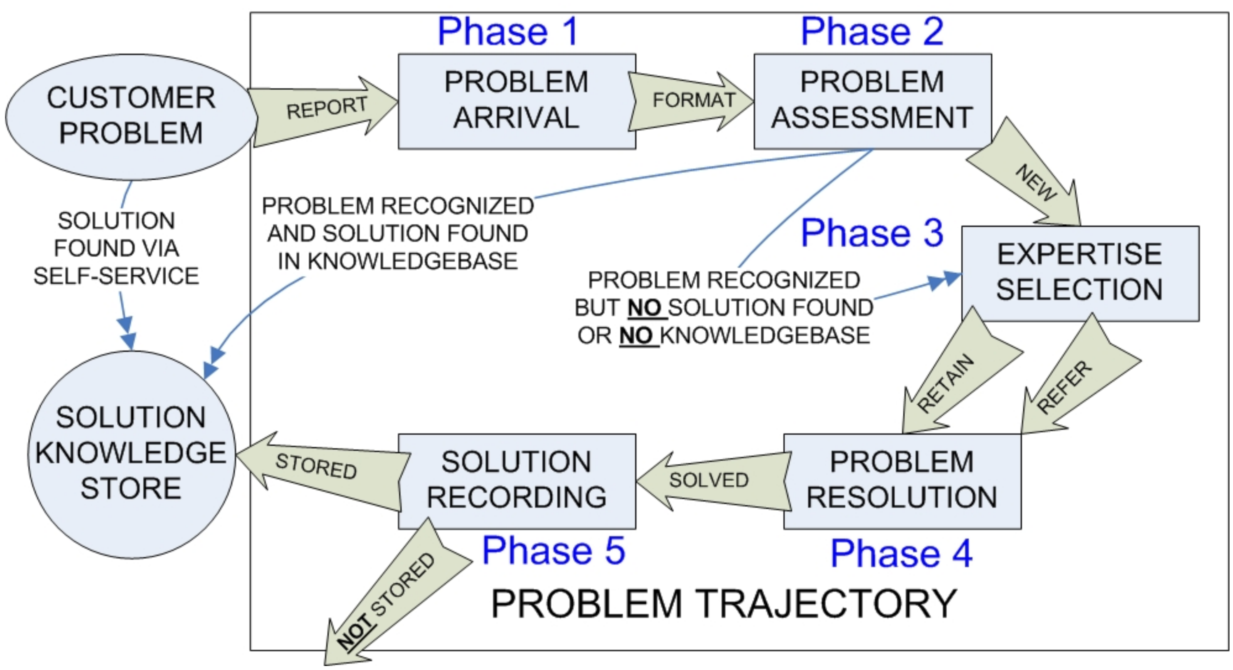

Figure 2. The complete life cycle of an IT problem from the initial action of the customer to solve or report the problem, to the storage of a solution in a knowledge base. The area contained in the closed box corresponds to the problem trajectory model. The diagram identifies the five IT support process steps in the problem life cycle as trajectory phases in the problem trajectory model.

A review of the findings from the pilot study provided the variables for the model, and the most promising values for each variable. I based the conditions and possible actions depicted in the initial model on actual observations rather than existing literature. I discovered pertinent literature on expertise selection later (Ackerman, Pipek, & Wulf, 2003) and incorporated it in the design of the third phase of the model. I used the resultant problem trajectory model, found in Appendix B, Figure B4 (detailed) and Appendix B, Figure B5 (simplified) to structure the research design of this inquiry. Several different versions of this model exist, some more complex than other variations in that the variables have a larger range of possible values. I developed several less complex versions either for clarity or for practical purposes including scenario construction. All of the variables appear diagrammed in relation to one another in Appendix B, Figure B6.

Problem Trajectory Scheme and Trajectory Projection

The last step in applying the concept of trajectory to this research plan was to develop a trajectory scheme and projection for the entire problem trajectory model. This plan identified the conditions, interactions, strategies, tactics, and consequences that I expected to appear during each phase of a problem resolution process. All of these variable types appeared in the original trajectory model depicted in Figure 1. I identified new variables for each phase consisting of the various considerations that IT support staff members typically use in the decision-making process, followed by variables for the full range of appropriate decisions. I drew these values from the observations and analyses I had made during the pilot study, the literature, and my own experience in information center and help desk operations and call-tracking systems. As noted in Hollan et al. (2000), the conduct of a cognitive, event-centered ethnography such as the pilot study required "technical expertise in the domain under study" (p. 179).

These considerations and the decisions that IT staff members could make based on them were the key variables in this investigation. I have laid out the trajectory scheme containing all of these variables by phase in Chapter 3, in Tables 3 through 7, and in its entirety in Appendix B, Figure B7. I used the 5-phased model of problem trajectory, expanded into the much more detailed trajectory scheme, to structure the investigation in terms of survey questionnaire development. I then evaluated the projected trajectory scheme using the data returned in the survey instrument, in order to verify the completeness of its constructs. I tested the model again during the selective interviews of survey respondents, questioning all of the respondents who appeared to have considered choices outside the model to obtain their personal assessments of its completeness. In preparation for this investigation, I developed two major research questions to guide the overall inquiry.

The Effects of Problem Trajectory

The first research question continued the pursuit of the research issues proposed in Walsh and Ungson (1991, p. 82). The primary research question was very general, covering the entire scope of the IT support problem resolution process. I developed several subordinate questions that centered on specific phases in that process. I formulated them to ensure that I would incorporate all of the various aspects that I intended to explore with the primary question into both the data collection and the data analysis plans. The subordinate questions segmented the original research question into separate sections for each phase of the problem trajectory scheme, making it much easier to correlate each portion of that question to both the trajectory model and the survey instrument. I used the subordinate questions to drive the data analysis process because only a few elements of that data were relevant to each question. The first research question and its four subordinate questions are as follows, with an indicator for which phase of the problem trajectory model each subordinate question addresses.

Research Question 1

1) How do the factors of problem trajectory, in particular criticality, scope, and frequency of occurrence, affect the problem resolution and solution recording behaviors of IT support staff?

    a) How does the communications medium of problem arrival affect the problem resolution and solution recording behavior of IT support staff? [Phase 1 Problem Arrival]

    b) How do the primary factors in problem assessment, criticality, scope, and frequency of occurrence, affect consultant behavior during the subsequent phases of problem trajectory? [Phase 2 Problem Assessment; Phase 4 Problem Resolution]

    c) What factors determine when a problem will be retained in the support center's own expertise network for resolution and when it will be referred to someone in an expertise network outside the support center for resolution? [Phase 3 Expertise Selection; Phase 4 Problem Resolution]

    d) What factors determine if, when, and how a problem solution will be recorded or broadcast to make it available to other support staff? [Phase 5 Solution Recording]

I based my selection of this research question and the formulation of its subordinate components primarily on the results of the pilot study. During that study, several of the informants reported that the communications format in which they received problem reports frequently made a difference in how they recorded and retained or referred the information, and it appeared to affect solution-recording behavior as well. The pilot study also revealed that most of the consultants focused on the criticality and scope implications of a problem, the question of whether it is an individual problem or a system-wide problem, rather than on the possible outcome of the original problem. Their behavior implied that the problem assessment phase, during which the consultants consider criticality and scope, tempered by frequency of occurrence, was an instrumental part of determining all subsequent actions in the problem trajectory.

In some of the most interesting data obtained during the pilot study, the consultants described the reasoning behind their decisions to retain or refer problems, and the conditions under which they might actually delay the resolution of a problem. In the extreme example, consultants reported that they would occasionally avoid referring problems to a particular group or individual based on experiences, often unpleasant. I found the recording of solutions to be problematic, as the consultants seldom performed this step and cited a general lack of any incentive to do so. They did report that they were willing to record solutions, but only if they thought that the information would be useful to them in the future. All of these findings were helpful in developing the first research question and its subordinate elements.

The Effects of Work Experience

The second research question addressed a completely different aspect of problem trajectory, but one that appeared to be crucial to the recording of a solution.

Research Question 2

2) How does experience in the workplace affect the problem resolution and solution recording behavior of IT support staff?

In some of the older organizational research literature, Walsh and Ungson (1991) stated, "the most important individual attribute that is relevant to the study of organizational memory may be length of service in the organization" (p. 78). In some of the most recent research, Oh (2002, p. iv) determined that organizational knowledge creation in a corporate environment was, in fact, related to work experience. His two findings about the effect of work experience on knowledge creation were as follows:

> Employees with 5-10 years of work experience in the current type of job created more organizational knowledge than those with 0-4 years of work experience.
>
> Employees with 5 years or more of work experience in the current organization created more organizational knowledge than those with 0-4 years of work experience (p. iv).

Oh (2002) did not investigate differences within the 0-4 years of work experience group, the range typical of most student employees and many new IT support staffers in a higher education environment. During the pilot study, this aspect of the investigation took place within the interview, and there was an indication of a possible inverse relationship between solution recording behavior and job tenure. This difference was evident between help desk consultants with 1 year of experience or less and those with 3 years of experience or more. Data were not available for consultants between 1 and 3 years of experience, and the small number of informants made the findings anecdotal at best. It was my intention that the second research question would explore the effect of work experience on solution recording in a much larger sample. I incorporated this research question into the demographics section of the survey instrument, in which each of the respondents answered a detailed set of questions about jobs they had held in the information technology support arena to determine their relative work experience.

Restatement of the Problem

According to observations made during the pilot study for this investigation and generalizations found in the literature on IT problem resolution, knowledge management, and knowledge creation, the process of storing reusable information about solutions to IT infrastructure problems is not being accomplished effectively in many of the situations in which it should have been. It is difficult to understand where the process is failing, due in part to the lack of a comprehensive model of the entire process that covers the complete trajectory of an IT problem from initial discovery through problem resolution to the possibility of solution recording. In order to better understand this process, and where it is breaking down, researchers in this topical area need a model that includes all of the factors and influences that have a bearing on the decision processes, and any characteristics of the individual IT support staff members that may influence those decisions.

CHAPTER 3

METHODOLOGY

This chapter provides a detailed explanation of the research design, the context of the study, the populations and samples, and the research instrumentation. I explain the development of the survey instrument in detail, to include the incorporation of the research questions from Chapter 2 and the use of the problem trajectory model to construct four distinct scenarios. The chapter concludes with the data collection procedures and data analysis processes.

Research Design

I designed this project as descriptive research into the dynamics of problem solving and the process of knowledge creation, more specifically solution recording, within the information technology (IT) support environment. It extended an earlier qualitative pilot study that used participant observation and artifact analysis to develop a proposed model of the entire problem resolution and solution recording process. The current study used survey research to collect both quantitative and qualitative responses from members of IT support staffs that routinely engage in these problem-solving processes. The principal group of respondents was a purposive sample of local IT support staff, of which I am also a member. I obtained a smaller purposive sample of similar IT support individuals working outside this university setting using a nearly identical survey instrument. I provided an incentive program for the completion of a valid survey, but no practical requirement or directive that the respondents must take the survey. As a result, the actual sample that I obtained was self-selected.

The general methodology used in this study was to apply mixed methods of data collection and analysis to investigate the problem solving and solution recording behavior of a specific type of knowledge worker, the members of IT support staffs. The primary data collection device was survey research, with limited interviewing for supplemental data and a capability for artifact inspection if needed. This study used a combination of within-participant and between-participant approaches to obtain data for the two major research questions. Within-participant designs measure variation for the same participant across situations, whereas between-participant designs measure differences between multiple participants at a single point in time (Cone & Foster, 2006, p. 128). I addressed the first research question using within-participant techniques, by presenting the same set of questions about problem resolution and solution recording behavior repeatedly within the context of four distinct trouble call scenarios. I performed the primary analysis for this research question across the sample, between the situational responses. I addressed the second research question using between-participant techniques, comparing the situational responses to different portions of the sample according to their self-reported length of work experience in IT support. Additional between-participant analysis was conducted to compare the situational responses of the local university IT support staff, who composed most of the sample, to the smaller set of respondents drawn from other educational institutions, corporate or government organizations, and the IT support software community.

I planned the research design for this study around the problem trajectory model that I had developed during the pilot study, as described in Chapter 2 and illustrated in Appendix B, Figure B4. I used the decisions about the criticality, scope, and frequency of occurrence of a problem that IT staffers must make during Phase 2 Problem Assessment to structure the inquiry around four discrete scenarios, incorporating the entire set of salient IT problem characteristics as shown in Appendix B, Figure B8. I created these scenarios by combining and recombining the characteristics of an IT problem that I had observed during the pilot study (Appendix B, Figures B9 through B11) until only two remained: severity and frequency of occurrence, which I then structured into a 2 x 2 matrix of four possible scenarios (Appendix B, Figure B12). These four scenarios appear in Table 2. Each scenario included a short text description that was as generic as possible, allowing me to administer the survey in the same form to IT support staff members from disparate types of organizations.

Table 2

IT Problem Scenario Design

IT Problem Characteristics	Severe	Moderate
Recurring	SR: Severe, Recurring	MR: Moderate, Recurring
New	SN: Severe, New	MN: Moderate, New

Each scenario incorporated into the survey had identical elements to make situational comparisons possible. I developed the questions or items for each scenario set from the remaining four phases of the problem trajectory model, Problem Arrival, Expertise Selection, Problem Resolution, and Solution Recording. The decisions that IT staff members could make during each of these four phases of problem trajectory became the variables for data collection via the survey instrument, and I used them to formulate each survey question or item. Each scenario set included several multiple-choice items and one multiple-selection item that all required the IT staffer to make a decision or select a course of action. Each set also contained an item displaying a group of factors related to decision process that the respondent had to rate individually, in terms of their importance to that decision in that scenario. Every multiple-choice or selection question incorporated an additional choice of *Other*, and included a text box for explaining that response. I provided at least one open-ended question at the end of each block of like items, designed to elicit an explanation of why the respondents had selected particular actions, or how they had arrived at their decisions.

This study explored the problem trajectory model and scheme using a survey of IT support staff members who shared a common attribute, privileged access to an enterprise call-tracking system for recording and tracking the problem resolution cycle. This system afforded them the ability to classify problems, locate expertise, refer problems to other IT staffers, and store solutions in a knowledge base. The processes I intended to investigate, however, extended beyond the scope of a single information system to all of the means of communication, tracking, and recording that were available in this setting to IT staff members. I designed the survey to explore the entire range of problem resolution activity in an information technology environment setting, whether a specific call-tracking application was involved or not.

The survey research results were mostly descriptive in nature, and I used them to inform the design of a brief semi-structured interview instrument. The interview process was used to clarify survey responses in which the respondent chose Other as the decision to refer or retain a problem for resolution, because that could have indicated that the problem trajectory model was not complete in the key area of Phase 2 Problem Assessment. If necessary or appropriate, I could have inspected some of the transactions recorded either in the enterprise call-tracking system or in various electronic mail and Web-based information stores to verify the behavior that the respondents had reported. My research design did not plan for nor did it intend to incorporate any extensive content analysis of the data stored in the call-tracking system. However, those external data remained available for possible use in verifying any informant-reported behavior or validating a tentative finding through triangulation.

Research Context

The original research design identified the University of North Texas (UNT) as the primary research site and a combination of both the central and the distributed IT support staffs as the population of interest. This design significantly expanded the context from that of the original pilot study that took place within the confines of the support services or central help desk unit of the UNT Computing Center. I designed the current study to obtain data from the human component of the entire IT infrastructure at the university rather than one small group. The university has adopted a distributed computing support model, with the central computing services separated organizationally from the college and administrative unit computing support staffs. As a result, there were more than twenty independent computer support activities on the campus, ranging in size from the central Computing and Information Technology Center with about 200 full or part-time staff members, to schools with only one or two full-time IT support staffers and several student assistants. Some of the larger areas such as the Libraries, the Colleges of Arts and Sciences, Business, Education, and Public Affairs and Community Service had relatively large IT support staffs numbering a dozen or more employees. None of the distributed support groups reported directly to the central computing organization. Similar independent IT support groups served the geographically separate campuses, and the Health Science Center had the largest of these with about 35 IT staff members.

All of the IT support staffs in the University System had representation on a coordinating body, the Distributed Computing Support Management Team (DCSMT) that the Director of Academic Computing chaired. This body met twice a month to coordinate the efforts of all IT support staffs on issues of common interest. This organization determined that the university needed an enterprise-wide trouble call tracking system to facilitate unified IT problem solving, and in 1997, a subcommittee selected the Remedy® Action Request System® (BMC Software, Inc., Houston, TX, http://www.bmc.com) help desk application for that purpose. I implemented the chosen application in full production by 1998. By the time that I conducted this study, the Remedy system was already in widespread use across most of the IT support organizations, at a minimum for reporting problems to the central computing service groups. Because that system provides support for problem referral and resolution as well as solution storage, I used privileged user access to Remedy as the primary factor in determining the participant sample within the overall IT support population at the university.

Research Participants

Populations Surveyed

The original population selected for this study was the information technology (IT) staff of the University of North Texas (UNT). This group consisted of more than 350 individuals who worked in either the central Computing and Information Technology Center (CITC) or one of the many distributed support areas described in the previous section. This population contained individuals from every level of the IT support organizations, ranging from the Associate Vice President for Computing and Chief Technology Officer who heads the CITC, to the part-time consultants in the general access computer labs.

I added three additional populations to the research plan in an effort to gain enough completed surveys to meet a target of 100, and to obtain responses from other educational institutions and from organizations outside education for comparison to the base sample from UNT. These were purposive samples obtained by offering the survey in a slightly modified form to three online communities who routinely discussed IT support issues in the areas of problem resolution and solution recording. I contacted three of the EDUCAUSE constituent and discussion groups, and two agreed to participate and allowed me to post survey invitations to their listserv. The groups that participated were User Services (USERSERV) with 460 subscribers and Distributed Technology Support (DTS) with 265 subscribers (J. Couse, personal communication, July 17, 2006). The Network Management (NETMAN) constituent group determined that the survey topics were outside the scope of normal discussion for their membership, and declined to participate. The EDUCAUSE constituent groups consist primarily of IT managers, who I asked to distribute the invitation within their own IT organizations. Only seven EDUCAUSE respondents completed surveys, and only one of those was on a referral from a manager.

The third online community that participated in the study was the ARSLIST, an international listserv for Remedy Action Request System (ARS) administrators, developers, and users that had more than 1,800 members worldwide. These were primarily IT support staffers who had the same roles in their organizations that I have at UNT; they design and operate the call-tracking systems that these institutions use for IT problem referral and solution recording. These individuals typically had in-depth knowledge of how their IT staff members handle problem resolution processes in their particular organizational environments.

Selection Strategy

Although I selected the sample groups, the individual respondents selected themselves to participate because it was voluntary for them to connect to the survey Web site and complete it online, or to return the Microsoft® Word (Microsoft

Corporation, Redmond, WA, http://www.microsoft.com) version of the survey edited electronically or manually marked up with answers. I provided an incentive program in order to encourage participation because the survey instrument contained 100 questions and was repetitive across four scenarios. I awarded a gift card from an electronics and technology store in the denomination of $100 by a drawing taken from each pool of participants, those at UNT, or those external to UNT, who submitted a complete and valid survey by the deadline.

Sampling Design

I designed the investigation for a specific IT support population, a purposive sample of all those IT staff members who were also members of the support users' permissions group (APP-Support) in the Remedy enterprise call-tracking application. APP-Support group membership grants users in the Remedy system the lowest level of permission that has full access to the application, including the Solutions module that integrates with the call-tracking interface to provide a means for solution storage. These individuals were the only users with the ability to create solutions in the call-tracking application. This group contained 283 people on the day that I sent out the first survey invitation by electronic mail. Other IT support staffers registered in the system have rights only as customers, the same as students, faculty, and non-IT staff, and are limited to reporting their own problems. It would have been inappropriate to include them in any sample that investigated problem resolution or solution recording because they did not have access to those functions in a central system. Within the central computing organization, 70 IT support staff members fell into that category and I did not include them in the sample. Approximately 130 central computing staff members had the appropriate permissions and I included them in the sample, so the remaining 150 qualified respondents came from distributed support units throughout the organization and its various campuses.

Survey Respondents

The actual respondents to the survey were predominantly from the UNT population; 78 members of the UNT IT staff and 1 other UNT employee completed surveys. Representatives from many different IT organizations at the university were contained in the sample, with no one group overrepresented. The non-UNT sample contained 23 respondents from the ARSLIST community and 7 from the EDUCAUSE constituent groups. The greatest variety in work experience appeared in the ARSLIST sample, with respondents who worked in diverse types of organizations including consulting, corporate, government, healthcare, and education.

Interviewees

The interview population was the same as the survey population, but the sample was much smaller, with only 18 individuals asked for electronic or telephone interviews. I reviewed all of the quantitative data and scanned some of the qualitative data from the survey process before selecting the respondents to ask for an interview. The survey contained a variety of open-ended questions at different points in the questionnaire, and I used the responses to those questions to select some respondents over others as candidates for the interviews. I selected interviewees from among all respondents who had answered Other to the four scenario questions that asked for a decision to refer or retain the problem for resolution, because that might indicate that they fell outside the model that I had used to structure the surveys. The other factor was that they had agreed to participate in an interview. I also conducted an analysis of the respondents' work experience answers as discussed later in this chapter, and used the job tenure groups derived from that process to define a stratified non-random sample for the interviews. I sent the requests for an interview to 18 of the 19 possible candidates identified through the process described above, and included at least 2 individuals from each work experience level and 3 respondents from the ARSLIST community. In one instance, a survey respondent from a particular experience group declined to participate, and I replaced that individual with another member of the same group. I conducted the interviews using email with an alternate option for a telephone interview. The email interview message contained three open-ended questions about the situational models used for the survey research.

Data Security and Confidentiality

The raw survey data from UNT respondents contained the enterprise user ID (EUID) assigned to each informant by the university, and I stored it in a directory on one of my CITC file servers to which only I have access. I established a cross-reference within a database from those data records to the actual names and email addresses of the UNT IT support staff members for the purposes of the incentive drawing and the interview process. All data taken from that server for analysis on UNT laptops, home desktops, or password-protected transfer media were in the form of records from which I had already removed the identifying EUID. I used the anonymous survey response code generated by either the QSurvey application or the SurveyMonkey.com Web site as an identifier for each record, labeling it as the *respondent ID* (RID). I did not import the EUIDs, and in the case of non-UNT participants the email addresses, into either the SPSS® Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, http://www.spss.com), or the NVivo™ (QSR International Pty Ltd, Victoria, Australia, http://www.qsrinternational.com) data analysis software files. The cross-reference between the actual respondent and the respondent ID remained on the server in the Microsoft® Access™ (Microsoft Corporation, Redmond, WA, http://www.microsoft.com) database.

It was my plan to download audio recordings of the interviews as digital files and store them in the same manner as the surveys. I intended to identify the audio files by their file names, incorporating the same respondent ID used for the surveys, and carry that pattern into the transcript files. I actually conducted all of the interviews using email, so I recorded no audio files and transcription was not necessary. Instead, I named and handled the responses submitted electronically for the interview in the same manner as the surveys, using the respondent ID (RID). I did not need to include personal identifications with the data beyond the selection of interview candidates from among the survey respondents, unless I determined a need to inspect an information artifact from a transaction of interest. Once the dissertation has been completed, accepted, and published, I will destroy the coding key containing information identifying the individual respondents.

Instrumentation and Materials Used

Development of the Variables

I developed the variables used for the research questions in this study through two separate processes, one involving the model of problem trajectory to answer the first research question, and the other using a number of different measures of experience in the workplace to address the second research question. The problem trajectory model described in Chapter 2 and diagramed in Appendix B, Figure B4 was a process model, and as such was not detailed enough to explore in depth with a research instrument. Drawing on pilot study observations and the literature, I expanded this model to include sets of specific variables for each phase that I could measure using a survey instrument. The variables I selected to measure work experience made it possible to calculate one or more summarized work experience values for each respondent that would support valid comparisons between them.

The Problem Trajectory Model

As stated in Chapter 2, the problem trajectory model (see Appendix B, Figure B4) is an expansion of the clinical trajectory model shown in Appendix B, Figure B3. I constructed the problem trajectory model through an iterative process, producing a series of variations while analyzing the data from the pilot study. I needed a much more detailed model in order to provide a practical framework for this investigation so I also developed a trajectory scheme and projection for the entire problem trajectory model. This plan still employed the original structure of conditions, interactions, strategies, tactics, and consequences from both the clinical and the problem trajectory models to identify what I expected to take place during each phase of a problem resolution process.

The variables I used to expand the model into a full trajectory scheme were of two types, with the first set consisting of the various considerations that IT support staffers must typically take into account during the decision-making processes. These considerations were closely associated with the conditions for the current phase, and as a result, they were subject to the same reciprocal impact from the consequences of the previous phase that the conditions are. This concept of reciprocity between phases was one of the main components of the trajectory model, as the consequences of each phase define or at least contribute to the conditions of the following phase. With the exception of Phase 3 Expertise Selection for which I incorporated an external theoretical model into the design, I had observed or described all of the considerations during the pilot study. In some cases, I had inferred the considerations from the observation of the decision-making processes.

Because of those inferences, each of the considerations led to one or more of the decision variables, the second new type of construct that I incorporated into the research design for testing and verification. I also drew these values directly from the observations and analyses made during the pilot study, where I had identified almost all of them as theoretical categories using a grounded theory approach. I reorganized and renamed the decisions for Phase 3 Expertise Selection to fit an external model for expertise that I had found in the literature. The trajectory scheme containing all of these variables appears by phase in Tables 3 through 7 and in its entirety as Appendix B, Figure B7. In the sections that follow, I have described the rationale for variable selection and the initial enumeration for each variable in detail for each phase, with references to the literature or previous studies. The schematic elements for each trajectory phase also appear in Tables 3 through 7. These include the conditions for the phase and any consequences from the previous phase, and the considerations identified during the pilot study that formed the basis for decision-making in that phase. The IT staffers apply these considerations directly to the conditions in order to determine the appropriate tactics and decisions. These are followed by the interactions that could occur during that specific phase and the strategies and tactics that are part of the scheme to shape those interactions. The decisions are the variables that I had defined, derived from the considerations and the tactics, from which an IT support staffer must select a course of action during this phase. The consequences of that decision feed directly into the conditions for the subsequent phase.

Phase 1 Problem Arrival

The first phase, the arrival or notification of the problem, begins at the point that the customer or an end user contacts an IT support staffer for assistance. If there were any sort of self-help process, facilitated by a public customer self-service interface or searchable knowledge base of some kind, that step would have occurred prior to Phase 1 Problem Arrival and must have been unsuccessful. I constructed the problem trajectory scheme entirely from the point of view of the IT support staff member rather than that of the customer.

I drew the considerations for problem arrival from the pilot study design. That study explored the behaviors employed by the help desk consultants to forward, track, or retrieve problem information during both the participant observation and the interview processes. I had originally defined the decisions for problem arrival as a binary choice in the research design, between Retain in Help Desk and Refer to Other Group, but the choices had tripled by the time the analysis was complete. During the investigation of the decision to retain or refer a problem, six more categories emerged from the observations and interviews. These appear in Table A1, found in Appendix A that summarizes the pilot study findings. These categories were Decide to Refer or Retain, Avoid Referral to Group, Refer in Same Medium, Change Medium to Refer, Consider Preferred Medium of Info Source, and Defer to Buy Time.

Two of these new codes, Refer in Same Medium and Change Medium to Refer, identified the choices for referring the problem in the same medium in which it had arrived, whether via e-mail, telephone, or trouble ticket, or to change it to a different medium for the referral process. An example would be the common practice of creating a Remedy ticket to refer a problem reported by telephone, making an oral communication explicit so that one could track it. I added a third code, Consider

Preferred Medium of Info Source, for changing the problem to the medium preferred by the information source that would be receiving the referral. This was particularly important in the case of referrals to support groups that had chosen not to use Remedy. From these considerations, I formulated three possible decisions about the format for retention or referral, and added two more decisions about the format for storage based on the responses from consultants during the pilot study interviews. These appear as the decisions in the Phase 1 Problem Arrival model shown in Table 3. While extending and explicating the trajectory scheme for the new model, I also transferred the first four decisions from the pilot study results in Table A1: Retain, Refer, Decide, and Avoid as well as the last decision for Defer, to Phase 4 Problem Resolution.

Table 3
Phase 1: Problem Arrival

Scheme	Phase Components
Conditions	Communication medium
Considerations	Ability to forward Ability to track Ability to store and retrieve
Interactions	Synchronous and/or asynchronous communications
Strategies	Fastest resolution with the minimum effort
Tactics	Retain format
Decisions	Retain Format Change to New Change to Expert's Retain to Store Change to Store
Consequences	Possible mismatch to the source of expertise

The first two decisions selected for Phase 1 Problem Arrival were Retain Format and Change to New, with the decision to Retain Format meaning that the IT staffers would resolve the problem in its original medium of Spoken Form or Electronic Form, whereas Change to New meant that they would use a different medium for resolution. The third decision, Change to Expert's meant that the IT staff member would use the medium preferred or required by the appropriate expert, referral group, or individual instead of the original form. The two remaining decisions for Retain to Store and Change to Store indicated whether the solution to the problem would be stored in the same medium as the original problem report, or changed to something else.

Phase 2 Problem Assessment

I also drew the considerations for Phase 2 Problem Assessment from the pilot study, from the anticipated trajectory codes or categories displayed in Table A3 of Appendix A. The design for the pilot study included observations and interview questions about individual problem trajectory, but the reactions and responses of the help desk staff indicated that only three factors mattered. The consultants immediately assessed the criticality and scope of a new problem in an attempt to ascertain the seriousness of the situation. They then used the factor of frequency of occurrence to validate their assessment of the first two factors, to decide whether the problem was a new problem or something that they already had a plan to handle. They seldom considered the trajectory, or anticipated outcome of the individual problem; their supervisors had trained them to look for evidence of a more widespread problem first.

If that were not found, they would then attend to the individual's problem as a lower priority, a more routine transaction, unless that individual had some sort of priority based on title or responsibility that warranted a higher precedence for resolution.

During the pilot study, I concluded that the three considerations listed in Table 4 and their corresponding decisions were the determining factors for how consultants would handle all of the subsequent problem trajectory phases. This was a very solid finding from the pilot study research, noted during all of the participant observation and confirmed in the subsequent interviews. Although the considerations did not really change, I developed several different variations of them and of the decisions that defined their variation in order to produce the scenarios, in which they would act as the independent variables for the survey research. The decisions shown in Table 4 represent the 3 x 2 model of Phase 2. The 3 x 3 model depicted in Appendix B, Figure B4 defined Criticality with three levels of variation, Critical, Moderate, and Routine, and Scope as System-wide, Localized, and Individual. I defined Frequency of Occurrence as Recurring, Occasional, and New. I considered this to be the most complete model of Phase II, but as described in the next paragraph, I eventually had to use a more simplified and compressed 2 x 2 model to design the survey instrument scenarios.

Table 4

Phase 2: Problem Assessment

Scheme	Phase Components
Conditions	Problem and customer
Considerations	Criticality Scope Frequency of occurrence
Interactions	Negotiate meaning
Strategies	Recognize problem and determine severity
Tactics	Pattern matching
Decisions	Significant or Routine Widespread or Individual Recurring or New
Consequences	Estimate of the problem complete

Because the decisions made during problem assessment appeared to be determinant factors for the actions taken in every subsequent phase of problem trajectory, it was logical to use those constructs as independent variables and structure the investigation into scenarios that addressed each of the possible combinations of choices. The level of detail used to operationalize each variable had a dramatic impact on scenario construction. The original model of problem trajectory developed for this inquiry had several variants, with the most complete model incorporating three possible values for each of three separate decisions as shown in Appendix B, Figure B4. Later I simplified the three decisions and assigned dichotomized values as shown in Appendix B, Figure B5, which I considered an adequate model after trading some detail for simplicity. As shown in Appendix B, Figure B9, the tertiary definition would have created

27 possible scenarios, whereas the binary definition of each variable displayed in Figure B10 yielded eight scenarios. As discussed in a later section covering survey development, I ultimately reduced the number to four scenarios by combining the Criticality and Scope variables into a new one, Severity, in order to make the size of the questionnaire manageable (Appendix B, Figure B11). I describe the revised Phase 2 Problem Assessment scheme used to structure the scenarios in that section, and present that final scheme in Table 9.

Phase 3 Expertise Selection

The considerations for Phase 3 Expertise Selection were drawn from Kate Ehrlich's chapter, "Locating expertise: design issues for an expertise locator system" in Ackerman et al. (2003). I have not found a better-explicated model of expertise anywhere else in the literature. Based on her research using focus groups and other methods, Ehrlich (2003) was able to describe five essential categories of information to use in the construction of expertise profiles: demographics, credibility, behavior, reputation, and accessibility (p. 148). She operationalized those categories, to include details about sources of information and issues, in a way that would facilitate automatic updates and maintenance of expert profiles in an automated locator system. I chose to incorporate these into my study due to their similarities to my pilot study findings, for both Phase 2 and Phase 4 of the model. The application of her categories to the current inquiry was not an exact fit, however, so I had to modify them to fit the problem resolution environment.

The demographics category described by Ehrlich pertains directly to the role of the expert within the organization. When IT support staffers use organizational data to locate an expert, they are often looking for the party who is responsible for the system of interest. This category should answer the question, "Whose responsibility is it to solve this problem?" During the pilot study, the informants used the term *responsibility* to describe one of their primary considerations, some of which are included in the report of that investigation in Appendix A, in Table A2.

Ehrlich's credibility and reputation categories are very similar. The major difference is that she ties credibility to professional qualifications that others evaluate internally, whereas reputation is something an expert must established externally within the organization and it acts as an independent verification of credentials. For the purpose of this study, I used credibility to describe expertise that the problem solver already knew about, and reputation as expertise that someone else had recommended or suggested to them. I observed both of these considerations in use during the pilot study, although I had not given them names at that time.

Ehrlich defined the category of behavior as the display of interest in a given topic or the demonstration of expertise. Behavior is an indication that the expert is demonstrably interested in the topic, and approachable for discussion of it. Behavior becomes an indicator of responsiveness in this case, something the problem solver must consider when selecting an expert source. The consultants consciously considered responsiveness during the pilot study, so this was also a good match.

The last category was accessibility, described by Ehrlich as a combination of availability and approachability. I also observed and reported these considerations during the pilot study, so I used this category as defined for the proposed study. An interesting finding was that the availability of a call-tracking system for very rapid referral to some of the second and third-level support groups was less important to the decision process than the other factors described here. The consultants were more interested in making the most appropriate retention or referral decision than they were in making the easiest decision.

All five of the categories described by Ehrlich as sources for information about expertise were applicable to the problem of locating the most appropriate expert, the central strategy during the expertise selection phase. They functioned within the model as variables that the problem solver must first consider, and then must make decisions about in order to arrive at a final selection of the most appropriate source of expertise to resolve the issue. Table 5 contains the complete model for Phase 3 Expertise Selection. I have transformed each of Ehrlich's categories into a consideration and a matching decision that the IT staff member must make while determining an appropriate expertise selection. I measured the importance of each of these variables relative to the Phase 4 Problem Resolution decision by using a Likert response scale in the survey instrument.

Table 5

Phase 3: Expertise Selection

Scheme	Phase Components
Conditions	New or recognized problem
Considerations	Organizational Credible (known) Reputation (recommended) Proven responsive Availability
Interactions	Referral tools, group discussion
Strategies	Find most appropriate expert
Tactics	Resource matching
Decisions	Who is Responsible Who is Credible Who is Suggested Who is Responsive Who is Accessible
Consequences	Expertise match determined

Phase 4 Problem Resolution

I also drew the considerations and decisions for Phase 4 Problem Resolution from the pilot study design and findings as shown in Appendix A, Table A1. In this case, the considerations for Phase 4 were a close match to both the decisions observed in Phase 3 and the expertise selection factors described by Ehrlich, and I combined some of the terminology for these considerations. As noted earlier in the problem arrival phase, I had originally defined the investigation of the decision to retain or refer a problem as a binary choice. Six more categories emerged from the observations and interviews, three of them pertaining to the arrival medium. I included all of the categories pertaining to problem arrival media in Phase 1 Problem Arrival. The remaining categories provided additional dimensions to the decision to retain or refer the problem, and I incorporated them into Phase 4 Problem Resolution as shown in Table 6.

The two original categories became Retain to Resolve and Refer to Resolve, reflecting the same strategy (Resolve) but requiring a tactical decision about which individual or group the IT staff member would task to solve the actual problem. Two more categories added a decision to defer the process by creating a trouble ticket specifically to buy time to work on the problem. The strategic decision to defer a problem became a tactical decision for either retention or referral, as Retain to Defer or Refer to Defer. Once again, the action was the same for both decisions but the assignee differed between the original receiving individual or group, or an external person or group that had the appropriate expertise. The most remarkable new category was an avoidance tactic, Retain to Avoid, that described the conscious forestalling of an otherwise appropriate referral to particular support groups or staff members based on their uncooperative attitudes. The analysis of the pilot study results produced a very well defined set of these five decisions, and they lacked only a larger sample for verification.

Table 6

Phase 4: Problem Resolution

Scheme	Phase Components
Conditions	Expertise selected
Considerations	Ability Responsibility Immediacy Willingness Communication access
Interactions	Self, expert, call tracking system
Strategies	Resolve or delay
Tactics	Retain or refer
Decisions	Retain to Resolve Retain to Defer Retain to Avoid Refer to Resolve Refer to Delay
Consequences	Problem resolved or deferred

Phase 5 Solution Recording

I drew the considerations for Phase 5 Solution Recording from both the literature and the results of the pilot study. The likelihood of reuse was noted as a major determining factor for solution recording in many of Ackerman and Halverson's (1999, 2000, 2004) call center studies. Reuse was also the only factor in the pilot study results that received positive responses from the informants. Consultant perceptions about the likelihood that someone would need a solution again, or that it would be useful to have it recorded in a knowledge base, appeared to be more important than any other possible incentive. The pilot study results identified the difficulty of recording and retrieving solutions in the available information systems as a strong disincentive for storage. The format of the solution was found to have some effect on recording, and because that was often just an extension of the original problem reporting format it was retained for more study and added to both the Problem Arrival and Solution Recording phases. The predominant behavior observed during the pilot study was that if the problems arrived electronically, the help desk staff would leave the details of solving the problems in the form in which they had arrived. Spoken form transactions were usually lost, unless they generated a subsequent email broadcast or someone transferred them to an electronic form at some point in the process.

Based on the pilot study results, I completely redesigned the decision variables for Phase 5 Solution Recording to match the observed behaviors better. The most striking finding was that help desk consultants regularly broadcast solutions to each other in electronic mail or stored records individually in their own email or paper files. These behaviors were far more prevalent than the making of entries in any central knowledge base, or even than the creation of frequently asked questions (FAQs). I used the decisions shown in Table 7 in the original design, but with the exception of Not Recorded, I modified them later during survey instrument pilot testing to the values shown in parenthesis to the right of each decision. I designed the initial decisions to be mutually exclusive categories, whereas the modified categories represented a menu of actions from which the respondent could select several choices.

Table 7

Phase 5: Solution Recording

Scheme	Phase Components	
Conditions	Solution to problem found	
Considerations	Likelihood of reuse Ease of recording Format of solution	
Interactions	To information systems or people	
Strategies	Retain solution information	
Tactics	Record; broadcast; both; not	
Decisions	Not Recorded Broadcast Individual Record General Record Broadcast & Record	 (Broadcast to Users) (Recorded Personal) (Recorded Formally) (Broadcast to IT Support)
Consequences	Knowledge recorded or not	

Work Experience

The survey instrument collected data for a number of different variables with which I was able to construct several measures of work experience for each respondent. The variables included the number of weeks or months of training received by IT staffers for both their current job and in their entire IT career, and the number of months they had worked in their current position at the university or organization. I also collected the number of months of similar IT support work in other jobs at the university or organization, as well as the number of months worked outside the organization. Additional questions separated part-time workers from full-time workers, and allowed a calculation of the difference in experience for each group assuming 40 hours or 20 hours of work per week.

Another variable called the Join Date collected the respondent's start date in their current position, from which I calculated a scalar Job Tenure value in months. I validated this value against the number of months the respondent had reported separately as current work experience in the variable called Present Experience. I resolved large disparities between the two values in favor of one or the other by inspecting all of the work experience information provided by the respondent, and my decision about which value to use was entered in a memo for that particular survey response. Part time workers in most cases had their Job Tenure reduced by half unless they had reported working more than 20 hours per week. Because I had calculated the Job Tenure value based on two separate textual values reported by the respondents and could consider it validated data, I used it to analyze the rest of the survey data for work experience-related differences in behavior.

Grouping Participants on Work Experience

One of the goals of this study was to identify any differences in behavior that might be attributable to the amount of work experience in a respondent's current job and organization. During the pilot study, I had observed that the newer staff members and those with much more experience exhibited very different approaches to the task of retaining solution information for reuse. This difference in behavior was not surprising; in his dissertation research, Hunseok Oh (2002) determined that workers who had been in the same organization or in the same position for 5 or more years created and stored significantly more knowledge than those with less experience. This was an interesting enough finding for general knowledge workers in information-rich industries, but it did not necessarily address the typical IT support organizations in which workers seldom remain in the same position for 5 years much less beyond that.

For this investigation, I took the value of Job Tenure drawn from the two survey response items discussed above as the most accurate measure of work experience in the respondent's current IT position. During data analysis, I grouped the participants several different ways, based on the numerical value of Job Tenure as calculated from Join Date and verified by Current Work Experience. I first developed 10 work experience brackets of one year for the first 5 years, then every 5 years after that out to 25 years of work experience. I used this strategy in order to compare each of the first 5 years of experience separately, beyond that I considered the 5-year brackets to have sufficient detail. I recorded the scalar value of Job Tenure in the data as a nominal value for each work experience bracket.

Ultimately, I created another nominal variable to store every single year of work experience out to the end of the sample at 24 years. To facilitate comparison to the results reported by Oh (2002), I also recoded the work experience factor into a dichotomized variable containing two nominal groups, IT support staff with up to 5 years of work experience and those with 5 or more years of work experience. The work experience brackets appear in detail in Table 8.

Table 8

*Work Experience Brackets and Groups (*N *= 109)*

Bracket and Code	Years of Experience	Job Tenure Range	*n*
		Work Experience Brackets	
1	1	0 – 12 months	18
2	2	13 – 24 months	15
3	3	25 – 36 months	9
4	4	37 – 48 months	5
5	5	49 – 60 months	8
6	5 to 10	61 – 120 months	38
7	11 to 15	121 – 180 months	12
8	16 to 20	181 – 240 months	3
9	21 to 25	241 – 300 months	1
		Work Experience 5-Year Split	
0	Less than 5	0 – 59 months	53
1	5 or more	60 plus months	56

Design of the Survey Instrument

I conducted the survey research on the Web, using online survey technology for the convenience of the respondents and for the immediate generation of live data without transcription. I also made the survey available in a downloadable form for offline completion, but no respondents made use of that capability. I asked participants to provide either their university enterprise user ID (EUID) or their email identification during the survey, and I selected a stratified non-random sample for interviews based on their responses to open-ended questions in the survey. I used the interviews as a tool for exploring possible variations from the model in the responses to Phase 4 Problem Resolution survey items, and to obtain respondent opinions on the completeness of the problem trajectory model as embedded in the survey instrument scenarios. The survey was prepared using the problem trajectory model and scheme to break the survey items up into phases and scenarios. A complete copy of the survey instrument, with four scenarios, is included in Appendix C. This survey was originally constructed online using the UNT Research Support Services (RSS) group's QSurvey application running on a Zope content management server, where it was pilot tested for usability and validity. The survey server stored responses in text files that I could access remotely or locally with statistical software, and as a result it was possible to prototype the data management and transformation processes using data obtained during pilot testing.

I originally believed that the major fault with the QSurvey application was the lack of ability to enforce answers for required questions. Although this remained true and contributed to some of the issues I had with missing data, a more severe problem occurred during the first several weeks of data collection that involved massive data loss from some or most of the sections of the survey, from the front toward the back of the survey. This was highly detrimental to the entire research project, as it took an excessive amount of additional effort to overcome during the course of the entire study. I never recovered or restored some of the lost responses because the participants declined to retake portions of the survey. I had to remove all of the incomplete responses, most with entire pages missing, from the final sample prior to my analysis.

Subsequent to the data losses on the Zope server, I recreated the entire survey on the SurveyMonkey.com commercial Web site that was available under my personal subscription. In retrospect, it would have been better if I had used this site to host the survey instrument from the very beginning. The benefits included the ability to make all or most of the survey elements required, such that the respondents had to enter something, even a blank space, before they could save each page. The other major benefit was the capability for respondents to return to a partially completed survey and continue at the page after their last save, or even to work on previously saved pages. Several respondents required two or three sessions to complete their surveys, data that would have been lost completely on Zope. The greatest penalty encountered while using SurveyMonkey.com was the excessive amount of time required to make the downloaded survey data usable for any kind of analysis process.

Survey Development

The survey design included four sections, the first three of which were demographics, work experience, and support role. These categories provided information about the respondents as individuals and members of work teams, and I used them to group the scenario responses for statistical analysis including the work experience information that made it possible to address the second research question. The fourth section contained the problem scenarios, based on Phase 2 Problem

Assessment decisions, and contained a set of questions for each of the remaining four phases of the problem trajectory scheme.

The initial models of problem trajectory had all operationalized the Phase 2 consideration variables for criticality, scope, and frequency of occurrence in three dimensions, as shown in Figure B9 in Appendix B. This model produced a matrix of 27 possible combinations, far too many to use as scenarios and test with every respondent. The next model I tested operationalized the variables for criticality, scope, and frequency of occurrence in only two dimensions, the extreme values, as shown in Appendix B, Figures B8 and B10. This second model produced a matrix of eight possible combinations and eight scenarios with 213 questions, and was still far too long to be a practical survey instrument. When tested online, it actually took more than 40 minutes to complete the entire survey. The only viable alternatives for shortening the survey would have been to either reduce the number of scenarios or reduce the number of items per scenario. Because each item in each scenario set had a direct relationship to one of the decisions defined in the problem trajectory scheme, eliminating any one scenario would drop part of that model out of the investigation. I made the decision to find a way to reduce the number of scenarios by revisiting the way that I had originally defined the problem assessment phase.

Compressing the Problem Trajectory Model

During the pilot study, I observed that the help desk consultants focused a great deal of their problem assessment effort on determining whether a problem was both critical and widespread. Only after they had determined the severity of the problem would they factor in frequency, which they used to determine whether it was a new or a recurring problem. They normally assigned critical and widespread problems the highest possible priority, Urgent. The original model used variables for both criticality and scope to help identify these higher priority problems, creating value quadrants that roughly corresponded to the priorities of low, medium, high, and urgent. The Urgent problems were so important and made up such a small percentage of the total that the consultants actually handled them by exception. Reviewing eight years of help desk trouble tickets in the call-tracking system revealed that the Urgent priority tickets made up only 2 percent of the total, or about 2,000 tickets out of the entire 92,000 stored in the system at that time.

A much more manageable distribution of the trouble tickets took shape when I divided them into one group with urgent and high priority tickets, which made up 34 percent of the total with 31,000 tickets, and a second group with medium and low priority tickets, which made up 66 percent of the total with 61,000 tickets. This also led to a far more efficient research design that combined the variables criticality and scope into a variable called Severity, with values of Severe and Moderate. I then combined these with the variable of Frequency that measures a completely different aspect of the problem, to create a new matrix of four possible value combinations as shown in Figure B11 in Appendix B. In the research design used for this study, the survey instrument presented all four of these scenarios to each respondent. The modified model for Phase

2 Problem Assessment appears in Appendix B, Figure B12 and at the end of this section in its revised form, in Table 9.

This modification resulted in considerably less granularity than I had originally wanted for each of the variables, but to get more detail I would have had to use all 27 scenarios and assign only a few of them randomly to each respondent. I had no assurance that doing so would have given me the data that I needed to answer my research questions unless I vastly increased the size of the sample to allow for the random assignment of selected scenarios to each respondent. An investigation of that scope may be more appropriate later, when attempting to validate the problem trajectory model through empirical research. At this stage, I was still trying to verify that the model was complete, accurate, and a reasonable explanation of the phenomenon under study. Because reducing the survey to eight scenarios still appeared to be impractical, with 213 total questions or items, the final design change before pilot testing reduced it to four scenarios and 117 questions or items, and later to 99 items. The scope of this version of the instrument appeared to be far more manageable from both a cognitive and an elapsed time perspective, and still provided sufficient data for determining results that were going to be primarily descriptive in nature.

Table 9

Phase 2: Problem Assessment: Revised to Reduce Scenarios

Scheme	Phase Components
Conditions	Problem and customer
Considerations	Severity Frequency of occurrence
Interactions	Negotiate meaning
Strategies	Recognize problem and determine severity
Tactics	Pattern matching
Decisions	Severe or Moderate Recurring or New
Consequences	Estimate of the problem complete

Pilot Testing the Instrument

I pilot tested the survey with several experienced IT support staff members who were also familiar with survey research at a practical level. Their observations and comments through several iterations of testing and refinement were invaluable for identifying structural and wording problems that I corrected in the final instrument. One pilot tester indicated that she could not treat the Phase 5 Solution Recording responses as exclusive, multiple-choice answers. In the different circumstances presented as problem scenarios, the question might have several appropriate responses such as recording a solution, broadcasting the solution to users, and broadcasting the solution to other support staff. I redesigned the survey item in question as a multiple response question instead of multiple-choice, which made much more sense to the respondents although it made the analyses of the data more difficult.

The arrangement of the questions pertaining to problem arrival medium confused several of the pilot testers and concerned one member of the committee. I completely restructured this section with the same questions for both resolution action and storage selection for two distinct media, spoken word and electronic. This eliminated unnecessary detail about specific formats within each medium that evoked dissimilar reactions from the respondents. I also incorporated the arrival medium question sets into all four scenarios, whereas they had been in a single trailing section for reasons that were actually borne out in the results. In other actions, I reworded the scenario descriptions several times at the request of pilot testers, each time becoming more generic and less specific to the university or any other work environment. As a result, when I eventually offered the survey to a population outside education there was no need to reword any of the scenarios.

In another observation that required corrective action, I found the survey of 100 questions so long that there was a fatigue effect during the completion of all four scenarios. The answers entered for open-ended questions in the first two scenarios were more detailed than those recorded for the last two scenarios were. When I viewed the data for all four of the scenarios in a single form, the difference in the volume of the textual responses was visually evident. The pilot testers recommended that I alternate the scenarios in different variants of the survey to spread the effects of fatigue across all of the scenarios. I accomplished this prior to the survey going into production as described below, and this had the effect of distributing the fatigue effects that actually did occur in the data across all four of the scenarios.

Controlling for Scenario Fatigue

To prevent fatigue from making scenario data from the end of the survey less complete or valid than that collected in the middle of the survey, I devised four separate variants of the survey in which each scenario appeared in each possible position in the scenario order. Initially I programmed a three-second timer on the starting Web page to make the assignment somewhat randomly to one of these survey sets, but I removed this early in the data collection process when I thought it might be part of the data loss problem. That was not the case, but I replaced it with four identical buttons that allowed the respondent to self-select the version of the survey to complete. One version of this switchboard page appears in Figure 3.

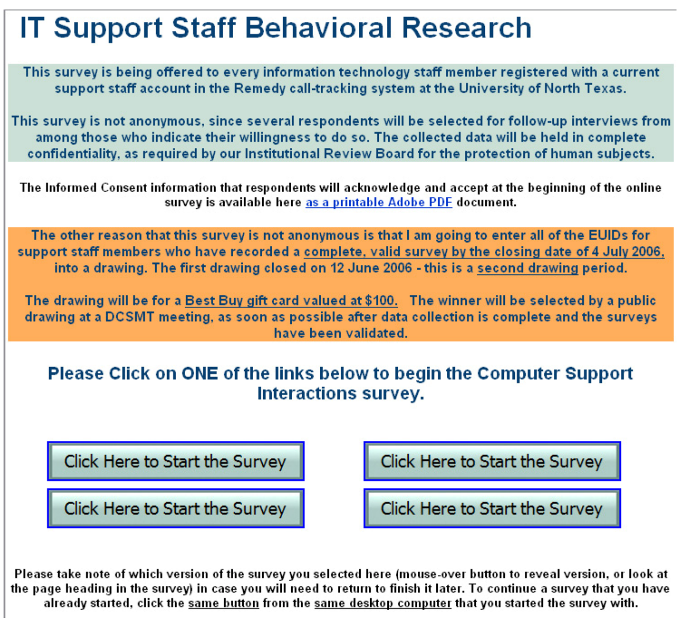

Figure 3. Web survey switchboard developed for UNT round two surveys, in which each button marked "Click Here to Start the Survey" linked to a different version of the survey. A similar page served survey respondents from organizations external to UNT.

On the Zope survey server, I actually moved these buttons around to increase use of the surveys with lower response counts. On SurveyMonkey.com, I could not do this because the button was the bookmark back into the same survey for people who needed a second session to complete it. The order of the buttons was set to differ between the UNT survey sets and non-UNT survey sets and what I had been collecting on the Zope server. Eventually the responses to two sets outnumbered the other two, but I had achieved some degree of randomness. The final distribution of scenarios in sets across all responses appears in Table 10. The result was that the survey responses spread out over four possible scenario orders in a way that negated some of the fatigue effects that I had seen in the last two scenarios answered during the pilot testing phase.

Table 10

Scenario Combinations Devised from Independent Variables (N = 109)

Scenario Order	Base and Data Files	Set 1	Set 2	Set 3	Set 4
Severe Recurring	Scenario 1 : SR	3rd	1st	2nd	4th
Severe New	Scenario 2 : SN	1st	3rd	4th	2nd
Moderate Recurring	Scenario 3 : MR	2nd	4th	3rd	1st
Moderate New	Scenario 4 : MN	4th	2nd	1st	3rd
Version frequencies	109 Total	30	34	23	22

Note. Set 1 includes survey version KMS1 on Zope for the University of North Texas (UNT) round one sample, and on SurveyMonkey.com it includes V1 for non-UNT samples and UNTV1 for UNT round two samples. Set 2 includes KMS2, V2, and UNTV2, et cetera.

Interview Question Formulation

The generation of questions for the interview process was relatively straightforward in the light of time constraints inflicted on the process by the data losses early in the survey response schedule. A key design purpose for the interviews was to investigate individual survey responses that might indicate the problem trajectory model was not complete or that the predefined decision responses were not exhaustive. The original plan was to interview 10 to 12 qualifying respondents. I drafted the interview questions at the point where I decided to include an Other option in every survey question that contained a decision selection. This provided a way to draw out responses that might fall outside of the model under test. I selected the interviewees specifically from the respondents who answered Other in their decision to retain or refer the problem for resolution in one or more of the scenarios, and I formulated the interview questions to obtain their reaction to the model as it appeared in the four different scenarios. The textual clarifications of the Other choices provided by the respondents left little doubt that that I had designed the Phase 4 Problem Resolution decisions properly. Because almost 20 respondents qualified for the interviews, I made the decision to use semi-structured email interviews of as many of them as possible with a very specific set of questions. The questions used for the interviews included:

1) How well do the two classifications of IT support problems and four combinations that I used in my model describe the world of IT problem solving that you see and experience?

2) How well does this four-quadrant model correlate to how you see and organize the IT problems in your workplace for resolution, or do the problems that you face have a different set of primary factors to consider?

3) What are the key factors or characteristics of IT problems that you use to classify them in your workplace in order to decide how to process them?

Procedures Followed

The requirements for the human subjects review board, or the Institutional

Review Board (IRB) approval process, drove the sequence of events that I followed in implementing the research methodology. I had to create the survey instrument in the QSurvey application and test it before I could submit it to the IRB for approval. The changes made after pilot testing the instrument required that I obtain an approved modification before the data collection could start. The recruitment letter also required IRB approval, as did the modified survey instrument and recruitment letters generated when the SurveyMonkey.com site was developed to replace Zope for UNT staff and for obtaining responses from additional populations outside the university. Following the approval of the initial set of documents by the IRB, the data collection efforts began. The major hurdles after that involved the efforts to clean up after data losses or omissions and to transform the SurveyMonkey.com data into some sort of usable form.

Notification of the Samples

I accomplished the notification of prospective respondents primarily through electronic mail. I extracted a report of all 283 current members of the APP-Support group in the call-tracking system and constructed three email groups of less than 100 members from that list. On April 18, 2006, I sent the recruitment letter approved by the IRB and shown in Appendix D to all 283 email addresses. Only one address bounced, and I learned that the individual had left the university shortly prior to the study and I removed them from the sample, the email group, and the Remedy permission group. I had to follow this notification with another to stop submitting surveys on May 4, 2006, due to the data loss problems on the Zope server. I finally restarted data collection on

May 10, 2006, after that problem had been resolved, and there were at least 16 respondents who had lost some or most of their data. I notified those individuals separately by email, and most of them made up the data. One declined to continue, and one simply never completed the survey. I began work shortly thereafter to add additional populations and to create an equivalent online data collection instrument for them on the SurveyMonkey.com commercial Web site.

I also extended the invitation to participate verbally to attendees of the Distributed Computer Support Management Team (DCSMT) during its April 7, 2006 meeting, and at several of its subsequent bi-weekly meetings. After one of those meetings, an attendee noted that I had not posted the invitation to the UNT-NETMAN list used by all UNT IT staff members for broadcast notifications. I had not done this originally because that listserv includes people who do not have APP-Support permissions in Remedy. The staff member informed me that he and several others had never seen the invitation because they filter out mail for multiple addressees and discard it unread as junk. Having no way of knowing whom this would have affected in the original email groups, I posted a follow-up invitation to UNT-NETMAN on May 15, 2006. Negotiations with EDUCAUSE and ARSLIST took place between 10 May and May 23, 2006, along with IRB approval of a modification to the research. I sent out email invitations to participate in the survey on May 23, 2006, to both the EDUCAUSE and the ARSLIST subscribers. When the extended data collection period for the UNT sample closed on June 12, 2006, I announced round two of the UNT data collection effort on the SurveyMonkey.com site with a new incentive program.

I emailed weekly or bi-weekly reminders to the sample members who had not already submitted a complete and valid survey, and a brief flurry of survey starts that produced only a few additional complete responses usually followed each announcement. A few members of the UNT sample replied and declined to participate, after which I removed those seven individuals from all of the mailing lists. I sent out reminders more frequently towards the end of data collection in an effort to wring the last few surveys out of the samples to reach my goal of 100 completed surveys. I sent specific email messages to Zope respondents who were missing whole sections or a few required data elements to inform them of how to restore that data. Additional messages went to SurveyMonkey.com respondents who were nearing the completion of their survey and needed to continue their session and finish the last one or two scenarios. Some of this message traffic rewarded me with missing data elements or completed surveys.

Survey Administration

I provided the informed consent forms approved by the Institutional Review Board (IRB) online on the version selection page of the UNT survey for download, signature, and return via campus distribution (Appendix E). I also passed out the forms directly to members of the survey sample population at several DCSMT meetings. This applied solely to the Zope surveys, and I filed the signed consent forms that respondents returned with the corresponding printouts of their surveys. I designed the SurveyMonkey.com instrument for off-campus respondents and it contained the informed consent form in the introduction with a selection box for agreeing to the terms of the survey. The survey instrument exited to the last page if the respondents did not agree to the consent form, and it did not permit them to continue the survey. The IRB approved this arrangement and I used it for both the UNT round two and the ARSLIST/EDUCAUSE versions of the SurveyMonkey.com instruments.

The actual administration of the survey instruments involved monitoring the Zope and SurveyMonkey.com server administrative interfaces on the Web and checking for new entries in the data sets. I kept a record of the completed surveys on Zope directly in the Access database into which I was importing the data. I kept the record of surveys on SurveyMonkey.com in a tabular Word document, in which the majority of the entries reflected connections where the visitors started no survey, or where they had abandoned the survey before completion. I downloaded data files from each version of each instrument at the end of the day on those occasions when there was actually new data to import. After the Zope system administrator and I had identified and eventually resolved the data loss problems on the Zope server, I monitored both sites for any sign of unintentional data loss and remained attentive to this problem throughout the remainder of the data collection period.

Survey Data Collection

The data collection efforts began on April 18, 2006, and I had originally intended to have them completed by May 13, 2006. Data losses on the Zope server before May 10, 2006, and very low response rates forced the collection period to be extended until

June 12, 2006, and then once more until July 4, 2006. This extension proved to be necessary, as I did not obtain my goal of 100 completed surveys until July 3, 2006. The complete timeline of the data collection process appears in Figure 4 below, including the period when I suspended survey activity on the Zope server.

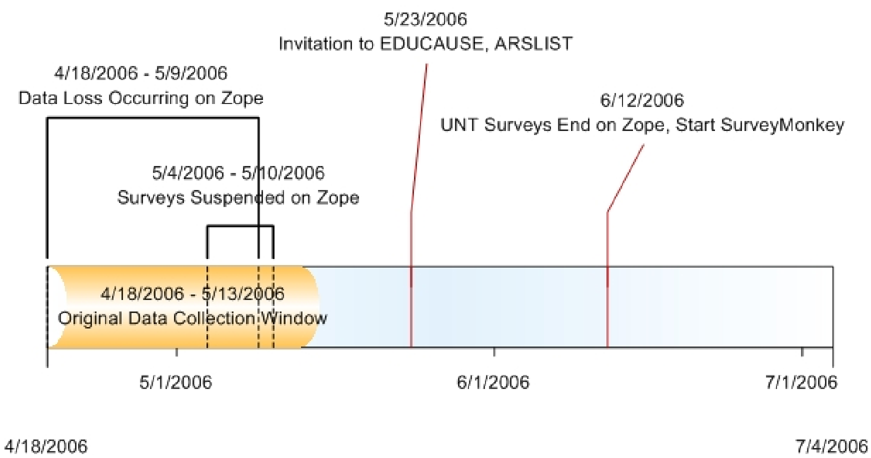

Figure 4. Data collection timeline showing the original data collection window overlaid with the actual data collection periods and significant problems or events in the process.

The Zope server stored the responses to the survey at the end of each survey session as a set of text strings for each respondent. The responses from the commercial SurveyMonkey.com site resided in an SQL database on that company's server. I downloaded the responses to my workstation on a daily basis during the conduct of the survey, and stored them on a University of North Texas server. I evaluated all of the responses for completeness because partial data posed a real threat in the conduct of any survey of this length. Many surveys on the Zope server had data loss, because there was no way to enforce the entry of a value into any part of the survey. Surveys that respondents abandoned before completion on the Zope server simply disappeared when the respondent closed their Web browser. They were never stored and no viable record of them exists. Many respondents opened and abandoned surveys on

SurveyMonkey.com, or filled out some portion of the survey but never completed them. All of the data, incomplete or not, was downloaded into text files organized by date, survey sample, and scenario order version and stored in separate folders.

Interview Plan

I offered the interviews by email and encouraged the respondents to simply reply, but gave them an option for a telephone interview. I sent the initial request to participate separately to each interviewee, not a group, and it contained the three questions for the interview (Appendix F). The message invited the recipients to return their answers electronically or schedule a telephone interview. If the respondents elected to do the telephone interview, I intended to schedule these at the convenience of the respondents in order to avoid any disruption of their work schedule. I had originally planned that the interviews should take no more than one hour, a period that had proven workable during the pilot study with a 68-question instrument, but that was inappropriate for the three questions contained in this instrument.

It proved to be much more efficient to accept email interview responses, lending credence to the statement by Meho (2006) that "semi-structured e-mail interviewing can be a viable alternative to the face-to-face and telephone interviews, especially when time, financial constraints, or geographical boundaries are barriers to an investigation" (p. 1293). It would have been less efficient to arrange and conduct telephone interviews with durations of 10-15 minutes, but that was not required. I had planned to record all telephone interviews in their entirety in a digital format and transcribe them verbatim for analysis. Because all of the interviewees submitted their responses to me electronically, and I did not need to conduct any telephone interviews or transcribe any recordings. The email interviews consisted of the questions and the written answers provided by the respondents. I secured their specific contents in the same manner as the survey responses, and named the files using the same RID identifier assigned to the original survey response for that participant.

Document or Artifact Analysis

One of the design factors incorporated into the survey was the need to identify the respondent in the event that I needed to analyze an information artifact cited in the survey response. The call tracking system widely used by the UNT population was available for the inspection of actual case records, and some of the email communications used for broadcasting problems and solutions were accessible to me. Using these tools, I could have investigated any of the self-reported behaviors using actual performance data if needed. This capability was an essential and extremely valuable part of the data collection process used during the pilot study. For the purposes of this study, if any respondent had created or edited tickets within the Remedy call-tracking system that were relevant to the behaviors that they had reported, those records were available for inspection. If the respondents reported that they had broadcast any solution information on the campus IT support mailing list, UNT-NETMAN, that information was available as well. In addition, I could have located and inspected any publicly available FAQ, Web page, or knowledge base article in the newly deployed system that a respondent might have referenced in their survey response. As was the case during the pilot study, the HelpDeskMail group mailbox of the CITC central help desk was also available to me, but it applied to such a small portion of the people included in this sample that it was unlikely to be an important source. I had anticipated that I would only need to use this investigative capability if it became necessary to confirm information provided during the surveys or the interviews. During the course of this investigation, the survey responses and interviews did not indicate a need to investigate the actual artifacts of information behavior.

Data Management

I managed the survey data through text files imported into several Access databases, in which I manipulated them into formats suitable for import into SPSS and NVivo for analysis. I developed a separate database for UNT IT staff identifications and contact information, and linked the other two into it for queries. I designed the original survey response database around the output from QSurvey on the Zope server, and produced queries that I could read directly from SPSS using an ODBC (Open DataBase Connectivity) database connection. This allowed me to create complete, updated data sets directly in SPSS as I imported new data records into the database from the survey text files. I applied the same model to the SurveyMonkey.com data and constructed a separate Access database to manipulate that data. I then linked the original database to the second one and combined all of the data from the Zope surveys, the SurveyMonkey.com UNT round two surveys, and the ARSLIST/EDUCAUSE surveys into a single data table for import into SPSS for quantitative analysis. I transformed the data sets from SPSS further in order to import them into NVivo for qualitative analysis.

Data Transformation

The processes I used to manipulate the data from the surveys were extremely complex, particularly for the SurveyMonkey.com data that downloads in several different formats, none of which are particularly useful to a researcher. I downloaded the data from QSurvey on Zope by running a script on the desktop machine that returned three text files for each version of the survey, one for multiple-choice items, one for multiple response items, and another for textual response items. I then ran four more R scripts to convert each three-file set into a single text file that I could import into a predefined table in Access. Because QSurvey used the variable names that I had defined for every data element, no matter what order the survey instrument presented them in, it was very straightforward to reassemble this data set. I was able to create additional cloned versions of the survey and reorder them by scenario, and they still maintained the correct variable name to item matches. Creating four variants of the survey was trivial. It was not particularly difficult to recombine the data so that all of the items from each scenario were together for every respondent, no matter which ordered version of the survey he or she had completed. I posted additional calculated values for training and work experience directly in the database, as well as codes for work experience brackets and groups and several data elements that were uniform across the UNT data but existed as choices for the non-UNT survey respondents. The data came out of the Access database in an analysis-ready form.

The process required to obtain the same level of analysis-ready output from SurveyMonkey.com data files was a nightmare. That particular site stores survey response data in relational database tables, and when I downloaded their relational data output files they arrived as fragments that I had to piece back together like jigsaw puzzles. I found their other output formats to be even less useful, especially for periodic imports into SPSS because it was impossible to automate the manual manipulations that they required in any way. Every data item for each response was a row in one of several excessively normalized tables, and I had to reference at least one more table in order to tell what code the respondent had selected. The tables used the full text of the question as their identifier instead of the actual variable names, making data management extremely difficult. Every table had unique column IDs to identify everything, and I had to write custom filters in Access to post every entry with the same variable names that were so easy to apply in QSurvey. Once I had finally combined the data into a vertical stack, I had to lay it on its side under the variable names using a crosstab procedure to create a new table that could actually be read for SPSS output. The first time I went through this process for one of the scenario versions for ARSLIST/EDUCAUSE surveys it took me three days to write the necessary filters and build the data dictionary for that one version of one survey. Cloning that instrument on SurveyMonkey.com and reordering its scenarios for the other three versions that I needed, as well as four more for the UNT round two surveys, was actually straightforward but the data import process was not. Each of these cloned versions used completely different column IDs for every data element in their relational database text file outputs. I had to construct a separate data dictionary and set of update and crosstab queries by hand for each of the additional seven scenario versions. This required several more days over several weeks to accomplish, and after that, I could finally load and process the data into a form suitable for analysis in just a few hours instead of days.

Once I had brought the data into the primary Access database, I imported them into SPSS for two separate purposes. Both required that I apply the SPSS codebook or variable name definitions developed for the data to the new data set after import. I have provided this codebook in Appendix G. One variant retained the 255-character limit on text fields and I used it for quantitative analysis. The other variant used a 1000 character limit to avoid data truncation and I used it for qualitative analysis. I saved the latter data set from SPSS into a Microsoft® Excel® (Microsoft Corporation, Redmond, WA, http://www.microsoft.com) format, from which I could merge it into a preformatted Word document that contained the entire survey instrument with data fields for each data element. Processing this through SPSS instead of pulling it straight from Access enabled me to post the actual variable values into the document instead of the numeric codes, for example, displaying Male or Female instead of 0 or 1. I then saved the merged document out to 109 separate documents averaging 17 pages in length that I imported individually into NVivo for coding using qualitative methods. I manually entered or pasted the interview data from email messages or interview transcripts into similar Word documents, formatted them for auto-coding, and imported them into NVivo for analysis. I spent significantly more time on data transformation than should have been necessary, primarily because of the tremendous shortcomings in the SurveyMonkey.com relational table output.

Transcription and Coding

I divided the data set into quantitative and qualitative responses and imported them into analysis software appropriate to each data type. I imported numerical coded data into SPSS version 14 for analysis to obtain descriptive statistics. I developed a detailed codebook in SPSS that I applied to each set of data after it was imported, which appears in Appendix G. This ensured the consistent application of coding to each updated data set with minimal manual processing while the data collection effort was still in progress. I imported the responses to open-ended questions into QSR NVivo version 7 for coding and analysis using qualitative techniques. I applied qualitative data analysis methods, in particular the grounded theory techniques described by Dey (1999), once the survey data became available in NVivo in order to develop questions for the semi-structured interview process.

Data Analysis

The analyses of collected data began as soon as survey data become available from the Zope server. Much of the data analysis was exploratory, because the initial investigation revolved around discovering patterns in the data through both statistical and grounded theory analysis. I had previous experience with analyzing qualitative data, but not quantitative, so I had to learn the application of various statistical tests during the actual data processing and analysis effort. The survey responses contained several different types of data. I imported demographic data including information about training, work experience, and IT support role into both the quantitative and qualitative data sets. I converted much of it from textual responses to calculated numeric values for the number of weeks of training or months of work experience. The responses for multiple-choice questions constituted quantitative data, but I coded the responses for their actual meanings and published them into a form suitable for qualitative analysis. The textual responses to open-ended questions provided essentially qualitative data. The initial analysis of both the quantitative and the qualitative data sets focused on developing questions for the follow-up interviews.

Coding Quantitative Data

Coding of the quantitative data elements began with their import from text files into the Access database, prior to their import into SPSS. I applied coding to the response sets during import in the form of additional fields and values to identify the survey version, source population and source of invitation to participate, and other record-level characteristics including a flag for the completeness of the data. Manual updates to each record included recoding the separate numerical flags for multiple response questions from null through 6 to just 0 and 1 to make analysis possible in SPSS. I performed calculations on the textual responses about training and work experience, and entered the numeric values manually in new fields. I then coded these into nominal groups in other fields by running update queries in Access. Other update queries summed these values into numeric totals for all work experience in the current organization, and a grand total. By pre-coding the values in Access, I made them available for immediate analysis in every subsequent SPSS data set without any requirement for tedious manual recoding within each SPSS file. The final query for import into SPSS then screened out the identifying information for the respondent, making the analysis-ready files completely anonymous.

Once the data set was in SPSS, I performed additional coding. I performed the basic process of adding labels and value definitions to the variables early in the process of data collection, and transferred these data definitions from data set to data set as the number of responses grew. Appendix G contains the SPSS codebook that stored these values. A separate codebook set was required for data intended for merging into documents for qualitative analysis, because SPSS identified the 1000 character text variables differently. Within the codebook definitions, I defined multiple response sets for each scenario for the questions about solution recording and broadcasting so that I could perform analyses on those responses. I also recoded the variables for several of the questions by combining codes in order to compress the responses into dichotomized sets. These processes created a new, simplified variable for the decision to either refer or retain the problem that removed the reason why, and another new variable for solution recording which coded all of the responses according to whether the respondent had made the solution available to other support staff. These made several analyses possible that I could not have performed on multi-valued variables.

The codebook included identification of the type of measure of each data element. In this study, the vast majority of the data variables were nominal. The responses that evaluated the decision factors for problem resolution were ordinal because they had been collected using a 5-point Likert scale. The only scalar or interval data elements were age, weeks of training (2 variables), and months of work experience (six variables). Of these only one was used extensively, Job Tenure or months employed in this job. I recoded the Job Tenure value three times for widespread use in the analyses, first as an ordinal value for work experience brackets in one year and 5-year blocks, and as a nominal value for either work experience of less than 5 years or work experience of 5 years or more. Later I recoded the Job Tenure value into individual year groups from 1 year through 24 years. I compared the 5-year group variable to most of the other response sets in order to obtain statistics that would help answer research question number 2.

Coding Qualitative Data

I accomplished the qualitative data exploration for this study primarily in Access because that was where all of the data resided after the surveys had been imported. The most efficient procedure was to create a query for all of responses to a given question in which a particular choice had been made, for example, if the respondent had chosen Other in at least one of the four scenarios, and then include in that query all of the fields that contained the textual responses. I then used an Access wizard to create a form for viewing the data in which each written response appeared in a large text box. Although there was no way to code the data, it was easy to do word searches across the entire query and it made it easy to get a feel for the range of meaning in the data by scanning all of the responses together.

During the study, I obtained NVivo version 7 for use as the tool for more thorough qualitative analysis and coding. I assembled all 109 of the complete survey responses that I had generated by bringing the data from Access into a Word document through the mail merge tools, saved them as separate documents by respondent, and then imported them into NVivo as survey source documents. These documents averaged 17 pages in length and included the questions, the response text labels (Male, Female) instead of the numeric values (0, 1), and the complete textual responses for open-ended questions. I pasted the electronic interview responses from their email sources into a boilerplate Word document containing the questions and headings pre-formatted for auto-coding, saved them as separate documents by interviewee, and imported them into NVivo as interview source documents. These 13 documents were only one page long with two exceptions. One respondent had included their organization's two page severity and priority document. I received the last 2 electronic interviews on July 17 and 18, 2006, and imported them into the final data set where I was able to include them in my analysis of the problem trajectory model.

Reporting Quantitative Data

For quantitative data analysis of the survey data, I used descriptive techniques such as measures of central tendency, variability, relative standing, and association or relationship (Tashakkori & Teddlie, 1998, pp. 113-114). The majority of the data displays were frequency tables with percentages and in most cases included the graphical charts that accompanied them in the statistical software output. I conducted much of the data analysis using the crosstab analyses that were suitable for nominal-to-nominal or nominal-to-ordinal data pairings. I used SPSS to generate statistics, of which the most useful were the chi square and the contingency coefficient (*C*) values. I used the value of *C* to calculate *w*, the effect size index as described by Cohen (1988, p. 222), using Equation 1:

$$w = \sqrt{\frac{C^2}{1 - C^2}} \tag{1}$$

Following Cohen (1988), I used *w* as an effect size (ES) index to measure the strength of association between categorical data elements. According to Cohen (1988), effect size is "the degree to which a phenomenon is present in the population" (p. 9) and does not imply causality. In theory, the value of *w* varies from zero to infinity but in practice, it is generally never greater than .90. Because *w* used the proportional relationships between variables, it was not limited to 2 x 2 contingency tables. It could be adapted to 2 x K tables without modification, and could be recalculated for 3 x K through 6 x K tables if necessary using ø, the fourfold point correlation coefficient. The effect sizes used as a starting point in this study were those suggested by Cohen, in which $w = .10$ was considered to be a small effect size, $w = .30$ was considered a medium effect size, and $w = .50$ was considered a large effect size (pp. 224-225). Where appropriate, the w statistic was included in tabular displays in the same way that the chi square statistic would have been.

Interpreting Qualitative Data

I interpreted the qualitative data for this study primarily by creating queries in Access that returned specific sets of quantitative responses and the associated open-ended question text with them. This proved to be more useful and less time-intensive than the grounded theory coding and categorizing employed so heavily during the pilot study. Most of the qualitative interpretation involved reviews of the textual data in an attempt to explain the results seen in the quantitative data, almost all of which were categorical to begin with. Because I had originally designed the categories and factors used in the survey research and defined in the problem trajectory model using qualitative analysis, this investigation was not intended to replace them with new ones but to verify the utility of the existing ones. As a result, I accomplished most of the interpretation of qualitative data manually, while comparing the textual contents to the quantitative responses arrayed in tables or graphs.

Analyzing Interview Data

I received the interview data electronically in all cases, and pasted the responses into formatted documents and then imported them into the NVivo qualitative data analysis software. Some of the methods I had developed during the pilot study for automatic coding of the question-answer relationships and for formatting the data before import to make management and searching easier, I applied again here. Once the data had been imported and auto-coded, I had originally intended to code and analyze the data manually for new categorizations, patterns, and emergent concepts using grounded theory techniques (Coffey & Atkinson, 1996; Dey, 1999; Glaser & Strauss, 1967; A.L. Strauss, 1987; Strauss & Corbin, 1998). My final research design for this study did not require that level of exploration of the qualitative data.

The actual analysis proved to be much simpler after I had reduced the interviews to three key questions about the assumptions and components of the problem trajectory model that I used to structure the research. This narrowed the purpose of the interview to one of confirming, refuting, or expanding the problem assessment factors used to design the survey instrument. I printed the 13 interviews that I had received and read them in their entirety, highlighting each phrase for key concepts that either supported or contrasted with the assumptions I had used in the model design. I summarized these in the results for Phase 2 Problem Assessment.

Summary of the Methodology

Application of Mixed Methods

Wherever possible, I applied techniques that included reflexivity, triangulation, and respondent confirmation to assess the validity of the research. This was particularly important because some of the data were quantitative and the rest were qualitative. I achieved reflexivity by questioning the conclusions drawn from the data during analysis, reflecting on how they compared to the qualitative pilot study findings, and by making new comparisons or running new tests from slightly different views of the data to see if the results were similar or different. A reflexive approach was appropriate to all aspects of this research project because the model being verified was of my own devising, making it difficult to adopt a completely objective stance at any point during the investigation. The fact that I was also a member of the IT support community that I was studying made reflexive techniques even more important during the process.

I achieved some validity through triangulation by comparing the data that I had collected using closed questions to data that I had collected using open-ended questions. This was particularly helpful where the inspection of the text responses for Other selections or "why" questions revealed the reasoning behind some of the quantitative decision selections, or explained the trends that had appeared in their graphical output. I employed simple within-method triangulation to obtain as accurate a value as possible for current work experience, by asking the question in different ways and collecting several different work experience values and then comparing the results.

The primary tool for achieving respondent confirmation during this study was the email interview for selected informants that followed the survey. I used this device to seek a subjective evaluation of the primary processes for which the participants had reported specific choices, and to obtain their assessment of the trajectory model that I had used to structure the problem scenarios. The secondary tool was the inclusion of the Other option in every decision selection question, followed by an open-ended question asking why the respondents had selected the options that they chose. The responses to both of these devices provided confirmation of the quantitative data, and by inference confirmation of the elements included in the model of problem trajectory.

Threats to Validity

A threat to construct validity existed because I had developed the decision variable constructs for the trajectory model and the survey instrument from observed categories that I had defined during my analyses of pilot study data. With the exception of the expertise selection criteria, some of which came directly from the literature, I had not employed expert judges to develop the decision variables nor had I found them in existing models. To compensate, I used IT support experts in the pilot testing of the instrument and made changes to some of the variables because of their evaluations. The other step I took to reduce this threat was to include an "Other action" selection option in every decision question to allow the respondents to opt out of the existing choice set and provide an alternate decision that did not exist in the current model.

There was a threat to measurement reliability in the form of internal consistency, in that the instrument was of entirely new construction and there was no way of ensuring that it was measuring the attributes of the variables correctly. This threat was addressed during analysis by comparing the expected to observed frequency variations across each survey item. The small amounts of variation observed indicated that the data for each measure was relatively consistent across all of the responses.

An implementation threat to inference quality existed in the form of possible participant reactivity. The trajectory model scenarios and the questions based on them may have unduly reflected my expectations and triggered undesired participant reactions. Two of the steps taken to reduce this threat were the formulation of situational descriptions that were as generic as possible to avoid bias from the actual environment, and the counterbalancing of respondents across different scenario orders so that they did not all encounter the problem situations in the same order.

Another threat to internal validity was from selection bias, the fact that the respondents to both the survey and the interview were a self-selected sample. The sample that I offered these instruments to was purposive, but the sample that actually completed them was self-selected. Based on the abandonment rates observed on the SurveyMonkey.com survey host, the interviewees were also the more durable members of the sample in that they tolerated the length of the survey instrument and actually completed it. The only offset that I applied to this threat was the provision for an incentive program, such that the primary motivation for some of the respondents to complete the survey may have been the chance to win a gift card in a drawing. I saw only one response that was so minimal that the respondent clearly just wanted to get in on the drawing. It failed so many of the requirements for completeness that I set it aside with the other incomplete surveys.

I observed a definite fatigue effect after the respondents had completed the first one or two scenarios. Evidence of fatigue included response data that became terse and rushed, or simply referred back to earlier entries. I did manage to control some of the consequences of fatigue by using four different scenario orders in the survey instruments to spread this effect out across all of the scenarios, but this threat to validity was still present in the data set to some degree. It was most evident in the responses related to problem arrival and solution storage formats, because in the view of the respondents these were actually redundant questions across all four scenarios.

CHAPTER 4

RESULTS

This chapter contains descriptions and displays of the data collected during this study and of the analyses made of that data. The chapter also includes a discussion of the complications that occurred during the investigation and the effects that this had on the research process. I have described the sample that I obtained in terms of the response rate, demographics, and other factors that are pertinent to the analyses of IT support staff information behaviors. I have discussed the results for the scenario-based questions in the order of each phase in the problem trajectory scheme. I have explained the results I found by analyzing the data for each trajectory phase in terms of organizational groups and work experience with the appropriate phase. I discussed the overall results found for the effects of work experience on information behavior in a separate section. The chapter ends with a discussion of how well the results fit the problem trajectory model developed for this study and includes a chapter summary.

Complications and Qualifications

Survey Data Losses

The survey instrument contained 100 questions and took between 30 and 45 minutes to complete depending on the diligence of the respondent. It required the respondent to answer the same 19 questions for each of the four different scenarios. With an instrument this difficult to complete, I could not reasonably expect to get a high response rate from the selected sample. The original instrument for University of

North Texas (UNT) respondents ran in an open-source application called QSurvey on a Zope document management server, which required that each respondent complete the survey in a single uninterrupted session. I expected the number of completed surveys to be low compared to the number of incomplete or abandoned surveys, but there was no way to keep a record of uncompleted survey starts on the Zope server. Any failure to close the survey properly in the Web browser resulted in partial or total data loss. During the first two weeks of data collection, this behavior triggered randomly from an unexpected condition in the application and truncated or deleted many surveys even when the respondent had completed them properly. Because the Zope server stored data from the end of the survey to the front, data losses occurred with the initial items of the survey, not the final portion. I halted the data collection process completely for a week while the administrator and I tracked down and corrected the data loss phenomenon. This did nothing to help the response rate or the attitude of the UNT sample population towards the survey. Sixteen respondents lost some or most of their data, and two declined to restore that data for the purposes of reconstructing their survey response.

Low Survey Completion Rates

The design of the survey instrument was such that I considered it unrealistic to expect a high number of completed surveys from any sample population, and I expected a high abandonment rate. For this reason, my research design included an incentive program, originally planned as a single $100 gift card that I would award using a random drawing from among those individuals who had submitted a complete and valid survey. I had to expand the incentive program to two additional drawing periods in order to meet the minimum survey response target of 100 surveys.

For a variety of reasons that included low response rates and issues with data loss on the Zope server, I opened a slightly different version of the survey on May 23, 2006, to the new external populations from ARSLIST and EDUCAUSE using the SurveyMonkey.com Web site, with their own gift card drawing as an incentive. This site had the capability to track each survey as soon as a respondent connected and again when he or she agreed to take it, giving visibility to the rejection or abandonment rates. It also saved partial results by page and allowed respondents to return later from the same workstation to complete the rest of the survey. At least four respondents were able to provide completed surveys from multiple sessions because of this capability. Due to the success of this site in collecting usable data, I halted data collection on the Zope server on June 12, 2006, and offered a second round of the survey to the UNT population on the SurveyMonkey.com site from that point until July 4, 2006, with a second gift card incentive drawing for new respondents. I awarded three incentive gift cards by drawing to individuals from the two pools of UNT respondents, and from the combined pool of EDUCAUSE and ARSLIST respondents. The incentives proved to be an essential factor in the data collection effort; the number of completed survey responses did not reach 100 until July 3, 2006, one day prior to the scheduled end of the data collection period.

Data Validation

I reviewed the data from the surveys within the two Microsoft® Access™ (Microsoft Corporation, Redmond, WA, http://www.microsoft.com) databases immediately after import for obvious omissions or erroneous data. I contacted the respondents who were missing data for multiple-choice or multiple selection items and asked them to provide that data. I manually added missing data to the database record if the respondent provided it after I had imported it into the database. It was impossible to tell whether the respondent had intentionally skipped the open-ended questions when null values appeared in the data from Zope. SurveyMonkey.com data items were almost all required so, with few exceptions, I assumed that a lack of response to an open-ended question was by choice, not by accident. I exported surveys from the database for analysis with either quantitative or qualitative methods only if they contained a complete set of the numeric values required for quantitative purposes. All of the surveys that I excluded from analysis were missing the data from at least one entire scenario. I excluded at least 101 surveys for having incomplete data, 4 of them from the Zope server and 97 of them from the SurveyMonkey.com server. Although SurveyMonkey.com kept a record of every survey started but not completed on that site, no count was available for those abandoned on the Zope survey because no record was ever stored in any way.

Characteristics of the Samples

I drew the survey respondents primarily from higher education settings, but by extending the survey to the ARSLIST, I brought in several additional organizational types. The organizational sectors represented in the survey data appear in Table 11.

Table 11

*Types of Organizations Represented in the Samples (*N *= 109)*

Organization Type	*n*	%
Consulting	4	3.7
Corporate	9	8.3
Government	3	2.8
Education	4	3.7
Higher Education	86	78.9
Other	3	2.8
Total	109	100.0

Because two of the three communities offered the survey were comprised of IT support staffs in university settings, either at the University of North Texas or as members of one of the EDUCAUSE listservs, the preponderance of recorded responses came from higher education institutions.

Response Rate

I set the minimum response target for this research project at 100 completed surveys because that was the smallest sample size for which the survey methods texts I consulted listed a sampling error (10 percent) at a 95% confidence level (de Vaus, 1995, pp. 71-72). This number would also provide me with the minimum subgroup size of 40 to 50 cases (Buckingham & Saunders, 2004, p. 116) if the sample split evenly on the work experience values, which was in fact the case.

The response rates for the survey varied dramatically between the different populations, something that I had expected due to the nature of the self-selection process and the differences between those populations. The purposive sample from UNT IT support staffs exhibited a 27.66% response rate (n = 282), whereas the EDUCAUSE constituency groups had 0.97% (n = 725). The ARSLIST had a 1.28% response rate (n = 1,800). Seven individuals in the UNT sample responded to the email invitation by declining to participate, and I removed them from the email groups used for follow-up reminder messages. As stated earlier, the Zope server did not record any information about survey starts or rates of abandonment from the first round of surveys, but those statistics were available from the SurveyMonkey.com site for the second UNT and external rounds of data collection. Those statistics indicated that there had been 5 connections to the UNT surveys and 23 connections to the external organization surveys in which the prospective respondent never even agreed to participate. I did not count those in the completion rates because technically they never even began the survey. Table 12 displays a summary of all of the response rate and completion rate statistics for the survey research process. On the SurveyMonkey.com site, the UNT participants exhibited a 44.44% completion rate, and the external organization participants had a 28.18% completion rate.

Table 12

Survey Completion Statistics (N = 109)

Sample	Connected	Dropped	Declined	Abandoned	Completed	Rate
UNT round 1	Unknown	Unknown	7	Unknown	54	Unknown
UNT round 2	59	5	0	30	24	44.44%
Non-UNT	133	23	2	79	31	28.18%

Demographics

The 109 participants in this research project included 72 men (66.1%) and 37 women (33.9%) ranging in age from 19 to 63 with one missing response and a mean age of 39.14. The majority of respondents 74 (67.9%) had completed at least a bachelor's degree, and 32 (29.4%) had completed a master's degree or higher reflecting the fact that 90 (82.6%) of them were working in a higher education environment. In terms of their IT support roles, 74 (67.9%) of the respondents reported they always or frequently supported end users, and 48 (44.0%) considered themselves to be first level support staff.

I recruited IT staff members to participate primarily through University of North Texas (UNT) electronic mail, with 78 (71.6%) of the respondents being UNT employees. I obtained another 23 respondents (21.1%) through the ARSLIST and 7 more (6.4%) through one of the EDUCAUSE constituency groups. The complete demographic statistics of the sample appear in Table 13.

Table 13

*Demographic Characteristics of the Survey Participants (*N *= 109)*

Characteristic		*n*	%	*n* Missing
Gender				
	Male	72	66.1	
	Female	37	33.9	
Age				1
	Up to 25	14	12.8	
	26 to 35	30	27.5	
	36 to 45	27	24.8	
	46 to 55	28	25.7	
	56 to 65	9	8.3	
Educational Level				
	High School	1	0.9	
	College Coursework	28	25.7	
	Associate Degree	6	5.5	
	Bachelors Degree	31	28.4	
	Graduate Student	11	10.1	
	Masters Degree	26	23.9	
	Doctorate	6	5.5	

Training and Work Experience

More than half of the respondents reported that they had received two weeks or less of formal training for their present position, and more than three quarters of them reported that they had received six weeks or less. Only 29 (26.6%) of the respondents reported having received no formal training for their current positions. The training data were somewhat skewed by a few respondents who reported as many as 100 weeks of formal training, probably reflecting on-the-job training as opposed to formalized coursework or training regimens. The range of responses was from 0 to 108 as shown in Table 14, such that the mean was not a useful statistic. The median response was 2 weeks of formal training, a much more representative figure. I found a considerable skew in the figures reported for total formal IT training at the high end, with a range from 0 weeks to 1,040 months, and I had to set them aside. Comparing educational to non-educational respondents did not reveal any dramatic differences in either training or work experience.

Table 14
Formal Training for IT Staff Member's Present Position (N = 109)

Weeks of Training	*n*	%	Cumulative %
0	29	26.6	26.6
1	9	8.3	34.9
2	20	18.3	53.2
3	7	6.4	59.6
4	10	9.2	68.8
5	3	2.8	71.6
6	8	7.3	78.9
7	0	0	78.9
8	11	10.1	89.0
9 to 108	12	11.0	100.0
Total	109	100.0	

The statistics in Table 15 show that the responses for work experience were more consistent when compared to those for training, probably because they were less subjective in nature.

Table 15

Work Experience in Information Technology Support (in Months)

Measures		Current Job	Current Organization	Total IT Experience
Mean		68.83	138.78	177.44
Median		60.00	119.00	149.00
Mode		18*	120	27*
Range		280	669	669
Percentiles	25	17.50	52.250	80.50
50		60.00	119.00	149.00
75		103.50	207.50	252.00

* These data had multiple modes and I have shown the smallest value.

Seven questions in the survey instrument pertained to work experience, and the key information requested was the number of months in one's current job, the number of months in the current organization, and the number of months of total IT support work experience. The responses summarized in Table 15 covered a very large range in months for every category due to the nature of the workforce that included everyone from part-time student workers to career IT managers in the same samples.

The average number of months of work experience reported by the respondents for their current organization was 68.83 (*SD* = 57.596) with a range of from 1 to 280 (23.3 years). The median was exactly 60 months or 5 years, with 53 respondents having less than 5 years of experience and 56 having 5 or more years of experience. The largest number of respondents, 38 (34.9%) of them, fell into the work experience bracket that was defined between 5 and 10 years. The median value of 60 for the current job and the 50 percentile values were noteworthy because 60 months is the 5-year mark. I would expect this finding to strengthen the results from any comparisons in behavior between participants in each group, including comparisons to the findings from Oh (2002) about knowledge creation.

Information Technology (IT) Support Levels

When reporting the level of support that they normally provide to end users, the total sample of respondents split almost evenly between first level support and second level support functions. Respondents from educational organizations retained that proportion. In contrast, non-educational respondents reported predominantly second and third level support functions, with 50% reporting second level and 31.3% reporting third level as displayed in Table 16 and Figure 5.

Table 16

IT Support Levels Grouped on Organization (N = 109)

Organization	Level of Support	*n*	%	Cumulative %
Education	First Level	45	48.4	48.4
	Second Level	46	49.5	97.8
	Third Level	2	2.2	100.0
Non education	First Level	3	18.8	18.8
	Second Level	8	50.0	68.8
	Third Level	5	31.3	100.0

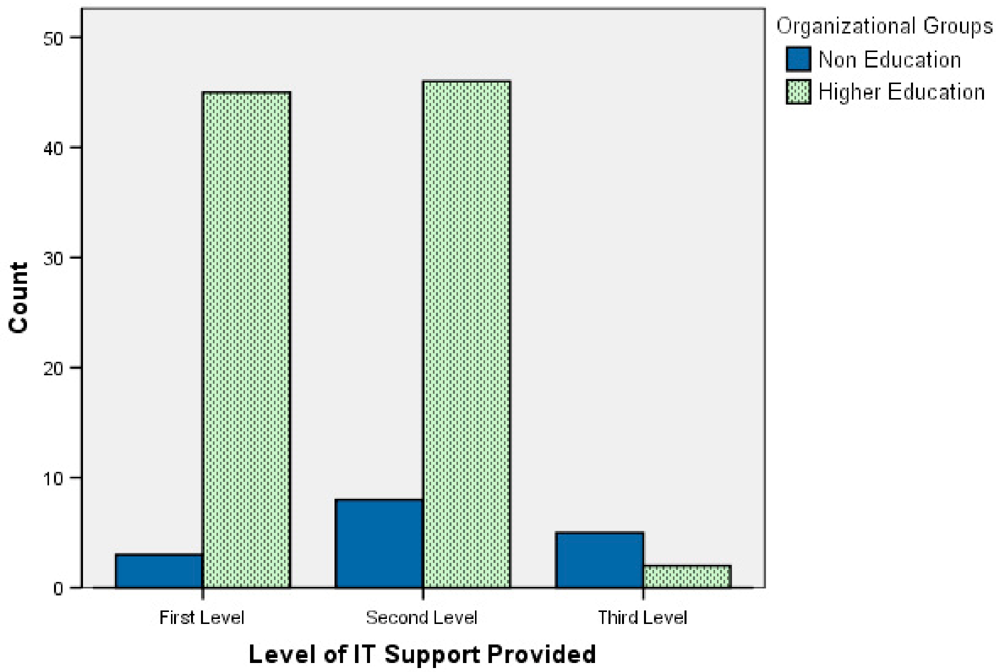

Figure 5. Comparison of the information technology support levels reported by non-education and higher educational respondents, grouped on support level.

The difference between organizational types was even more visible in the responses to end user support role, as displayed in Table 17 and Figure 6. Seventy-one percent of the educational participants reported they supported end users always or frequently, with always being predominant at 41.9 percent. In contrast, only half of the non-educational respondents reported they supported end users always or frequently, and 37.5% of non-educational respondents reported that they rarely supported end users. Overall, the responses obtained from the educational and non-educational samples indicated very different outlooks on their levels and roles of IT support activity.

Table 17

End User Support Roles Grouped on Organization (N = 109)

Organization	Supports End Users	*n*	%	Cumulative %
Education	Always	39	41.9	41.9
	Frequently	27	29.0	71.0
	Rarely	22	23.7	94.6
	Never	5	5.4	100.0
Non education	Always	3	18.8	18.8
	Frequently	5	31.3	50.0
	Rarely	6	37.5	87.5
	Never	2	12.5	100.0

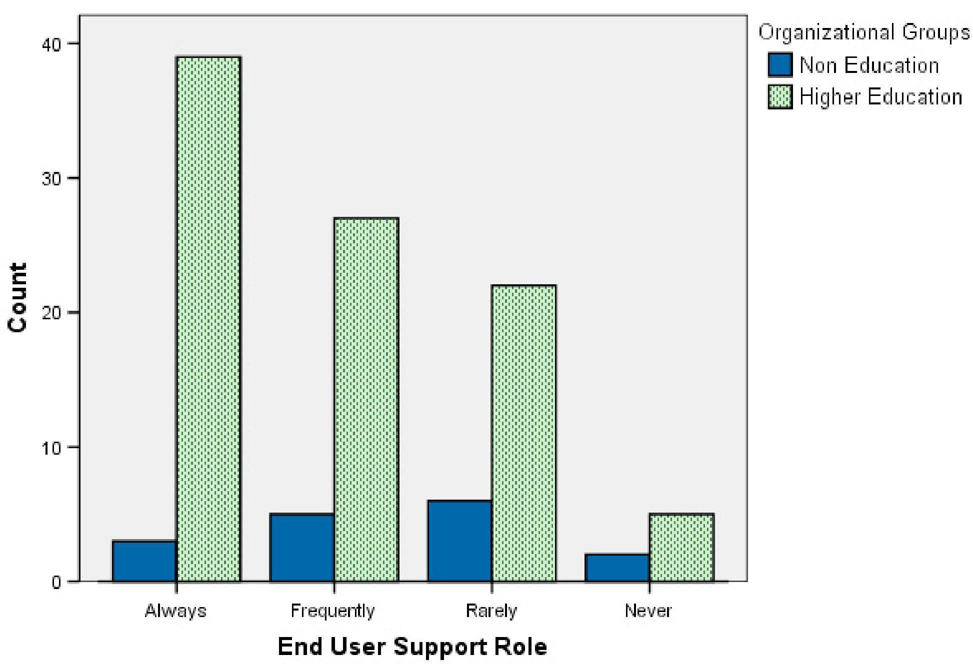

Figure 6. Comparison of the end user support roles reported by higher education and non-educational respondents, grouped on frequency of occurrence.

The Effects of Problem Trajectory

I have reported the results for the scenario-based questions by phase in order to keep them logically placed within the problem trajectory model and scheme. With the exception of the questions pertaining to the problem arrival medium, most of the survey instrument items were phase-specific in their orientation. I have added the matching question number or numbers from the first scenario of the survey instrument in Appendix C to each table caption with a prefix of "Q" as a point of reference.

Phase 1: Problem Arrival

The Effects of the Problem Communications Medium during Phase 1

The responses to questions about the medium in which the problem arrived exhibited striking similarities from scenario to scenario. The results for both spoken word action selection and electronic action selection were almost scenario independent. The proportions of the choices showed slight variation from the severe to the moderate problem scenarios, but were almost indistinguishable between recurring and new problem scenarios on most of the variables. The more dramatic differences appeared between the results for spoken forms of communication and those of an electronic form. The first set of results displayed in Table 18 pertains to the problem resolution decision when the problem has arrived in Spoken Form.

Table 18

Spoken Action Selection for Resolution or Referral Q34

Response Selected	Scenario	*n*	%	Cumulative % within Scenario
Resolved or referred in Spoken Form	SR	18	16.5	16.5
	SN	18	16.5	16.5
	MR	27	24.8	24.8
	MN	25	22.9	22.9
Resolved or referred in a Different Medium preferred by the respondent	SR	48	44.0	60.6
	SN	52	47.7	64.2
	MR	46	42.2	67.0
	MN	50	45.9	68.8
Resolved or referred in a Different Medium only if the logical referral person or group prefers or requires it	SR	16	14.7	75.2
	SN	22	20.2	84.4
	MR	19	17.4	84.4
	MN	17	15.6	84.4
Other action taken if not listed above	SR	27	24.8	100.0
	SN	17	15.6	100.0
	MR	17	15.6	100.0
	MN	17	15.6	100.0

Note. I have rearranged the data to make it easier to see the between-scenario differences for the same decision response. The scenario abbreviations are as follows: SR = Severe Recurring, SN = Severe New, MR = Moderate Recurring and MN = Moderate New.

Thirty-five respondents selected the *Other* action choice for this item in one or more of the scenarios. Key words found in these responses included *documented*, *track*, and *accountability*. Differences in the responses between scenarios included a noticeably greater proportion of selections of Other action than of Refer Other Medium in the Severe Recurring scenario. In the overall assessment of the responses to this question across all four scenarios, the respondents resolved or referred more problems in Spoken Form for moderate problem scenarios than for severe ones.

The data shown in Table 19 reflects the responses to the same problem resolution medium decision as above, but the problem has arrived in Electronic Form. Twenty-two respondents selected the Other action choice for this item in one or more of the scenarios. No particular key words stood out in the text. The only noticeable difference in the responses between scenarios was a slightly greater proportion of selections of Refer Other Medium rather than My Other Medium in the Severe Recurring problem scenario.

Table 19

Electronic Action Selection for Resolution or Referral Q38

Response Selected	Scenario	*n*	%	Cumulative % within Scenario
Resolved or referred in Electronic Form	SR	70	64.2	64.2
	SN	68	62.4	62.4
	MR	66	60.6	60.6
	MN	70	64.2	64.2
Resolved or referred in a Different Medium preferred by the respondent	SR	11	10.1	74.3
	SN	17	15.6	78.0
	MR	16	14.7	75.2
	MN	14	12.8	77.1
Resolved or referred in a Different Medium only if the logical referral person or group prefers or requires it	SR	17	15.6	89.9
	SN	13	11.9	89.9
	MR	16	14.7	89.9
	MN	15	13.8	90.8
Other action taken if it was not listed above	SR	11	10.1	100.0
	SN	11	10.1	100.0
	MR	11	10.1	100.0
	MN	10	9.2	100.0

The Effects of Work Experience during Phase 1

A graphical comparison of responses to the Spoken Form action question between participants with less than 5 years of work experience and those with 5 or more years revealed two noticeable differences. Across all scenarios, those with less than 5 years selected Refer Other Medium more often than did those with 5 or more years. The latter group selected My Other Medium more frequently. The difference was the most pronounced in the Moderate Recurring scenario. I also found a noticeable decrease in the selection of Spoken Form and a corollary increase in the selection of Other actions that was specific to the Severe Recurring problem scenario and particularly strong for those with less than 5 years of work experience. The results were still within the range of expected frequencies.

A graphical comparison of the responses to the Electronic Form action question between participants with less than 5 years of work experience and those with 5 or more years revealed two visually distinctive differences. In both the Spoken Form and Electronic Form action selection items, the more experienced respondents chose My Other Medium slightly more than the less experienced ones did. In the Severe Recurring scenario, the proportion of respondents who selected Refer Other Medium increased slightly whereas My Other Medium decreased when compared to all other scenarios. Tests for the effect size of any of these relationships revealed negligible to small effects. There did not appear to be any significant effects on Phase 1 decisions when comparing groups with work experience above and below the 5-year mark.

The Effects of Organization Type during Phase 1

The fact that the educational respondents composed 82.6% of all responses rather than the convenient 50-50 split on work experience hampered my comparison of graphical output for educational and non-educational organizations. The small *n* for the non-educational responses yielded very different results sets, whereas the educational responses were very similar to those of the whole sample. Across all four scenarios and every question related to the problem communication medium, the selections for Other were considerably higher from non-education respondents than for educational IT staff. Tests for effect size on these relationships found *w* values between .27 and .34, indicating a medium effect. Reviewing the Other text entries revealed that non-educational organizations required trouble tickets for almost everything they did, and survey respondents from non-educational organizations felt the need to state this in their responses. Because of their selecting Other more frequently, these respondents appeared to be even less likely to leave problems in Spoken Form for problem resolution than were the educational IT support staff.

Phase 2: Problem Assessment

The considerations and decisions contained in Phase 2 Problem Assessment constituted the independent variables in the study and I incorporated them into the survey instrument design in the form of problem scenarios. The survey did not collect data on these variables because the instrument presented them as part of the situation. The only measure of their validity is in the assessment of the problem trajectory model, which I investigated first through qualitative exploration of the open-ended questions that I had incorporated into the survey design. Based on an initial assessment of these textual responses, I employed the interview process to evaluate the completeness of the problem trajectory model.

Evaluation of the Model

The evaluation process for the model was twofold, with the first part consisting of an evaluation of all of the text responses accompanying the Other selections for the problem resolution decisions in all four of the scenarios. In the original survey design, I intended for the Other items to collect comments about what actions the respondents would have taken had they not been limited to the existing choices. The primary purpose of the Other choice on every decision question was to obtain indirect feedback on the completeness of the model as presented in the scenarios.

The second part of the evaluation process consisted of the electronic interview, in which I directed the questions towards ascertaining the adequacy of the model as depicted in Appendix B, Figure B12, the version used to structure the scenarios. The responses were quite interesting in that many of the suggestions to extend or elaborate the model would simply return some of the variables that I had to remove from the original 3 x 3 version in Appendix B, Figure B4 to compress the model to its 2 x 2 form for scenario construction.

Summary of Situational Responses

I coded twenty-four survey responses for the choice of Other action in the item for the decision to retain or refer a problem. I screened these respondents for an indication that they were willing to participate in an interview. From this sub sample, I requested 18 interviews and received 12 complete responses. I analyzed the data manually from the Other responses in the survey along with the elaborations from the returned electronic interviews to obtain their assessment of the model of problem trajectory used for Phase 2 Problem Assessment. I transformed the Other responses into reports in Access and printed them for review and markup, and I simply printed the interviews, which were already Microsoft® Word (Microsoft Corporation, Redmond, WA, http://www.microsoft.com) documents. For purposes of continuity and validation, I reviewed each of the interviews in conjunction with the survey responses entered by the same respondent. I have reported the results for the review of Other survey responses in the following section. The numbers in parentheses are the respondent ids (RID) identifying the individual survey or interview responses in the data.

Responses to Survey Items for Decision to Retain or Refer the Problem

One respondent stated that she would always test and try to duplicate a new problem before referring it to the proper expert or group (RID 236347984). In a similar fashion, many respondents indicated that they would definitely spend time troubleshooting a New problem before making their decision to Refer or to Retain it (RID 1798; RID 240617536; RID 241973604; RID 249840932; RID 249855726; RID 250256707; RID 250764820; RID 4568; RID 8144; RID 8457; RID 9401; RID 9438).

The description of the problem used in the survey did not provide these respondents with sufficient information to make their decision about retention or referral for resolution immediately, so they selected Other for that response item. The choices that they would ultimately use according to their textual responses were already present in the item responses, so they were not choosing to act outside the model. They might have been more comfortable if I had begun the survey with specific questions for Phase 2 Problem Assessment rather than simply using that phase to build scenarios.

Responses to Survey Item for Why the Respondent Made the Decision

One respondent provided a classic explanation for the decision to Refer to Resolve a Severe Recurring problem: “It needs to be fixed, but it’s not my monkeys, not my circus. Refer with high priority” (RID 229311454). For the decision to Retain to Resolve, another respondent provided “My users, my problem” (RID 249855726). At the other end of the spectrum, one respondent explained in detail why he retained a case that he would normally need to refer to another group for resolution:

> Our business process is to keep the ticket in our queue and be the primary contact for our users. In the case of a severe problem, we may additionally add a new trouble ticket to the appropriate queue for the group to resolve it. When their ticket is resolved we make notes in our ticket, notify our users and resolve our ticket. (RID 8457)

The review of the Other selections within the survey instrument responses was not exhaustive, but the general tone of the remarks was that the situations presented in the scenarios were generic enough so that they did not always support an unambiguous choice for one decision selection over the others. These respondents felt the need to select Other and explain the process that they actually used in their IT support activity, which in most cases was to (a) retain and troubleshoot and (b) fix or refer as necessary. A possible extension of this investigation might involve recoding the Other responses for the choice first mentioned by the respondents, usually Retain to Resolve, and then re-run the quantitative analyses to obtain stronger statistics. That process was not a part of the plan for this study and was not included in the execution. Interviews were a part of the plan, and I directed these towards obtaining a more thorough assessment of the scenario construction and the problem trajectory model.

Responses to Interview Questions Confirming the Model

One interviewee confirmed the model and listed some of the same factors for decision-making that I had used in Phase 3 Expertise Selection: "I think the categories work well for the majority of problems I see" (RID 8457). The same respondent offered commonly held factors that he used to classify problems: "What is the customer trying to accomplish? When did it last work? Are other customers affected? Is this a problem I can solve? If I cannot solve the problem who can?" (RID 8457)

A different interviewee confirmed that the "criticality of the case would depend on the combination of the urgency (how quickly it needs to be done) and the impact (how many people are affected or the designation of a person or process as mission critical)" (RID 245003986). These two factors represent elements from the trajectory model that I had combined into Severity for the purposes of constructing the 2 x 2 scenarios. The same individual made the interesting statement that "Whether the Help Desk first tier staff retains or refers the case would never depend on what the Priority was but on whether they had the ability (access and expertise) to solve the issue" (RID 245003986).

Another interviewee posed his own list of key factors that was interesting because it included factors from all over the process that I had already incorporated into different parts of the problem trajectory model.

1) Who is impacted?
2) What is the impact of the problem?
3) Is it recurring?
4) Who is responsible for resolution?
5) Is resolution by one group or more than one?
6) Who will oversee resolution?
7) How is resolution chronicled? (RID 249855726)

The only new factor here was oversight, and the interviewee stated:

> In addition to shared responsibility there is the need for resolution oversight of shared issues. Oversight can occur either with the owner of the problem or with one of the problem solving areas involved. If there is no oversight, the resolution can be delayed by intransigence. (RID 249855726)

Another interviewee confirmed the model: "I think it fair to say that they cover a majority of incidents/problems" (RID 6408). The interviewee then added a factor that is already in the model from my point of view, but hidden in the Moderate Recurring scenario: "The model is accurate, although personally I'd add a third, lower, severity level like 'Minor' for problems that need to be corrected yet are not necessarily production critical, i.e. they can 'live with it' until we can get around to looking into it" (RID 6408).

The key factors from this individual's point of view included:

> Criticality, i.e. is this a Production critical problem. Sphere of Influence, i.e. is this something that it is within my specific area of influence or does it need to be passed on. Expertise, i.e. can I handle this myself from something I already

> know or time to research a solution, or is it so far outside my experience that I need someone who has specialized knowledge/training in the problem area. (RID 6408)

An additional interviewee confirmed the model; "I'd say that it covers 99.9 percent of the issues one will encounter" (RID 9438). This respondent offered some insights into the tradeoffs between severity and difficulty, which do not necessarily correlate with each other:

> I think in most cases your model works fine. I do find that at times I'm working on more than one problem at a time, and that I might try and knock out the easier problems quickly, just so I can give more time to the more difficult issue. So in this case severity of the problem isn't necessarily the issue, it's getting most issues cleaned up the quickest, to give time to the harder issues. Usually I'm working on them in parallel, anyway. And the more difficult issue might not be the more severe issue, either. (RID 9438)

Responses to Interview Questions Extending the Model

One interviewee wanted an additional frequency of occurrence for "a problem (that) can be intermittent for a user… but it is also not recurring, meaning it is not a frequent problem" (RID 234593963). Another respondent wanted to add a factor for shared responsibility, stating that, "You are not adequately covering the scenarios where multiple areas may have shared responsibility in solving the problem" (RID 249855726). A different interviewee expressed a different concern, "One other type of 'problem' I see stems from lack of knowledge or training... I don't see that as really fitting your 'Moderate' description'" (RID 8457).

One interviewee wrote, "The axis of 'severe vs. moderate' (by your definition) is highly applicable. The 'new vs. recurring' is less useful, as a well-engineered environment should not experience specific, repetitive problems…" (RID 4568). This individual proposed moving the model closer to the original 3 x 3 model that the I favored: "The Cartesian pair I would utilize is: axis 1: Severity (severe/ moderate/ inconvenient) and axis 2: Scope (entire campus, one area, one logical service, etc)" (RID 4568).

Another interviewee suggested a classification that I had already identified as Occasional in the original 3 x 3 problem trajectory model but had removed from the compressed model, stating, "I think the two major classifications could be split one more time for 'Recurring, infrequently.' There are number of 'anomalies' that appear and disappear in our network. We have many cases which we would consider 'Routine, recurring;' End-user error, etc." (RID 8493)

The same interviewee considered VIP status to be a key factor in Problem Assessment, stating, "VIP status, known issues, workstation/network based, and 'unknown' or troubleshooting are the factors we use for processing incidents. VIPs directly affect the enrollment or image of the college" (RID 8493). Two other interviewees also supported this position.

One interviewee stated, "Similar to your model, urgency and impact are two of the most important factors, but …reputation and prestige (of the customer) also carry a lot of weight" (RID 240617536).

Another interviewee who stated agreement with the model added the same caveat: "The title/amount of complaining of the user experiencing the problem has much more to do with the resources applied than any logical model" (RID 250764820).

Responses to Interview Questions that were Outside the Model

One interviewee had a different worldview of the process that colored her response:

> We handle very specific operations, so the examples do not necessarily apply. Most of our problems fall into one of 3 categories. Not our problem...we send these on, simple password problems, and complicated software/hardware issues. Our simple problems are reoccurring; our difficult issues are rarely seen again once solved. (RID 521)

Another respondent described the adoption of an even simpler model:

> We originally used 4 levels and found that it left some “gray” areas. After several department wide meetings we determined that there is no "low" level problem. We use a "Severity Level" set of 3. Severity 1 - A major outage. Severity 2 - A clinical or financial system is experiencing problems. Severity 3 - An individual is experiencing a problem with a PC/Printer/Application that is not directly related to patient care or finance. The 4 levels you describe would not work in our institution for applications, most application problems are new. The 4 levels you describe would work if all we did was maintain hardware. (RID 232791022)

The interview responses served in most cases to validate the model, in particular the 3 x 3 design, because the items suggested for inclusion already existed in that model. Some of the factors they had suggested were functionally equivalent to values that I had compressed out of the 2 x 2 design for the sake of scenario simplicity: Occasional, Routine, Individual, and Localized.

Phase 3: Expertise Selection

Situational Decision-making for Expertise

The IT support staff members make a decision about expertise whenever they choose to either retain or refer a problem for resolution. The IT staffers must believe either that they have the correct expertise or that another group or person is the more appropriate choice. Expertise selection normally takes place just prior to the problem resolution decision, and is highly dependent on the actual problem details as well as the context within which the support staff member is working. For this inquiry, I presented the respondents with a generic situational problem and asked how they would normally resolve that problem. I then asked them how important the different factors for choosing expertise would be in the process of making that decision. This question took the form of Likert scale assessments of the five expertise factors that I had developed from the pilot study results and the literature. Two open-ended questions explored how they employed these factors in the decision process and asked if there were any other factors used to make the decision besides these five. I compared these results across scenarios on frequency of selection to establish most prevalent rating for each expertise factor. Next, I compared the importance ratings for expertise to the problem resolution decisions using crosstab contingency tables to determine which factors played the primary roles in certain types of decisions.

Importance of Expertise Selection Factors

The respondents rated each factor on a 5-point Likert scale from *unimportant* to *very important* within each of the four scenarios. The highest one or two ratings for each factor and scenario appear in Table 20 for comparison between the scenarios. These figures represent the ratings that the respondents selected the most frequently for all of their decision-making across the entire range of possible decisions, from Retain to Resolve to Other, within a given scenario. As such, they signify the importance of the expertise selection factor to general decision-making within that scenario, not its importance to any one particular decision. In Tables 21 through 25, I compared the selection factors directly to the different, specific decisions that were possible. In Table 20, the intent was to display the preponderance of the ratings for each factor across all of the scenarios, with Credibility having the highest ratings of Very Important in all scenarios, followed very closely by Responsibility.

Table 20

*Top Rated Expertise Selection Decision Factors Q25-Q29 (*N *= 109)*

Factor	Scenario	Strongest Rating	*n*	% of Response Set
Responsibility	SR	Very Important	51	46.8
	SN	Very Important	41	37.6
	MR	Important	33	30.3
		Very Important	33	30.3
	MN	Very Important	39	35.8
Credibility	SR	Very Important	59	54.1
	SN	Very Important	56	51.4
	MR	Very Important	44	40.4
	MN	Very Important	49	45.0
Recommendation	SR	Important	34	31.2
	SN	Important	40	36.7
	MR	Moderately Important	30	27.5
	MN	Moderately Important	31	28.4
Responsiveness	SR	Very Important	48	44.0
	SN	Very Important	50	45.9
	MR	Important	28	25.7
	MN	Very Important	33	30.3

(*table continues*)

Table 20 (*continued*).

Factor	Scenario	Strongest Rating	*n*	% of Response Set
Accessibility	SR	Of Little Importance	30	27.5
	SN	Of Little Importance	29	26.6
		Important	30	27.5
	MR	Of Little Importance	28	25.7
		Important	27	24.8
	MN	Of Little Importance	30	27.5

I compared these results for expertise selection to the Phase 4 decisions to retain or refer a problem across all four scenarios, and inspected the crosstab contingency tables for observed values that exceeded the expected values. I found a number of relationships that had medium to large effect sizes for a specific factor, in a specific scenario, for a specific problem resolution decision. In all of these results, an effect size index of $w = .10$ is considered a small effect size, $w = .30$ is considered a medium effect size, and $w = .50$ is considered a large effect size (Cohen, 1988).

Tables 21 through 25 display the results for each comparison between the factors of expertise selection and the problem resolution decisions in turn, and contain data only for those cells found to have an expected to observed frequency difference greater than 2 and an effect size greater than $w = .10$. Table 21 reports results for Responsibility, Table 22 for Credibility, Table 23 for Recommendation, Table 24 for Responsiveness and Table 25 for Accessibility. The density of the information in these tables made it difficult to see the relative importance of each factor in the overall decision-making process, leading me to develop the information reported in Table 26.

Table 21

Effect of Responsibility on Problem Resolution Decisions (N = 109)

Decision	Scenario	Response	Expected	Observed	Delta	*w*
Retain to Resolve	SR	Of Little Importance	1.1	4	+2.9	.47
	SR	Very Important	11.2	8	-3.2	.47
	SN	Of Little Importance	6.8	12	+5.2	.51
	SN	Very Important	21.4	16	-5.4	.51
	MR	Of Little Importance	8.4	11	+2.6	.45
	MR	Important	14.5	12	-2.5	.45
	MN	Of Little Importance	5.7	9	+3.3	.35
	MN	Very Important	15.7	13	-2.7	.35
Refer to Resolve	SR	Of Little Importance	3.5	1	-2.5	.47
	SR	Very Important	35.6	42	+6.4	.47
	SN	Of Little Importance	4.4	0	-4.4	.51
	SN	Very Important	13.9	20	+6.1	.51
	MR	Moderately Important	3.3	1	-2.3	.45
	MR	Very Important	8.5	13	+4.5	.45
	MN	Very Important	15.7	20	+4.3	.35
Refer to Defer	MR	Important	5.8	8	+2.2	.45
Other	SR	Important	1.7	4	+2.3	.47
	MN	Important	2.9	5	+2.1	.35

Table 22

Effect of Credibility on Problem Resolution Decisions (N = 109)

Decision	Scenario	Response	Expected	Observed	Delt a	*w*
Retain to Resolve	SR	Very Important	13.0	10	-3.0	.32
	SN	Important	17.8	14	-3.8	.35
	SN	Very Important	29.3	32	+2.7	.35
	MR	Unimportant	3.5	6	+2.5	.42
	MR	Important	17.2	13	-4.2	.42
Retain to Resolve cont.	MN	Moderately Important	4.8	7	+2.2	.33
	MN	Very Important	19.8	15	-4.8	.33
Refer to Resolve	SR	Very Important	13.0	10	-3.0	.32
	SN	Important	11.5	16	+4.5	.35
	SN	Very Important	19.0	15	-4.0	.35
	MR	Important	10.0	12	+2.0	.42
	MN	Moderately Important	4.8	2	-2.8	.33
	MN	Very Important	19.8	26	+6.2	.33
Other	MR	Very Important	4.0	2	-2.0	.42

Table 23

*Effect of Recommendation on Problem Resolution Decisions (*N *= 109)*

Decision	Scenario	Response	Expected	Observed	Delta	*w*
Retain to Resolve	SR	Important	7.5	10	+2.5	.29
	SN	Of Little Importance	6.8	9	+2.2	.32
	SN	Important	20.9	17	-3.9	.32
	MR	Unimportant	6.6	11	+4.4	.44
	MR	Very Important	5.7	2	-3.7	.44
	MN	Unimportant	4.4	7	+2.6	.25
Refer to Resolve	SN	Moderately Important	9.8	7	-2.8	.32
	SN	Important	13.6	16	+2.4	.32
	MR	Unimportant	3.9	0	-3.9	.44
	MR	Of Little Importance	6.7	9	+2.3	.44
	MN	Moderately Important	12.5	10	-2.5	.25
	MN	Important	11.3	14	+2.7	.25

Table 24

*Effect of Responsiveness on Problem Resolution Decisions (*N *= 109)*

Decision	Scenario	Response	Expected	Observed	Delta	*w*
Retain to Resolve	SN	Moderately Important	5.2	8	+2.8	.38
	SN	Important	15.7	13	-2.7	.38
	MR	Unimportant	5.7	9	+3.3	.57
	MR	Of Little Importance	7.5	2	-5.5	.57

(*table continues*)

Table 24 (*continued*).

Decision	Scenario	Response	Expected	Observed	Delta	*w*
Retain to Resolve (*continued).*	MR	Moderately Important	11.0	8	-3.0	.57
	MR	Very Important	11.4	15	+3.6	.57
	MN	Of Little Importance	7.7	5	-2.7	.34
	MN	Important	12.1	17	+4.9	.34
	MN	Very Important	13.3	9	-4.3	.34
Retain to Defer	MR	Important	1.0	3	+2.0	.57
Refer to Resolve	SN	Unimportant	2.0	4	+2.0	.38
	SN	Of Little Importance	4.4	2	-2.4	.38
	SN	Moderately Important	3.4	1	-2.4	.38
	SN	Important	10.2	13	+2.8	.38
	MR	Of Little Importance	4.4	7	+2.6	.57
	MR	Important	7.2	4	-3.2	.57
	MR	Very Important	6.7	10	+3.3	.57
	MN	Of Little Importance	7.7	10	+2.3	.34
	MN	Moderately Important	6.9	4	-2.9	.34
	MN	Important	12.1	8	-4.1	.34
	MN	Very Important	13.3	18	+4.7	.34
	MN	Very Important	13.3	18	+4.7	.34
Refer to Defer	MR	Unimportant	2.3	0	-2.3	.57
	MR	Of Little Importance	3.0	5	+2.0	.57
	MR	Moderately Important	4.4	9	+4.6	.57
	MR	Very Important	4.5	0	-4.5	.57
Other	SR	Of Little Importance	1.0	4	+3.0	.45

The final table of results for a comparison between the factors of expertise selection and the problem resolution decisions was for the factor of Accessibility (Table

25). This factor displayed a noticeably lower importance rating than the other four factors, as evidenced by the many responses of Unimportant or Of Little Importance.

Table 25

Effect of Accessibility on Problem Resolution Decisions (N = 109)

Decision	Scenario	Response	Expected	Observed	Delta	*w*
Retain to Resolve	SR	Of Little Importance	6.6	4	-2.6	.28
	SR	Very Important	3.5	6	+2.5	.28
	SN	Moderately Important	11.0	14	+3.0	.41
	MR	Of Little Importance	12.3	10	-2.3	.37
	MN	Of Little Importance	12.1	8	-4.1	.34
	MN	Important	10.5	14	+3.5	.34
Refer to Resolve	SN	Unimportant	4.8	7	+2.2	.41
	SN	Moderately Important	7.1	5	-2.1	.41
	MR	Unimportant	5.4	3	-2.4	.37
	MR	Important	6.9	9	+2.1	.37
	MN	Important	10.5	7	-3.5	.34
Other	SR	Of Little Importance	1.9	4	+3.0	.28
	SN	Of Little Importance	2.9	5	+2.1	.41
	MR	Unimportant	1.9	5	+3.1	.37
	MN	Of Little Importance	3.0	5	+2.0	.34

Relative Importance of the Expertise Selection Factors

Subsequent to the generation of the crosstab contingency tables, I conducted a manual analysis of the graphical displays accompanying that output and compared all of the problem resolutions to all of the expertise selection factors, scenario by scenario. I calculated relative importance factors for every combination by subtracting the Unimportant and Of Little Importance frequencies from the sum of the Very Important, Important, and Moderately Important frequencies. Tabulated results are given in Table 26, displaying how the respondents rated the factors against the decision selections and the scenarios.

Table 26

Relative Importance of Expertise Selection Factors by Decision, Scenario

	Scenario				
Decision	SR	SN	MR	MN	Total Score
		Responsibility			
Retain to Resolve	25	28	14	20	87
Retain to Defer	0	1	2	0	3
Retain to Avoid	0	1	0	0	1
Refer to Resolve	70	33	18	34	155
Refer to Defer	3	2	11	8	24
Other	0	8	4	9	21
Importance score					291
		Credibility			
Retain to Resolve	18	45	28	30	121
Retain to Defer	0	1	2	0	3
Retain to Avoid	0	2	0	0	2
Refer to Resolve	65	30	28	38	161
Refer to Defer	2	1	20	6	29
Other	2	7	4	7	20
Importance score					336

(*table continues*)

Table 26 (*continued*).

Decision	Scenario SR	SN	MR	MN	Total score
			Recommendation		
Retain to Resolve	15	35	6	12	68
Retain to Defer	0	1	2	0	3
Retain to Avoid	0	2	0	0	2
Refer to Resolve	40	28	10	20	98
Refer to Defer	2	1	9	4	16
Other	0	9	0	5	14
Importance score					201
			Responsiveness		
Retain to Resolve	15	35	26	26	102
Retain to Defer	0	1	4	0	5
Retain to Avoid	0	2	0	0	2
Refer to Resolve	45	25	10	16	96
Refer to Defer	2	1	9	6	18
Other	3	5	0	5	13
Importance score					236
			Accessibility		
Retain to Resolve	10	15	8	8	41
Retain to Defer	0	1	2	0	3
Retain to Avoid	0	2	0	0	2
Refer to Resolve	11	7	4	0	22
Refer to Defer	0	0	3	0	3
Other	0	0	0	0	0
Importance score					71

The Importance of Responsibility

Between 30.3% and 46.8% of the respondents rated the Responsibility factor of expertise selection as Very Important across all four of the scenarios. In the Moderate New scenario it received another 30.3% of the ratings as Important, matching those for Very Important. In the assessment of relative importance it scored 291, the second highest score after Credibility. Based on the graphical displays and the effect size measures in Table 21, the strongest association for this factor was to the decision to Refer to Resolve. The observed results for Responsibility compared to Refer to Resolve were consistently higher than expected and the effect sizes were all medium to high. In contrast, the observed results for Responsibility when compared to Retain to Resolve reflected higher than expected frequencies for Of Little Importance and reduced frequencies for Important and Very Important. Refer to Defer and Other action displayed modest increases beyond expected. This factor displayed an increased importance in support of the decision to Refer to Resolve and a reduced importance that moderated the decision to Retain to Resolve. One interpretation of this would be that knowing who is responsible for something is much more important if you are going to refer it to them than if you are going to be retaining it to solve yourself.

The Importance of Credibility

Between 40.4% and 54.1% of the respondents rated the Credibility factor for expertise selection as Very Important across all four scenarios. It received the highest ratings of the five expertise selections factors, and it scored 336 in the assessment of relative importance. Reviewing the graphical displays and the effect sizes in Table 22 revealed that Credibility was more important in severe situations than in moderate ones, and that the strongest association for this factor was with the decision to Refer to Resolve. The effect sizes with Refer to Resolve were medium and the positive variation from expected frequencies was greatest in the Moderate New scenario. The next largest variations were negative, reducing the Refer to Resolve importance ratings for Credibility in severe situations. Slightly smaller variations appeared for the decision to Retain to Resolve, with the largest ones reducing the frequencies for Important and Very Important. The factor of Credibility showed increased importance in support of the decision to Refer to Resolve in moderate situations, and reduced importance in the decisions to Retain to Resolve in all scenarios or to Refer to Resolve in severe situations.

The Importance of Recommendation

Between 31.2% and 36.7% of respondents rated the expertise selection factor of Recommendation, representing a suggested resource in the Phase 3 Expertise Selection model, as Important in severe scenarios. Between 27.5% and 28.4% of the respondents rated the expertise selection factor of Recommendation as Moderately Important in moderate scenarios. In the assessment of relative importance, Recommendation scored 201, the fourth highest score after Credibility. Based on the graphical displays and effects in Table 23, Recommendation was more important in severe situations than moderate ones and had its strongest positive association to the decision to Refer to Resolve. The observed results for Recommendation compared to Refer to Resolve were consistently higher than expected and the effect sizes were all medium approaching high. Recommendation displayed increased importance in support of decisions to Retain to Resolve or Refer to Resolve in severe situations and Refer to Resolve in moderate scenarios. Recommendation had reduced importance in the decision to Retain to Resolve in a moderate problem situation.

The Importance of Responsiveness

The factor of Responsiveness in expertise selection was rated as Very Important by 30.3% to 45.9% of respondents in all scenarios except Moderate Recurring, in which only 25.7% of the respondents rated it as Important. In the assessment of relative importance, it scored 236, the third highest score after Credibility. Based on graphical analysis and the effect size measures in Table 24, Responsiveness was much more important in severe situations than moderate, had the strongest association with decisions in Moderate New scenarios, but had almost no association with Severe Recurring situations. The effects size for Moderate Recurring measures was large, whereas all others were medium. Responsiveness did not appear to favor either one of the primary decision selections, Retain to Resolve or Refer to Resolve, but it did have increased importance in decisions to Defer. It also appeared to have a polarizing or centralizing effect on importance ratings by strengthening the extreme ends of the scale or the middle.

The observed results for Responsiveness when compared to Retain to Resolve demonstrated higher than expected frequencies for Important by reducing frequencies for both Of Little Importance and Very Important in a Moderate New scenario. In a similar manner, the observed results for Responsiveness in a moderate recurring scenario and decision to Refer to Defer demonstrated higher than expected frequencies for Of Little Importance and Moderately Important by reducing frequencies for both Unimportant and Very Important. Conversely, the differences from observed to expected in four different decision and scenario combinations but primarily Refer to Resolve spread out the ratings for Responsiveness by increasing Unimportant or Of Little Importance and Very Important at the expense of the middle values. The factor of Responsiveness reflected variation based on subjectivity far more than what I saw for the other factors in expertise selection. Responsiveness consistently had an increased importance when the respondent was deciding whether to Retain to Defer or Refer to Defer a problem in a Moderate Recurring scenario. In the other three scenarios, when the assessment of Responsiveness varied from the expected values, it tended to polarize the ratings, flattening the curve or raising the ends of the distribution of ratings so that it did not operate as a decisive factor.

The Importance of Accessibility

Between 25.7% and 27.5% of the respondents rated the expertise selection factor of Accessibility as Of Little Importance across all four scenarios. It was also rated as Important by 24.8% to 27.5% in two of the scenarios. In the assessment of relative importance it scored 71, the lowest score of any factor. The distribution of the scores for this decision factor had multiple modes at the ratings of Important and Of Little Importance. Interpreting the graphical displays and the effect size measures in Table 25, the strongest associations for this factor were to the decision to Retain to Resolve across all four scenarios. The effects strengths were all in the medium range and the differences between observed and expected were lower than for the other four expertise selection factors. The factor of Accessibility displayed increasing importance in support of the decision to Retain to Resolve in all situations, was well as in decisions to Refer to Resolve in moderate recurring scenarios. It had reduced importance in decisions to Refer to Resolve in new situational scenarios. Accessibility also had the effect of reducing its importance for decisions to take Other actions by elevating the selection frequency above expected for the ratings of Unimportant and Of Little Importance.

Reflection on the Results for Expertise Selection Factors

The variations in the responses to each of these decision factors may reflect the differences in how the respondents perceived each of them. Responsibility and Recommendation are concrete; someone is either responsible for something or not, and someone has either been recommended as having the proper expertise or not. Someone has to earn Credibility; organizational structure or a third party does not impart it to them. Responsiveness is an entirely subjective measure, as it is the IT staffer's perception of how quickly they can get the problem solved if they keep it within their group rather than refer it to someone else. In the case of a referral, it is the staff members' personal assessments of how fast the individual or group they would be referring the problem to will respond, based on prior experience with that source. IT staff members also evaluate Accessibility based on prior experience with the source, although they may ground their assessment in organizational structure similar to Responsibility. During the pilot study accessibility was often a factor in the decision to retain or refer a problem, with physical location and access to the problem tracking system as key determinants. Shortcomings in accessibility favored the decision to Retain to Resolve instead of referrals. The data from this study has shifted away from that factor due to increased acceptance of the campus call tracking system.

The Effects of Work Experience during Phase 3

A crosstab contingency table comparison of the selection factors for expertise compared with the 5-year group split on work experience revealed some observed variations that were greater than expected. Some of the variations that I did find were too minor to report here, and I did not attempt to conduct any more detailed analyses using work experience measured in either the number of years or in experience brackets. In the Severe New scenario, respondents with 5 years or more of work experience rated Responsibility as Very Important -5.1 less than expected and as Moderately Important +2.3 more than expected, a downward shift for that factor (w = .22) and experience demographic. In the Moderate New scenario, respondents with 5 years or more of work experience rated Responsiveness as Very Important +3.0 more than expected, then rated Of Little Importance -2.1 less than expected and

Unimportant -2.8 less than expected, a visible upward shift for that factor and that demographic even though the effect size was small (w = .21).

In the Severe Recurring scenario, respondents with less than 5 years of experience rated Recommendation as Important +3.5 more than expected and as Very Important +2.3 more than expected with a small effect size (w = .25) and shifted their distribution to center on the Important rating. Respondents with 5 years or more of experience rated Recommendation as Moderately Important +3.1 more than expected and this shifted the center of their distribution to the Moderately Important rating. In the Moderate Recurring scenario, the same displacement was visible in the graphical display. Respondents with less than 5 years of experience rated Recommendation as Important +2.8 more than expected and as Unimportant -2.3 less than expected with a small effect size (w = .23) and shifted their distribution to center on the Important rating. Respondents with 5 years or more of experience rated Recommendation as Very Important -2.7 less than expected and as Important -2.8 less than expected, shifting the center of their distribution to the Moderately Important rating.

The graphical displays for Accessibility indicated that the two modes observed in the distribution of that factor could be attributed to the respondents with 5 years or more of work experience, who had fairly large shifts outside the expected values from the top, bottom, and center ratings towards the two modes of Important and Of Little Importance. Respondents with less than 5 years of work experience had no such tendency. In the Severe New scenario respondents with 5 years or more of work experience rated Accessibility as Very Important +2.3 more than expected and as

Moderately Important -4.8 less than expected, creating the right hand peak. They went on to rate Unimportant as -2.2 less than expected and Of Little Importance -4.1 more than expected with a medium effect size (*w* = .30), creating the left hand peak. In the Moderate Recurring scenario respondents with 5 years or more of work experience rated Accessibility as Moderately Important -5.8 less than expected, then rated it as Of Little Importance +3.6 more than expected, creating the left hand peak. The effect size was small, approaching medium (*w* = .27), but the graphical representation was distinct. The two-mode distribution for Accessibility as rated by respondents with 5 years or more of experience was also visible in the Severe Recurring and Moderate New scenarios, but was not as pronounced.

The Effects of Organization Type during Phase 3

A crosstab comparison between the respondents' ratings of the expertise selection factors and the organizational groups revealed several points where organizational type appeared to affect the ratings. I observed no effects in the Severe New scenario, but in the Severe Recurring situation I found data in which the education respondents rated Credibility as Moderately Important -4.7 less than expected and as Very Important +2.7 more than expected with a medium effect size (*w* = .46), shifting their distribution even farther to the right towards higher importance. In the same scenario, the non-education group rated Responsiveness as Unimportant +2.7 more than expected and as Very Important -3.0 less than expected with a medium effect size (*w* = .30), shifting their distribution to the left. In both cases, the education group rated

Credibility and Responsiveness as Very Important by about 10 to 1 over the non-education group. The education group also rated Credibility as Very Important +3.2 more than expected in the Moderate New scenario, with a small effect size (*w* = .22), once more shifting their distribution even farther to the right towards a higher importance.

I observed the greatest amount of variation from organization type in the Moderate Recurring scenario, in which non-education organizations displayed increased assessments of importance for Responsibility and Recommendation and decreased measures for Credibility, all with small effect sizes. Educational groups reflected equal changes in the opposite direction for each of these factors. The non-education group rated Responsibility as Very Important +3.2 more than expected (*w* = .25), Recommendation as Moderately Important +2.6 more than expected, and Of Little Importance +2.2 more than expected (*w* = .26). Educational organizations rated Credibility as Important +2.7 more than expected (*w* = .27) and Recommendation as Unimportant +2.2 more than expected (*w* = .26). None of these variations for organization type had a large effect size, and the only common thread was that the respondents rated Credibility as more important than expected in both groups across several different scenarios.

Phase 4: Problem Resolution

Situational Decision-making to Retain or Refer

The four scenarios that I had constructed from different combinations of problem severity and frequencies of occurrence were sufficiently different to describe four major categories of IT problems. The survey respondents perceived the scenarios as dramatically different, at least in terms of their responses to questions 23, 42, 61, and 80 in the survey instrument: responses have been grouped by decision factor in Table 27 in order to make the contrast between each of the different scenarios more apparent; graphical displays can be found Appendix B, Figures B13 though B16.

Table 27

*Decisions to Retain or Refer a Problem Q23 (*N *= 109)*

Response Selected	Scenario	*n*	%	Cumulative % within Scenario
Retain to Resolve	SR	24	22.0	22.0
	SN	57	52.3	52.3
	MR	48	44.0	44.0
	MN	44	40.4	40.4
Retain to Defer	SR	0	0.0	22.0
	SN	1	0.9	53.2
	MR	4	3.7	47.7
	MN	0	0.0	40.4
Retain to Avoid	SR	0	0.0	22.0
	SN	2	1.8	55.0
	MR	0	0.0	47.7
	MN	0	0.0	40.4
Refer to Resolve	SR	76	69.7	91.7
	SN	37	33.9	89.0
	MR	28	25.7	73.4
	MN	44	40.4	80.7

(*table continues*)

Table 27 (*continued*).

Response Selected	Scenario	*n*	%	Cumulative % within Scenario
Refer to Defer	SR	2	1.8	93.6
	SN	1	0.9	89.9
	MR	19	17.4	90.8
	MN	10	9.2	89.9
Other action not listed above	SR	7	6.4	100.0
	SN	11	10.1	100.0
	MR	10	9.2	100.0
	MN	11	10.1	100.0

The responses to this decision selection item in the survey were the most demonstrably different between problem scenarios of any of the results obtained during this investigation. The decision to Retain to Resolve constituted almost half of the responses for the moderate scenarios, more than half for the Severe New scenario, and less than a quarter of the responses for the Severe Recurring problem. In the latter category, the selection was almost three quarters (70%) for Refer to Resolve in a Severe Recurring scenario. This result makes sense in terms of the normal response to a known issue that IT staffers must always refer to the appropriate system administrator for resolution. For this scenario, none of the respondents selected two of the decisions, Retain to Defer or Retain to Avoid, at all.

The Severe New scenario results saw Retain to Resolve encompassing more than half of the response selections, but Refer to Resolve constituted one third of the responses and Other action made up most of the rest. This was the only scenario that obtained any responses of Retain to Avoid (two selections), an unusual and unexpected decision that I had first observed during the pilot study.

The Moderate Recurring and Moderate New scenarios both produced responses in the 40% range for Retain to Resolve. The Moderate New scenario allocated another 40% to Refer to Resolve, but that same decision obtained only 25% of the Moderate Recurring responses. This result reflected the likelihood that a Moderate Recurring problem would be the responsibility of the respondent's group to resolve rather than the responsibility of an external group, whereas the Moderate New problem was just as likely to require outside assistance to resolve as not. The Moderate Recurring problem also exhibited the highest rate of Refer to Defer selections (17%), followed by Moderate New problems (9%). The Other action selection garnered about 10% of the responses in all of the scenarios except Severe New, in which it was only 6%.

The Effects of Work Experience during Phase 4

I conducted a graphical and effect size analysis of the differences in selections from a dichotomized variable for retain or refer when compared to the 5-year group variable or respondents with less than 5 years of work experience and those with 5 years or more. This process revealed both similarities and variations. The two experience groups had almost identical responses in severe scenarios, favoring referral over retention by more than 2 to 1 in Severe New situations and reversing the preference in Severe Recurring situations. In moderate situations, especially in the Moderate Recurring scenario, the experience groups diverged with the more experienced staff members more likely to retain than refer. None of these observed behaviors fell outside the range of expected frequencies.

Another comparison of the 5-year work experience group to the individual response choices for problem resolution revealed additional trends but the values remained within expected ranges. The two groups exhibited almost identical responses for the Severe Recurring scenario, but in the Severe New situation the less experienced staff members made use of Retain to Defer, Retain to Avoid, and Refer to Defer whereas the more experienced staffers did not use any of those. Both experience groups used these delaying tactics in moderate situations, but the respondents with less than 5 years of experience used them much more frequently. In all of the scenarios except Severe Recurring, respondents with 5 or more years of experience were also much more likely to select Retain to Resolve, possibly because the more experienced IT staff members had a better idea of what they could solve themselves. This tendency was particularly strong in the Moderate Recurring scenario, significantly depressing the selection of Refer to Resolve for that one situation.

The Effects of Organization Type during Phase 4

The non-educational respondents continued their trend of selecting Other much more often than did the educational respondents, but a review of all of the associated textual responses indicated that these should have been Retain to Resolve. These respondents also eliminated or reduced the selection of any choices that would have resulted in the deferring of a problem. The only deviation from expected to observed with any perceptible effect size was for non-education respondents who selected Other action in the Severe Recurring scenario. The expected count was 1.0, the observed was 3, and the effect size was small at w = .22. This statistic supported the first statement in this paragraph.

Phase 5: Solution Recording

Situational Decision-making to Record or Broadcast Solutions

I designed the survey item for solution recording as a multiple response item, such that respondents were able to select none or all of the listed options for each presented scenario. This design element made the results unusual in that the responses are not mutually exclusive, and I could not use normal proportions between all of the responses. Table 28 displays the responses to questions 32, 51, 60, and 89 in the survey instrument by item, frequency, the percentage within the response item, and the percentage within the overall scenario. The graphical displays appear in Appendix B, Figure B17, and Figure B18, for clarity.

Table 28

Solution Recording Behavior (N = 109)

Response Selected	Scenario	*n*	% within Response	% within Scenario
Solution Not Recorded: Did not record the solution or how the problem was resolved	SR	12	29.3	6.3
	SN	1	2.4	0.5
	MR	15	36.6	8.7
	MN	13	31.7	7.2

(*table continues*)

Table 28 (*continued*).

Response Selected	Scenario	*n*	% within Response	% within Scenario
Solution Recorded Personal: Made a personal record of the solution for my own use	SR	35	23.8	18.5
	SN	43	29.3	20.6
	MR	33	22.4	19.2
	MN	36	24.5	20.0
Solution Broadcast to Users: Broadcast the solution to my customers using email	SR	28	24.6	14.8
	SN	37	32.5	17.7
	MR	25	21.9	14.5
	MN	24	21.1	13.3
Solution Broadcast to IT Support: Broadcast the solution to other IT support staff in an email group or listserv	SR	32	25.4	16.9
	SN	40	31.7	19.1
	MR	26	20.6	15.1
	MN	28	22.2	15.6
Solution Recorded Formally: Recorded the solution in a trouble ticket work log, solution table, knowledge base, or frequently asked question (FAQ)	SR	60	23.4	31.7
	SN	76	29.7	36.4
	MR	59	23.0	34.3
	MN	61	23.8	33.9
Solution Recorded Other: Other action not listed above	SR	22	33.3	11.6
	SN	12	18.2	5.7
	MR	14	21.2	8.1
	MN	18	27.3	10.0

The participants responded differently to the question, with some entering only one response per scenario and others selecting many responses. Even though there is no inherent problem with participants selecting only one response, there is no way to tell how many respondents may have missed the statement “You may select MORE THAN ONE of these actions” in the survey instructions and then treated the item as multiple-choice instead of multiple selection. I discounted the potential negative effects of this possible oversight because the respondents could be expected to select the action that they would be the most likely to take in the particular situation. The QSurvey application contained no provision for obtaining a rank order measurement of the selected options, so this was not attempted.

The Effects of Work Experience during Phase 5

I placed the responses from the solution recording survey item in multiple response tables in SPSS® Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, http://www.spss.com), and compared them in crosstab displays to the various measures of Work Experience. These measures included the interval value for months of experience and several nominal groups coded from that variable, including years of experience, the mixed 1-year and 5-year experience brackets, and the dichotomized variable for less than 5 years and 5 years or more. Wherever I could compute contingency tables, I calculated the effect size and inspected the observed-to-expected frequency relationships in every cell. I ran these analyses exhaustively with each response item against the years of work experience and across all four scenarios, producing four 2 x 19 matrices for analysis.

I found a small number of relationships that had medium to large effect sizes for a specific response, in a specific scenario, with one or two of the year groups of work experience. I did not find any large, obvious relationships between solution recording and work experience in the available data. I was able to see that several information behaviors noted during the pilot study were present in these data, but I saw none of the suspected trends. Table 29 displays the results for Solution Not Recorded.

Table 29

Solution Not Recorded

Work Experience (years)	Scenario	Response	Expected	Observed	Delta	*w*
Up to 1	MN	No	15.9	18	2.1	.48
1 to 2	MR	Yes	2.1	5	2.9	.37
	MN	Yes	1.8	6	4.2	.48
5 to 6	MN	Yes	1.1	3	1.9	.48

Note. The effect size index of *w* = .10 is considered a small effect size, *w* = .30 is considered a medium effect size, and *w* = .50 is considered a large effect size (Cohen, 1988).

When I analyzed the data against the 1- and 5-year groups, the less experienced respondents were twice as likely not to record a solution as the more experienced ones were in the Moderate Recurring scenario. I found no preferential trend in the other three scenarios, but in the Severe New scenario only 1 of the 109 respondents selected Solution Not Recorded for this item. In that scenario, 76 respondents matched this trend by selecting Solution Recorded Formally. Crosstab analysis of the results for this item using the 5-year groups found no evidence of association in the difference between the expected and observed values. This action was selected the least of the six presented, even less than the Solution Stored Other option.

Analyzing the data using the 1- and 5-year groups, the less experienced respondents were more likely to record a personal solution than were those with 5 or more years of experience, across all four of the scenarios. During the pilot study, I observed several junior consultants recording notes about solutions for their own personal use. I confirmed the reason for their behavior during the interviews. Table 30 displays the results for Solution Recorded Personal.

Table 30

Solution Recorded Personal

Work Experience (years)	Scenario	Response	Expected	Observed	Delta	*w*
Up to 1	MN	Yes	5.9	8	2.1	.44
1 to 2	SR	Yes	4.8	7	2.2	.41
2 to 3	MR	Yes	2.7	5	2.3	.35
	MN	Yes	3.0	5	2.0	.50
5 to 6	SR	Yes	2.9	5	2.1	.41
9 to 10	SR	No	6.1	9	2.9	.41
	SN	No	5.4	8	2.6	.35
	MR	No	6.3	9	2.7	.50
	MN	No	6.0	8	2.0	.44

When I analyzed the data in crosstab contingency tables with the 1- and 5-year groups, I found the more experienced respondents to be twice as likely to broadcast a solution to their users as the less experienced ones were in the Severe New and

Moderate Recurring scenarios. I found no observable trend in the other two scenarios. This was a somewhat different result from what I had found them reporting for the action of broadcasting a solution to other IT support staff members. Table 31 displays the results for Solution Broadcast to Users, and Table 32 displays the results for Solution Broadcast to IT Support Staff.

Table 31

Solution Broadcast to Users

Work Experience (years)	Scenario	Response	Expected	Observed	Delta	*w*
Up to 1	SN	No	11.9	14	2.1	.45
1 to 2	SN	No	9.9	13	3.1	.45
	MR	No	11.6	14	2.4	.46
2 to 3	SR	Yes	2.3	5	2.7	.42
5 to 6	MN	No	7.0	9	2.0	.39
7 to 8	MR	Yes	0.9	3	2.1	.46
8 to 9	SN	Yes	2.7	5	2.3	.45
	MR	Yes	1.8	4	2.2	.46

Table 32

Solution Broadcast to IT Support Staff

Work Experience (years)	Scenario	Response	Expected	Observed	Delta	*w*
1 to 2	SR	No	10.6	14	3.4	.40
2 to 3	MR	Yes	2.1	5	2.9	.43
5 to 6	SN	No	5.7	8	2.3	.41
	MN	No	6.7	9	2.3	.44
13 to 14	MR	Yes	0.7	3	2.3	.43

Analyzing the data using the 1- and 5-year groups, I found that the more experienced respondents were more likely to broadcast a solution to other IT staffers than the less experienced ones were in both of the Severe and the Moderate New scenarios. An opposing trend appeared in the Moderate Recurring scenario, in which the more experienced demographic should have already known the answer but this might be new information for the less experienced staff members.

The set of results for Solution Recorded Formally that I obtained after analyzing the data in crosstab contingency tables using the 1 year groups was mixed, with the stronger associations switching back and forth as experience increased. Table 33 displays these results and I discuss them in detail immediately following the table.

Table 33

Solution Recorded Formally

Work Experience (years)	Scenario	Response	Expected	Observed	Delta	*w*
Up to 1	SR	Yes	9.9	13	3.1	.39
	MN	Yes	10.1	14	3.9	.44
1 to 2	MR	No	6.9	12	5.1	.49
	MN	No	6.6	9	2.4	.44
2 to 3	MR	Yes	4.9	8	3.1	.49
5 to 6	SR	No	4.0	6	2.0	.39
	MN	No	4.0	6	2.0	.44
9 to 10	MR	Yes	4.9	7	2.1	.49
	MN	Yes	5.0	7	2.0	.44
14 to 15	SN	No	0.9	3	2.1	.48

The respondents with up to one year of experience favored recording a solution formally; those with between one and two years of experience did not. Then those with between two and three years of experience favored recording a solution formally, and the preference changed directions again every year after that for several more. The frequencies involved in each cell were too small for me to assign them a great deal of meaning, because the individual differences between respondents could easily skew them. The differences between the first and second year had larger deltas than did the rest, and this brought to mind one of the comments from a help desk consultant during the pilot study. When asked about recording solutions for new problems, he responded that he would do so the first or second time he saw it, but if he saw it more often he would not make a record of it because "I should know it by then, I guess" (p. 112). When I analyzed the data using the 5-year groups, the less experienced respondents were more likely to record a formal solution than were those with 5 or more years of experience across three out of four of the scenarios.

Table 34 presents the results of data analyzed in crosstab contingency tables for responses of Solution Recorded Other using the 1-year groups. All of the variations for this response exhibited trends towards an affirmative answer, but overall this response garnered the second lowest number of selections after solution not recorded. When I analyzed the data with the 5-year groups, the respondents with less than 5 years of experience were somewhat more likely to store a solution in a way not presented in the model in the Severe Recurring and Moderate New scenarios than were the more experienced respondents. The reverse of this finding was true in the Severe New scenario, and there was no trend in Moderate Recurring situations.

Table 34

Solution Recorded Other

Work Experience (years)	Scenario	Response	Expected	Observed	Delta	*w*
1 to 2	SR	Yes	3.0	5	2.0	.48
4 to 5	MR	Yes	1.0	4	3.0	.46
14 to 15	SR	Yes	0.6	3	2.4	.48

Overall, there were only minor differences measured in the proportions between expected and observed frequencies in crosstab comparisons of work experience and solution recording. Those that occurred were somewhat more frequent in the 0-6 year experience range and showed large effect sizes so there were measurable influences on solution recording from work experience. The scattered nature of the results may actually say more about some of the individual respondents in several of the experience year groups than about the strength of association between work experience and solution recording.

The Effects of Organization Type during Phase 5

I compared the dichotomized grouping of organizations coded as education and non-education to the Store to Share composite variable using crosstab procedures, and found no noticeable deviation of observed from expected values. The same was true when I compared the organizational groups to the Solution Not Recorded variable. I found no evidence that organization type had any effect on solution recording behavior.

The Effects of Problem Communication Medium during Phase 5

The second half of the questions in each scenario about problem arrival communication medium had to do with its effect on solution storage. I found that the responses to those questions favored electronic media more heavily than they had during the problem arrival phase. The responses were relatively consistent across all four scenarios, implying that there was very little scenario dependence. Once again, the proportions of the choices showed slight variation from the severe problem scenarios to the moderate problems and were almost indistinguishable between Severe Recurring and Severe New problem scenarios on most of the variables. The Moderate New scenario varied more noticeably from all of the other scenarios, for both the spoken and electronic storage forms. Much more recognizable differences appeared between the results for the Spoken Form of communication and those for the Electronic Form.

The first set of questions displayed in Table 35 assumed the conditions that the problem had arrived in Spoken Form and that the respondent had decided to store the solution.

Table 35

*Spoken Form Storage Selection Q36 (*N *= 109)*

Response selected	Scenario	*n*	%	Cumulative % within scenario
Stored in the original medium of the problem report (Spoken Form)	SR	14	12.8	12.8
	SN	15	13.8	13.8
	MR	17	15.6	15.6
	MN	22	20.2	20.2
Stored after changing the medium to something else	SR	80	73.4	86.2
	SN	81	74.3	88.1
	MR	84	77.1	92.7
	MN	77	70.6	90.8
Other action taken if not listed above	SR	15	13.8	100.0
	SN	13	11.9	100.0
	MR	8	7.3	100.0
	MN	10	9.2	100.0

Twenty-eight respondents selected the Other action choice for this item in one or more of the scenarios. Key words found in these responses included *refer*, *track*, and *documented*. Differences in the responses between scenarios included a noticeably greater proportion of selections of Other action than of Spoken Form in the severe problem scenarios as compared to the moderate ones. The highest number of responses was for the decision to store the solution in a Changed Medium in the

Moderate Recurring scenario, but that choice received its lowest selection rate in the Moderate New scenario. The respondents left more problems in Spoken Form for Moderate New situations than for any other scenario. The differences between all of the response proportions were still small, but they were the most visible in the Moderate New problem scenario.

The second set of questions displayed in Table 36 assumed the conditions that that the problem had arrived in Electronic Form and that the respondent had decided to store the solution.

Table 36
*Electronic Form Storage Selection Q40 (*N *= 109)*

Response selected	Scenario	*n*	%	Cumulative % within scenario
Stored in the original medium of the problem report (Electronic Form)	SR	60	55.0	55.0
	SN	55	50.5	50.5
	MR	58	53.2	53.2
	MN	53	48.6	48.6
Stored after changing the medium to something else	SR	37	33.9	89.0
	SN	43	39.4	89.9
	MR	39	35.8	89.0
	MN	48	44.0	92.7
Other action taken if not listed above	SR	12	11.0	100.0
	SN	11	10.1	100.0
	MR	12	11.0	100.0
	MN	8	7.3	100.0

Twenty-two respondents selected the Other action choice for this item in one or more of the scenarios. A new key word *editable*, stood out in this text. I found a little more variation between scenarios for these responses than for any others in the group related to problem arrival medium. Only the Severe Recurring and Moderate Recurring scenarios appeared to have almost identical selections. Scenario responses for recurring problems were more likely to store the solution in the original electronic medium than were those for new problems, whereas Moderate New scenario responses were more likely to store it after Changing the Medium than in any of the other scenarios.

The Effects of Work Experience and Medium during Phase 5

A graphical comparison of responses to the Spoken Form storage question between participants with less than 5 years of work experience and those with 5 or more years revealed two detectable differences. I detected a distinct decrease in the selection of Changed Medium and Other action and a corollary increase in the selection of Spoken Medium over those choices that was specific to the Severe New scenario and those with less than 5 years of work experience. The more experienced workers exhibited trends in the opposite directions on all three variables, and this behavior did not appear in the other three scenarios. In both the Spoken Form and Electronic Form storage selection questions, the more experienced respondents chose Changed Medium slightly more often than the less experienced respondents did. The results were within the range of expected frequencies.

A visual analysis of the responses for Electronic storage selection in the case of the Moderate New scenario, the scenario that had displayed an overall variation towards Changed Medium, revealed that the respondents with 5 years or more of work experience were, in fact, responsible for that preference. This was the only response in which any group selected Changed Medium more often than the Electronic Form although the textual comments indicated that the information remained in some sort of electronic medium. Respondents with 5 or more years in the Severe New scenario also selected the Changed Medium response more frequently. The difference between the experience groups was even greater than it was in the Moderate New situation. The corollary effect was that in the two new problem scenarios, the respondents with less than 5 years of work experience elected to store the solution in the original Electronic Form more often than did the experienced IT staff. It could be that the experienced staff members were more selective about which electronic medium they chose to use when storing solutions for new problems. All of the results were within the range of expected frequencies, indicating that work experience did not have a significant effect on decisions about solution storage that pertained to medium.

The Effects of Organization Type and Medium during Phase 5

The fact that the non-education sample was less than 20% of the whole served to complicate the comparison of graphical output for educational and non-educational organizations. The small *n* for the non-educational responses produced very different looking results sets, whereas the educational responses appeared similar to those of the entire sample. Again, across all four scenarios and every question related to the problem communication medium, the selections for Other were higher from non-education respondents than for educational IT staff, but in the area of solution storage they were within expected levels. When the original medium was Electronic Form, respondents from both types of organizations had similar responses to storage selection decisions. When the original medium was Spoken Form, participants from education selected Changed Medium more than expected, with a medium effect size of $w = .32$ in the Severe Recurring scenario.

The Effects of Work Experience

I analyzed experience in the workplace using crosstab contingency tables against each of the primary decision items or rating assessments on the survey instrument for each phase of the problem trajectory model except Phase 2. The tables of detailed statistics and the discussions of the analyses are included with the results for each phase. I performed a full set of comparisons using the 5-year nominal groups of all respondents with less than 5 years of work experience and those with 5 or more years. I made an additional comparison for some of the phases using the work experience bracket groups, that set of nominal codes for 1, 2, 3, 4, 5, 5-10, 11-15, 16-20, and 21-25 years of experience, and another comparison for every year of work experience from up to 1 year through 23 to 24 years. Graphical comparisons and the test for effect size between expected and observed values were my primary analysis tools.

In Phase 1, I compared the 5-year groups to the responses for the Spoken Form action question and the Electronic Form action question. Graphical analysis indicated that less experienced IT staff members preferred Refer Other Medium but those with 5 or more years of experience preferred My Other Medium. Several other minor variations appeared in the responses associated with specific scenarios. All of the effects sizes were negligible (*w* less than .10) to small (*w* = .10), so there were no significant associations between the variables to indicate any relationship between problem arrival medium decision-making and work experience.

In Phase 3, I compared the 5-year groups to the selection factors for expertise, which were ordinal values reflecting the importance ratings for each factor. Most of the findings showed small effect sizes and were very specific to one scenario or another. Graphical analysis and effect size comparisons showed that in both of the recurring scenarios for the Recommendation factor, the respondents with less than 5 years of experience shifted their distribution of importance selections to the right to center on Important, whereas those with 5 or more years shifted their distribution of selections left to center on Moderately important. The graphical displays for the Accessibility factor showed that the two modes observed in all of the distributions of that factor were attributable to the respondents with 5 or more years of experience. Again, there were several minor variations in responses associated with other specific scenarios. All of the effects sizes were between small (*w* = .10) and medium (*w* = .30) so there were no significant associations between the variables to indicate any relationship trends between the expertise selection factors and work experience.

In Phase 4, I compared the 5-year groups to a composite dichotomized variable for Retain or Refer that I recoded from the decision selections for problem resolution. Using graphical analysis, I observed that in moderate scenarios, especially in the Moderate Recurring scenario, the more experienced IT staff members were more likely than the less experienced staffers to retain a problem rather than refer it. In a comparison of the 5-year groups directly to the problem resolution decisions, in the Severe New scenario the less experienced respondents made use of the decisions to Retain to Defer, Retain to Avoid, and Refer to Defer but the more experienced staffers made no use of these selections. Both groups used these delaying tactics in Moderate situations, but the less experienced staffers used them noticeably more than did those with 5 or more years of experience. In new scenarios and especially in Moderate Recurring, the more experienced staff members were much more likely to Retain to Resolve than were the junior staffers. Although none of these associations fell outside the range of expected frequencies, the trends were visible in the graphical displays. Although it was not dramatic, I could attribute a certain amount of the variation in the problem resolution behavior observed in Phase 4 to differences in work experience.

For Phase 5, I prepared crosstab contingency tables comparing solution-recording decisions to years of experience, work experience brackets, and the 5-year groups for experience. I ran these comparisons against all of the decision selections in all four of the scenarios. These analyses were exhaustive because I also used them to provide an answer to the second research question. Graphical and effects strength analyses found that the respondents with less than 5 years of work experience were more likely to select Make a Personal Record of the solution than were those with 5 or more years of experience, across all four scenarios. Another trend noted was that the less experienced respondents were more likely to record a formal solution than were the more experienced ones, in three out of four scenarios. This finding corroborated my observations of consultant behavior recorded during the pilot study, in which the more experienced staffers were less likely to record solutions than the newer ones were.

Another trend I found in the data was that in half of the scenarios the respondents with 5 years or more of experience were twice as likely to broadcast the solution to their users as the junior staffers were, and in three of the scenarios they were more likely to broadcast the solution to other IT staff. This behavior, which means that they would be willing to go public with their solutions, probably reflects the greater confidence in their solutions that one could expect from more experienced IT staff members. An opposite trend appeared regarding the junior staff members that were more likely to broadcast the solution to other IT staffers in a moderate recurring scenario, a situation in which the more experienced staff probably already knew the answer. During the pilot study, I frequently observed the junior consultants broadcasting new solutions to their peers whereas the more experienced ones broadcast policies and procedures to all for handling new problem situations. I also noted several other minor variations in the responses associated with specific scenarios, from which no conclusions may be drawn.

All of the effects sizes for variations between observed and expected frequencies occurred in the medium range, with $w = .44$ being a common value and some w values reaching a strong effects size at .49 or .50. Observed variations were more common for respondents with between 0 and 6 years of work experience, with some variation out to 10 or 14 years. These results indicated that there could be some significant associations between variables to indicate relationships between solution recording and work experience.

Summary of the Findings

During this study I collected data from 109 survey responses and 13 electronic interviews, and analyzed it primarily with the tools in Access, Microsoft® Excel® (Microsoft Corporation, Redmond, WA, http://www.microsoft.com), and SPSS. A sufficient amount of data was available to provide a wide range of response selections across the survey items, suitable for descriptive quantitative analyses. The respondents were representative of the higher education IT workplace and possessed a wide range of age, educational levels, training, and work experience. Their distribution was evenly spread between first level and second or third level support, and almost three-quarters of them reported providing support directly to end users as a normal part of their work. I have keyed the summary of the findings to the problem trajectory model by phase, to the research questions by number (RQ), and to the first scenario of the survey instrument by question (Q) number.

The responses from the survey pertaining to the different phases of the problem trajectory model exhibited a noticeable amount of variation between the four scenarios. This trend was perhaps the most pronounced in the Phase 4 decisions selected for retaining or referring the problem (RQ1B, Q23), in which the results for each scenario were dramatically different from each other (Appendix B, Figures B13 through B16). The next major survey item evaluated the importance of five different factors for selecting expertise using ordinal measures (RQ1C, Q25-29). The responses were sufficiently different to identify clearly which factors were the most important when each of the problem resolution decisions was selected during Phase 3, and indicated that in this setting one of the factors was of significantly less importance than the others. The final major survey item was solution recording (RQ1D, Q32), and here the responses ranged from dramatically different to very similar across scenarios. The most striking observation was that only one individual chose Solution Not Recorded in the Severe New scenario. Every other decision selection across all four of the scenarios was so similar that the frequencies were within a few percentage points of each other. This one selection stood out.

In contrast to the other scenario-driven selections above, the responses obtained for the effects of problem arrival medium (RQ1A) in Phase 1 were very different between the two media (Q34 and Q38) but very consistent across the scenarios and were determined to be virtually scenario independent. The observed differences appeared at the very end of the problem trajectory scheme (Q36 and Q40) and did not detract from the unity of the overall response.

A significant amount of analyses were centered on the search for interaction between the problem trajectory model and work experience (RQ2). Because the respondent sample divided almost evenly at the 5-year mark, I ran many of the tests with the dichotomized variable I created for that difference. The results of these analyses varied, with some stronger than others and a wide range of effects sizes between expected and observed values. Several trends were visible in the data in problem resolution and solution recording, with the latter exhibiting the most variation from work experience. Although the levels of association were not remarkable, they were observable and measurable.

In addition to the analyses conducted with work experience, mentioned above and reported in detail in the previous section, I prepared other crosstab contingency tables for organization type. These comparisons did not enjoy the near even split that work experience did on the 5-year mark because 82.6% of the respondents were from educational institutions. The results of these analyses were not strong but indicated that non-educational respondents had more structured requirements for recording problems and solutions, used call tracking systems more and spoken forms less, and selected more of the Other responses in the survey instrument in order to explain their choices.

In their answers to the interview questions, the respondents directed their comments towards the legitimacy of the problem trajectory model. Their responses served to reinforce the more detailed three variables by three values (3 x 3) version of that model rather than the simplified one that I had used to structure the scenarios. Several of the responses nominated variables for inclusion in the model that I had dropped out of the original 3 x 3 version in order to simplify the survey instrument scenarios. The responses from the interviews supported the comments collected from the Other selection text and open-ended question responses for the problem resolution decision. The contents of those responses also discussed using some of the same decision selection criteria and values that were available in the 3 x 3 version of the model. The respondents also discussed the order in which they would normally make their decisions and take actions, explaining that they often made several of them in rapid succession during the troubleshooting process for a newly arrived problem. Ultimately, they would have selected one of the choices that I had provided.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

This chapter restates the problem and reviews the methodology that I employed to conduct the investigation. The remainder of the chapter contains a summary of the results and a discussion of their implications. In the previous chapter, I ordered the results by the phases of the problem trajectory model. In this chapter, I have summarized the results in the order and context of the research questions.

Statement of the Problem

A review of the findings from the pilot study and of the literature on knowledge creation and knowledge management, with a focus on problem resolution in an IT environment, revealed that the IT support staff seldom carries out the practice of recording reusable solution information effectively. The points at which the procedure breaks down are poorly understood, a situation that is largely attributable to the lack of an all-encompassing model of the entire IT problem resolution process. In order to address this situation effectively, investigators in the field require a comprehensive process model of the problem resolution procedures for the IT support domain, from problem arrival and assessment through resolution and solution recording. More specifically, researchers need a model that contains all of the measures and controls that determine how IT staff members make their solution storage decisions, including any demographic factors that appear to influence that process.

Review of the Methodology

Research Design and Method

I designed this study as descriptive research using surveys and limited interviewing to examine and verify a model of problem trajectory in an information technology (IT) support environment. I developed this model from an earlier qualitative field study, referred to as the pilot study, which provided the categorical, variable definition, and process details that I used to construct the model. I have organized the problem trajectory model into five different phases that include problem arrival, problem assessment, expertise selection, problem resolution, and solution recording. I further organized each phase of the model into conditions, considerations, interactions, strategies and tactics, decisions and consequences, the components of the trajectory scheme. The decisions became the variables for the research, with the situational selections for Phase 2 Problem Assessment acting much like independent variables to drive the scenarios whereas those from the other phases served as dependent variables. The other situational characteristics such as problem communication medium and the demographic factors of the survey respondents such as work experience functioned as mediating variables.

The methodology employed to investigate the model was one of mixed methods, combining descriptive quantitative analysis with qualitative examination of the data from surveys and interviews. The study used both within-participant and between-participant techniques to develop instruments, collect data, and analyze that information. I used the problem trajectory model to structure the research and to formulate the plan for data collection. I used the Problem Assessment phase of the model to develop four discrete scenarios from a simplified 2 x 2 matrix of the problem classifications, severity, and frequency of occurrence. I was then able to conduct data collection with identical questions reoccurring within the context of four situational scenarios. I conducted my analyses using crosstab contingency tables and graphical displays to explore the data. I also conducted tests for association using the effect size statistic described by Cohen (1988), and made visual comparisons of graphical output.

Populations and Samples

I originally designed the investigation for one population and I later extended it to two others. The base population was about 350 IT support staff members at the University of North Texas (UNT), who compose both the central and the distributed computer support activities. I invited a purposive sample of the 282 individuals who had privileged access to a University-wide Remedy® Action Request System® (BMC Software, Inc., Houston, TX, http://www.bmc.com) application for trouble call tracking and solution storage to participate in the survey research. I also invited additional populations to take the survey, and obtained purposive samples from three external online community groups: the EDUCAUSE constituency groups for User Services and for Distributed Technology Support, and the ARSLIST, an international listserv for Remedy call-tracking system administrators and developers. From the survey respondents, I selected a stratified non-random sample of 18 individuals for email or telephone interviews, based on several responses to specific survey questions.

Survey Research

The primary investigatory device for this study was an online survey instrument of 102 questions for UNT respondents and 104 questions for external respondents. I presented the initial survey on a QSurvey application running on a Zope content management server, and later shifted the survey to SurveyMonkey.com after serious data loss problems occurred with the QSurvey application. The survey instrument contained questions about demographics, IT training, IT work experience and IT support levels for each respondent. I organized the main portion of the survey around four discrete problem scenarios: Severe Recurring, Severe New, Moderate Recurring, and Moderate New. This represented a compression of the Phase 2 Problem Assessment portion of the problem trajectory model that I had to make in order to limit the survey to a manageable size.

I designed specific sets of questions to obtain respondent decisions for each of the four remaining phases of the problem trajectory model and duplicated them across the four scenarios. I used multiple-choice and multiple selection questions to gather the decisions, and I used the Other response device to obtain exception information. Each question or group of questions included at least one trailing open-ended question to explore the respondents' rationale for their decision. The goal set for a minimum survey response was 100 completed surveys, for a sampling error of 10% at a 95% confidence level. I provided three separate $100 gift card incentives for various populations and periods in order to improve participation. The survey took 30 to 40 minutes to complete and required concentration; the measurable abandonment rate for incomplete surveys on the SurveyMonkey.com site was 55.6% for UNT participants and 71.8% for external participants.

From the survey responses, I developed follow-up interviews with three open-ended questions about the scenario structure and the variables used for scenario construction, the Phase 2 Problem Assessment portion of the model. I sent these by email to the interview sample and the respondents returned them by email. I imported the data files gathered from the online surveys into Microsoft® Access™ (Microsoft Corporation, Redmond, WA, http://www.microsoft.com) databases and organized them there for output through queries into SPSS® Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, http://www.spss.com), as Access reports, and as Microsoft® Word (Microsoft Corporation, Redmond, WA, http://www.microsoft.com) merge documents. I imported the interview data from the email responses directly into Word documents and imported those into NVivo™ (QSR International Pty Ltd, Victoria, Australia, http://www.qsrinternational.com). Then I analyzed the data sets and outputs in Access as well as in SPSS and NVivo.

Summary of the Results

I obtained complete survey responses from 78 respondents or 27.66% of the UNT purposive sample (n = 282), and from 31 respondents in the external purposive sample. All were self-selected, as there was no requirement to participate. I obtained completed electronic interviews from 13 respondents or 72.22% of the stratified non-random sample (n = 18). These data sources translated into about 1,661 pages of mixed quantitative and qualitative data with more than 160 variables for analysis. The overall response set contained data from 109 individuals of whom 66.1% were men and 67.9% had completed at least a bachelor's degree, with a mean age of 39.14. In terms of IT support, 67.9% of the respondents provided support to end users, and 44.0% considered themselves to be first level support staff. The average number of months of work experience in their current organizations was 68.83 (5.7 years) with a range from 1 to 280 months, or 0 to 23.3 years. The median work experience was 60 months, or 5 years, which split the respondents almost in half with 52.9% reporting less than 5 years of work experience and 47.1% reporting 5 years or more. With the preponderance of responses coming from UNT staff, 82.6% worked in higher education settings.

Results Observed

The results reported here are primarily from the survey research, in which I had designed the questions, collected the data, and performed the analyses all within the context of the separate phases of the problem trajectory model. In this chapter, I have reorganized the results and conclusions to address each of the research questions in turn, with references back to the phases and the survey instrument.

Results for Research Question 1

The first research question was as follows:

1) How do the factors of problem trajectory, in particular, criticality, scope, and frequency of occurrence, affect the problem resolution and solution recording behaviors of IT support staff?

I had further divided the first research question into four subordinate questions to facilitate data collection and analysis within the separate phases of the model.

Results for Research Question 1 A

a) How does the communications medium of problem arrival affect the problem resolution and solution recording behavior of IT support staff? [Phase 1 Problem Arrival]

I have summarized the results from the analyses of Phase 1 survey data here in terms of their arrival medium and storage format. Links back to the original observations from the pilot study are included wherever they were appropriate.

The Problem Arrives in Spoken Form: Resolution

The respondents retained problems for resolution that arrived in Spoken Form in that same form only 16% of the time in severe situations and 24% of the time in moderate situations, whereas they changed the problems into a different medium that they preferred between 42% and 48% of the time (Table 18). An additional 15% to 20% of the respondents changed the problem into another format to match the preferences of the referral destination. In Severe Recurring situations, 25% selected Other action, 10% higher than in the other three scenarios. In their text responses some went so far as to report they would enter the problem in a trouble ticket and also put it in any other format preferred by the referral destination, anything but leaving it in Spoken Form alone. Accountability was an issue, and the respondents clearly wanted to have a way to track the problem later.

Several interesting textual responses indicated that the respondent would transfer the problem report to written form for documentation and either call or physically go to the office of the referral person in the case of a severe problem. Several more respondents stated they would refer the problem by phone, and then follow up with electronic mail. The clearest Other response was "resolve spoken, follow up written" (RID 250251177).

These results were very consistent across all four of the scenarios, with only a few visible variations. Generally, the respondents resolved or referred more problems in original Spoken Form in the moderate problem scenarios than in the severe ones. The respondents transferred over three fourths of the problems arriving in Spoken Form to another medium, meaning a written or an Electronic Form, at some point in the problem resolution process.

The Problem Arrives in Spoken Form: Storage

The respondents retained problems that arrived in Spoken Form in that medium for solution storage 13% to 20% of the time (Table 35). The respondents changed the problem reports and solution information to another medium that they preferred, normally an electronic or written form, between 71% and 77% of the time. Between 7% and 14% of the time, the respondent selected the Other choice and several indicated in the text responses that local policy would be the determining factor in how or where they recorded their solutions. Others indicated that if they had referred the problem, it would not be up to them to store the solution. A review of the textual entries for respondents who selected storage in the original Spoken Form revealed that only a few of them really meant that. Most of the elaboration cited the need to transcribe the Spoken Form information into an electronic format at some point. An extensive constant comparison analysis of the textual responses to this and the other problem medium questions would be likely to moderate the Spoken Form statistics even further, but I did not plan or accomplish that for this particular investigation.

The Problem Arrives in Electronic Form: Resolution

The respondents retained problems for resolution that arrived in Electronic Form in that same medium 61% to 64% of the time (Table 19). They changed the problem reports into a different medium that they preferred between 10% and 16% of the time. An additional 12% to 16% of the respondents changed the problem into another format to match the preferences of the referral destination. Only 10% of the respondents selected the Other action, and their textual responses indicated that they would copy some of the problems arriving in email directly into a call-tracking system for referral or accountability. At least one respondent reported using of a mixture of standard media for every part of the problem resolution process, and, therefore, the particular arrival medium did not affect anything, except that copying and pasting text from an electronic source was easier than transcribing it.

Problems reported in an electronic format stayed electronic, with some of those who changed the format indicating that they were simply moving information between email problem reports and a tracking system. One respondent summed it up best: "An e-mail would be transferred to the tracking system. A trouble ticket would be updated" (RID 5777). It was not possible to tell how much of the 61% to 64% of the problem reports kept in Electronic Form would have been email as compared with trouble tickets, but a logical conclusion from reading the textual responses would be that a large amount of it would arrive as email and would remain as email. This solution was observed during the pilot study when many problems arriving in HelpDeskMail, the group mailbox for the help desk, were resolved right there by bouncing the mail to second level support and then back to the end user, and these never made it into a trouble ticket. Another note of interest was that many of the respondents stated that they would keep the report electronic but would call the referral destination to tell them about it in severe scenarios.

The Problem Arrives in Electronic Form: Storage

The respondents retained problems that arrived in Electronic Form in the original medium for solution storage 49% to 55% of the time (Table 36). They changed the problem reports and associated solution information into another medium that they preferred, normally also an Electronic Form, between 34% and 44% of the time. Between 7% and 11% of the time, the respondents selected the Other action choice. Several indicated in the text responses that they were seeking an editable form for storage and that email was the least suitable electronic medium for that purpose. The respondents frequently mentioned trouble tickets as the preferred alternative electronic storage medium, as well as Web pages and word processing files used for FAQs.

Several respondents discussed organizational policy, and a few mentioned using actual knowledge bases.

Visual inspection of the graphical displays of the data revealed a little more variation between scenarios for this particular question set, the storage decision for electronic arrival medium, than for any other questions related to medium. Respondents were more likely to store the solutions to recurring problems in the original medium than new problems, and in the Moderate New scenario, they were more likely to store the solution after changing the medium than they were in the other scenarios.

Results for Research Question 1 B

b) How do the primary factors in problem assessment, criticality, scope, and frequency of occurrence, affect consultant behavior during the subsequent phases of problem trajectory? [Phase 2 Problem Assessment; Phase 4 Problem Resolution]

The responses to the survey item pertaining to the decision to retain or refer the problem provided the most tangible evidence of how the factors in Phase 2 Problem Assessment affected the problem trajectory. Because I had divided the survey instrument into four identical question and item sets based on the four problem scenarios, comparing situational responses took place during every part of the analyses processes. The most fundamental comparison came from the problem resolution decisions, displayed in Table 27 in tabular form by decision, and in Appendix B, Figures B13 through B16, in graphical form by scenario.

Severity was the first factor in problem assessment, and the one that I used to construct the scenarios for the survey instrument. This factor was actually a combination of two others from the original models, Criticality and Scope. I operationalized these for this study with values of Significant or Routine for Criticality, and Widespread or Individual for Scope. This combination already represented a simplification from the model developed from the pilot study, in which all three of the original variables contained three values. In order to create a manageable survey instrument with only four scenarios, I compressed these two factors into a single variable for Severity, with values of Severe and Moderate. The variable for Frequency of Occurrence remained in its simplest, dichotomized state with values of New and Recurring.

From these four values, Severe, Moderate, New, and Recurring, I formed a 2 x 2 matrix and wrote scenarios to match each pair. The situational responses to the survey fell entirely into one or another of these four quadrants. The differences between those responses are prominent when viewed in graphical form, as in Appendix B, Figures B13 through B16. The criticality and frequency of occurrence of any of the problems posed in the scenarios had a considerable effect on all of the actions selected by respondents in Phase 3 through Phase 5 of the problem trajectory. Some of the actions varied on criticality, others on frequency, and still others on three or even all four of the quadrants. Some of the most prominent and measurable effects are summarized here.

Severe Recurring (SR) Problems

Respondents looking at the Severe Recurring scenario displayed an overwhelming tendency to select Refer to Resolve and move the problem to the responsible group or individual for expedited action. About 70% of the respondents selected this action, whereas 22% selected Retain to Resolve. Another 6% selected Other, but when I reviewed the textual responses for these respondents it became clear to me that they simply wanted to clarify that they were required to retain a problem for verification before they referred it to the next level of support. Presented with a Severe Recurring scenario, the respondents reported they took very strong actions to resolve the problem as quickly as possible on the premise that it was a known problem with a known referral or response based on previous experience. It was under these conditions that respondents stated they would refer the problem by the fastest possible means and follow up with a trouble ticket, or if the report were already electronic, they would route it and then telephone the referral destination to bring it to their attention. The entire response revolved around rapid action. Solution recording for this scenario was weak with 29.3% reporting Solution Not Recorded. Solution Recorded Other was the highest at 33.3% with the explanation that someone should have already recorded the solution to a Severe Recurring problem. Several respondents explained that it would normally be the responsibility of the group that they had referred the problem to for action to record the solution after resolving it, unless they were acting as a go-between and relaying the solution back to the customer.

Severe New (SN) Problems

Respondents reacted quite differently to a severe situation in which the problem was new or unknown. The rate of selection for Retain to Resolve doubled from the 22%

in Severe Recurring to 52.3% because the respondents did not yet know the correct referral. This was the only scenario in which Retain to Avoid appeared (1.8%), and Other action grew to 10.1%. Many of the respondents explained that in this scenario they would have to troubleshoot the problem before routing it elsewhere. The Refer to Resolve decision was still relatively high at 33.9% and was explained by statements that this problem would most likely be above their support level and would have to be referred somewhere else to be resolved. Once the Severe New problem was resolved, the solution recording was also quite different; this was the scenario for which only a single respondent reported that he would Not Record the solution.

Moderate Recurring (MR) Problems

The moderate problems elicited a much different response than did the severe, and the respondents treated them quite differently between Moderate Recurring and Moderate New. The respondents selected to Retain to Resolve a Moderate Recurring problem 44% of the time. Refer to Resolve dropped to 25.7% but Refer to Defer climbed to its highest level at 17.4% and Retain to Defer also peaked at 3.7%. This trend indicated that the respondents had accorded this problem the lowest priority of all the scenarios for resolution; they were willing to defer action on it 21.1% of the time. Other action remained at 9.2%, just below the rate for Severe New and Moderate New problems. These responses reflected the fact that the Moderate Recurring problem was described in such a way that many support areas would consider this to be their problem to fix, although some of the individual IT support staff members would most likely report the problem to their network manager or desktop support group for tracking and resolution. Both explanations were clear in the textual responses that amplified their decision selections. As could be expected, the respondents selected the option to Not Record a Solution for this scenario 36.6% of the time, making the assumption that it had already been documented or that recording the solution was the responsibility of the referral group.

Moderate New (MN) Problems

The respondents reacted to Moderate New problems very even-handedly; they selected Retain to Resolve 40.4% of the time and Refer to Resolve 40.4% of the time. Refer to Defer and Other each got about 10% to complete the selections. The issue presented in this scenario was one that was just as likely to require outside assistance as it was to be resolvable internally as a desktop issue because it was affecting more than one user. As a result there was an even split between keeping it and referring it. The priority accorded to this problem was the second lowest observed, with Refer to Defer at 9.2%. Solution recording behavior for this scenario remained fairly even with Severe Recurring and Moderate Recurring, even though this was a new problem. The formal recording of a solution edged slightly higher in this scenario to 23.8%, but was still lower than that observed for Severe New problems at 29.7%.

Clearly, the different combinations of Severity and Frequency of Occurrence incorporated into the structure of the four scenarios were successful in drawing out very different decision selections from the respondents during the various phases of the problem trajectory.

Results for Research Question 1 C

c) What factors determine when a problem will be retained in the support center's own expertise network for resolution and when it will be referred to someone in an expertise network outside the support center for resolution? [Phase 3 Expertise Selection; Phase 4 Problem Resolution]

In each scenario of the survey instrument, a multiple response question followed the decision about how to resolve the problem and asked the respondent to rate the importance of five factors that drive expertise selection. These factors, drawn from the pilot study observations and the literature, included Responsibility, Credibility, Recommendation, Responsiveness, and Accessibility. I analyzed these factors across all of the scenarios for their importance ratings (Table 20) and against the problem resolution decisions (Tables 21-25). I used contingency tables to identify any associations for which the expertise selection factor appeared to have an effect, and effects sizes ranged from medium to strong as none were less than w =.25 and many were greater than .50 and approaching .60. Overall, Credibility got the highest ratings with Very Important in all scenarios, followed closely by Responsibility and Responsiveness. Recommendation was farther back in fourth place with Important and Moderately Important, and Accessibility was a distant fifth rated at Of Little Importance.

Associations between Expertise and Problem Resolution

Retain to Resolve

When the respondents said they decided to retain a problem to resolve it, they appeared to base their decision primarily on Credibility and Responsiveness, and to a lesser extent on Responsibility in severe problem situations. Recommendation was only important for this decision in the Severe New scenario. I saw the strongest associations in terms of unexpected effects with Responsibility, but all were negative towards Of Little Importance and actually decreased the significance of that factor. Accessibility was the least important factor in the decision to Retain to Resolve although it had the strongest associations to that decision with medium effect sizes. The analysis of relative importance for Accessibility showed that two thirds of the positive ratings were for Retain to Resolve, the other third for Refer to Resolve.

Retain to Defer

In the case of decisions to retain a problem to defer it, Responsiveness was the only factor with a frequency that was greater than expected, with an increase in the rating of Important. It was also the only factor with any relative importance to the decision to Retain to Defer.

Retain to Avoid

When deciding to retain a problem to avoid it, the relative importance for all of the factors was barely detectable except that Responsibility was even lower than the others were. The respondents selected only Retain to Avoid in the Severe New scenarios.

Refer to Resolve

Respondents making the decision to Refer to Resolve considered Credibility and Responsibility to be the most important factors by a wide margin, with Credibility just slightly higher. The strongest associations in terms of unexpected effects for Credibility and Responsibility all occurred in the direction of decisions to Refer to Resolve across all four scenarios, with medium to large effect sizes for both of these factors. The data also revealed medium associations to Recommendation, the third rated factor in this decision, followed closely by Responsiveness. These results are somewhat skewed by the fact that Refer to Resolve decisions were at least twice as frequent in the Severe Recurring scenario as they were in any other.

Refer to Defer

When deciding to Refer to Defer, respondents considered Credibility, then Responsibility, followed by Responsiveness and Recommendation. These decisions were most closely associated with Moderate Recurring problems in all cases.

Other Action

Respondents who selected Other action in their decision to retain or refer considered Responsibility and Credibility to be the most important factors and of equal weight and did not consider Accessibility at all. These decisions were most closely associated with new problems.

The relationships observed between the problem resolution decisions and the expertise selection factors were generally quite clear, with some of them scenario-dependent and others occurring across the scenarios. Table 37 contains a summary of these results.

Relative Importance of the Expertise Selection Factors

I derived a set of relative importance scores for the selection factors while analyzing their frequencies of selection across the decisions and the scenarios, a purely manual process because these were multiple selection data (Table 26). The relative scores revealed that the respondents rated Credibility the highest with a score of 336 followed by Responsibility with a score of 291. Responsiveness was next with a score of 236 and Recommendation followed with a score of 201. Accessibility was the lowest rated expertise selection factor with a score of 71. The ratings did not match the order in which they were listed in the question, that had followed the order in which they were discussed in the literature and enumerated in the model, so the responses should not be carrying a great deal of question order bias.

Table 37

Problem Resolution Decisions and Associated Expertise Selection Factors

Decision selected	Expertise selection factors associated to the decision
Retain to Resolve	Credibility and Responsiveness, then Responsibility; Recommendation only in Severe New scenarios
Retain to Defer	Responsiveness
Retain to Avoid	No effect, occurs in Severe New scenarios ONLY
Refer to Resolve	Credibility and Responsibility, then Recommendation and Responsiveness for Severe scenarios
Refer to Defer	Credibility and Responsibility in Moderate Recurring scenarios, then Responsiveness and Recommendation
Other action	Responsibility and Credibility in New scenarios, then Recommendation and Responsiveness in New scenarios

Results for Research Question 1 D

d) What factors determine if, when, and how a problem solution will be recorded or broadcast to make it available to other support staff? [Phase 5 Solution Recording]

Severe New Scenario

A review of the survey data (Table 28) and the graphical displays created from those data (Appendix B, Figures B17 and B18) established that the problem had to be new and serious before there was a virtual guarantee that someone would record the solution. In the Severe New scenario, only 1 out of 109 respondents selected the choice for Solution Not Recorded. Across all of the scenarios and all of the response choices, the Severe New scenario achieved the highest frequency in all of the response sets except Other, in which it received the lowest. Survey respondents selected Solution Recorded Formally 76 times for the Severe New scenario, but the rest of the scenarios were equally likely to result in a formally stored solution with frequencies of 59, 60, and 61 respectively. These figures are also noteworthy, in that the respondents selected Solution Recorded Formally about twice as frequently as any other choice within each of the four scenarios. The next most frequent selection, again in all four of the scenarios, was Solution Recorded Personal, indicating that the respondents had stored it locally for their own use, probably in their email based on the observations made during the pilot study and comments in the textual responses. The third most popular choice, again in every scenario, was Solution Broadcast to IT Support, followed closely by Solution Broadcast to Users, then finally Solution Stored Other. The effective rankings of the choices were almost completely consistent across all four of the scenarios.

Moderate Recurring Scenario

In most of the responses selected for this survey item, the Moderate Recurring problem lies at the other end of the scale from a Serious New one. It had the highest number of responses for Solution Not Recorded at 15 and the lowest selection rate for three out of the other five choices. This was also the only scenario that deviated from the near perfect ranking of the choices, in which the respondents had consistently selected Other more often in the remaining three scenarios. In the Moderate Recurring scenario, the respondents selected Solution Not Recorded one more time than they had selected Solution Recorded Other.

Multiple Factors Influence Solution Recording

Apparently, several contrasting variables had a direct effect on if, when, and how someone would record a solution or broadcast it to others. All but one of the respondents agreed that they would record a solution to a Severe New problem, and overall they reported that they would be twice as likely to record it formally when compared to any other choice. They also indicated by their selections and in textual responses that documentation of a recurring problem should already exist – that known issues by definition already had recorded solutions. The lower frequencies of selection of all types of storage or notification for recurring problems as compared to new ones reflected that throughout the data.

A review of the textual responses for the Other selection as well as the open-ended question accompanying it in the survey revealed that many of the respondents believed solution recording was the responsibility of the resolving entity. If they had referred the problem to someone else to solve, then that person or group would be responsible for storing any solutions or broadcasting them to the user or IT community. Some stated they might never even hear how it was resolved after referring it to another group for action. If the respondent had referred a problem to another group for resolution, the procedures followed by that group would determine if and how the solution might be stored or shared.

The respondents demonstrated that they knew the textbook answer to the question about recording a solution by selecting to store the solution in a trouble ticket work log, solution table, knowledge base, or frequently asked questions (FAQ) twice as often as any other choice. Their second choice in every scenario was to make a personal record for their own use, which was the predominant form of storage observed during the pilot study. The decision appeared to turn on whether the respondents were more concerned about knowing how to handle the problem themselves, or about whether they thought others should know the answer as well. The comparison of the responses to this question to work experience statistics provided additional information on this behavior.

Work Experience as a Factor

An extensive contingency table analysis of solution recording and work experience measured in years, brackets, and 5-year groups revealed several trends in the data in terms of associations with medium to large effect sizes (Tables 29-34). The respondents with less than 5 years of work experience were twice as likely as more experienced IT staffers not to record a solution in the Moderate Recurring situation. The less experienced respondents were more likely to store a personal solution across all four scenarios, but they were also more likely to store a formal solution across three of the scenarios. These observations in the data verified several of the behaviors observed during the pilot study. In terms of notifying others, the less experienced respondents were less likely to broadcast a solution either to their users or to other IT staff than the more experienced staffers were. An exception was the Moderate Recurring scenario in which the more experienced staff members broadcast to users but the less experienced staffers broadcast primarily to other IT staff. The latter behavior was also very evident during the pilot study. The small sample size hindered drawing conclusions from some of the other variations because they changed direction with each year of experience. Overall there was more variation between the expected and the observed frequencies of behavior for respondents in the 0 to 6 years range of work experience than there were for the more experienced IT staff. In terms of solution recording and broadcasting behaviors, experience did matter.

Results for Research Question 2

I stated the second research question as follows:

2) How does experience in the workplace affect the problem resolution and solution recording behavior of IT support staff?

I compared the work experience in three different forms, using graphical analysis and crosstab contingency tables, to every phase of the problem trajectory model that produced nominal or ordinal data through the survey instrument. I described the results of those analyses in detail with each phase in the previous chapter, summarizing them at the end, and I included them in the summary for research question 1 D. In this chapter, I have summarized the results in terms of the two salient information behaviors that I investigated during this study, as well as in terms of the problem arrival and solution storage media.

Work Experience and Problem Resolution

I analyzed the effects of work experience by comparing the 5-year work experience groups to the selection options for the problem resolution decision, and again to a recoded variable in which the decisions to retain or refer had been reduced to a single dichotomized choice. In the latter comparison, the two work experience groups had nearly identical responses in severe problem scenarios: (a) preferring to refer a problem by 2 to 1 in Severe New situations and (b) preferring to retain a problem by 2 to 1 in Severe Recurring situations. The two groups diverged in Moderate problem situations in which the respondents with 5 years or more of work experience were more likely to retain a problem for resolution rather than to refer it. In the comparison to the complete set of problem resolution decision choices, the less experienced IT staff members made significant use of delaying tactics in Severe New situations by selecting Retain to Defer, Retain to Avoid, and Refer to Defer, whereas the more experienced respondents did not. Even when both groups used these tactics in the moderate scenarios, the more experienced IT staffers avoided them. These differences were not dramatic and did not fall outside the expected range of variation using effects strengths, but there were visible trends in which work experience affected what decisions were made and which problem resolution actions were selected by the two different groups of respondents.

Work Experience, Problem Resolution, and Problem Arrival Medium

Another factor in the effect of work experience on problem resolution was that of problem arrival medium. When the problem arrived in Spoken Form, there was an increased frequency of selection of Refer Other Medium across all scenarios by respondents with less than 5 years of work experience. In contrast, there was an increased frequency of selection of My Other Medium across all scenarios by respondents with 5 years or more of work experience for problems arriving in Spoken Form, that also carried over to the electronic problem medium. The differences were most prominent in the Moderate Recurring scenario. I also found a visually remarkable decrease in the selection of Spoken Form and a corollary increase in the selection of Other actions over it that was specific to the Severe Recurring scenario and particularly strong for respondents with less than 5 years of work experience. In the same scenario when the problem report originated in Electronic Form, the selection of Refer Other Form increased slightly at the expense of My Other Medium, without relation to work experience. The first observation about selections by respondents below and above the 5-year mark had explanatory value because it was consistent across all of the problem scenarios. The other observations were too scenario specific to indicate any particular trend.

Work Experience and Solution Recording

I analyzed the effects of work experience by comparing the 5-year work experience groups to the selection options for the solution recording decision. I also conducted comparisons using the work experience brackets as well as the complete range of work experience coded in one-year intervals. I also used a custom recoded variable labeled Store to Share, for which I had consolidated the solution recording decisions into one code for all actions that made solutions publicly available and another code for all those that did not. I found only a small number of associations that I could consider trends, and these indicated a possible interaction between work experience and solution recording. The problem with these observations from the analyses was that they varied a great deal by scenario and did not produce any clear patterns or rules of thumb that could define the relationships between the factors.

Across all four scenarios, respondents with less than 5 years of work experience were more likely to create a personal record of a solution than were those with 5 or more years of experience. They were also more likely to record a formal solution to a problem in three out of four scenarios. The less experienced IT staffers were more likely to broadcast a new solution to other IT staff in a Moderate Recurring Scenario whereas in the other three scenarios, the respondents with 5 or more years of experience were more likely to broadcast the solution to other IT staff. I surmised that the more experienced staff members would already be familiar with the solutions in a Moderate Recurring scenario, but the less experienced ones would not know them, resulting in the variation. The more experienced respondents were also twice as likely to broadcast the solution to their users in two out of four of the scenarios. Again, these differences were not dramatic but many of them did fall outside the expected range of variation with effects strengths in the medium (w = .30) to large (w = .50) range. These were visible trends indicating that work experience did affect the decisions about solution recording actions made by the two groups of respondents.

Work Experience, Solution Recording, and Problem Arrival Medium

An ancillary factor in the effects of work experience on solution recording was that of problem storage medium. In the Severe New problem situation with the problem report in Spoken Form, respondents with 5 years or more of work experience were more likely to store the solution after changing the medium to something else or to select Other action than the less experienced staff members were. In New problem situations with electronic problem reports, the respondents with 5 years or more of work experience were more likely to store the solutions in a different electronic medium whereas the less experienced staff members left them in the original electronic medium. The first observation was too scenario-specific to indicate any trend. The second observation had some explanatory value because it was consistent across new problem scenarios.

Evaluation of the Model

I found the problem trajectory model to be a very useful tool for structuring all aspects of the research effort to include the data collection processes and the subsequent analysis. The phase structure remained valid throughout the investigation although I had applied it to the survey instrument in a manner that precluded a thorough investigation of Phase 2 Problem Assessment. I partially compensated for this limitation by applying the interview process to that specific phase and asking for a direct assessment of the situational model.

Phase 1 Problem Arrival

I verified this portion of the model using the responses to questions about the communications medium in which the problem had arrived. This phase precedes problem assessment so the fact that the answers to Phase 1 questions had uniform responses across all four scenarios indicated that these decision variables were appropriate precedents to any situation that would develop in Phase 2. In their textual answers, the respondents used all of the considerations listed for Phase 1, and they made full use of the decisions presented in their selections. I concluded that the Phase 1 portion of the model required no changes.

Phase 2 Problem Assessment

The two variables by two values (2 x 2) model used to structure the scenarios was too shallow, but the more complete 3 x 2 and 3 x 3 models will require a different survey instrument or research design to investigate them fully. The interview respondents requested the addition of many of the elements that I had removed from the 3 x 3 model for simplicity, and the complete set of considerations was a better match to those mentioned in their replies. Respondents considered criticality to be a combination of urgency and impact but considered scope separately. I had combined Criticality and Scope into Severity for the 2 x 2 model. The respondents also requested that the model represent the lower end of the problem spectrum better, and asked for selections such as Routine to describe intermittent or infrequent problems, or situations unique to an individual. Routine, Occasional, and Individual were all values from the 3 x

3 model that I had removed in the 2 x 2 version. Respondents described several new problem characteristics that are not in any version of the model, such as shared responsibility and resolution oversight. Several of them mentioned the factor of how they were required to handle special customers or VIPs, but the model actually had a device for considering those in the conditions for Phase 2 Problem Assessment. I used the interview responses and the Other text and open-ended question responses from the survey to verify the 3 x 3 model of problem trajectory conditionally. These results also underscored the limitations of the compressed 2 x 2 model.

Phase 3 Expertise Selection

The results verified the five considerations and decision factors, although there had been a significant reduction in the importance of Accessibility since the timeframe of the pilot study because a unified call-tracking system is now in widespread use. A more thorough analysis of the Other responses might produce a candidate to replace it, but on the initial review of the data, the term *experience* stood out as a factor constantly cited by the respondents as the basis for their decisions. Because two or three out of the other four factors (Credibility and Responsiveness definitely, and Responsibility, probably) can only be known thorough experience, I am not sure that Experience is a value that can be differentiated from the other decision factors. In any case, the retention of Accessibility is open to question, whereas the results showed that the distribution of the other four factors was very complete across all of the scenarios. I conditionally verified this phase of the model with the possibility of modification.

Phase 4 Problem Resolution

I found that the five considerations and decisions defined for this phase of the model were exhaustive. Even when respondents selected Other, they did so to discuss the process of retaining, troubleshooting, fixing, or referring the problem. One could argue that Retain to Resolve should be Retain to Troubleshoot/Fix, but those would still be functionally equivalent. The respondents seldom used Retain to Defer and Retain to Avoid, but they did select them several times and they associated them closely with specific problem scenarios. Because I had observed and validated these selections very explicitly during the qualitative field study, I retained them. I considered the results to have verified this phase of the model.

Phase 5 Solution Recording

I actually measured two of the problem arrival medium decisions from Phase 1 during Phase 5, as they pertained to solution recording. I verified these two, Retain to Store and Change to Store, thoroughly with the same question sets used to evaluate Phase 1. These decisions exhibited a small amount of variation by scenario that I did not see with the first three decision variables that I had measured at the beginning of each scenario. Because I measured these two variables at the other end of the problem trajectory scheme, it was reasonable to expect that the scenario that led to them would have imparted some discernable effect. The only change to the model worth considering is whether to break these two decisions out into more detail because there were several different electronic media involved with very different characteristics that complicated the retain or change to store decisions.

Prior to data collection, I had modified the five decisions for this phase of the model slightly for the survey instrument to make the operationalized decision selections more exclusive. I then used them in a multiple selection question format so that the respondents could select more than one decision for each response. Broadcast became Solution Broadcast to Users, and Broadcast and Record was replaced by Solution Broadcast to IT Support. Individual Record became Solution Recorded Personal but General Record became Solution Recorded Formally. For clarity, I have also applied the newer terminology to the final Phase 5 model. I verified all five of these decision options, as the respondents had selected all of them almost equally across some of the scenarios. I considered this phase of the problem trajectory model verified.

Overall, I concluded that the study results had verified the complete model of problem trajectory, with one modification under consideration for Phase 3 and the possibility of expansion in Phase 5. The Phase 2 portion of the model remained somewhat unstable, as I had modified this phase extensively in order to generate a manageable number of scenarios. Based on the actual data, the full 3 x 3 model remained the best description of what actually went on in the environment, but I did not verify it exactly in its original form during this study because I had to adapt it to meet the limitations of the survey instrument. I developed a new 3 x 3 model after the analyses had been completed that incorporated the recommendations from model verification and the findings for the expertise selection ratings, as well as several changes to the solution recording behavior variables. I considered this version of the model, displayed in Appendix B, Figure B19, to be the most complete and verified problem trajectory model.

Discussion of the Results

Interpreting the Findings for Research Question 1 by Phase

Research Question 1 A: Phase 1 Problem Arrival

The survey responses indicated that the communications medium in which a problem arrived had a measurable effect on how the respondents processed the information while making their decisions to retain or refer the problem for resolution. I found was very little ambiguity in their responses, and when graphically displayed together, the responses for Spoken Form and Electronic Form were strikingly similar for each medium across all four scenarios, and very different between the two media. The respondents were three times more likely to have to change a problem that arrived in Spoken Form to another medium for the resolution process than one that had arrived electronically. In many of the textual responses, the participants indicated the problem handling procedures were essentially the same, but that Spoken Form problems involved more choices and they were inevitably required to transcribe the problems to some other medium.

The survey responses for the solution storage decisions made in the context of Spoken Form or Electronic Form arrival media were even stronger in their preference for electronic media. This preference made sense because there is really no practical storage media yet for Spoken Form communications, especially not one that provides easy search and rapid retrieval of solutions. In their textual entries, respondents discounted any ability to store solutions in Spoken Form and considered anything in that medium to be transient.

Research Question 1 B: Phase 2 Problem Assessment and Phase 4 Problem Resolution

The different combinations of Severity and Frequency of Occurrence in the structure of the four scenarios elicited very different action selections from the respondents in Phases 3, 4, and 5 of the problem trajectory. The 2 x 2 matrix was effective at separating the responses for the survey instrument, but it was still too simplistic compared to the reality of the IT support workplace. The original model with 3 x 3 factors remained the most realistic match to the environment. My abbreviation of the model for the practical purpose of survey construction compelled many of the respondents to use the Other response items to discuss that issue in each phase of the problem trajectory. Their comments drove the design of the electronic interview questions, and I discussed those responses in the evaluation of the problem trajectory model.

Based on the results seen in each phase of the trajectory, the problem assessment factors embodied in the four scenarios did in fact drive the actions selected and decisions reported by the respondents. Some responses would vary or cluster based on Severity, the combination of Criticality and Scope, whereas others would congregate around one or the other values for the Frequency of Occurrence. I even found one example of data that appeared to be the most similar diagonally across the scenarios; the expertise factor of Accessibility showed the most similarity between Severe Recurring and Moderate New, and between Severe New and Moderate Recurring. The effects of the problem assessment factors carried all the way through the phases, with the effects in Solution Recording just as strong as in Expertise Selection. I observed the strongest effects in the Problem Resolution decisions, whereas I saw the least effects in the handling of the problem arrival medium and solution storage media. These were almost scenario independent.

Research Question 1 C: Phase 3 Expertise Selection and Phase 4 Problem Resolution

I found the expertise selection factors included in the model to be valid, with only Accessibility showing a marginal level of associations. Accessibility was a more significant issue during the pilot study because a large number of IT support staff members at the university, and in particular in the Computing Center, did not use the Remedy call-tracking system and were inaccessible to the help desk staff for the referral of problems. That situation was no longer the case at the time of this investigation so the factor of Accessibility was far less of a determinant factor during this study than it was in 2001 during the pilot study observations.

An analysis of the textual responses accompanying the ratings for the expertise selection factors did not identify any new factors, but underscored the point that experience in the workplace was the best source of information about which factors mattered in a given situation. I determined that the most important factors were

Credibility and Responsibility, with Responsiveness close behind, and that all of these are factors that one learns the answers to in the workplace. People normally carry these in implicit knowledge as opposed to explicit knowledge with the exception of Responsibility in some settings. Some call centers and call-tracking tools carry a significant amount of information about Responsibility in referral lists or categorization schemes that provide automatic routing. Even if these tools exist, they are not always readily available so the IT staffers tend to rely on their own or group memory to determine responsibility.

Credibility is earned and Responsiveness is learned through experience, through interaction with the other IT support staff members, so most of the expertise selection process depends on the staff member's own implicit memory. This was the likely reason for so much variation in decision selection across the sample for each problem scenario. The range of response was determined by what each individual already knew or by what those immediately accessible to them knew. This finding corresponded well to a number of the consultant behaviors observed during the pilot study during which a decision on how to handle a problem was the sum of what everyone in the room at the time already knew about it.

Research Question 1 D: Phase 5 Solution Recording

Research question 1 D asked, "What factors determine *if*, *when*, and *how* a problem solution will be recorded or broadcast to make it available to other support staff." The factor that had the greatest bearing on *whether* a respondent would record a solution was the classification of the original problem. If the problem was a Severe New problem, the respondents elected to record or broadcast a solution in some manner 108 out of 109 times. Out of those 108 respondents, 76 also chose Solution Recorded Formally. In the other three scenarios, a dozen or slightly more respondents selected Solution Not Recorded for an aggregate of 40 lost solutions. I determined that there was a 6% to 9% chance that the respondent would record no solution in those scenarios.

When the recording of a solution would take place was a somewhat more subjective question, because it also raised the issue of who was responsible for doing it. Many of the Other and open-ended question responses discussed the topic of who would be responsible for documenting the solution. Most respondents considered it their responsibility, but if they had referred the problem to another group, they considered it the responsibility of that group. Otherwise, the solution would most likely have been recorded when it was a Severe or a Moderate New problem. In contrast, the Moderate Recurring problem exhibited the largest number of responses for Solution Not Recorded and the least number for Solution Recorded in any manner or Solution Broadcast in any manner.

How a respondent would record or broadcast a solution was also clear from the responses. The respondents selected Solution Recorded Formally twice as frequently as any other choice in all four of the scenarios. Solution Recorded Personal was next in popularity, again across all four scenarios. The third choice was invariably Solution Broadcast to IT Support, followed immediately by Solution Broadcast to Users and

Solution Stored Other. Solution Not Recorded was the last choice in three out of four of the scenarios.

The patterns for solution recording found in the survey results were fairly clear and predicable. Clearly, entries into a central knowledge base were the exception, with trouble ticket work logs, email, and personal notes absorbing the preponderance of the material. The responses indicated a high frequency of selection for Solution Recorded Formally, but the explanatory text indicated that by *formally* they meant in the trouble ticket or in electronic mail.

Interpreting the Findings for Research Question 2

The answer to the question "Does experience in the workplace affect the problem resolution and solution recording behavior of IT support staff" was clearly yes. An answer to the question "How does it affect that behavior" was much more difficult to provide. Clearly, there was variation from work experience found in every part of the data set, but its effects were frequently subtle and hidden behind other variables that had even greater variances. The contingency table test for effects size provided one of the best indicators that something was going on; however, there were instances in which the effects of work experience showed up clearly in the graphic display but the observed values for those factors were within the expected range. I also found cases where both the variation and the effects sizes were large, but the graphical displays indicated that there was no difference. I ran the analyses using three different variations of the work experience variable, from two groups on each side of the 5-year mark to 24 groups by single year. The best results were those that I could see in the graphical output and that registered variation between observed and expected values with medium to large effects sizes. Those results offered evidence that work experience was in fact affecting both problem resolution and solution recording behavior and gave clear indications of where that was happening. It was possible to infer several overall statements from the responses to the surveys and the results of the many different comparative analyses run on the data:

Phase 1 Problem Arrival

IT support staff members with less than 5 years of work experience were more likely to select Refer Other Medium if the problem arrived in Spoken Form.

IT support staff members with 5 or more years of experience were more likely to select My Other Medium if the problem arrived in either Electronic Form or Spoken Form.

Phase 3 Expertise Selection

IT support staff members with 5 or more years of experience selected extreme ratings for the importance of Accessibility, resulting in two modes at the ratings of Important and Of Little Importance.

Phase 4 Problem Resolution

IT support staff members with less than 5 years of work experience were much more likely to select actions that would delay or even avoid the response to a problem in a Severe New situation, and somewhat more likely in Moderate situations.

IT support staff members with 5 or more years of experience were more likely to retain a problem for resolution than to refer it to someone else or to another group, except when that problem was a Severe New problem.

Phase 5 Solution Recording

IT support staff members with less than 5 years of work experience were more likely to create a personal record of the solution across all four scenarios.

IT support staff members with less than 5 years of work experience were more likely to record a solution formally across three out of four scenarios.

IT support staff members with less than 5 years of work experience were twice as likely to Not Record a solution in a Moderate Recurring scenario.

IT support staff members with less than 5 years of work experience were more likely to broadcast the solution to other IT support staff in Moderate Recurring cases.

IT support staff members with 5 or more years of experience were more likely to broadcast the solution to other IT support staff in three out of four scenarios.

IT support staff members with 5 or more years of experience were twice as likely to broadcast a solution to their users in two out of four scenarios.

IT support staff members with 5 or more years of experience were more likely to store the solutions for electronically reported new problems in a different electronic medium rather than leave them in the original electronic medium.

There are definitely effects from work experience on the operations within the problem trajectory model, but they are neither prominent nor pervasive. These effects appeared as trends in some of the graphical output from various analyses, and some of the associations would probably not have been visible at all without the stimulation of the multiple scenario survey instrument.

Comparing the Findings for Work Experience

This study collected respondent work experience both as a demographic text value and a numeric value measured in the number of months in the current job and organization. I calculated a numeric value of months of work experience, Job Tenure, from those data. I coded nominal brackets ranging from single years to everyone with less than 5 years and everyone with 5 or more years using the scalar value for months. One reason for coding in this manner was to obtain statistics to compare to the findings of Oh (2002) on the effect of work experience on knowledge creation. I located no other study that compared those two factors directly.

Based on the questions in his survey instrument, Oh (2002) collected work experience data in whole years. Oh grouped the data three ways: from 0 to 4 years, 5 to 10 years, and for more than 10 years. Oh found that the 5- to 10-year group created more organizational knowledge than did the 0 to 4-year group. He also found that when taken together, the combination of the 5- to 10-year group and the more than 10-year group created more organizational knowledge than did the 0 to 4-year group. Oh also found that there was no difference in knowledge creation between the 5- to 10-year group and more than 10-year group. Oh measured the creation of that knowledge subjectively, using data from the Likert scale agreement responses to his questions. These were questions about creative activities including building models, creating and justifying concepts, and sharing tacit knowledge. If Oh's data are comparable to the data from this study, then the knowledge creation behavior reported by the group with less than 5 years of work experience in this study should be similar to that of the 0 to 4-year group in his study. The same should be true of the group with 5 years or more of work experience in this study and Oh's combined group of the 5- to 10-year and more than 10 years of experience groups.

Although in Oh's (2002) study the group with 5 or more years of work experience created more organizational knowledge than the less experienced group, in this study I observed the exact opposite. The group with 5 or more years of experience in this study broadcast more solutions to users and other IT support staff, but the group with less experience actually recorded more solutions, either formally, personally, or in some other way. As a result, the knowledge creation findings for this study did not match those of Oh, and there are a number of possible reasons. His study measured knowledge creation in subjective assessments of creative activity and knowledge sharing. This study measured knowledge creation in terms of solutions to problems that the respondents would have recorded for future use. These measures were probably so dissimilar that I should not have attempted to compare them. Even abstraction to the simplistic level of "knowledge was created" may have been too great a reach for the two studies to support. Other possibilities are that his population, full-time employees other than custodians in Korean manufacturing companies, may simply have been too different to compare successfully to IT support staff employed in higher education. For whatever reasons, the two studies posed findings that were opposite on the surface.

Verification of the Model

Overall, the research process verified the original 3 x 3 model of problem trajectory, and the surrogate 2 x 2 model used for the survey instrument held up fairly well during the data collection and analyses. I confirmed the phased trajectory scheme as designed, and authenticated the variables defined in the scheme in terms of their interactions and ranges of variation. The study did not attempt to validate the model statistically, an effort that will require a much wider study with a larger population and different sampling techniques.

I did identify several minor changes that I can consider for incorporation into the model, or removal from it. With the possible exception of Accessibility, the data did not strongly support any major modifications. I could consider adding the Other choice selection to some of the decision sets in the model, just as it was in the survey instrument. The respondents selected the Other action choices frequently enough and had responses different enough that an "other choice" variable might need to remain as part of the model for the sake of completeness. Inclusion may be appropriate only in those phases in which Other received a significant number of responses, at least equal to some of the remaining decision selections. I did not identify any new selection items or other dependent variables that I needed to add to the model.

Meaning of the Results

Relationship to Previous Research

This research project extended the investigation that originally began as a pilot study in 2001. That preliminary study consisted of a qualitative investigation of the IT problem solving behaviors of a central help desk at the same site used for this research. The pilot study found inspiration and guidance in the literature reporting research into call center and information facility processes by Ackerman and Halverson (1998, 1999, 2000). Just as I designed the pilot study on the foundation of some of their research techniques and findings, I designed this project around a model of information behavior built in large part directly from the pilot study findings. The model of problem trajectory used theory that dates back to classic qualitative research by Glaser and Strauss (1968), but I assembled most of it from the categories and variables that I had developed during the pilot study. I gained additional insight from a more recent report of the call center research conducted by Ackerman and Halverson (2004) that extended the discussion of the theoretical background beyond that contained in their earlier publications. Because of that influence, I further grounded the current study in the same organizational memory and distributed cognition literature that Ackerman and Halverson had incorporated into most of their research.

I originally oriented the second research question in this study towards confirming or refuting a possible relationship between consultant information behavior and work experience that I had tentatively identified during the pilot study. The dissertation by Oh (2002) led me to recast the question somewhat to be able to compare it to Oh's findings. Apparently, there were enough differences between Oh's research parameters and those used in this study that the comparison was unsuccessful. The top-level findings from each study for any relationship between knowledge creation and years of work experience were in opposite directions.

Implications of the Findings

The implications of the findings of this study are twofold. First, I developed a new process model for problem trajectory and verified it in information technology support settings in the real world. I based the model on a classic model of trajectory developed by Glaser and Strauss (1968), constructing it from the variables and considerations that I observed during a field study of a help desk as well as from process models drawn by the informants and combined with one of my own. I found a set of variables in the related literature and merged it into one of the phases of the model to ground it further in existing theory. This model is available to other researchers, who can either apply it in its current form or modify it to design inquiries into additional sites or populations. In a modified form, it has the potential to advance similar studies into completely new environments: anywhere that people process information and make many small decisions in the course of managing problems, situations, or any other activity that has a trajectory.

Second, the findings related to knowledge creation and work experience in this study differed from those measured by Oh (2002) in his dissertation research. Although this study was exploratory, it appears that IT support staff members with less than 5 years of experience are more likely to create knowledge, to store solutions, than those with 5 or more years of work experience. These results represent the exact opposite of the findings from Oh's research. This contradiction implies that the two studies were not sufficiently comparable in design or in the populations investigated to permit valid comparisons in terms of knowledge creation and work experience. The studies neither supported nor refuted each other.

Limitations of the Findings

These finding are not very generalizable outside the research setting, primarily IT support staff in a state university. The sample was not random and the response rate was low. Respondents were predominantly IT support staff members in higher educational environments (82.6%) with only a small number of respondents from outside that work environment. The addition of external respondents beyond the core university both enriched and complicated the study. The comparisons between the groups by work experience should be quite valid because the distribution of work experience above and below the 5-year mark was almost equal. The comparisons between groups by organizational type are less valid due to the imbalance (82.6% to 17.4%) between the sample subgroups after I added the external sample to the study.

The limitations on transferability of the specific findings about the information behavior of IT support staff during this study should not apply to the problem trajectory model, which I developed from theory and populated with variables based on participant observation. Although the model is fairly specific to information technology support environments, it should be relatively adaptable to other environments, such as general customer service and crisis response activities. The final model in Appendix B, Figure B19 incorporates the results that I found and the conclusions that I reached during this investigation.

Limitations of the Overall Study

The analyses of the collected data are far from complete, and there may be contradictions hidden within them that I have not yet discovered. Even though the sample was small, the survey instrument was very long and contained a large number of open-ended and Other option questions. The textual responses encompass more than 1,600 pages of material, and may take months to explore and code in detail. I used these data to verify and explain the results of the quantitative analyses, but I did not explore them fully using content analysis or constant comparison techniques for developing new categories or concepts. That was beyond the scope of this research project. I collected data to support a network analysis, but that particular technique was not included in the plan for this investigation. I completed thorough quantitative analyses of the data, but I have only just begun the qualitative analyses that are possible with this data set.

The greatest limitation of this study is the inability to compare its results to another, similar study because there is none. I have not found any investigation into IT support staff behavior in the workplace that has covered the full range of problem solving and solution storing activities. No study has measured the differences in behavior between situations by employing scenarios, either. The ethnographic inquiry that preceded this study was quite similar to the body of research pursued by Ackerman and Halverson (1998, 1999, 2000, 2004) in call centers and other information handling facilities, but the findings of those studies are not compatible or comparable to those of this particular research effort. The problem trajectory model created for this investigation, with which it is possible to study information-intensive problem solving organizations such as those found in the information technology support domain, offers the potential to overcome this limitation through new investigations.

Contribution to the Literature

The primary contribution that this investigation makes to the literature is to provide a verified model of problem trajectory that has its grounding in well-established process and behavior theory for representing situations. I constructed the model from a rich set of variables developed using ethnographic research and existing literature, and employed it to describe the five different phases of the process. I evaluated the model using multiple methods in an information technology support environment with actual IT support practitioners, and verified it to be a realistic representation of the IT support problem solving and knowledge creation processes. Other researchers can modify this model to fit other environments and research goals, or they may manipulate it to test only some parts or phases of the problem trajectory scheme. Other aspects of the process that are components of the trajectory scheme can now be tested, explored, enriched, or even refuted by future research, using the problem trajectory model as a starting point.

Suggestions for Future Research

Additional analyses of several kinds, including network analysis and constant comparative analysis of the textual responses, are possible with the data collected for this study. Although these analyses were not part of this research plan, they could be included in any extension of this study in the future.

A large-scale survey with a truly random sample would serve to validate the problem trajectory model. Another researcher could test it in different settings or on contrasting populations to determine whether it has a wider applicability.

A specific study to validate the Phase 2 Problem Assessment portion of the model would overcome the limitations in this study caused by having to adapt the factors of that phase into a smaller set of independent variables for survey scenario construction.

Another study could further investigate the work experience interactions with solution recording by using a truly random sample to make them more generalizable. One could apply the same technique to any of the variables in one or more of the phases of the model.

It is possible to conduct further analyses on the specific findings about problem resolution and solution storage obtained from data collected and analyzed during the course of this investigation, if one can locate similar research for comparison. Even though the sample was small, the data set collected from each participant was rich in both situational decisions and textual amplifications.

A very interesting possibility would be to run the same survey instrument with a completely different population in another organizational location in order to conduct comparative analyses that this data set alone cannot adequately support.

Recommendations for Practitioners

This study appeared to confirm some of the observations made in the pilot study, that IT support staff members tend to store more solutions and create more new solution-related knowledge in the first several years of their employment in an organization than do employees that are more senior. This phenomenon suggests that IT support managers should implement policies that encourage new knowledge creation by junior staff members and specifies that solutions be stored in a central repository. The policy should also institutionalize a review process of solutions by senior staff members to provide quality assurance, but not at the expense of stifling the creativity of the newer staff members. The findings of this study indicate that the less experienced staffers do record new solutions, but in locations that are accessible only to them or are not widely accessible to others. The common practice of storing solution information in email may need to be discouraged unless there is some systematic way to harvest and reclaim that information. The practice of storing solution details in trouble ticket work logs is proper and should be encouraged, but techniques for either harvesting the solutions or dual posting them to another information repository should be considered to make this information centrally available. Many options exist to accomplish collection, storage, and searchability of solution information in a more efficient manner. The first step is to ensure that you are capturing solution-related knowledge systematically and encouraging solution recording by the IT support staff members who are the most inclined to create it.

Summary of the Study

This investigation into the information and problem solving behaviors of IT support staff members as they interact with the situations they face in their workplace caps a line of research that began six years ago as an ethnographic field study into help desk operations. The study employed mixed methods and a challenging survey instrument to investigate the reactions of this population to four different situational problems and to collect not only their decisions but also the reasons behind those decisions, in their own words. The data obtained are rich with explanations, rationales, and descriptions of how and why IT support staffers make decisions and store solutions. The primary research framework was a model of problem trajectory that I constructed from the findings of my ethnographic pilot study. I developed this model from categories that I had derived using grounded theory techniques and I used as its foundation the classic situational modeling theory of trajectory from Glaser and Strauss (1968).

The primary data analyses produced descriptive statistics that I supported with the findings from a surface-level analysis using qualitative methods. The qualitative data set will support a much more extensive investigation in the future. This emphasis was appropriate because the pilot study research that led up to this project was qualitative, and the primary goal of this study was to verify the completeness and applicability of the problem trajectory model. During this investigation, I found that the model and the trajectory scheme that elaborates each of its phases were both practical and enlightening when applied to an empirical study. I was able to develop a large range of findings using graphical, crosstab contingency tables and effects size analyses of the data, and I found it possible to draw a number of conclusions from those results. I was able to verify the problem trajectory model by comparing the effects of the situational responses across scenarios and through an email interview process that evaluated that model directly. This research project achieved its primary goals, and with a verified model and a wealth of situational data in hand, I should be able to extend the research in many different directions.

APPENDIX A

REPORT OF THE PILOT STUDY RESEARCH

Introduction

I designed the research project[2] reported here as a pilot study into the areas of knowledge creation, which I defined as solution storage, and the subsequent use of that knowledge in a computer support help desk environment. During the research, I gave special attention to the location of information storage and retrieval, decisions to retain or refer problems, and the incentives for knowledge creation. I conducted the pilot study using qualitative research methodology and practice, and employed several different data collection and analysis techniques across a broad set of research questions. The pilot study implementation followed the qualitative Phase 1 design of an exploratory, sequential mixed model investigation (Tashakkori & Teddlie, 1998, p. 151). That inquiry culminated in a quantitative-qualitative Phase 2 study that I conducted as dissertation research.

Background and Purpose

The original problem that led to the pilot study was an observation that IT staff members were not recording solutions to problems in the IT domain in the system provided for that purpose, and as a result, they were not creating new knowledge and storing it as organizational memory. During the first two years that the Remedy®

[2] The source documents for the research project summarized in this report are available from the author, and consist of the following unpublished materials:

Strauss, C. E. (2001). [Ethnographic field study of organizational memory components and distributed cognition processes in a computer support environment] Unpublished Raw Data. (Restricted portions available from http://tonic.acs.unt.edu/pilot/). Pilot Analysis, QSR N5 project, 2001 [Data file].

Strauss, C. E. (2005). Organizational memory components and distributed cognition processes in a computer support environment. Unpublished Manuscript.

Action Request System® (BMC Software, Inc., Houston, TX, http://www.bmc.com), call-tracking system was in operation at the university, the IT support staff created more than 16,000 trouble tickets but recorded only 105 solutions, and a single support group created more than half of those. Clearly, a lot of problem resolution was going on, but the information describing how the IT staffers solved the problems, or even why the problems had occurred, was being lost. The design of the pilot study research proposed to explore the interactions involved in the process of providing computer support to customers, and to identify where knowledge creation should have been occurring. One of the purposes of the pilot study was to discover how to better support help desk and computer support staff with automated tools for creating knowledge from solution information, for locating expertise, and for subsequently making that information available to a wider audience. The only research found in the literature that appeared to have any application to this problem was that which Mark Ackerman and a small group of co-researchers had published.

The pilot study research built on the work by Ackerman (1998), Ackerman and Halverson (1998, 1999, 2000), Ackerman and Malone (1990), and McDonald and Ackerman (1998) bringing together many different lines of research that they had pursued in different settings and applying them to one specific site. The investigation used many of the same theoretical basis and methodological techniques to guide the research, including distributed cognition theory and ethnographic methods such as participant observation and semi-structured interviews. It also studied the processes and artifacts used by computer support consultants to diagnose problems, locate solutions, resolve problems, and to record new knowledge. The results provided additional insights into information transfer processes in the data-rich environment of a call center, and into the roles that organizational memory information systems should play in improving both the encoding and storage of solutions, and the subsequent retrieval of them.

Research Design

The primary activity examined during this study was the information problem solving behavior of computer help desk consultants working in a computer support environment. The arena of practice was the help desk of a medium-sized state-supported university computing center, which combined a telephone call center, a customer service desk, and various asynchronous computer support services in the forms of electronic mail, a customer-accessible Remedy call-tracking database, and several Web-based resources. At this site, the Remedy system functioned as an organizational memory information system (OMIS) for the specific domain of information technology support. This study attempted to identify the components and processes of organizational memory used by consultants as they responded to customer problems and inquiries. As the principal investigator, I was very familiar with the support group under study because I administer the Remedy system that they used for call-tracking and solution storage, and I was the manager of the help desk organization during the period from 1993 to 1997.

During the data collection process I employed techniques of event sampling using semi-structured field observation, combining both structured observation using predefined categories and less-structured or participant observation to identify emergent categories. I observed and recorded the support transactions of five consultants that took place in the help desk area during different times and at different levels of activity over a period of two weeks. I incorporated document and artifact analysis of the email messages and trouble tickets that were relevant to the observed support contacts into the event analysis for each transaction. Following the field observation stage and the subsequent analyses and coding of those data, I prepared standardized open-ended interview questionnaires and conducted semi-structured interviews with the consultants who had been involved with transactions during the observations. Consultants who had not been observed conducting support transactions during the event sampling were not included in the interview process. The interviews incorporated more than 60 questions with the construction of the informant's own model of help desk interactions.

Results by Research Question

The questions for the pilot study addressed two major theoretical areas, organizational memory and socially distributed cognition. The latter area overlapped into decision theory because socially distributed cognition usually appears in the context of problem solving processes with more than one actor. As a result, the questions fell into two major groups. The first two questions were essentially descriptive, and incorporated my intent to find a definition of the locus of organizational memory in the help desk under study. The next three questions were about specific facets of socially distributed cognition processes that affect consultant interaction with organizational memory. Earlier research had found these to be essential for successful problem resolution and knowledge creation.

The first two research questions pertained to the identification and use of information sources for problem solving, as they related to organizational memory, and the investigation explored these in detail. The first research question also contained two subordinate questions:

1. Which information sources used by a customer support center are primarily explicit in documentation and automated systems, and which are primarily tacit memories retained only by support staff and experts?
    a. Can these information sources be mapped to a model of organizational memory?
    b. Can these information sources be differentiated well enough to clearly designate which should be incorporated into organizational memory information systems (OMIS), and which should be supported by training and socialization?

    The second research question contained one subordinate question:

2. Which information sources, explicit and tacit, are used to solve customer problems in different situations?
    a. Are some types of customer contacts more successfully resolved with explicit memory and others with tacit memory, and can correlations be established empirically?

The findings for these questions validated many of the previous studies into technical information sources and transfer in the workplace. The high use of immediately available implicit sources, primarily the other help desk staff members, was consistent with Allen's (1977) studies of scientists and engineers in problem-solving environments. So was the frequent use of a small set of high-value explicit sources, primarily the account management system and help desk staff Web site, for access to very specific university account and procedural information. In contrast, the consultants reported that they seldom used well over half of the information sources that they had named.

The third research question also contained two subordinate questions:

3. What are the organizational and social factors involved in the problem referral process?
    a. What factors determine when a problem will be retained in the support center's own expertise network for resolution, and when it will be referred to someone in an expertise network outside the support center for resolution?
    b. Does the use of an OMIS for referral make the decision easier to make, or implement, or not?

This question elicited rich data on several different aspects of problem referral decision-making. Part a of this research question uncovered unexpected behaviors and a few conflicting perceptions as reported by the informants. A number of unforeseen decision points were observed or reported and are displayed in Table A1, such as the avoidance of uncooperative support groups and the use of referral as a delaying tactic.

The transaction observation transcripts were coded first, and only for actions of Retain or Refer. I then coded the interviews for these two basic choices, but six additional logical choices emerged that more completely described the process and I subsequently coded these as well. Two of these reflected behaviors observed during the decision processes for retaining or referring the problem, including the conscious avoidance of referral to some support groups. Three more codes pertained to the communications medium of the original problem report. I added another code for the action of deferring the resolution process by entering a trouble ticket specifically to buy the help desk time to investigate the problem. The resultant categorization set appears in Table A1, and contains five action codes and three medium or formatting codes.

Table A1

Problem Referral Codes, and Coding of Passages, Text, and Documents

Problem referral codes	Passages	Text units	Documents
Retain in help desk	51	72	36
Refer to other group	61	165	16
Decide to refer or retain	55	187	5 (interviews)
Avoid referral to group	10	33	5 (interviews)
Refer in *Same Medium*	13	36	5 (interviews)
Change Medium to refer	7	21	5 (interviews)
Consider *Preferred Medium* of info source	7	16	5 (interviews)
Defer to buy time	7	9	5 (interviews)

Note. Numeric entries indicate the frequency of occurrence of the code in the data.

The coding for actions related to the problem communications medium became a separate issue from the coding for problem referral decisions. Two additional codes identified the choices for referring the problem in the same medium in which it had arrived (email, telephone, trouble ticket), or changing it to a different medium for the referral process, for example, the common practice of creating a Remedy ticket to refer a problem reported by telephone. I also developed a code for changing the referral to the medium preferred by the selected information source. In this case, the information source refers to the individual or group to which the consultant intended to refer the problem. This option was particularly important when working with support groups that did not use Remedy.

The interview process collected data specifically to address part a of the third research question, about which factors would determine the retention or referral of a problem for resolution. I asked the respondents three major and nine subordinate questions on the topic of referral alone. Several identifiable concepts became very clear while coding the interview responses for these questions in the section about problem referral:

a. How do you decide when to retain an issue at the help desk, and when to refer it to someone else?
b. How comfortable are you about referring issues to different people or groups?
    i. Who or which groups are you completely comfortable referring issues to?
    ii. Who or which groups are you fairly comfortable referring issues to?
    iii. Who or which groups are you NOT comfortable referring issues to?
    iv. What factors determine the difference for you?

These concepts, displayed in Table A2, provided the clearest picture of the organizational, social, and technical factors used by the consultants to determine retention or referral, and formed the basis for a decision model of the entire process. A portion of that interface was included in the help desk interaction model that I developed with the assistance of the consultants during their interviews.

Table A2

Decisions to Retain or Refer an Issue Based on Subjective Factors

Decision	Factors on which the decision will normally be based
Retain the issue in the help desk if:	
	Someone else in the help desk staff probably knows the answer
	This is clearly a first level issue, and is the responsibility of the help desk
	This is clearly a usage issue, and is the responsibility of the help desk
	The attitude of the area you would need to refer this to is hostile
Refer the issue to another support group if:	
	None of the above conditions are true
	The attitude of the area you need to refer it to is helpful in this regard

Note. The subjective factors reported in this table were as perceived by the consultant or consultants making the decision to retain or refer a problem for resolution.

Part b of the third research question, about the use of an information system to make referrals, obtained a number of interesting observations about the different modes of communication involved. Problems arrived in the help desk through one set of channels, and others came into play if the help desk staff decided to retain or to refer the problems. An overlapping set of channels was involved in the decision to forward problems in their existing format, or to change the mode of communication for a referral. An additional dynamic was the consideration of which communications channel the intended recipient(s) of the problem referral preferred to use. Clearly, the communications media added an entirely different dimension to the decision-making process for retaining or referring a problem. This topic warranted further exploration during the second phase of the investigation.

The fourth research question contained one subordinate question:

4. What is the role of the anticipated trajectory (expected outcome) of a problem in determining how it is handled by the support center staff, to include their decisions to use expertise networks or referrals?
    a. What role does anticipated trajectory play in the decision to invest effort in recording the solution found for the problem?

Investigation of the main question revealed that most consultants focused on the scope implications of a problem, the question of whether this was an individual problem or a system-wide problem, rather than the possible outcome of the original, individual problem. The more narrowly defined parameter of individual problem trajectory did not appear to be a determining factor in consultant information behavior, and I decided that it did not require further investigation. In the eyes of the consultants, their perception of problem trajectory in terms of its possible scope was much more important, if not critical, to determining the proper response to a problem. The analyses of the data for this question produced the coding statistics displayed in Table A3 for the five probable trajectory codes.

Table A3

Anticipated Trajectory Codes, and Coding of Passages, Text, Documents

Probable trajectory codes	Passages	Text units	Documents
One-time event	23	50	12
Recurring event	47	90	16
Routine event	42	60	21
Significant event	27	49	14
New event	11	19	5

Part a of the fourth research question, which asked about the role of anticipated problem trajectory in the decision to record a solution, appeared to be tied to both the scope of the problem and the frequency of its occurrence, and fed into the fifth research question on incentives for knowledge creation. The fifth research question also contained two subordinate questions:

5. What incentives are available to encourage knowledge creation (solution storage) by consultants during the normal course of work, while resolving problems for customers?
    a. What other techniques for facilitating solution storage in an OMIS are available to support center managers?
    b. Are any of these incentives or techniques particularly effective in improving knowledge creation and storage?

The investigation of this question got to the heart of consultant information behavior, in which the interplay of experience in the workplace, an absence of formal incentives, problems with the various information systems and sources, and the lack of a central knowledge base system combined to produce interesting and conflicting explanations from the informants. The first and most general conclusion was that consultant tenure, which is the number of months or years that a consultant has worked at the help desk, has a measurable effect on the approach a consultant takes to solution recording and knowledge creation. The sample included 5 informants ranging in tenure from 7 months to 42 months, so I was able to observe a wide range of experience. The most striking differences appeared between the less experienced group consisting of one consultant with 7 months of tenure and two consultants with 12 months, and the more experienced group of a supervisor and a consultant with 38 and

42 months of experience respectively. It was not possible to measure Part b of the fifth question, on managerial techniques for facilitating the recording of solutions, at this particular workplace because, as with formal incentives for knowledge creation, there were none.

Discussion and Conclusions

During the pilot study, I explored the information sources and expertise networks of a computing service help desk using qualitative research methods and grounded theory techniques. I compared these to a model of organizational memory and mapped them in terms of location and usefulness. The informant rankings of the various resources confirmed earlier research in terms of the types and proximity of information sources that would be the most valued and consulted; a short list of those was developed and validated. The investigation identified and labeled a number of previously unidentified consultant interaction or information behaviors. Using direct informant input, I combined these behaviors with the decision-making processes surrounding problem retention and referral to develop a prototypical model of help desk interaction. A graphical representation of help desk activity made it possible to see relationships between the theoretical concepts of organizational memory and socially distributed cognition, and the processing of information between consultants, customers, information systems, and other support staff.

The study also obtained consultant responses pertaining to the incentives, or lack thereof, to create and record knowledge, and measures of when consultants would consider it appropriate to create knowledge. During this investigation, I discovered several possible correlations and discrepancies in solution storage behavior among the consultants. I found noticeable differences among respondents by level of experience in terms of when, or even if, they would create knowledge by recording a solution in some manner, as well as differences in where they would record it. The pilot study identified the need to conduct an investigation into the effect of work experience on solution recording with a larger sample of consultants in order to confirm or refute some of these observations.

The numerical results, supported by narrative comments obtained during the interviews, painted a picture of sharp disparity in the approach to knowledge creation between the less and more experienced help desk personnel in the sample. A graphical portrayal of the values obtained from the questions noted above indicated a marked difference in the likelihood that a consultant would create (document, or make explicit) a new solution to a problem, when one directly compared the frequency of problem occurrence to the years of consultant tenure in the help desk. These results seemed to indicate that new consultants, those who had worked on the help desk for a year or less, were much more likely to record a solution to a problem after the first one or two times that they encountered and solved it, than to document one that they had encountered or heard about much more frequently. This was in direct contrast to the behavior of more experienced consultants, who reported that they needed to see a problem multiple times before they would be willing to invest the effort to document a solution. They were more likely to follow a classic model of knowledge base creation in which heavily used solutions take priority over one-of-a-kind solutions for documentation. This contrast may also have important implications for knowledge management efforts in a help desk environment, to include hindering efforts to establish and maintain a useful Web self-help presence. This also indicated that a single approach to encouraging knowledge creation and solution recording would probably fail, as the consultants' motivations appeared to change over time as they gained experience.

The supporting evidence for these conclusions came partly from the numerical values of the measures of likelihood of solution creation reported during the interviews, and partly from the interview responses of the informants. Although the sample of 5 consultants was appropriate for the in-depth ethnographic data collection of this pilot study, it did require any conclusions about general patterns of behavior to be speculative. However, the repeated instances of observed behaviors and the fact that the consultants were at opposite ends of the tenure spectrum lent some credence to the comparison. At each end of the scale, more than one consultant reported similar behaviors and tendencies. Several apparent paradoxes in knowledge management behavior were uncovered during this portion of the study, including the possible inverse relationship between consultant tenure and solution recording behavior discussed above. The other paradoxes were disparities between the kinds of information the consultants were willing to record, and the locations where they were most likely to store that information.

All of the help desk consultants who participated in this study exhibited a strong tendency toward storing and distributing problem solutions via electronic mail. They seldom if ever used the Solution table provided in the OMIS, Remedy, as a place to store knowledge, and they reported that their use of the Web as a place to record and store answers to frequently asked questions (FAQs) had actually fallen sharply in the years prior to the study. Instead, they reported sending email with solutions to the help desk group, and indicated that they used their own email folders (inbox, other folders, and outbox) as a primitive knowledge base. Because the recording media for solutions were simple email messages, the responsibilities for storage and retrieval lay entirely with the individual consultants. If they were using their university email accounts to store the solutions, that system automatically deletes all messages 180 days old unless they take additional steps to archive them. An assessment of their statements revealed that they were accomplishing the task of knowledge creation, but only at the most rudimentary level of sophistication and effectiveness. Much of the new knowledge was being stored in places where background processes would routinely delete it.

I noted several interesting differences between the modes of solution storage and broadcast that the two groups of consultants, the less and more experienced, reported using. All three of the junior consultants, those with a year or less of employment, stated that they would create the solution in email and broadcast it to their co-workers. The two more experienced consultants, with more than three years of experience each, stated that they would typically store their solutions on the help desk staff Web site and send only notifications of a new entry, or a short synopsis, out to the others by email. It was interesting to note that the newer consultants seemed to be much more focused on spreading the word than on adding to any formal knowledge base, and one even stated that it would be inappropriate for him as a part-time student to do any "official" knowledge creation. Several of the consultants drew a distinction between how they would phrase an explanation to the customer and how they worded notification messages to their co-workers; this fit neatly into the frequently observed consultant behavior that I had labeled as information sufficing.

Clearly, there were differences in information behavior between groups of consultants with different levels of work experience. Just as obvious was the fact that the sample was so small that any conclusions were speculative, and a much larger sample would be required in order to test statistically the effects of consultant tenure on solution recording behavior. I also found differences in problem resolution behavior and the recording of solutions that appeared to have a relationship with the medium of the original problem report. Both of these were important issues that recommended themselves for incorporation into Phase 2 research. The pilot study provided ample justification for extending the research to a wider range of sites, and for conducting a more detailed investigation into several of the salient concepts uncovered by the preliminary Phase 1 research.

Perhaps the single most valuable product of the exploration into consultant behavior was the formulation of the help desk interaction model. During the investigation, I asked the informants a number of questions about their information problem solving behavior during the interaction model portion of the interviews. I collected data on their conceptual model for problem resolution and referral interactions by having them draw their own flow charts of the processes during the interview. I combined this information with my process maps from data analysis to produce a more complete help desk interaction model. By the end of the analysis stage of the pilot study, a complete model had been developed and elaborated to incorporate many of the consultant behaviors in relation to the problem resolution and knowledge creation processes. This help desk interaction model became the basis for the process model of problem trajectory in the Phase 2 research for the dissertation. The categories of problem referral depicted in Table A1, the decisions described in Table A2, and the probable trajectory codes in Table A3 became the building blocks for the problem trajectory model, and for its component parts as represented in the problem trajectory scheme.

APPENDIX B

ILLUSTRATIONS

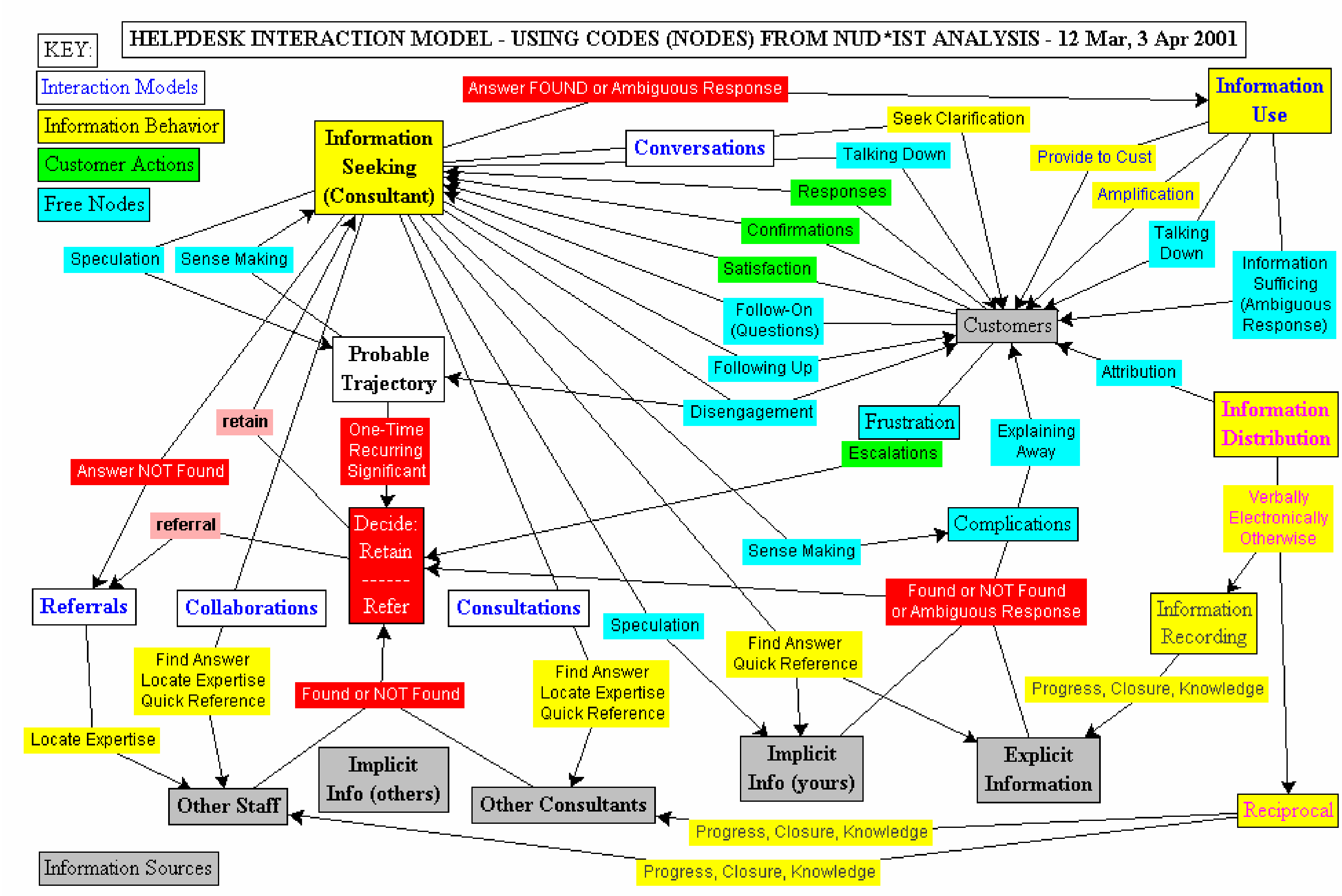

Figure B1. The help desk interaction model developed during the pilot study from direct observation of the processes and with consultant input during the interviews.

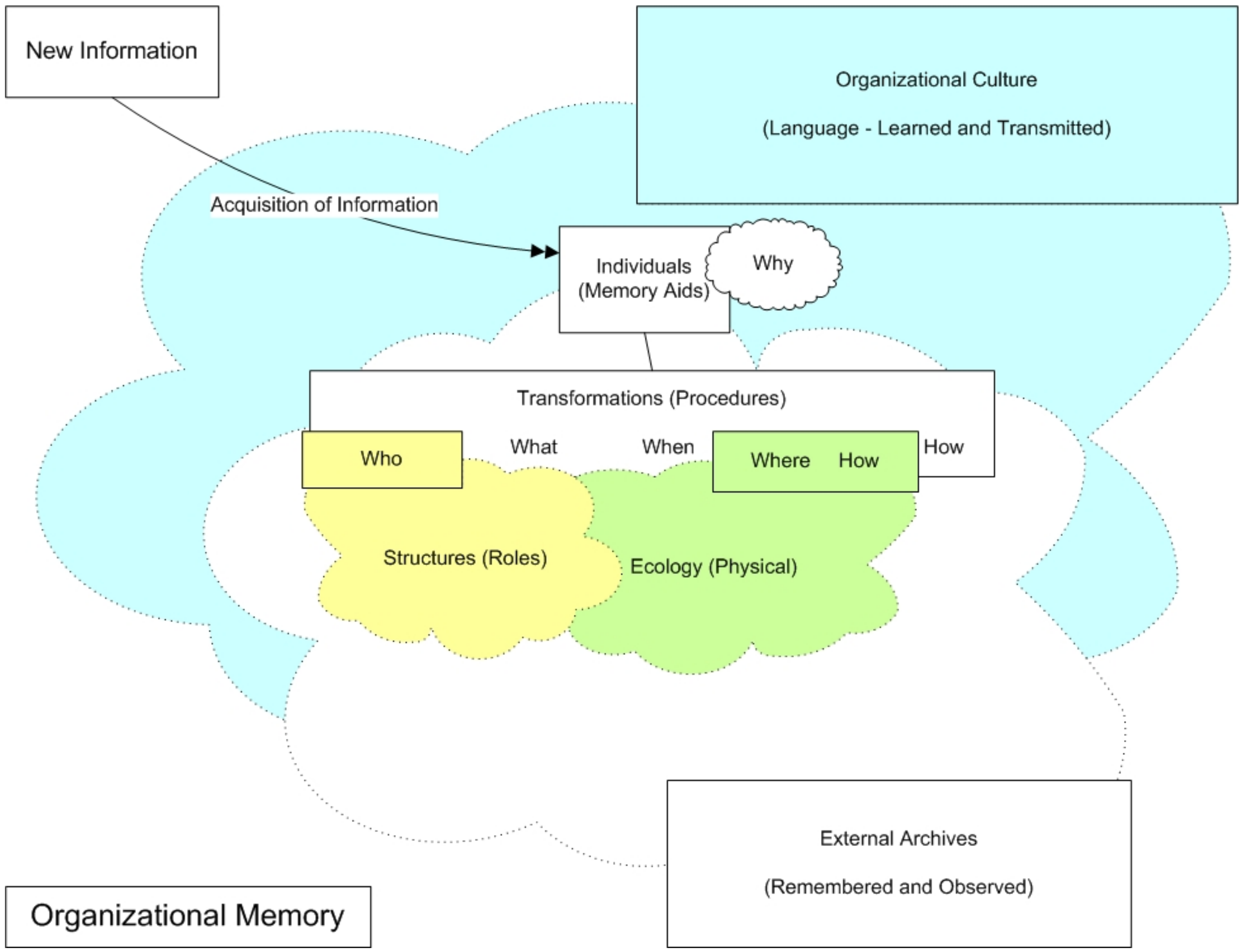

Figure B2. A diagram of organizational memory developed for the pilot study. This diagram is the author's visualization of the components and relationships of organizational memory components, originally described as storage bins by J. P. Walsh and G. R. Ungson in their journal article titled Organizational Memory (1991).

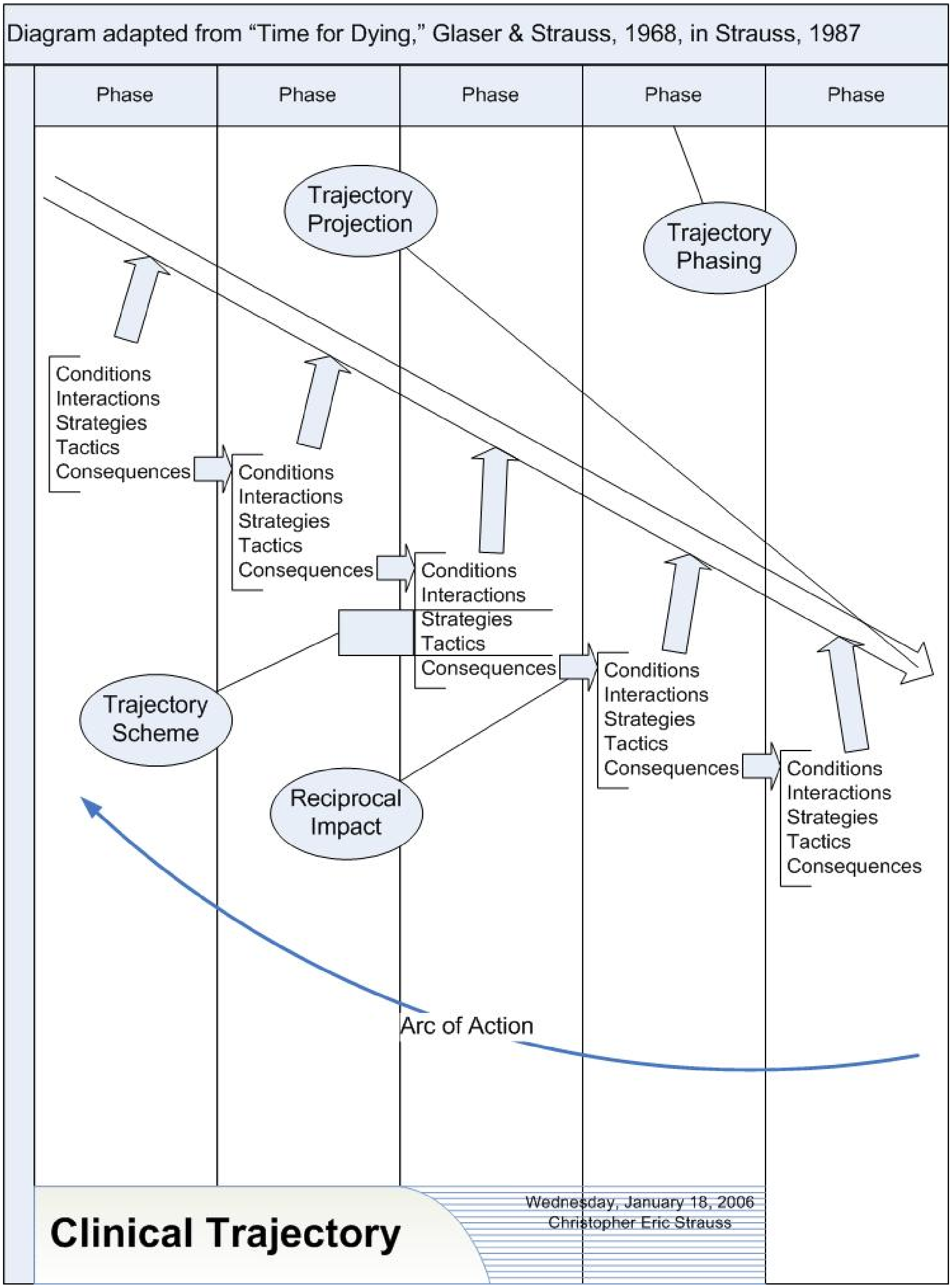

Figure B3. A diagram of clinical trajectory adapted from Glaser and Strauss (Figure 1).

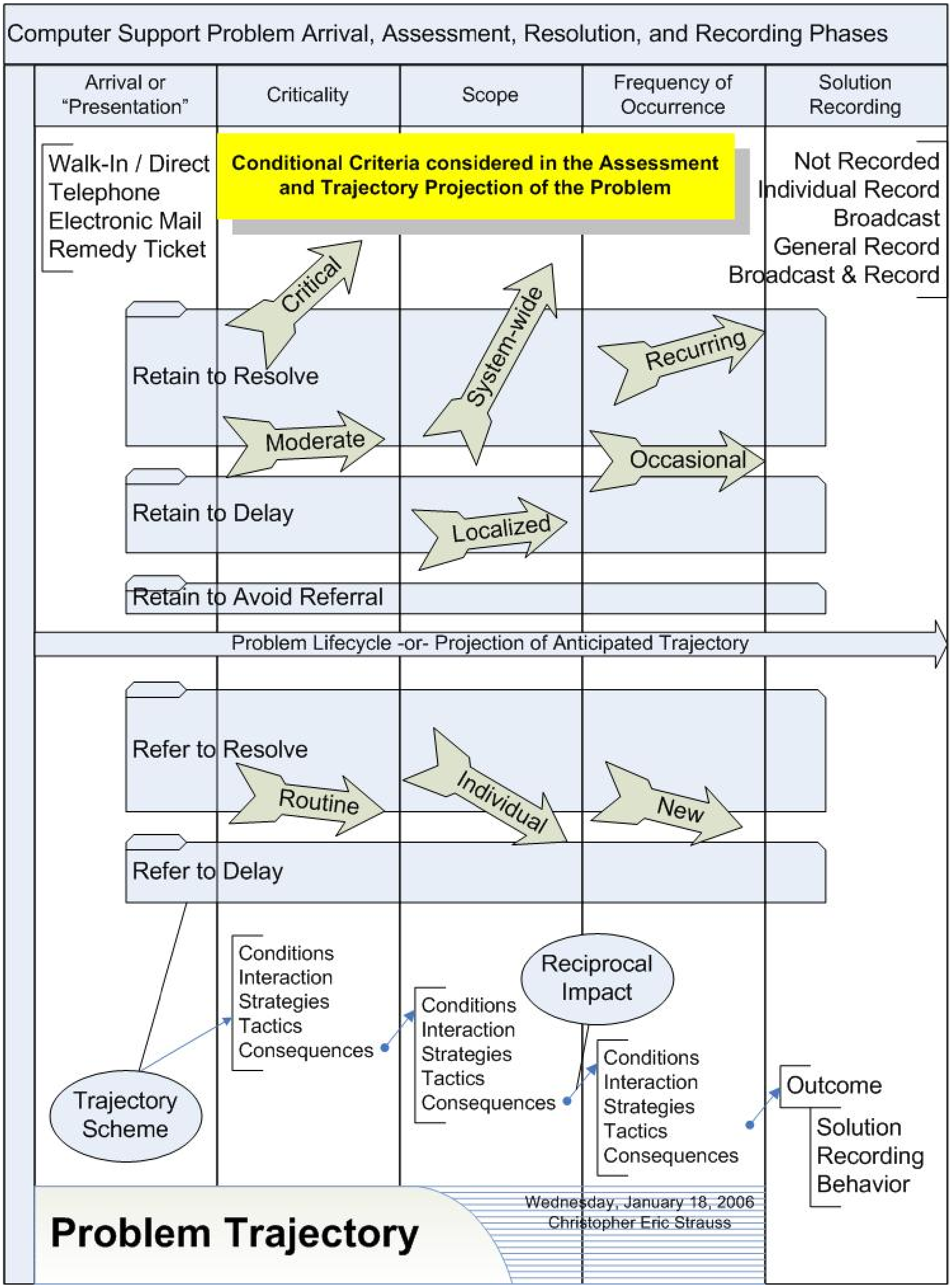

Figure B4. Problem trajectory model: Original 3 x 3 variant of the conditional criteria.

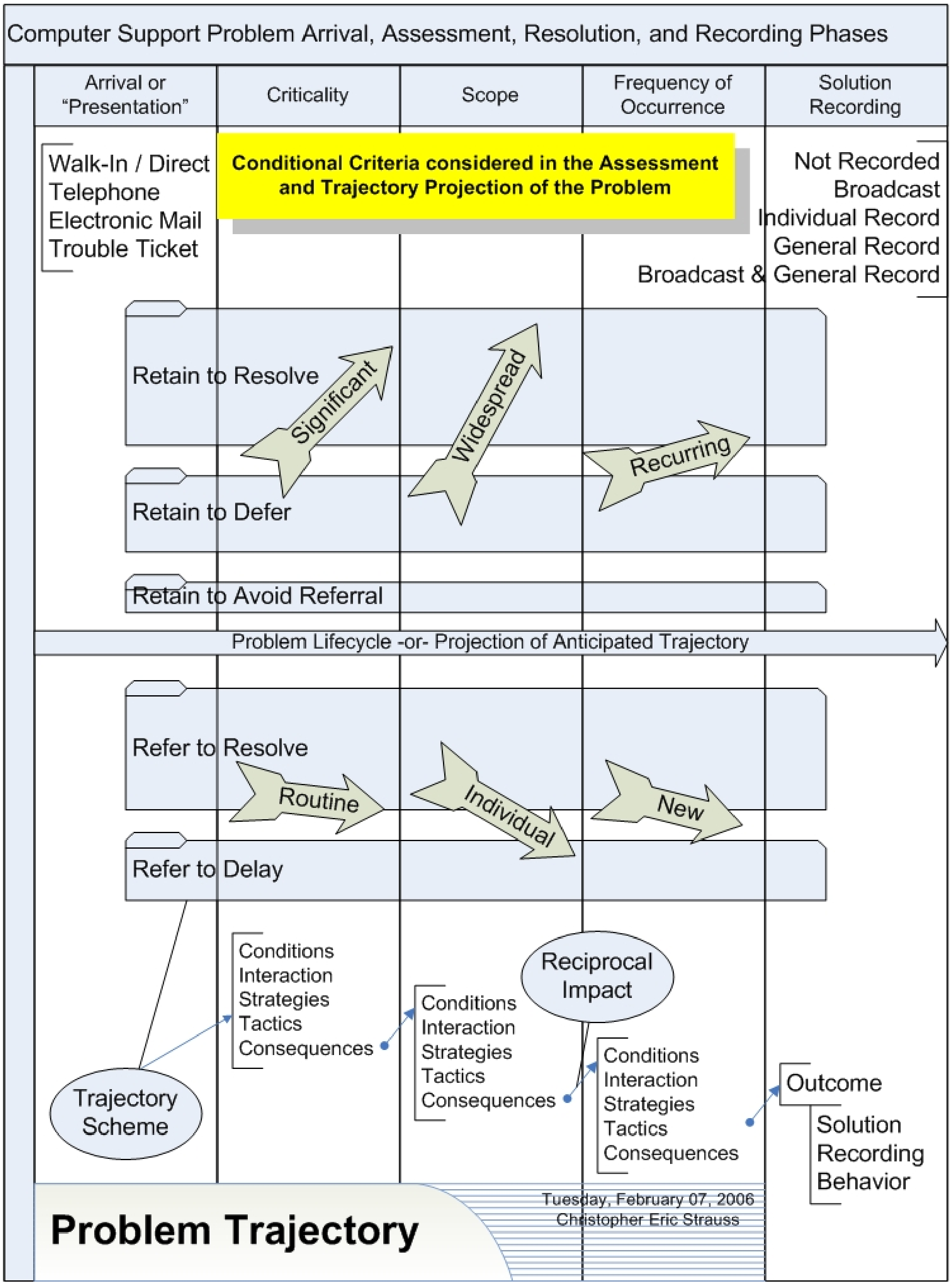

Figure B5. Problem trajectory model: Simplified 3 x 2 variant of conditional criteria.

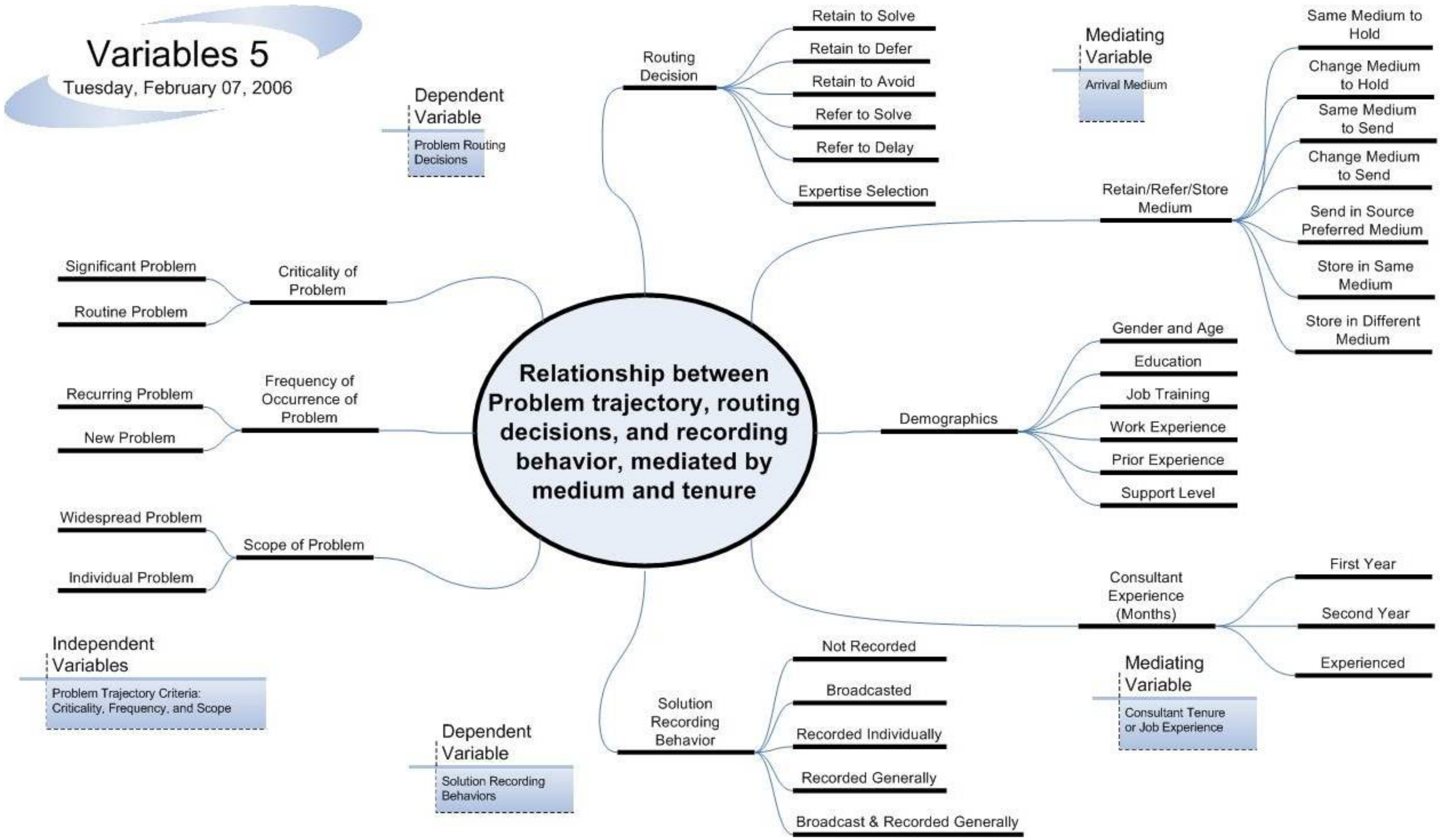

Figure B6. Variable design developed from the pilot study results, including groups of independent, dependent, and mediating variables.

TRAJECTORY SCHEME		Eight Scenarios (3x3) (When)			
	Phase I	***Phase II***	***Phase III***	***Phase IV***	***Phase V***
	Problem Arrival	**Problem Assessment**	**Expertise Selection**	**Problem Resolution**	**Solution Recording**
Conditions	Communications Medium	Problem and Customer	New or Recognized Problem	Expertise Selected	Solution to Problem Found
Considerations (Why)	o Ability to Forward o Ability to Track o Ability to Store and Retrieve	o Criticality o Scope o Frequency of Occurrence	o Organizational o Credible (known) o Reputation (recommended) o Proven Responsive o Availability	o Ability o Responsibility o Immediacy o Willingness o Communication Access	o Likelihood of Reuse o Ease of Recording o Format of Solution
Interactions	Synchronous and/or Asynchronous Communications	Negotiate Meaning	Referral Tools, Group Discussion, Inquiry	Self, Expert, or Call Tracking System	To Info Systems or People
Strategies	Fastest Resolution with the Minimum Effort	Recognize Problem, and Determine Severity	Find Most Appropriate Expert	Resolve or Delay	Retain Solution Information
Tactics	Retain Format	Pattern Matching	Resource Matching	Retain or Refer	Record, Broadcast, Not
Decisions (What) (How)	o Retain Format 0 Change to New o Change to Expert's o Retain to Store o Change to Store	o Significant or Routine o Widespread or Individual o Recurring or New	o Who is Responsible o Who is Credible o Who is Suggested o Who is Responsive o Who is Accessible	o Retain to Resolve o Retain to Defer o Retain to Avoid o Refer to Resolve o Refer to Delay	o Not Recorded o Broadcast o Individual Record o General Record o Broadcast & Record
Theory Source	Observations/ interviews C Strauss (2005)	Observations/ interviews C Strauss (2005)	Expertise profiles K Ehrlich (2003)	Observations/ interviews C Strauss (2005)	Observations/ interviews C Strauss (2005)
Consequences (*Conditions for the next Phase*)	Possible Mismatch to the Source of Expertise	Estimate of the Problem Complete	Expertise Match Determined	Problem Resolved or Deferred	Knowledge Recorded or Not

1. Conditions, Interactions, Strategies, Tactics, and Consequences are the components of trajectory scheme as described by Glaser & Strauss (1968).
2. The consequences for each phase become conditions for the next through "reciprocal impact," according to Glaser & Strauss (1968).
3. The Decisions for Phase II become the situational scenarios that include all possible combinations of Criticality, Scope, and Frequency.
4. The Decisions for Phases I, III, IV, and V become the four 5-question sets in the scenarios-based portion of the survey instrument.

Figure B7. Problem trajectory scheme developed from trajectory model and variables.

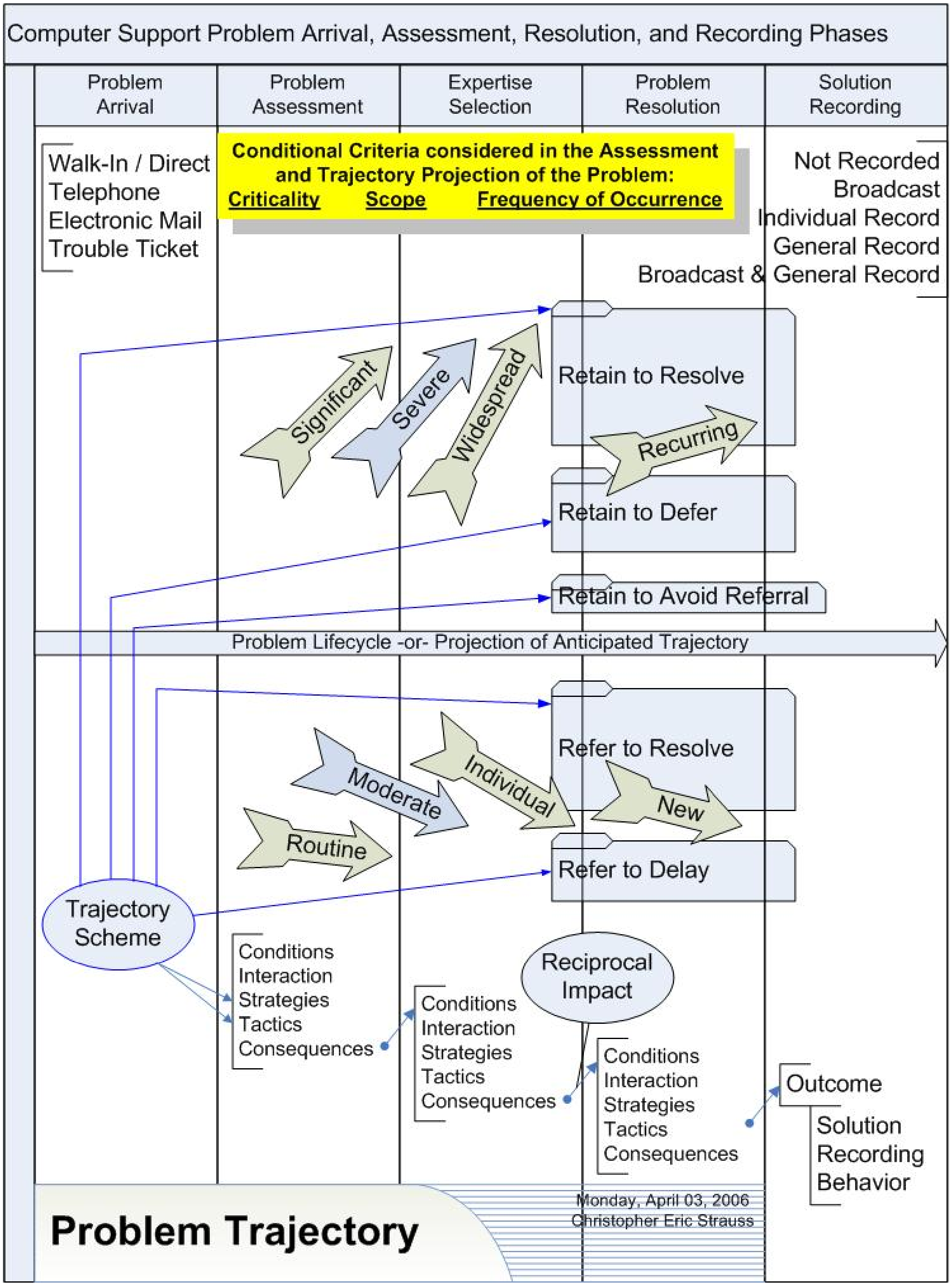

Figure B8. Problem trajectory model: Simplified 2 x 2 variant of conditional criteria.

Variables	Urgent			Moderate			Routine		
	U	U	U	M	M	M	R	R	R
Systemwide	S	S	S	S	S	S	S	S	S
	R	O	N	R	O	N	R	O	N
	U	U	U	M	M	M	R	R	R
Localized	L	L	L	L	L	L	L	L	L
	R	O	N	R	O	N	R	O	N
	U	U	U	M	M	M	R	R	R
Individual	I	I	I	I	I	I	I	I	I
	R	O	N	R	O	N	R	O	N
	Recurring	Occasional	New	Recurring	Occasional	New	Recurring	Occasional	New

Figure B9. Problem trajectory model variables in their most complete form, 3 x 3, with three values for each of three variables. This configuration requires 27 separate scenarios in order to test every possible combination of the values, completely impractical in a single survey instrument.

	Significant				Routine			
	S	S	S	S	R	R	R	R
Widespread Individual	W	W	I	I	W	W	I	I
	R	N	R	N	R	N	R	N
	Recurring	New	Recurring	New	Recurring	New	Recurring	New

Figure B10. Problem trajectory model variables in a simplified form, 3 x 2, with two values for each of three variables. This configuration requires eight separate scenarios in order to test every possible combination of the values, too many for a single survey instrument with separate sets of questions for each scenario.

	Recurring	New
Severe	S R	S N
Moderate	M R	M N

Figure B11. Problem trajectory model variables in a compressed form, 2 x 2, with two values for each of two variables. This configuration requires four separate scenarios in order to test every possible combination of the values. The loss of detail when compared to either the 3 x 3 or 3 x 2 forms of the model is obvious, but the survey instrument is manageable with identical questions for each of the four scenarios.

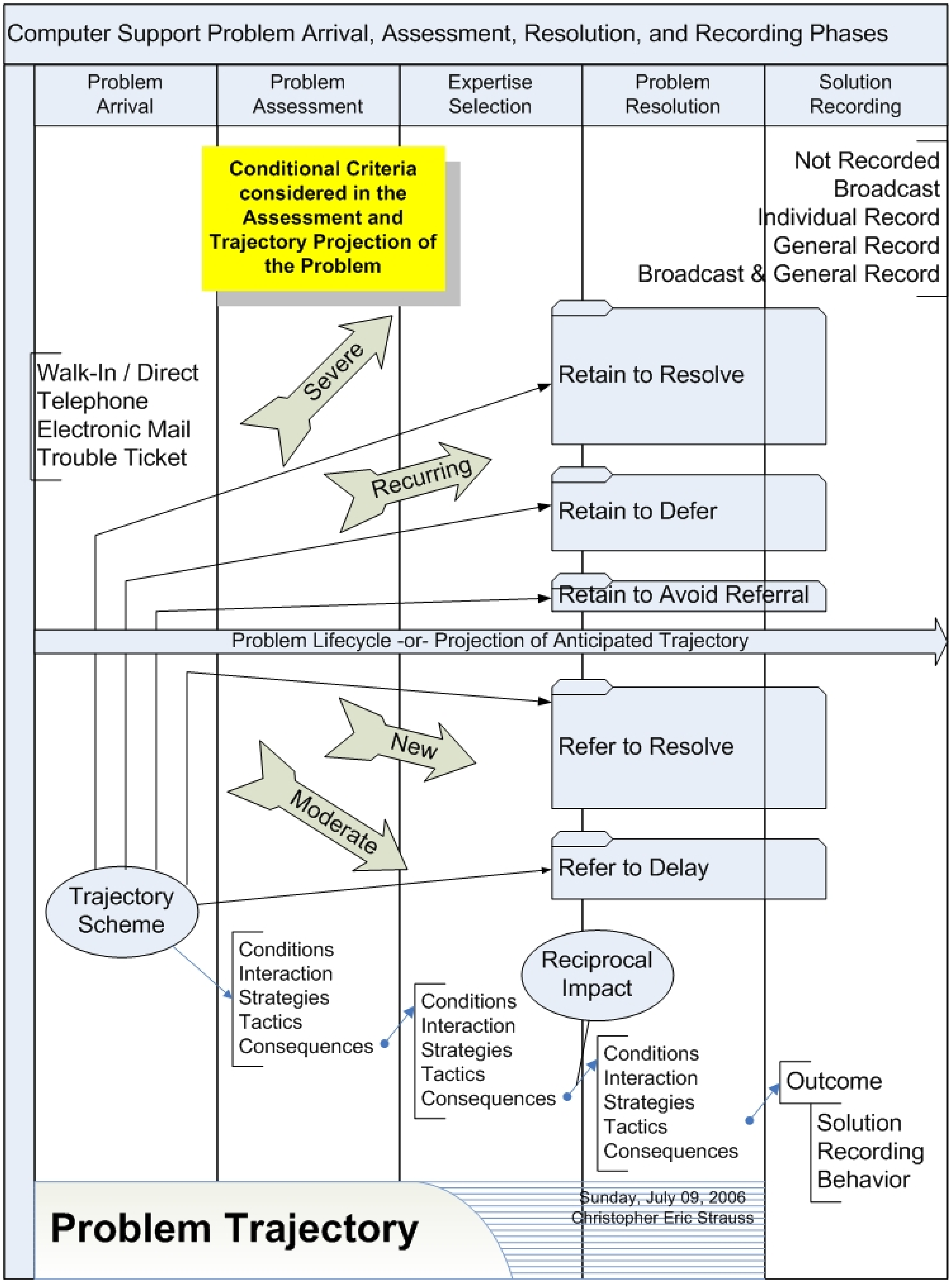

Figure B12. Problem trajectory model: 2 x 2 variant used for survey construction.

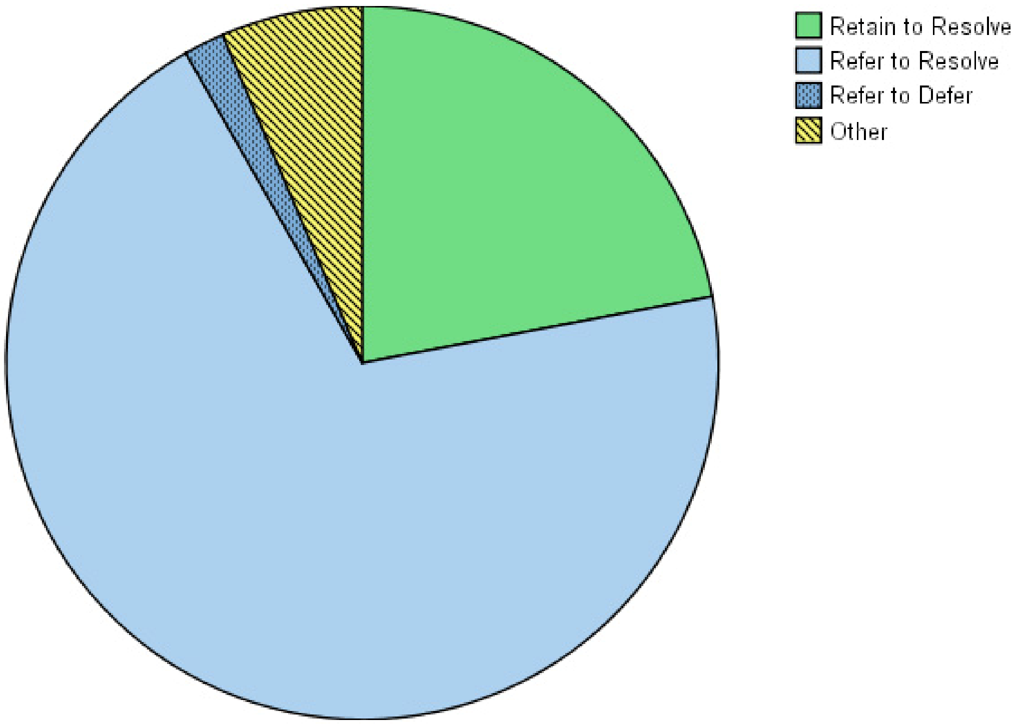

Figure B13. Decisions selected to Retain or Refer a Severe Recurring Problem.

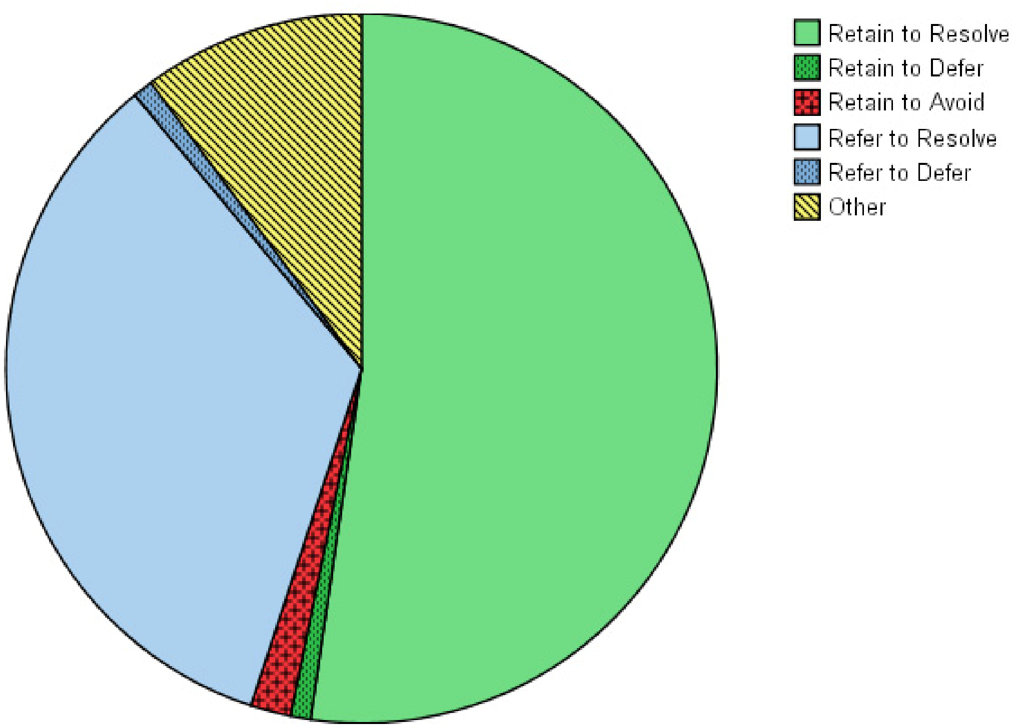

Figure B14. Decisions selected to Retain or Refer a Severe New Problem.

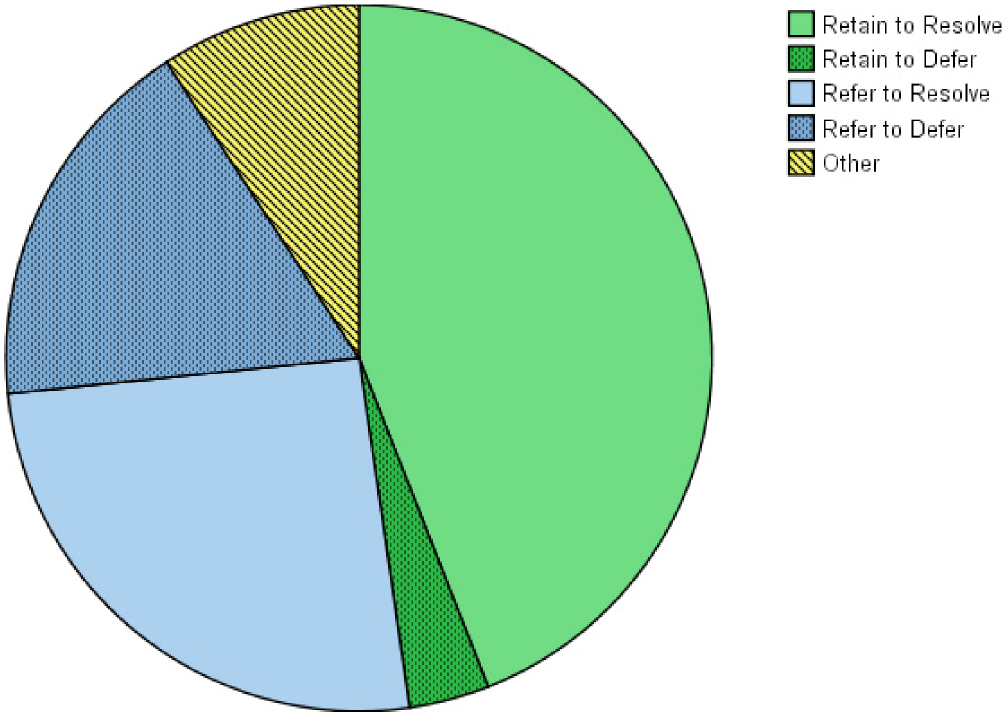

Figure B15. Decisions selected to Retain or Refer a Moderate Recurring Problem.

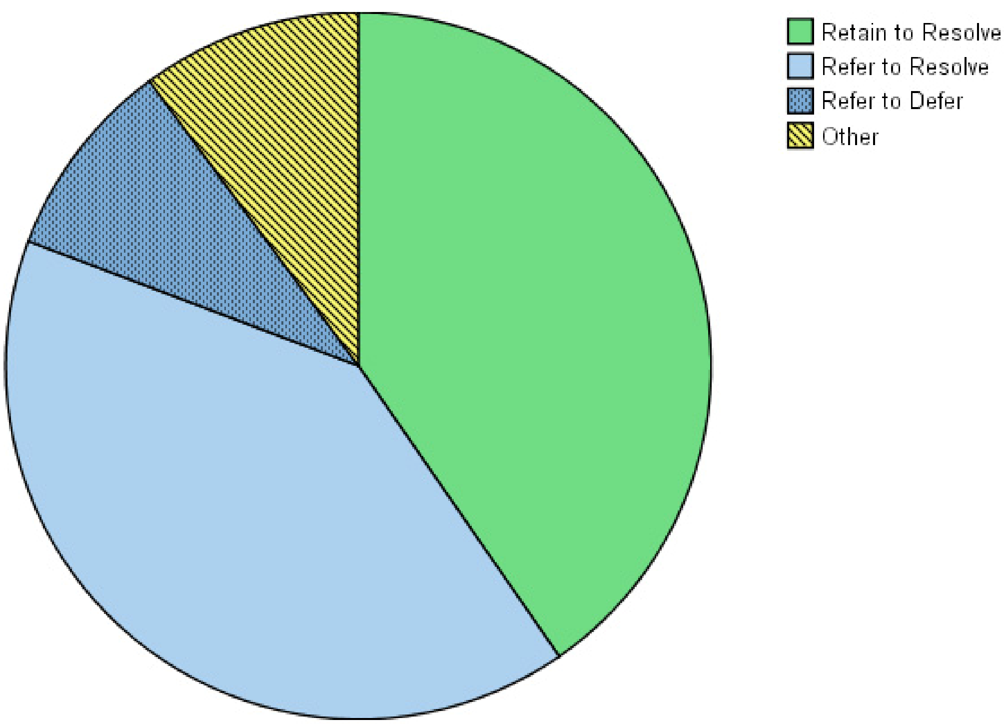

Figure B16. Decisions selected to Retain or Refer a Moderate New Problem.

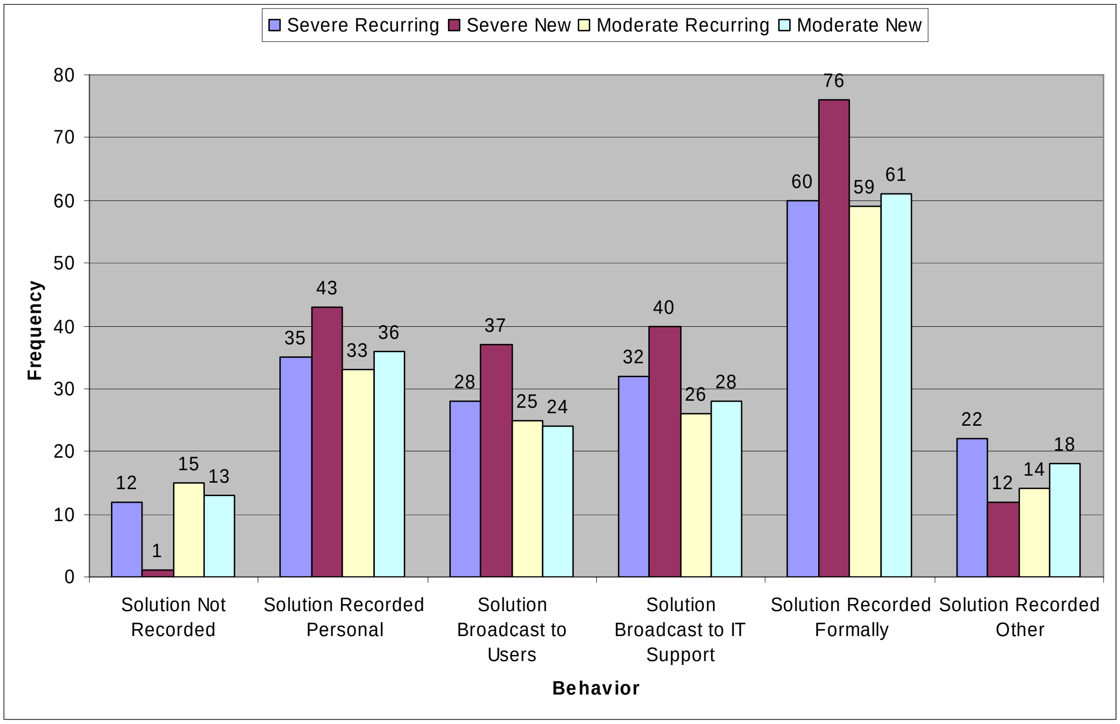

Figure B17. Solution recording behavior, grouped by the reported action taken.

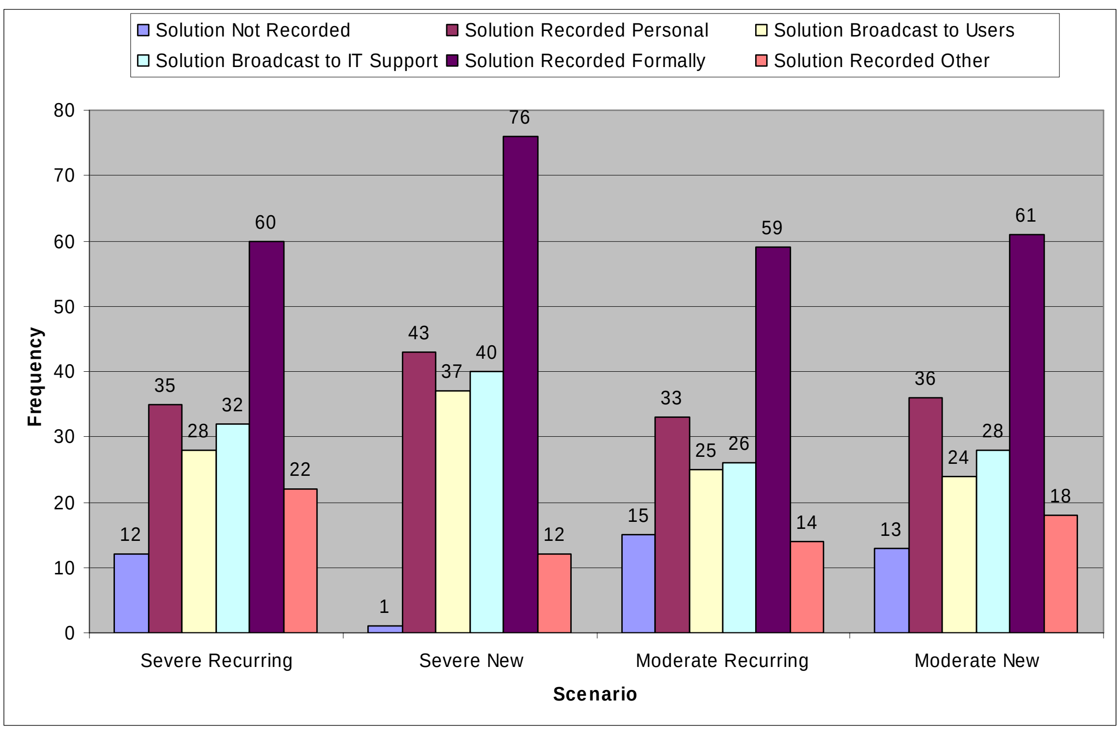

Figure B18. Solution recording behavior, grouped by the type of scenario presented.

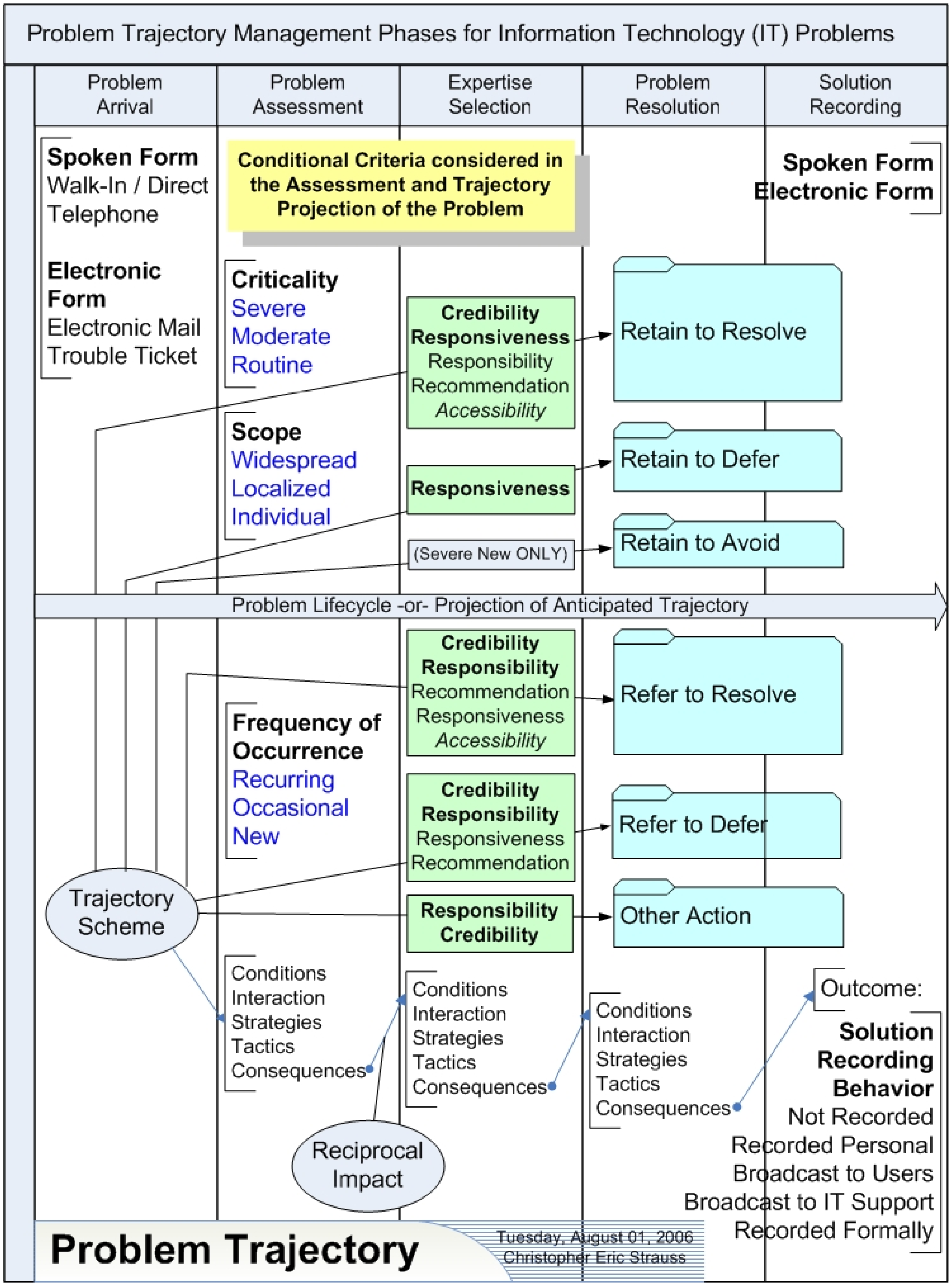

Figure B19. Problem trajectory model: Revised 3 x 3 model verified by survey research.

APPENDIX C

SURVEY INSTRUMENT WITH CODES

Information Technology Support Survey: Introduction

This survey contains four sections of questions or items:

1. **Demographics** (a few key elements of information about you)
2. **Work Experience** (a few questions about your work experience)
3. **Computer Support Level** (to determine what level of support you normally provide to customers)
4. **Computer Support Problem Scenarios** (four simple scenarios with the same set of questions for each)

CAUTION #1: The Zope QSurvey server does not save any data until the final Submit button is clicked. Closing your browser at any point during the survey will dump all of your work into the bit bucket!</p>

CAUTION #2: The Zope QSurvey server does not check missing entries for the survey items, so if you overlook any of them the survey will not be complete. Please review your entries on each page carefully before going on to the next page. <u>All survey items are required</u> unless marked as **(Optional)**.

Enter your UNT Enterprise User ID here. If you record a complete and valid survey by the cutoff date of 13 May, 2006, your EUID will be entered in the drawing.

Enter your EUID in the text box below, then click the button

IntroEUID

Button Text: Click Here to Begin the Survey

Section 1: Questions about you

The next five questions will gather general demographic information about you that will be used to compare different groups of information technology (IT) support staff to each other for statistical purposes.

	Question	**Response**
1.	What is your gender? Gender	*Please select one of the following* Male 1 Female 2
2.	As of your most recent birthday, how many years old are you? Age	*Enter the number of Years* ___ ###
3.	How much schooling have you completed? Select the highest level completed, or degree received. Education	☐ 12th grade or less 1 ☐ High school graduate or equivalent, such as GED 2 ☐ Some college but no degree 3 ☐ Associate degree (academic or occupational) 4 ☐ Bachelor's degree 5 ☐ Graduate student but no degree 6 ☐ Master's degree 7 ☐ Professional school degree (such as MD, LLB, JD, DDS, DVM) 8 ☐ Doctorate (such as PhD, EdD, DMA, DrPH) 9
4.	Approximately how many weeks or months of formal or job-specific training have you received for your CURRENT IT support staff position? TrainingPresent	*Please enter a number and indicate whether this is Weeks or Months* ___________
5.	Approximately how many weeks or months of formal or job-specific training have you received in your ENTIRE IT support staff career? TrainingTotal	*Please enter a number and indicate whether this is Weeks or Months* ___________

Section 2: Questions about your work experience

The next fourteen questions will gather information about your work experience in information technology support. Anyone working in support of information technology at the University is considered *IT support staff* for the purposes of this survey.

	Question	Response
6.	Of which University computer support group, programming team, or similar information technology organization are you currently a member? If more than one, name the organization where you have your primary job. Question01SupportGroup	______________________________ *Enter the Name of your Team or Group*
7.	When (month and year) did you begin working as a member of this IT support group or team? Question02JoinDate	*Enter the Month AND the Year that you began working there* ________
8.	Is your current position full-time or part-time? Question03FTStatus	*Select Either Full Time* __ *or Part Time* __ Full Time 1 Part Time 2
9.	If part-time, how many hours a week is this position? Question04PartTime	*Enter the Number of Hours* _____ week
10.	What is your total work experience (in years AND months) in your CURRENT IT support job? Question05PresentExperience	*Enter the Number of Years, and the Number of Months* ___ Years ____ Months
11.	Not including your current job, what is your TOTAL work experience (in years AND months) in any SIMILAR IT support jobs at the University before [prior to] this one? Question06PastExperience	*Enter the Number of Years, and the Number of Months* ___ Years ____ Months

Question	Response
12. Do you have any other relevant work experience in IT support outside the University that was not included in the totals above? Question07OtherExperience	*Enter the Number of Years, and the Number of Months* ___ Years ____ Months
13. Briefly describe any other details about your previous work experience in IT support. Question08AdditionalWorkDetail	(Blank text box)

Please name, RANKED IN ORDER, the TOP THREE individuals (other IT support staff at UNT only) WHO CONTACT YOU with questions, problems, or looking for technical information.

14. ________ (1) Full name of the person who contacts you the most often Top3WhoContactYou01
15. ________ (2) Full name of the person who contacts you the Second most often Top3WhoContactYou02
16. ________ (3) Full name of the person who contacts you the Third most often Top3WhoContactYou03

Please name, RANKED IN ORDER, the TOP THREE individuals (other IT support staff at UNT only) that YOU CONTACT when you have questions, problems, or are looking for technical information.

17. ________ (1) Full name of the person that you contact the most often Top3WhoYouContact01
18. ________ (2) Full name of the person that you contact the Second most often Top3WhoYouContact02
19. ________ (3) Full name of the person that you contact the Third most often Top3WhoYouContact03

Section 3: Questions about your IT support level

The next three questions will gather information about the level of IT support that you normally provide at the University. For the purposes of this survey, the levels of customers are as follows:

- **End Users**: Faculty, staff, student workers, and students who have no IT support role. Includes part-time computer lab employees.
- **First Level support staff**: CITC helpdesk consultants, PC/LAN Support, EIS family heads, distributed support area staff members, lab consultants. Primarily, those taking trouble calls or working directly with end users or their machines.
- **Second Level support staff**: CITC teams such as GroupWise support, EIS PeopleTools Support, UNIX Services Group; distributed support area managers, lab managers, micro-maintenance. Primarily, those who support first level or other support staff instead of end users.
- **Third Level support staff**: For this study, external support or vendors.

20. **I Support Computer and Information Technology End Users...**
Select ONE of the choices
Supportusers0

✓ All of the time, as a primary job duty. 1

✓ Frequently, when they are referred to me. 2

✓ Rarely, when no one else is available. 3

✓ Never, only other IT support staff with questions. 4

21. **What level of IT Support do you normally provide?**
Select ONE of the choices
SupportUsers5

✓ First Level Support 1

✓ Second Level Support 2

22. What is your Primary IT Support Role at the University? (Blank text box)
SupportRoleText1

Section 4: IT Support Problem Scenarios

The next four sets of items will gather information about how you would handle problem resolution in a given scenario. The same set of items or questions will be asked about each of the five scenarios.

Problem Scenario Differences:

- Each scenario is a unique combination of the two different ways that IT support problems are classified for this study.
- Each IT support problem is classified as follows:

Severity of Problem (a combination of Criticality and Scope)

1. This is a **severe** problem: one or more individuals cannot do administrative or academic work.
2. This is a **moderate** problem: one or more individuals are experiencing limitations with information technology.

Frequency of Occurrence of Problem

1. This is a **new** problem, not seen before.
2. This is a **recurring** problem, which has been seen before.

- The classification of the problem is included in the scenario title for clarity.
- We want to know what actions you will be likely to take in each type of situation.
- We are not trying to find out how you would classify each situation; that has been done for you.

Instructions for each set of questions:

- Read the Problem Scenario.
- Imagine yourself in the position of the individual who will try to resolve the customer's computer-related problem.
- Indicate which decisions you would make, and why you would do so, in each of the five sections under each scenario.

Scenario One: Severe, Recurring Problem

You have received notice of a problem for computer users in your area of responsibility. It is a network name service problem that occurs occasionally, and it is causing a significant problem by blocking access to an online instruction system used by faculty members, their teaching assistants, and their students.

The Decision to Retain or Refer the problem…

23. **When notified of this problem, I would…**
Select ONE of these choices
Scenario1Question01
- ✓ Retain this problem in my group for troubleshooting and resolution. 1
- ✓ Retain this problem in my group but defer action on it until later. 2
- ✓ Retain this problem in my group to avoid referring it to a non-cooperative support group or person. 3
- ✓ Refer this problem to another support group with a high priority for resolution as soon as possible. 4
- ✓ Refer this problem to another support group, deferred for eventual resolution. 5
- ✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario1Question01_Other

24. Briefly, why did you select the action that you chose in the list above (Retention or Referral of the problem)? Scenario1Question02 (Blank text box)

You have decided to either retain this problem, or to refer it to a different IT support person or group for resolution. You selected the most appropriate party to resolve the problem by determining the relative importance of several factors.

Please indicate the degree of importance of each factor in making this decision, in this situation.

25. Responsibility: Using referral tools, call-tracking categorization, organization, or contingency plans to determine who is responsible for resolving this problem.
Scenario1Question03 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

26. Credibility: Knowing from experience who or which group is the most appropriate choice for solving this or similar problems.
Scenario1Question04 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

27. Recommendation: Asking someone else who or which group is the most appropriate choice for solving this or similar problems.
Scenario1Question05 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

28. Responsiveness: Determining who or which group will resolve this problem as quickly as possible.
Scenario1Question06 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

29. Accessibility: Selecting who or which group to use based upon the ease of communicating the problem referral to them.
Scenario1Question07 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

30. Describe how you selected the appropriate retention or referral, considering the factors listed above. Scenario1Question08	(Blank text box)
31. (*Optional*) Describe how you selected the appropriate retention or referral if you used a factor that is NOT listed above. Scenario1Question09	(Blank text box)

This is a Severe and Recurring problem.

32. Once the problem has been resolved I would…
    You may select MORE THAN ONE of these actions

Scenario1Question10

- ✓ Not Record the solution or how the problem was resolved. 1
- ✓ Make a Personal Record of the solution for my own use. 2
- ✓ Broadcast the solution to my customers using email. 3
- ✓ Broadcast the solution to other IT support staff in an email group or the campus listserv (UNT-NETMAN). 4
- ✓ Record the solution details in a trouble ticket work log, solution table, knowledge base system, or FAQ 5
- ✓ Other: (describe the action that you would take if it is not listed above) 6
  Scenario1Question10_Other

33. Briefly, why did you select the action(s) that you chose in the list above (the decision whether or not to Record and/or Broadcast the solution)? Scenario1Question11	(Blank text box)

You received this problem in spoken form, in a telephone call or voicemail, or face-to-face.

34. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario1Question12

✓ Resolve or refer the problem in spoken form. 1

✓ Resolve or refer the problem in a different medium more preferable to me. 2

✓ Resolve or refer the problem in a different medium only if the logical referral person or group prefers or requires it. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario1Question12_Other

35. Briefly, state how the spoken form communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution.
    Scenario1Question13

(Blank text box)

36. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario1Question14

✓ Store the solution for future use in the original medium of the problem report. 1

✓ Store the solution for future use after changing the medium of the problem report from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario1Question14_Other

37. Briefly, state how the spoken form communications medium of a problem notification affects your decisions to keep or change that format for solution recording.
    Scenario1Question15

(Blank text box)

You received this problem electronically, in an email or a trouble ticket.

38. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario1Question16

✓ Resolve or refer the problem in electronic form. 1

✓ Resolve or refer the problem in a different medium more preferable to me. 2

✓ Resolve or refer the problem in a different medium only if the logical referral person or group prefers or requires it. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario1Question16_Other

39. Briefly, state how the electronic communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution.
    Scenario1Question17

(Blank text box)

40. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario1Question18

✓ Store the solution for future use in the original medium of the problem report. 1

✓ Store the solution for future use after changing the medium of the problem report from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario1Question18_Other

41. Briefly, state how the electronic communications medium of a problem notification affects your decisions to keep or change that format for solution recording.
    Scenario1Question19

(Blank text box)

Scenario Two: Severe, New Problem

You have received notice of a problem for computer users in your area of responsibility. It is an unknown problem, one you have never heard of before, and it is causing a significant problem by blocking access to an information system that academic and administrative staff must use to do their work.

The Decision to Retain or Refer the problem…

42. **When notified of this problem, I would…**
Select ONE of these choices
Scenario2Question01

✓ Retain this problem in my group for troubleshooting and resolution. 1

✓ Retain this problem in my group but defer action on it until later. 2

✓ Retain this problem in my group to avoid referring it to a non-cooperative support group or person. 3

✓ Refer this problem to another support group with a high priority for resolution as soon as possible. 4

✓ Refer this problem to another support group, deferred for eventual resolution. 5

✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario2Question01_Other

43. Briefly, why did you select the action that you chose in the list above (Retention or Referral of the problem)? Scenario2Question02 (Blank text box)

You have decided to either retain this problem, or to refer it to a different IT support person or group for resolution. You selected the most appropriate party to resolve the problem by determining the relative importance of several factors.

Please indicate the degree of importance of each factor in making this decision, in this situation.

44. Responsibility: Using referral tools, call-tracking categorization, organization, or contingency plans to determine who is responsible for resolving this problem.
Scenario2Question03 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

45. Credibility: Knowing from experience who or which group is the most appropriate choice for solving this or similar problems.
Scenario2Question04 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

46. Recommendation: Asking someone else who or which group is the most appropriate choice for solving this or similar problems.
Scenario2Question05 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

47. Responsiveness: Determining who or which group will resolve this problem as quickly as possible.
Scenario2Question06 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

48. Accessibility: Selecting who or which group to use based upon the ease of communicating the problem referral to them.
Scenario2Question07 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

49. Describe how you selected the appropriate retention or referral, considering the factors listed above. Scenario2Question08	(Blank text box)
50. Describe how you selected the appropriate retention or referral if you used a factor that is NOT listed above. Scenario2Question09	(Blank text box)

This is a Severe and New problem.

51. Once the problem has been resolved I would…
You may select MORE THAN ONE of these actions

Scenario2Question10

- ✓ Not Record the solution or how the problem was resolved. 1
- ✓ Make a Personal Record of the solution for my own use. 2
- ✓ Broadcast the solution to my customers using email. 3
- ✓ Broadcast the solution to other IT support staff in an email group or the campus listserv (UNT-NETMAN). 4
- ✓ Record the solution details in a trouble ticket work log, solution table, knowledge base system, or FAQ 5
- ✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario2Question10_Other

52. Briefly, why did you select the action(s) that you chose in the list above (the decision whether or not to Record and/or Broadcast the solution)? Scenario2Question11	(Blank text box)

You received this problem in spoken form, in a telephone call or voicemail, or face-to-face.

53. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario2Question12

- ✓ Resolve or refer the problem <u>in spoken form.</u> 1
- ✓ Resolve or refer the problem <u>in a different medium more preferable to me</u>. 2
- ✓ Resolve or refer the problem <u>in a different medium only if the logical referral person or group prefers or requires it</u>. 3
- ✓ Other: (describe the action that you would take if it is not listed above) 4
  Scenario2Question12_Other

54. Briefly, state how the <u>spoken form</u> communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution. (Blank text box)
    Scenario2Question13

55. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario2Question14

- ✓ <u>Store the solution</u> for future use <u>in the original medium of the problem report</u>. 1
- ✓ <u>Store the solution</u> for future use <u>after changing the medium of the problem report</u> from its original form into something else. 2
- ✓ Other: (describe the action that you would take if it is not listed above) 3
  Scenario2Question14_Other

56. Briefly, state how the <u>spoken form</u> communications medium of a problem notification affects your decisions to keep or change that format for solution recording. (Blank text box)
    Scenario2Question15

You received this problem electronically, in an email or a trouble ticket.

57. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario2Question16

✓ Resolve or refer the problem in electronic form. 1

✓ Resolve or refer the problem in a different medium more preferable to me. 2

✓ Resolve or refer the problem in a different medium only if the logical referral person or group prefers or requires it. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario2Question16_Other

58. Briefly, state how the electronic communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution. (Blank text box)
    Scenario2Question17

59. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario2Question18

✓ Store the solution for future use in the original medium of the problem report. 1

✓ Store the solution for future use after changing the medium of the problem report from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario2Question18_Other

60. Briefly, state how the electronic communications medium of a problem notification affects your decisions to keep or change that format for solution recording. (Blank text box)
    Scenario2Question19

Scenario Three: Moderate, Recurring Problem

You have received notice of a problem for computer users in your area of responsibility. It is a print queue issue that occurs occasionally, and it is causing a problem by preventing faculty members and their teaching assistants from printing slides to the color laser printer.

The Decision to Retain or Refer the problem…

61. **When notified of this problem, I would...**
Select ONE of these choices
Scenario3Question01

✓ Retain this problem in my group for troubleshooting and resolution. 1

✓ Retain this problem in my group but defer action on it until later. 2

✓ Retain this problem in my group to avoid referring it to a non-cooperative support group or person. 3

✓ Refer this problem to another support group with a high priority for resolution as soon as possible. 4

✓ Refer this problem to another support group, deferred for eventual resolution. 5

✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario3Question01_Other

62. Briefly, why did you select the action that you chose in the list above (Retention or Referral of the problem)? Scenario3Question02 (Blank text box)

You have decided to either retain this problem, or to refer it to a different IT support person or group for resolution. You selected the most appropriate party to resolve the problem by determining the relative importance of several factors.

Please indicate the degree of importance of each factor in making this decision, in this situation.

63. Responsibility: Using referral tools, call-tracking categorization, organization, or contingency plans to determine who is responsible for resolving this problem.
Scenario3Question03 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

64. Credibility: Knowing from experience who or which group is the most appropriate choice for solving this or similar problems.
Scenario3Question04 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

65. Recommendation: Asking someone else who or which group is the most appropriate choice for solving this or similar problems.
Scenario3Question05 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

66. Responsiveness: Determining who or which group will resolve this problem as quickly as possible.
Scenario3Question06 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

67. Accessibility: Selecting who or which group to use based upon the ease of communicating the problem referral to them.
Scenario3Question07 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

68. Describe how you selected the appropriate retention or referral, considering the factors listed above. Scenario3Question08	(Blank text box)
69. Describe how you selected the appropriate retention or referral if you used a factor that is NOT listed above. Scenario3Question09	(Blank text box)

This is a Moderate and Recurring problem.

70. Once the problem has been resolved I would…
You may select MORE THAN ONE of these actions

Scenario3Question10

- ✓ Not Record the solution or how the problem was resolved. 1
- ✓ Make a Personal Record of the solution for my own use. 2
- ✓ Broadcast the solution to my customers using email. 3
- ✓ Broadcast the solution to other IT support staff in an email group or the campus listserv (UNT-NETMAN). 4
- ✓ Record the solution details in a trouble ticket work log, solution table, knowledge base system, or FAQ 5
- ✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario3Question10_Other

71. Briefly, why did you select the action(s) that you chose in the list above (the decision whether or not to Record and/or Broadcast the solution)? Scenario3Question11	(Blank text box)

You received this problem in spoken form, in a telephone call or voicemail, or face-to-face.

72. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario3Question12

✓ Resolve or refer the problem <u>in spoken form.</u> 1

✓ Resolve or refer the problem <u>in a different medium more preferable to me</u>. 2

✓ Resolve or refer the problem <u>in a different medium only if the logical referral person or group prefers or requires it</u>. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario3Question12_Other

73. Briefly, state how the <u>spoken form</u> communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution.
    Scenario3Question13

    (Blank text box)

74. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario3Question14

✓ <u>Store the solution</u> for future use <u>in the original medium of the problem report</u>. 1

✓ <u>Store the solution</u> for future use <u>after changing the medium of the problem report</u> from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario3Question14_Other

75. Briefly, state how the <u>spoken form</u> communications medium of a problem notification affects your decisions to keep or change that format for solution recording.
    Scenario3Question15

    (Blank text box)

You received this problem electronically, in an email or a trouble ticket.

76. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario3Question16

✓ Resolve or refer the problem <u>in electronic form.</u> 1

✓ Resolve or refer the problem <u>in a different medium more preferable to me</u>. 2

✓ Resolve or refer the problem <u>in a different medium only if the logical referral person or group prefers or requires it</u>. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario3Question16_Other

77. Briefly, state how the <u>electronic</u> communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution. Scenario3Question17	(Blank text box)

78. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario3Question18

✓ <u>Store the solution</u> for future use <u>in the original medium of the problem report</u>. 1

✓ <u>Store the solution</u> for future use <u>after changing the medium of the problem report</u> from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario3Question18_Other

79. Briefly, state how the <u>electronic</u> communications medium of a problem notification affects your decisions to keep or change that format for solution recording. Scenario3Question19	(Blank text box)

Scenario 4: Moderate, New Problem

You have received notice of a problem for some of the computer users in your area of responsibility. It is an unknown problem that you have never heard of before, and it is preventing the users from accessing their email address books.

The Decision to Retain or Refer the problem…

80. **When notified of this problem, I would…**
Select ONE of these choices
Scenario4Question01

- ✓ Retain this problem in my group for troubleshooting and resolution. 1
- ✓ Retain this problem in my group but defer action on it until later. 2
- ✓ Retain this problem in my group to avoid referring it to a non-cooperative support group or person. 3
- ✓ Refer this problem to another support group with a high priority for resolution as soon as possible. 4
- ✓ Refer this problem to another support group, deferred for eventual resolution. 5
- ✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario4Question01_Other

81. Briefly, why did you select the action that you chose in the list above (Retention or Referral of the problem)?
Scenario4Question02 (Blank text box)

You have decided to either retain this problem, or to refer it to a different IT support person or group for resolution. You selected the most appropriate party to resolve the problem by determining the relative importance of several factors.

Please indicate the degree of importance of each factor in making this decision, in this situation.

82. Responsibility: Using referral tools, call-tracking categorization, organization, or contingency plans to determine who is responsible for resolving this problem.
Scenario4Question03 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

83. Credibility: Knowing from experience who or which group is the most appropriate choice for solving this or similar problems.
Scenario4Question04 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

84. Recommendation: Asking someone else who or which group is the most appropriate choice for solving this or similar problems.
Scenario4Question05 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

85. Responsiveness: Determining who or which group will resolve this problem as quickly as possible.
Scenario4Question06 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

86. Accessibility: Selecting who or which group to use based upon the ease of communicating the problem referral to them.
Scenario4Question07 (values 1-5)

□ Unimportant □ Of Little Importance □ Moderately Important □ Important □ Very Important

87. Describe how you selected the appropriate retention or referral, considering the factors listed above. Scenario4Question08	(Blank text box)
88. Describe how you selected the appropriate retention or referral if you used a factor that is NOT listed above. Scenario4Question09	(Blank text box)

This is a Moderate and New problem.

89. Once the problem has been resolved I would…
You may select MORE THAN ONE of these actions

Scenario4Question10

✓ Not Record the solution or how the problem was resolved. 1

✓ Make a Personal Record of the solution for my own use. 2

✓ Broadcast the solution to my customers using email. 3

✓ Broadcast the solution to other IT support staff in an email group or the campus listserv (UNT-NETMAN). 4

✓ Record the solution details in a trouble ticket work log, solution table, knowledge base system, or FAQ 5

✓ Other: (describe the action that you would take if it is not listed above) 6
Scenario4Question10_Other

90. Briefly, why did you select the action(s) that you chose in the list above (the decision whether or not to Record and/or Broadcast the solution)? Scenario4Question11	(Blank text box)

You received this problem in spoken form, in a telephone call or voicemail, or face-to-face.

91. Thinking about the resolution and referral process, in this situation I would be most likely to…
    Select ONE of these choices
    Scenario4Question12

✓ Resolve or refer the problem <u>in spoken form.</u> 1

✓ Resolve or refer the problem <u>in a different medium more preferable to me</u>. 2

✓ Resolve or refer the problem <u>in a different medium only if the logical referral person or group prefers or requires it</u>. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario4Question12_Other

92. Briefly, state how the <u>spoken form</u> communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution.
    Scenario4Question13

(Blank text box)

93. Assuming that you had decided to store this solution, in this situation you would be most likely to…
    Select ONE of these choices
    Scenario4Question14

✓ <u>Store the solution</u> for future use <u>in the original medium of the problem report</u>. 1

✓ <u>Store the solution</u> for future use <u>after changing the medium of the problem report</u> from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario4Question14_Other

94. Briefly, state how the <u>spoken form</u> communications medium of a problem notification affects your decisions to keep or change that format for solution recording.
    Scenario4Question15

(Blank text box)

You received this problem electronically, in an email or a trouble ticket.

95. Thinking about the resolution and referral process, in this situation I would be most likely to…
Select ONE of these choices
Scenario4Question16

✓ Resolve or refer the problem <u>in electronic form.</u> 1

✓ Resolve or refer the problem <u>in a different medium more preferable to me</u>. 2

✓ Resolve or refer the problem <u>in a different medium only if the logical referral person or group prefers or requires it</u>. 3

✓ Other: (describe the action that you would take if it is not listed above) 4
Scenario4Question16_Other

96. Briefly, state how the <u>electronic</u> communications medium of a problem notification affects your decisions to keep or change that format for tracking or referral to someone else for resolution.
Scenario4Question17

(Blank text box)

97. Assuming that you had decided to store this solution, in this situation you would be most likely to…
Select ONE of these choices
Scenario4Question18

✓ <u>Store the solution</u> for future use <u>in the original medium of the problem report</u>. 1

✓ <u>Store the solution</u> for future use <u>after changing the medium of the problem report</u> from its original form into something else. 2

✓ Other: (describe the action that you would take if it is not listed above) 3
Scenario4Question18_Other

98. Briefly, state how the <u>electronic</u> communications medium of a problem notification affects your decisions to keep or change that format for solution recording.
Scenario4Question19

(Blank text box)

Request for Permission to Contact You for an Interview

After the surveys have been reviewed, the researcher will select several for follow-up interviews.

99. Are you willing to participate in a follow-up interview with the researcher if asked to do so? InterviewOK01	___ Yes ___ No
100. Please Re-Enter your EUID to confirm your choice.	*Enter your EUID* InterviewOK02

Congratulations, You have completed the Survey!

Thank you very much for participating in this survey of IT support staff at the University of North Texas.

Please Click ONE LAST TIME on the button below to Submit your survey.

Button Text: Click Here to Submit the Survey

APPENDIX D

SURVEY RECRUITMENT LETTER

To: (email addresses of all APP-Support level users of the Remedy call-tracking system)

From: Chris Strauss (GroupWise address)

Subject: Invitation to participate in an information technology research study.

I am asking you to complete an online survey about how you solve information technology (IT) problems and keep track of the solutions in your workplace. This survey is being offered to all IT support staff members who have APP-Support or higher level permissions in the Remedy call-tracking application. The degree to which your department, team, or group actually uses Remedy is not a relevant part of this study, but having access to it and the solutions and knowledge base components contained within it, is a requirement. The survey will take approximately 25 minutes to complete. Some of you will be asked to participate in an interview, if at the end of the survey you have indicated your willingness to do so.

The details of this study are contained in the attached Informed Consent document, which you will need to print, read, sign, and return to me in order to participate in the study. You can return it to me thorough UNT campus distribution, or at one of the April DCSMT meetings.

Due to the length of the survey and the amount of time that will be needed for you to complete it, I will enter your EUID into a drawing for a Best Buy gift card after you have submitted a complete and valid survey. The cutoff date for survey submission will be posted on the survey, and the drawing will be held at a DCSMT meeting after that date.

I appreciate your participation in this study. Once you have signed and sent your consent form to me, you may complete the survey at https://web2survey.unt.edu/users/strauss/survey/index.html .

Christopher E. Strauss,

Principal Investigator: Graduate student in the University of North Texas (UNT) School of Library and Information Sciences.

Research Study: "Computer support interactions: the affect of projected problem trajectory and work experience on the problem resolution and solution recording behavior of IT support staff."

Please Sign and Return the attached form By UNT Distribution to:

CHRISTOPHER STRAUSS

ACADEMIC COMPUTING

INFORMATION SCIENCES BLDG ROOM 131

APPENDIX E

INFORMED CONSENT FORM

University of North Texas Institutional Review Board

Informed Consent Form

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study and how it will be conducted.

Title of Study: Computer support interactions: the affect of projected problem trajectory and work experience on the problem resolution and solution recording behavior of IT support staff.

Principal Investigator: Christopher E. Strauss, a graduate student in the University of North Texas (UNT) School of Library and Information Sciences.

Purpose of the Study

You are being asked to participate in a research study which is investigating how information technology (IT) support staff members make decisions as they receive problem reports from computer users and take steps to solve their various problems. The study is also investigating how and where IT support staff members may store solution information, once the problem has been solved.

Study Procedures

You will be asked to complete an online survey with questions about how you, as an information technology staff member, solve IT problems and keep track of the solutions in your workplace. The survey will take approximately 25 minutes to complete, and will ask you to respond to the same set of questions under four different problem scenarios. A small number of the people who completed the survey and have indicated a willingness to be interviewed will be asked to participate in an interview. The interview will be less than an hour long, and will be used to obtain additional detail on the survey responses and to verify some of the initial findings.

Foreseeable Risks

No foreseeable risks are involved in this study.

Benefits to the Subjects or Others

We expect the project to benefit you by providing information with which the administrator of the call-tracking and knowledge base applications can better tailor these systems to your needs. The insight that you provide into how computer problems are solved at this institution will be used to inform the design and configuration decisions that we must make for the next generation of Remedy applications.

Compensation for Participants

You will receive no compensation for your participation. Due to the length of the survey and the amount of time that will be needed for you to complete it, the investigator will enter your EUID into a drawing for a Best Buy gift card in the amount of $100 after you have submitted a complete and valid survey. The cutoff date for survey submission will be posted, and the drawing will be held at a DCSMT meeting after that date.

Procedures for Maintaining Confidentiality of Research Records

The raw data containing your EUID and the file linking the EUID to an anonymous identifier will be stored only in secure directories on UNT CITC servers. All data moved to workstations for analysis or presented to the academic community will have had the EUID replaced with the anonymous identifier. The only purpose of the EUID is to make selections for interviews possible, or any lookups into the call-tracking system or email for artifacts of transactions that you mention. Digital audio recordings of the interviews will be identified only with the anonymous identifier code, heard only by the investigator/transcriber, and archived offline. Once the dissertation has been completed, accepted, and published, the coding key containing the only identifying information will be destroyed. The confidentiality of your individual information will be maintained in any publications or presentations regarding this study.

Questions about the Study

If you have any questions about the study, you may contact Christopher E. Strauss at telephone number (940) 565-4979 or Dr. Linda Schamber, UNT School of Library and Information Sciences, at telephone number (940) 565-2445.

Review for the Protection of Participants

This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

Research Participants' Rights

Your signature below indicates that you have read or have had read to you all of the above and that you confirm all of the following:

- Christopher Strauss has described the study to you and answered all of your questions. You have been told the possible benefits and the potential risks and/or discomforts of the study.

- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.

- You understand why the study is being conducted and how it will be performed.

- You understand your rights as a research participant and you voluntarily consent to participate in this study.

- You have been told you will receive a copy of this form.

____

Printed Name of Participant

_______________________________ ____________

Signature of Participant Date

For the Principal Investigator or Designee

I certify that I have reviewed the contents of this form with the participant signing above. I have explained the possible benefits and the potential risks and/or discomforts of the study. It is my opinion that the participant understood the explanation.

_______________________________________ ___________

Signature of Principal Investigator or Designee Date

PLEASE SIGN AND RETURN THIS FORM BY UNT DISTRIBUTION TO:

CHRISTOPHER STRAUSS

ACADEMIC COMPUTING

INFORMATION SCIENCES BLDG ROOM 131

APPROVED BY THE UNT IRB
FROM 4/3/06 TO 4/2/07
SB

APPENDIX F

INTERVIEW RECRUITMENT LETTER

Subject: Request for Electronic or Telephonic Interview

Thanks again for filling out a survey for my information technology support research project. Your survey contained two elements that caught my eye: first, you had agreed to be interviewed, and second, in one or more of the problem scenarios you selected Other as the action for your decision to retain or refer the problem for resolution.

In the interest of time – yours and mine – I wanted to give you the opportunity to be interviewed electronically, via email, although at any point we can discuss this on the telephone instead. I have three short questions for you that you can answer and send back to me in email, or you can suggest a time for me to call and discuss them with you.

You may recall the introductory information to the scenario-based questions, but I will review it here to refresh your memory.

Each scenario was a unique combination of two major classifications of IT support problems, Severity, and Frequency of Occurrence, which were based upon a model of problem resolution processes developed specifically for this research study (overview diagram attached or at http://remedy.unt.edu/images/Problem_Trajectory.gif).

My problem resolution model was broken down into four (4) scenario quadrants for the Severity of the problem and the Frequency of Occurrence. Simplified, a problem was considered to fall into one of these four combinations of the two major classifications.

Severe, Recurring

Severe, New

Moderate, Recurring

Moderate, New

Severity of problem (a combination of criticality and scope which can be measured separately) is defined as follows:

1. Severe: this is a serious problem: one or more individuals cannot do administrative or academic work.

2. Moderate: this is a moderate problem: one or more individuals are experiencing limitations with information technology.

Frequency of Occurrence of problem is:

1. New: this is a novel problem, not seen before.

2. Recurring: this is a frequent problem, which has been seen before.

QUESTIONS:

1. How well do the two classifications of IT support problems and four combinations that I used in my model describe the world of IT problem solving that you see and experience?

2. How well does this four-quadrant model correlate to how you see and organize the IT problems in your workplace for resolution, or do the problems that you face have a different set of primary factors to consider?

3. What are the key factors or characteristics of IT problems that _you_ use to classify them in your workplace in order to decide how to process them?

You may simply want to answer these questions by replying to my email. If you want to discuss them over the telephone, let me know of a convenient time early next week (and the phone number to call) to contact you. If I have not heard back from you by some time Monday I will begin trying to call you at your listed number (UNT staff).

Thanks again for your assistance with my research effort.

APPENDIX G

VARIABLE CODEBOOK FROM SPSS

Table P1. *Codebook report of all variables reported from SPSS® Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, http://www.spss.com) statistical software.*

Var	Name	Type	Label	Values	Measure
1	RespondentID	String	Respondent ID	None	Nominal
2	SurveyVersion	String	Survey Version	None	Nominal
3	Gender	Numeric	Gender	{1, Male}...	Nominal
4	Age	Numeric	Age in Years	None	Scale
5	Education	Numeric	Educational Level	{1, Grade School}...	Ordinal
6	TrainingPresentCalculated	Numeric	Training for Present Job in Weeks	None	Scale
7	TrainingTotalCalculated	Numeric	Total Training for IT Support in Weeks	None	Scale
8	Question01SupportGroup	String	IT Support Group	None	Nominal
9	JobTenure	Numeric	Months Employed this job	None	Scale
10	WorkExperience	Numeric	Work Experience Bracket	{1, One Year}...	Ordinal
11	WorkExperience5yr	Numeric	Work Experience 5 Year Split	{0, Under 5 Years}...	Nominal
12	Question03FTStatus	Numeric	Employment Status	{1, Full Time}...	Nominal
13	Question04PartTime	String	Part Time Hours per Week	None	Nominal
14	PresentExperienceUNT	Numeric	Months Employed at UNT Now	None	Scale
15	PastExperienceUNT	Numeric	Months Employed at UNT Previously	None	Scale
16	TotalUNTExperience	Numeric	Months Total UNT IT Experience	None	Scale
17	Question07OtherExperience	String	Other IT Support Experience	None	Nominal
18	OtherExperienceNonUNT	Numeric	Months Employed in IT Not at UNT	None	Scale
19	TotalITExperience	Numeric	Months Total IT Support Experience	None	Scale
20	Question08AdditionalWorkDetail	String	Additional Details about IT work	None	Nominal
21	Top3WhoContactYou01	String	1 of Top 3 Who Contact You	None	Nominal
22	Top3WhoContactYou02	String	2 of Top 3 Who Contact You	None	Nominal
23	Top3WhoContactYou03	String	3 of Top 3 Who Contact You	None	Nominal
24	Top3WhoYouContact01	String	1 of Top 3 Who You Contact	None	Nominal
25	Top3WhoYouContact02	String	2 of Top 3 Who You Contact	None	Nominal
26	Top3WhoYouContact03	String	3 of Top 3 Who You Contact	None	Nominal
27	SupportUsers0	Numeric	End User Support Role	{1, Always}...	Nominal
28	SupportUsers5	Numeric	Level of IT Support Provided	{1, First Level}...	Nominal
29	SupportRoleText1	String	Primary IT Support Role	None	Nominal
30	Scenario1Question01	Numeric	SR Decision to Retain or Refer	{1, Retain to Resolve}..	Nominal
31	Scenario1Question01_other	String	SR Decision Other Text	None	Nominal
32	Scenario1Question02	String	SR Decision Explanation	None	Nominal
33	Scenario1Question03	Numeric	SR Decision Factor Responsibility	{1, Unimportant}...	Ordinal
34	Scenario1Question04	Numeric	SR Decision Factor Credibility	{1, Unimportant}...	Ordinal
35	Scenario1Question05	Numeric	SR Decision Factor Recommendation	{1, Unimportant}...	Ordinal
36	Scenario1Question06	Numeric	SR Decision Factor Responsiveness	{1, Unimportant}...	Ordinal
37	Scenario1Question07	Numeric	SR Decision Factor Accessibility	{1, Unimportant}...	Ordinal
38	Scenario1Question08	String	SR Decision Factor Selection Text	None	Nominal

Var	Name	Type	Label	Values	Measure
39	Scenario1Question09	String	SR Decision Other Factor Text	None	Nominal
40	Scenario1Question10_1	Numeric	SR Solution Not Recorded	{0, No}...	Nominal
41	Scenario1Question10_2	Numeric	SR Solution Recorded Personal	{0, No}...	Nominal
42	Scenario1Question10_3	Numeric	SR Solution Broadcast to Users	{0, No}...	Nominal
43	Scenario1Question10_4	Numeric	SR Solution Broadcast to IT Support	{0, No}...	Nominal
44	Scenario1Question10_5	Numeric	SR Solution Recorded Formally	{0, No}...	Nominal
45	Scenario1Question10_6	Numeric	SR Solution Recorded Other	{0, No}...	Nominal
46	Scenario1Question10_other	String	SR Solution Recorded Other Text	None	Nominal
47	Scenario1Question11	String	SR Solution Recorded Selection Text	None	Nominal
48	Scenario1Question12	Numeric	SR Spoken Action Selection	{1, Spoken Form}...	Nominal
49	Scenario1Question12_other	String	SR Spoken Action Other Text	None	Nominal
50	Scenario1Question13	String	SR Spoken Action Selection Text	None	Nominal
51	Scenario1Question14	Numeric	SR Spoken Storage Selection	{1, Spoken Form}...	Nominal
52	Scenario1Question14_other	String	SR Spoken Storage Other Text	None	Nominal
53	Scenario1Question15	String	SR Spoken Storage Selection Text	None	Nominal
54	Scenario1Question16	Numeric	SR Electronic Action Selection	{1, Electronic Form}...	Nominal
55	Scenario1Question16_other	String	SR Electronic Action Other Text	None	Nominal
56	Scenario1Question17	String	SR Electronic Action Selection Text	None	Nominal
57	Scenario1Question18	Numeric	SR Electronic Storage Selection	{1, Electronic Form}...	Nominal
58	Scenario1Question18_other	String	SR Electronic Storage Other Text	None	Nominal
59	Scenario1Question19	String	SR Electronic Storage Selection Text	None	Nominal
60	Scenario2Question01	Numeric	SN Decision to Retain or Refer	{1, Retain to Resolve}..	Nominal
61	Scenario2Question01_other	String	SN Decision Other Text	None	Nominal
62	Scenario2Question02	String	SN Decision Explanation	None	Nominal
63	Scenario2Question03	Numeric	SN Decision Factor Responsibility	{1, Unimportant}...	Ordinal
64	Scenario2Question04	Numeric	SN Decision Factor Credibility	{1, Unimportant}...	Ordinal
65	Scenario2Question05	Numeric	SN Decision Factor Recommendation	{1, Unimportant}...	Ordinal
66	Scenario2Question06	Numeric	SN Decision Factor Responsiveness	{1, Unimportant}...	Ordinal
67	Scenario2Question07	Numeric	SN Decision Factor Accessibility	{1, Unimportant}...	Ordinal
68	Scenario2Question08	String	SN Decision Factor Selection Text	None	Nominal
69	Scenario2Question09	String	SN Decision Other Factor Text	None	Nominal
70	Scenario2Question10_1	Numeric	SN Solution Not Recorded	{0, No}...	Nominal
71	Scenario2Question10_2	Numeric	SN Solution Recorded Personal	{0, No}...	Nominal
72	Scenario2Question10_3	Numeric	SN Solution Broadcast to Users	{0, No}...	Nominal
73	Scenario2Question10_4	Numeric	SN Solution Broadcast to IT Support	{0, No}...	Nominal
74	Scenario2Question10_5	Numeric	SN Solution Recorded Formally	{0, No}...	Nominal
75	Scenario2Question10_6	Numeric	SN Solution Recorded Other	{0, No}...	Nominal
76	Scenario2Question10_other	String	SN Solution Recorded Other Text	None	Nominal
77	Scenario2Question11	String	SN Solution Recorded Selection Text	None	Nominal
78	Scenario2Question12	Numeric	SN Spoken Action Selection	{1, Spoken Form}...	Nominal
79	Scenario2Question12_other	String	SN Spoken Action Other Text	None	Nominal
80	Scenario2Question13	String	SN Spoken Action Selection Text	None	Nominal
81	Scenario2Question14	Numeric	SN Spoken Storage Selection	{1, Spoken Medium}...	Nominal

Var	Name	Type	Label	Values	Measure
82	Scenario2Question14_other	String	SN Spoken Storage Other Text	None	Nominal
83	Scenario2Question15	String	SN Spoken Storage Selection Text	None	Nominal
84	Scenario2Question16	Numeric	SN Electronic Action Selection	{1, Electronic Form}...	Nominal
85	Scenario2Question16_other	String	SN Electronic Action Other Text	None	Nominal
86	Scenario2Question17	String	SN Electronic Action Selection Text	None	Nominal
87	Scenario2Question18	Numeric	SN Electronic Storage Selection	{1, Electronic Form}...	Nominal
88	Scenario2Question18_other	String	SN Electronic Storage Other Text	None	Nominal
89	Scenario2Question19	String	SN Electronic Storage Selection Text	None	Nominal
90	Scenario3Question01	Numeric	MR Decision to Retain or Refer	{1, Retain to Resolve}..	Nominal
91	Scenario3Question01_other	String	MR Decision Other Text	None	Nominal
92	Scenario3Question02	String	MR Decision Explanation	None	Nominal
93	Scenario3Question03	Numeric	MR Decision Factor Responsibility	{1, Unimportant}...	Ordinal
94	Scenario3Question04	Numeric	MR Decision Factor Credibility	{1, Unimportant}...	Ordinal
95	Scenario3Question05	Numeric	MR Decision Factor Recommendation	{1, Unimportant}...	Ordinal
96	Scenario3Question06	Numeric	MR Decision Factor Responsiveness	{1, Unimportant}...	Ordinal
97	Scenario3Question07	Numeric	MR Decision Factor Accessibility	{1, Unimportant}...	Ordinal
98	Scenario3Question08	String	MR Decision Factor Selection Text	None	Nominal
99	Scenario3Question09	String	MR Decision Other Factor Text	None	Nominal
100	Scenario3Question10_1	Numeric	MR Solution Not Recorded	{0, No}...	Nominal
101	Scenario3Question10_2	Numeric	MR Solution Recorded Personal	{0, No}...	Nominal
102	Scenario3Question10_3	Numeric	MR Solution Broadcast to Users	{0, No}...	Nominal
103	Scenario3Question10_4	Numeric	MR Solution Broadcast to IT Support	{0, No}...	Nominal
104	Scenario3Question10_5	Numeric	MR Solution Recorded Formally	{0, No}...	Nominal
105	Scenario3Question10_6	Numeric	MR Solution Recorded Other	{0, No}...	Nominal
106	Scenario3Question10_other	String	MR Solution Recorded Other Text	None	Nominal
107	Scenario3Question11	String	MR Solution Recorded Selection Text	None	Nominal
108	Scenario3Question12	Numeric	MR Spoken Action Selection	{1, Spoken Form}...	Nominal
109	Scenario3Question12_other	String	MR Spoken Action Other Text	None	Nominal
110	Scenario3Question13	String	MR Spoken Action Selection Text	None	Nominal
111	Scenario3Question14	Numeric	MR Spoken Storage Selection	{1, Spoken Medium}...	Nominal
112	Scenario3Question14_other	String	MR Spoken Storage Other Text	None	Nominal
113	Scenario3Question15	String	MR Spoken Storage Selection Text	None	Nominal
114	Scenario3Question16	Numeric	MR Electronic Action Selection	{1, Electronic Form}...	Nominal
115	Scenario3Question16_other	String	MR Electronic Action Other Text	None	Nominal
116	Scenario3Question17	String	MR Electronic Action Selection Text	None	Nominal
117	Scenario3Question18	Numeric	MR Electronic Storage Selection	{1, Electronic Form}...	Nominal
118	Scenario3Question18_other	String	MR Electronic Storage Other Text	None	Nominal
119	Scenario3Question19	String	MR Electronic Storage Selection Text	None	Nominal
120	Scenario4Question01	Numeric	MN Decision to Retain or Refer	{1, Retain to Resolve}..	Nominal
121	Scenario4Question01_other	String	MN Decision Other Text	None	Nominal
122	Scenario4Question02	String	MN Decision Explanation	None	Nominal
123	Scenario4Question03	Numeric	MN Decision Factor Responsibility	{1, Unimportant}...	Ordinal

Var	Name	Type	Label	Values	Measure
124	Scenario4Question04	Numeric	MN Decision Factor Credibility	{1, Unimportant}...	Ordinal
125	Scenario4Question05	Numeric	MN Decision Factor Recommendation	{1, Unimportant}...	Ordinal
126	Scenario4Question06	Numeric	MN Decision Factor Responsiveness	{1, Unimportant}...	Ordinal
127	Scenario4Question07	Numeric	MN Decision Factor Accessibility	{1, Unimportant}...	Ordinal
128	Scenario4Question08	String	MN Decision Factor Selection Text	None	Nominal
129	Scenario4Question09	String	MN Decision Other Factor Text	None	Nominal
130	Scenario4Question10_1	Numeric	MN Solution Not Recorded	{0, No}...	Nominal
131	Scenario4Question10_2	Numeric	MN Solution Recorded Personal	{0, No}...	Nominal
132	Scenario4Question10_3	Numeric	MN Solution Broadcast to Users	{0, No}...	Nominal
133	Scenario4Question10_4	Numeric	MN Solution Broadcast to IT Support	{0, No}...	Nominal
134	Scenario4Question10_5	Numeric	MN Solution Recorded Formally	{0, No}...	Nominal
135	Scenario4Question10_6	Numeric	MN Solution Recorded Other	{0, No}...	Nominal
136	Scenario4Question10_other	String	MN Solution Recorded Other Text	None	Nominal
137	Scenario4Question11	String	MN Solution Recorded Selection Text	None	Nominal
138	Scenario4Question12	Numeric	MN Spoken Action Selection	{1, Spoken Form}...	Nominal
139	Scenario4Question12_other	String	MN Spoken Action Other Text	None	Nominal
140	Scenario4Question13	String	MN Spoken Action Selection Text	None	Nominal
141	Scenario4Question14	Numeric	MN Spoken Storage Selection	{1, Spoken Medium}...	Nominal
142	Scenario4Question14_other	String	MN Spoken Storage Other Text	None	Nominal
143	Scenario4Question15	String	MN Spoken Storage Selection Text	None	Nominal
144	Scenario4Question16	Numeric	MN Electronic Action Selection	{1, Electronic Form}...	Nominal
145	Scenario4Question16_other	String	MN Electronic Action Other Text	None	Nominal
146	Scenario4Question17	String	MN Electronic Action Selection Text	None	Nominal
147	Scenario4Question18	Numeric	MN Electronic Storage Selection	{1, Electronic Form}...	Nominal
148	Scenario4Question18_other	String	MN Electronic Storage Other Text	None	Nominal
149	Scenario4Question19	String	MN Electronic Storage Selection Text	None	Nominal
150	Invitation	Numeric	Invitation to take Survey	{1, ARSLIST}...	Nominal
151	Invitation_other	String	Other Invitation to take Survey	None	Nominal
152	Organization	Numeric	Type of Organization	{1, Consulting}...	Nominal
153	Organization_other	String	Other Type of Organization	None	Nominal
154	AgeRange	Numeric	Age Range	{0, Up to 25}...	Nominal
155	SR_RetainRefer	Numeric	SR Retain or Refer	{0, Retain}...	Nominal
156	SN_RetainRefer	Numeric	SN Retain or Refer	{0, Retain}...	Nominal
157	MR_RetainRefer	Numeric	MR Retain or Refer	{0, Retain}...	Nominal
158	MN_RetainRefer	Numeric	MN Retain or refer	{0, Retain}...	Nominal
159	SR_StoreToShare	Numeric	SR Store to Share	None	Nominal
160	SN_StoreToShare	Numeric	SN Store to Share	None	Nominal
161	MR_StoreToShare	Numeric	MR Store to Share	None	Nominal
162	MN_StoreToShare	Numeric	MN Store to Share	None	Nominal

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