

Chapter 3

Study Design and Methodology

3.1. Introduction

This study conducted exploratory and descriptive research on the creation of a specific information technology standard to gain an understanding of how such standards are developed. Specifically, the researcher used a case study of *ANSI/NISO Z39.50: Information Retrieval (Z39.50) Application Service Definition and Protocol Specifications for Open Systems Interconnection* (National Information Standards Organizations, 1995) that had two primary goals:

- Document the development of Z39.50
- Develop a holistic understanding of Z39.50 development.

Chapter 2 highlighted both the critical need for standards in the networked environment and the current lack of systematic, empirical research on information technology standards development. These two conditions were primary motivations for the researcher.

To address the goals of this study, the researcher developed a multi-method research strategy that supported the exploratory and descriptive nature of the research. This chapter discusses the overall study design and the study's multiple data collection and data analysis activities used to collect sufficient data to answer the study's research questions. The chapter also highlights methodological issues and limitations encountered by the researcher.

3.2. The Research Strategy: Qualitative, Case Study, and Model Building

Keeping in mind the study's goals, the research strategy needed to support both the documentation of Z39.50 development and the understanding of its development. This strategy also needed to result in a data repository sufficient to answer three research questions posed by the study:

- What are the activities, entities, processes, and forces, and the contexts that influenced, enabled, or constrained Z39.50 development?
- What are the components of a systems-theoretic conceptual model that reflects Z39.50 development?
- What working hypotheses are warranted based on Z39.50 development to guide future research?

Three facets characterize the research strategy: qualitative, case study, and model building. The following sections discuss these three facets in more detail.

3.2.1. A Qualitative Study

Weiss and Sirbu (1990, p. 111) state that “when studying the process by which voluntary standards are developed, one is struck by the complexity and subtlety of the process.” Schmidt and Werle (1992) report on the difficulties in conducting research on standards development and suggest that the “empirical reconstruction of standardization processes is confronted with difficult problems of gathering and interpreting ‘data’.... Thus, in the final analysis not so much the problems involved in theorizing about standardization but rather the empirical difficulties of grasping the ‘real world’ of standard-setting processes may turn out to be the main impasses to this on-going research process” (p. 326). A suitable research approach for the study of Z39.50 would acknowledge the complexity of social processes and focus on both the context and specifics of Z39.50 development.

The researcher concluded that a qualitative research approach oriented towards discovery, description, and holistic understanding of processes and activities was a suitable point of departure. The following list identifies some basic assumptions of a qualitative study and links them to a study of Z39.50:

- *Research enables a holistic perspective:* Qualitative research assumes that a whole phenomenon is under study and that a complex system cannot be meaningfully reduced to several variables and linear causal relationships. Patton states, “The advantages of qualitative portrayals of holistic settings and impacts is that greater attention can be given to nuance, setting, interdependencies, complexities, idiosyncrasies, and context” (Patton, 1990, p. 51). The systems-theoretic conceptual framework discussed in Chapter 2 combined with a qualitative research approach oriented the study towards a holistic understanding of Z39.50 development.
- *Research incorporates an emergent design:* The research design cannot be completely specified in advance of the fieldwork. Understanding develops and evolves through the research process and each data collection and analysis activity informs subsequent data collection and analysis activities. This study, as an exploratory study, required flexibility to respond to the researcher’s evolving understanding and to pursue new avenues of inquiry as needed.
- *Research is descriptive:* Qualitative research focuses on describing and understanding a phenomenon. Description includes a detailed account of the context, the activities, the participants, and the processes. The goal of the research was to describe Z39.50 development and have that description assist in understanding it.
- *Research is primarily concerned with process rather than outcomes or products:* Qualitative research focuses on processes and is interested in understanding and describing dynamic and complex processes. This study was concerned with “what” and “how” questions about Z39.50 including: What was the Z39.50 development process? How was Z39.50 developed?
- *Research involves fieldwork:* Fieldwork implies that the researcher has direct and personal contact with the people involved in a phenomenon and in the natural setting of the phenomenon. The researcher conducted fieldwork with participants involved in the Z39.50 development to understand the phenomenon in its natural setting.
- *Research uses the researcher as the primary instrument for data collection and analysis:* Qualitative research assumes that data are mediated directly by the researcher rather than

through questionnaires, surveys, or other data collection instruments. In this study, the researcher collected data through examination of documentary evidence, interviews with participants in Z39.50 development, and observation of Z39.50 standards work.

- *Research is interested in how people make sense of their lives, how they interpret experiences, and how they structure their social world:* Standards development is a social process in which a variety of stakeholders come together to agree on one or more ways of doing something. A qualitative approach assumes that each stakeholder brings various interpretations and values to the process. This study directed attention to the individuals and their perceptions, values, and interpretations of Z39.50 development.
- *The process of research is inductive:* The qualitative research approach is exploratory and focuses on discovery. This study did not begin with a set of hypotheses to test, nor did it intend to test the generalizability or predictive power of the preliminary conceptual model. Instead, it collected data through a variety techniques and then used a modified inductive analysis, in conjunction with the systems model as an analytical tool, to identify and characterize important categories, dimensions, and interrelationships in the phenomenon.

Linking the assumptions to the specific character of the research demonstrates that a qualitative research approach was appropriate for this study. The study of Z39.50 development required:

- A holistic orientation to address the complex of activities, entities, processes, and forces, and their interrelationships
- A flexible research design to allow the researcher to pursue new directions in data collection as understanding developed during the research
- An orientation towards detailed description that addresses both the context and specifics of Z39.50 development.
- A focus on the participants and the process through fieldwork activities
- An inductive process that identifies and characterizes categories and patterns in the data and grounds the findings in the data.

This qualitative approach complemented the second facet of the research strategy, using a revelatory case study of one standard's development.

3.2.2. A Case Study

Stake (1994, p. 244) suggests that a case study is useful when “opportunity to learn is of primary importance.” A case study approach provides a mode of inquiry for an in–depth examination of a phenomenon. Yin (1989, p. 23) characterizes case study research as empirical inquiry that:

- investigates a contemporary phenomenon within its real–life context; when
- the boundaries between phenomenon and context are not clearly evident; and in which
- multiple sources of evidence are used.

He states that the “distinctive need” for case study research “arises out of the desire to understand complex social phenomena” (p. 14). Given that standards development is a complex social

process comprising activities, entities, processes, and forces and their interrelationships, a case study design was warranted.

The case study enables the use of multiple methods for data collection and analysis. The primary sources in this study were primary source materials and documentary evidence, interviews with key participants, and observation of the standards work. Each of these data sources provided the study with specific types of information (see Section 3.4. and Table 3–1 below for a summary of the data sources and type of data collected). Multiple sources of evidence and different data collection techniques (e.g., documentary evidence, interviews, and observations) are two of several methods that Patton (1990) suggests to improve the quality of the data and research findings.

Yin (1989, p. 48) argues that a single–case design is warranted or appropriate on the basis that the case is revelatory. A revelatory case is one for which there is a belief or assumption that the problems discovered in a particular case are common to other cases as well. If Z39.50 can serve as a revelatory case, then there is a basis, according to Yin, for discovering and describing problems that may be common to other cases of information technology standards development.

Beyond the aspects of Z39.50 development that made it a revelatory or interesting case, two other points suggest why this research was conducted on the development of a specific standard. First, Stake (1994, p. 237) described three types of case studies:

- *Intrinsic*: One explores a particular case to gain a better understanding of it
- *Instrumental*: A particular case is examined to provide information or insight on issues or the refinement of theory
- *Collective*: A number of cases are studied jointly in order to inquire into the phenomena, population, or general condition.

This study served both intrinsic and instrumental purposes. One research goal was to develop a holistic understanding of the development of Z39.50. The study explored and described a particular process. Given the rich history of Z39.50 development, documenting and understanding its development was valuable for its own sake, thus, the study served intrinsic purposes.

The study was instrumental to the extent that it shed light on problems and issues that may be common to other information technology standards development efforts. The study produced a revised model focused on describing and representing Z39.50 development. The model may have utility (i.e., be instrumental) in investigations of other information technology standards processes. The study also produced a set of working hypotheses that can guide subsequent research. Thus, as a revelatory case, the study of Z39.50 was aligned with Stake’s suggestion that a case study can serve instrumental purposes.

Case study research, while an appropriate research approach for studying the development of Z39.50, was not without limitations and problems. A major limitation of a single–case study is the lack of statistical generalizability. This study did not have a goal of generalizability but one of

understanding a complex phenomenon. The researcher believes, however, that insofar as Z39.50 may be a revelatory case of information technology standards development, it was possible to abstract or distill important conclusions for the study of one instance of standards development, conclusions that may be tested in other standards development contexts. The study, however, makes no claims for generalizability about other standards development activities based on this investigation of a single case.

Yin (1989) and Stake (1994) suggest the importance of setting boundaries of the case, or what is to be considered part of the case. Yin, in one example, suggests that specific time boundaries need to define the beginning and end of the case. Stake claims that bounding the case is part of conceptualizing the object of study. The study addressed bounding the case in two ways; temporal and logical. First, the study covered the time period from the initiation of the formal standards work in 1979 through the approval of Z39.50 Version 3 in 1995. Since a standards effort responds to problems, the study investigated the period prior to 1979 to understand, describe, and document the context from which the Z39.50 work emerged.

Second, the preliminary conceptual model introduced in Chapter 2 offers an initial logical bounding of the case. The model assumed standards development represents an open system, and the boundaries of the various systems or components are not firmly fixed or clear. The assumption is that open systems, by definition, have somewhat permeable boundaries. The preliminary model, however, provided a point of departure for what was investigated in the case study (i.e., the environment, the processes, the entities, the stakeholders, etc.).

3.2.3. Model Building

The third facet of the research strategy was that of model building. The systems–theoretic preliminary conceptual model introduced in Chapter 2 guided the initial stages of the research by identifying a framework for what was in scope of the case as well as reflecting the researcher’s previous experience and knowledge of standards development. To reiterate from Chapter 2, a model is an “explicit interpretation of one’s understanding of a situation, or merely of one’s ideas about that situation” and a “description of entities and the relationships between them” (Wilson, 1984, p. 8).

The model provided a sensitizing framework for approaching the topic of standards development. It did not drive the data collection as in traditional hypothetico–deductive research. Instead, the model organized concepts such as inputs, outputs, processes, information feedback, boundaries, and environment that the researcher explored indirectly in data collection. The model oriented the researcher, at least initially, towards inclusion and openness to discovering what data to collect rather than setting out limits and exclusions on what to attend or collect. Patton (1990, p. 218) points out, however, that the researcher “does not enter the field with a completely blank slate” and that “some way of organizing the complexity of reality is necessary.” He suggests that sensitizing concepts serve such a purpose by providing a “basic framework highlighting the importance of certain kinds of events, activities, and behaviors” (Patton, 1990, p. 216).

The study did not have a goal of developing a generalizable or predictive model. Instead, the study was an exercise in developing a descriptive model that would adequately represent Z39.50 development and accommodate the interactions and evolution of the standard. Wilson suggests that a model may be prescriptive or illustrative, “but above all, it must be useful” (p. 8). For this study, the revised model presented in Chapters 5 and 6 is a conceptual step forward in gaining a holistic understanding of Z39.50 development. The model is grounded in the study’s data and improves upon the descriptive power the preliminary model. While keeping within a systems–theoretic framework, the revised model extends the power of a systems perspective by accounting conceptually for the evolutionary mode of Z39.50 development.

Throughout this study, the goals of exploration and description took precedence over generalizability, predictability, and model testing. The results of the model building, however, lay the groundwork for subsequent research in standards development. The character of Z39.50 development discussed in Chapters 4 and 5 highlights the unpredictable and chance occurrences that impacted its development. While accommodated in the model, the conceptual insights related to such aspects of Z39.50 development need further exploration.

3.3. Study Design

The research strategy provided a framework for designing a systematic study that would address the study’s goals, objectives, and questions. This section summarizes the overall study design, activities, and the extent of data resulting from this approach.

Figure 3–1 presents the study’s design. The study design reflects the logical flow from the preliminary activities that initiated the study and the development of the preliminary conceptual model through the data collection and analysis, the refinement of the conceptual model, and the articulation of a set of working hypotheses.

- *Preliminary activities*—To justify and initiate the study, the researcher:
 - Conducted an extensive literature review of writings on standards development, previous research on standards development, theoretical frameworks and models appropriate to the research. The review corroborated the need for this research and provided support for the preliminary conceptual model
 - Conducted a series of preliminary interviews with experts in the standards arena that confirmed the need for research on this topic and assisted the researcher in identifying an initial list of issues related to standards development
 - Incorporated the researcher’s knowledge and assumptions about standards development (based on his previous involvement in Z39.50 standards development activities) into the study design and the preliminary conceptual model.
- *Development of preliminary conceptual model*—The researcher proposed a preliminary conceptual model based on a review of the literature and the researcher’s experiential knowledge to serve as a guiding framework for the research.
- *Data collection, data reduction, and data analysis*—The researcher collected data sufficient to address the study’s three research questions by using multiple methods of

data collection and multiple sources of evidence. Collection and analysis was an iterative process. The researcher coded the data as a method of data reduction. Synthesis of the data involved comparing and checking data from various sources.

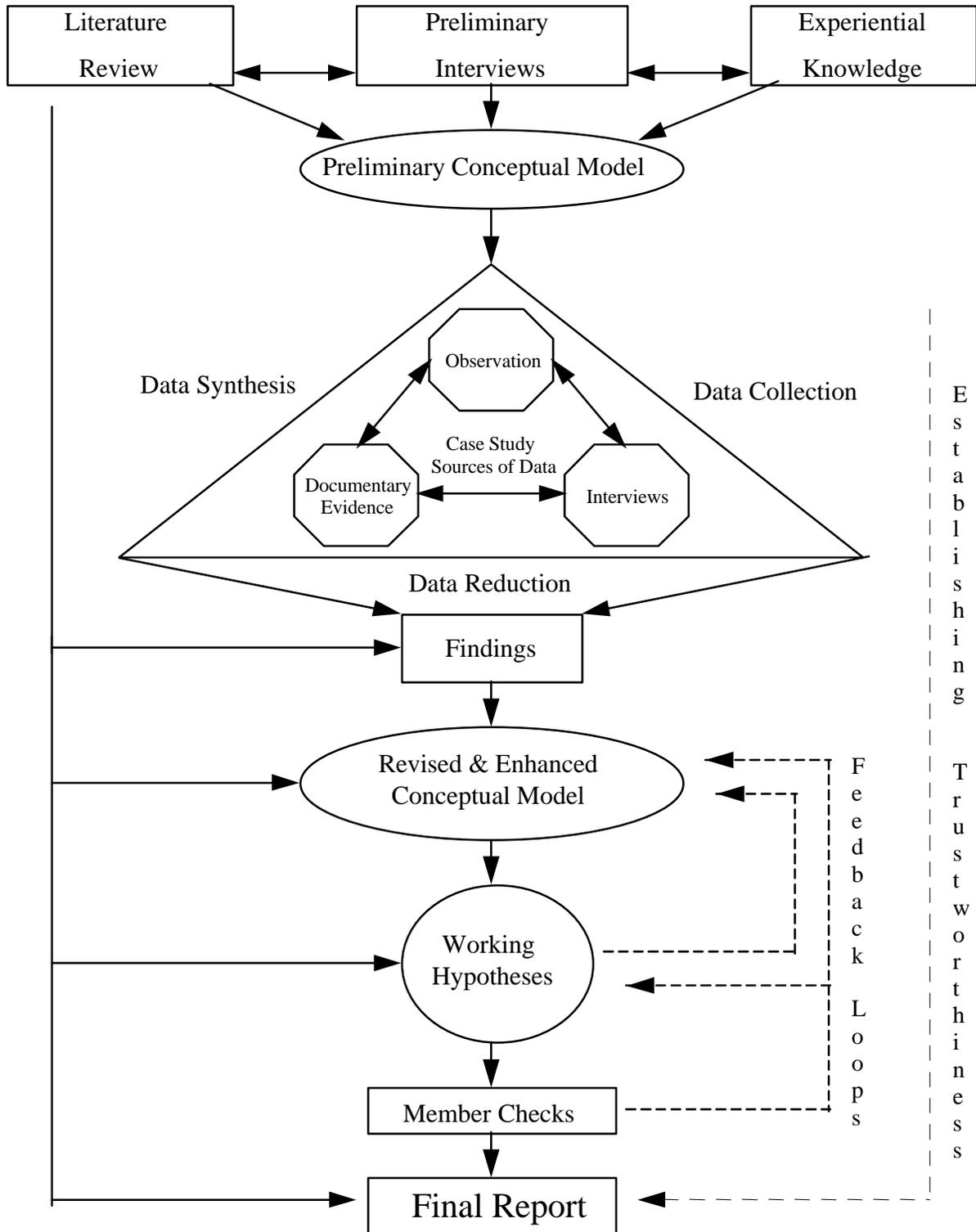
- *Findings*—The researcher reported findings from the data in two separate accounts: an historical reconstruction of Z39.50 development, and a set of key findings framed in the context of the systems–theoretic model.
- *Revise and enhance the conceptual model*—On the basis of the findings from the data analysis, the researcher revised the preliminary conceptual model to represent the development of Z39.50.
- *Derive working hypotheses*—On the basis of the exploration and description of Z39.50, the researcher identified a set of working hypotheses. These statements, based on study findings, propose relationships between activities, entities, forces, and processes involved Z39.50 development to be tested in subsequent research.
- *Member checks*—The researcher engaged participants and experts in Z39.50 and other standards efforts to respond to and comment on data and findings to their accuracy and credibility.
- *Final report*—The researcher compiled the results of all study activities into this document.

Figure 3–1 identifies the primary sources and methods for collecting data (i.e., documentary evidence, interviews, and observations) and suggests that a central part of the research is the data collection, data reduction, and data synthesis activities. These three activities were linked in an iterative process. The researcher collected, analyzed, and synthesized data, an understanding of which guided subsequent data collection. The study design assumed an evolving understanding on the part of the researcher that guided the purposeful collection of additional data.

Purposeful sampling (Lincoln & Guba, 1985) was an integral component of the study’s evolving design: as the researcher collected and analyzed data, the researcher identified additional data needed to refine the emerging understanding. Purposeful sampling (more or less synonymous with theoretical sampling (Glaser and Strauss, 1967)) is characteristic of qualitative inquiry and is based on “informational, not statistical, considerations...Its purpose is to maximize information, not facilitate generalization” (Lincoln & Guba, 1985, p. 202).

Establishing trustworthiness for the study was an ongoing process. Section 3.6. describes the activities the researcher used to improve the overall quality and trustworthiness of the study. For example, prolonged engagement with the participants in the development of Z39.50 and triangulation using multiple sources of evidence and different data collection techniques were important activities for establishing trustworthiness in the data collection and analysis phases of the research. The researcher used member checks at various points during the research to assess the accuracy of data and the credibility of study findings.

**Figure 3-1
Research Design**



3.4. Sources of Data and Data Collection Activities

The study used three techniques to collect data:

- Documentary evidence consisting of primary source material related to Z39.50 development.
- Guided interviews with participants in Z39.50 development and experts or stakeholders related to standards development
- Participant observation of Z39.50 standards development.

This section discusses the sources of data, the techniques to collect the data, and the data collected. Section 3.5. describes procedures for managing the study's data.

Since this was a qualitative study, the researcher anticipated the multiple methods and multiple sources of data would result in a wealth of textual data. To give an indication of the mass of data produced in the course of the study, the following summarizes the data collection events and the resulting data.

- *Documentary Evidence*: Nearly 400 primary source documents selected from three primary repositories of records related to Z39.50. Most of these were summarized and analyzed, the results of which amount to approximately 150 pages. Some of the documentary evidence was available in electronic format (e.g., minutes of Z39.50 Implementors Group meeting in electronic format comprised nearly 250 pages).
- *Guided Interviews*: Three categories of interviews (i.e., preliminary, Z39.50 participants, debriefing) involving nearly 30 individuals. Typical interviews lasted approximately 60 to 90 minutes and resulted in transcripts averaging 10–15 single-spaced pages (nearly 300 pages of interview data).
- *Participant Observation*: Recorded approximately 100 pages of field notes from three Z39.50 Implementors Group meetings.

The researcher estimates the data collection resulted in approximately 800 pages of textual data that served as the foundation for answering the study's research questions.

Most of the data collection focused on answering the first research question:

- What are the activities, entities, processes, and forces, and the contexts that influenced, enabled, or constrained Z39.50 development?

Primary source material and documentary evidence, guided interviews, and participant observation all focused on addressing this question. The resulting data also served as the basis for answering the second and third research questions:

- What are the components of a systems-theoretic conceptual model that reflects Z39.50 development?

- What working hypotheses are warranted based on Z39.50 development to guide future research?

Answering these questions, however, was less a matter of collecting additional data but rather analysis and model building. Thus, the extensive data collection effort resulted in sufficient data upon which to base answers to the three research questions.

3.4.1. Preliminary Interviews with Experts on Standards Development Processes

As part of the process in designing the study, the researcher conducted seven preliminary interviews with experts in the field of information technology standards and standards development. The experts represented key participants from a variety of standards development processes and contexts (see Appendix A for names, organizational affiliations, and dates of those interviews). Several of the interviewees had direct involvement in the development of Z39.50.

The purpose of the interviews were to:

- Gain preliminary background on general issues and concerns related to information technology standards development
- Investigate whether research on the topic is warranted
- Provide a basis for developing the scope and orientation of the research.

These interviews informed the researcher's preliminary understanding of some of the concerns and issues related to standards development and corroborated the assertions that technology standards is problematic. The interviews confirmed the researcher's perception that a systematic research study on standards development was warranted.

The interviews also provided a broad context in which to view Z39.50 development. Although this study investigated the specifics of Z39.50, the preliminary interviews provided data on the broader context of information technology standards development. Understanding this broader context allowed the researcher to locate Z39.50 development in a larger sphere of standards development. Thus, these interviews also provide data relevant to the first research question.

3.4.2. Primary Source Material and Documentary Evidence

Yin (1994, p. 81) states that documentary information "is likely to be relevant to every case study topic." Merriam (1988, p. 118) claims that "documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem." The researcher relied on primary source material for developing an accurate chronology of Z39.50 development, identifying key organizations and individuals involved with Z39.50, and discovering information related to the context within which Z39.50 developed. This data was critical in answering the first research question.

A key criteria for selection of primary source material was its authority (e.g., official report of a meeting) to establish a document's credibility. A second criteria was a document's relevance to Z39.50 development. The strategy for collecting primary source material was to identify relevant documents and record information from or about those documents. As appropriate in an exploratory study, the researcher's criterion of relevance expanded as his understanding evolved. Some documents became more relevant on the basis of knowledge gained from the study's other data collection activities (e.g., an interview) or simply because the researcher was able to synthesize information from those documents only after having analyzed other documents.

Three repositories were sources of official and unofficial documents regarding the development of Z39.50:

- The National Information Standards Organization (NISO) Archives at the University of Maryland, College Park, MD
- The Council on Library Resources (CLR) Archives, Washington, DC
- The Z39.50 Maintenance Agency, Library of Congress, Washington, DC

These sources provided highly credible data related to administrative, organizational, and institutional aspects of Z39.50 development. These records (official and semi-official) were essential sources for names of organizations and individuals and the dates of activities and events involved in Z39.50 development. The repositories included records of meetings and activities of numerous groups and projects directly or indirectly associated with Z39.50.

The NISO Archives and the Z39.50 Maintenance Agency included the official results of Z39.50 balloting (i.e., comments and votes) of NISO members. Additionally, the NISO and Z39.50 Maintenance Agency archives contained important project documents, papers, and reports that provide an indication of influences on the technical development of Z39.50.

The CLR archives provided reports on its funding of and interaction with the standards developing organization responsible for Z39.50. At the outset of the Z39.50 standards work CLR initiated a major effort, the Bibliographic Service Development Program (BSDP). As part of BSDP, CLR funded computer-to-computer protocol development, and the results of that development had a dramatic impact on Z39.50 evolution. Data about BSDP were critical to understanding that interaction.

As a result of this data collection effort, the researcher identified approximately 400 documents including meeting agendas and minutes; correspondence among key participants involved in Z39.50 development; technical reports; and records related to financing, managing, and administering Z39.50 development. The researcher complemented these primary source materials with a range of published reports, articles, and books related to Z39.50 development. Reliance on primary source materials, however, provided an important quality assurance for the credibility of the data (see Section 3.6. for a discussion of data quality).

3.4.3. Guided Interviews with Z39.50 Participants and Stakeholders

Interviews provide a way of collecting information on and finding out about things that the researcher cannot directly observe (Patton, 1990). Interviews are an important data collection technique for a case study since “case studies are about human affairs.... These human affairs should be reported and interpreted through the eyes of specific interviewees, and well-informed respondents can provide important insights into a situation” (Yin, 1994, p. 85). For this study, the interviews served several of the purposes listed by Lincoln and Guba (1985, p. 268):

- Obtaining here-and-now constructions of a phenomenon
- Reconstruction of previous events
- Projections of the future
- Verification and corroboration of data from other sources (triangulation).

The researcher conducted interviews with a variety of individuals who participated in or were observers of Z39.50 development and with individuals whose organizations were Z39.50 stakeholders. Interviews with participants and observers provided a basis for understanding Z39.50 development from the perspectives of the people directly or indirectly involved. The interviews provided historical information (e.g., background on the context, origin, and early development of the standard) and information about more recent development activities (e.g., the Z39.50 Implementors Group (ZIG) processes). This data also served to answer the first research question.

For purposes of systematic research design, the researcher identified two primary thrusts in the interviews:

- Interviews to gather historical and contextual information on Z39.50 (e.g., interviews with early advocates/visionaries)
- Interviews to gather information on the processes and activities involved in Z39.50 development (e.g., interviews with individuals directly involved in developing the standard).

These categories were not mutually exclusive, and, in some cases, a single interviewee fit into both categories.

Available resources limited the number of interviews the researcher could conduct. To ensure that the interviewees represented a wide range of participants and perspectives on Z39.50 development, the researcher used purposeful sampling techniques to select interviewees. Purposeful sampling aims at maximizing information collection for variance (Lincoln & Guba, 1985) and identifies information-rich sources for in-depth data collection (Patton, 1990). Two objectives guided the researcher in selecting interviewees: maximize the breadth of perspectives on the Z39.50 development; and focus on specific topics for which the researcher needed additional explanation, characterization, and refinement.

The researcher developed a list of people as potential interview candidates. The documentary evidence provided important leads to certain interview candidates (e.g., membership on Subcommittee D, attendance lists from the ZIG meetings). Interviewees suggested other potential candidates, and the researcher's own involvement with Z39.50 development assisted in identifying key participants to interview. Selection criteria for interview candidates included:

- Role of individual in Z39.50 evolution (e.g., was the individual involved in earlier or later Z39.50 development, did the individual serve on Subcommittee D or participate in the Z39.50 Implementors Group, could the individual serve as a spokesperson for an organizational stakeholder in Z39.50 development, etc.)
- Assessment of authority and knowledge of individual in discussing Z39.50 development (e.g., was the individual a chair of a committee or group or did the individual have technical expertise in addressing certain topics related to the standard)
- Organizational affiliation (i.e., identifying the individual's organizational affiliation to ensure a range of organizations' perspectives).

The goal of these interviews was to ensure broad representation of perspectives on Z39.50 development and maximize the range of information collected. Data from these interviews shed additional light on answers to the first research question. The researcher conducted approximately 20 guided interviews and Appendix A contains a list of interviewees.

The interviews were semi-structured. Patton (1990, p. 280) characterizes such interviews as a "general interview guide approach" in contrast with the "informal conversational interview" and the "standardized open-ended interview." The researcher developed a series of interview guides that outlined a set of issues and questions to cover in the interview. While the general topic of Z39.50 development was common in all the interviews, the researcher crafted specific questions appropriate for interviewees. The guides allowed the researcher to be flexible and responsive to unexpected paths and discoveries during the interview. "Thus the interviewer remains free to build a conversation within a particular subject area, to word questions spontaneously, and to establish a conversational style—but with the focus on a particular subject that has been predetermined" (Patton, 1990, p. 283).

Some of the interview guides served as a template for interviews with several individuals (e.g., current participants of the ZIG). Because of the purposeful sampling strategy, however, the researcher had to craft many of the guides individually for interviews. Appendix B contains samples of interview guides used.

The researcher recorded the majority of interviews (with the permission of the interviewee). When interviewees granted permission to have their interviews recorded, they were asked for permission to use direct quotes from the interview, with the stipulation that neither they nor the organizations they are affiliated with would be associated with any of the direct quotes or paraphrases of their words. Subsequent to the interview, the researcher transcribed the recorded sessions for analysis.

3.4.4. Participant Observation of Z39.50 Standards Work

Participant observation, as a data collection technique, implies an active engagement with individuals in their natural setting. For this study, the researcher had direct experience with Z39.50 standards work by attending meetings of the Z39.50 Implementors Group (ZIG), the forum in which the standards work has occurred since 1990.

Guba and Lincoln (1981, p. 193) offer the following basic arguments for the utility of participant observation:

- Maximizes the inquirer's ability to grasp motives, beliefs, concerns, interests, unconscious behaviors, customs and the like
- Allows the inquirer to see the world as his subjects see it, to live in their time frames, to capture the phenomenon in and on its own terms, and to grasp the culture in its own natural, ongoing environment
- Provides the inquirer with access to the emotional reactions of the group introspectively—that is, in a real sense it permits the observer to use himself as a data source
- Allows the observer to build on tacit knowledge, both his own and that of members of the group.

Participant observation in this study involved two components: 1) observation of ZIG meetings and recording the observation in a set of field notes; and 2) interviews subsequent to the meetings with selected participants to serve as debriefings and member checks for data quality of the researcher's field notes.

During the research, Z39.50 was under active development by a group of Z39.50 implementors. As described in Chapter 4, the ZIG has assumed *de facto* responsibility (in conjunction with the Z39.50 Maintenance Agency) for evolving Z39.50. ZIG meetings were opportunities for the researcher to observe the current processes involved with standards work. The researcher was a participant observer at the following regularly scheduled meetings of the ZIG:

- September 1994, Triangle Park, North Carolina
- January 1995, Palo Alto, California
- September 1995, Washington, DC.

One intervening meeting in April 1995 was held in Europe, but the researcher was unable to attend that meeting.

The role of the researcher at these meetings was to observe individuals, activities, events, and processes. During the meetings, the researcher recorded observations and impressions in a set of field notes. Following Merriam (1988, p. 98), the field notes included descriptions of the setting, the people, and activities; direct quotations or summaries of what people said; and observer comments. The researcher paid particular attention to the processes by which the ZIG worked, how decisions were made, the key participants, and a range of other activities.

One concern about participant observation is the potential for researcher bias (Yin, 1994, p. 89). This study used prolonged engagement as one mechanism to improve the quality of data

collected. Prolonged engagement offered the researcher a means to view individuals, activities, events, and processes over time. The researcher should also note that the meetings attended during this study were not the only interaction he had with the ZIG. The researcher had attended past meetings of the ZIG. He attended the first organizational meeting of the ZIG in 1990 while an employee of the Library of Congress. He also attended regularly scheduled ZIG meetings during 1993 and 1994 as part of his responsibilities related to the Government Information Locator Service project.

A series of interviews with participants in the meetings attended by the researcher served as another strategy to reduce researcher bias in the participant observation data collection. The researcher identified participants and arranged interviews with them subsequent to each ZIG meeting. These interviews were debriefings during which the ZIG members identified what they saw as important aspects of the recent meeting, and commented on and interpreted what they experienced at the ZIG meeting. The interviews served the purpose of a member check in which the researcher could assess the quality and accuracy of his field notes, his observations, and his understanding of meeting activities and behaviors.

The researcher used purposeful sampling to select these candidates, based on the following criteria:

- Experience with ZIG meetings (having attended three or more previous meetings)
- Represent distinct stakeholder communities (e.g., vendor and university)
- Willing to commit to debriefing interviews over several meetings.

The researcher identified three individuals willing to participate (see Appendix B)

Although the researcher did not attend the April 1995 meeting, interviews with participants who attended that meeting assisted in gaining information about that meeting, which was especially important since it was the first ZIG meeting held outside of North America.

The interviews took the form of guided interviews. Appendix B contains a sample interview guide. The researcher conducted interviews via telephone usually within one week of the ZIG meeting, facilitating participants' recall of the meeting. The conversations were recorded (with the permission of the interviewee).

The ZIG produced a set of minutes for each of their meetings, and the minutes for the meetings attended by the researcher complemented and supplemented his field notes.

3.4.5. Summary of Data Collection for Case Study

The study's three data collection techniques offered complementary perspectives on the development of Z39.50. Each technique collected different types of information, each of which had special utility for the research. A primary concern of the data collection was to develop a data repository upon which the researcher could answer the study's research questions, especially

the first research question. Table 3–1 summarizes the sources of data and the utility of each type of data.

The multi–method approach for the study’s data was to maximize the range of information available to the researcher, improve the trustworthiness of the data, and provide a basis for triangulation between data sources. Each data source and technique had particular advantages and disadvantages, and by using a combination of sources and techniques, inadequacies of one source or technique was supplemented by the advantages of another source or technique. The combination of data sources also provided a mechanism to gain different perspectives on the development of Z39.50—official records, personal interpretations, and direct experience with the process of Z39.50 development.

Table 3–1
Type and Utility of Data from Each Data Collection Activity

Data Source	Type of Data	Utility of Data	Purpose
Primary Source Material and Documentary Evidence	Textual data in the form of: - Official Records; - Historical and Chronological Data; - Administrative Procedures	Provided official and semi–official accounts of Z39.50 development; Corroborated data gathered from other sources	Assisted in discovering activities, entities, processes, and forces, and the contexts that influenced, enabled, or constrained the development of Z39.50
Guided Interviews	Textual data in the form of: - Participants’ Constructions, Reconstructions, and Projections; - Historical and Contextual Information	Provided in participants’ own words, their interpretation and understanding of problems and issues related to Z39.50 development; Corroborated data gathered from other sources	Assisted in discovering activities, entities, processes, and forces, and the contexts that influenced, enabled, or constrained the development of Z39.50
Participant Observation	Textual data in the form of: - Researcher’s Field Notes (Observations and Experience of Individuals, Events, Activities, and Process	Provided researcher with experience of Z39.50 development in the natural context of the people and activities involved.	Assisted in collecting descriptive details about current Z39.50 development and to interpret and understand data collected in the guided interviews.

Although the researcher focused data collection first on an examination of documentary evidence, data collection was in fact an iterative and interactive process using all three data sources. For example, the archives provided important historical information, but some materials gained meaning and utility only because of information gathered through the interviews. As an example, a document in the archive listed a person’s name and some action taken by the person. In a subsequent interview, an interviewee discussed that person and the importance of an action taken

by that person. Knowledge gained through the interview, in effect, changed the researcher's relevance assessment of the original document.

3.5. Data Management and Analysis

The data collection activities resulted in a wealth of qualitative data. Two primary challenges faced the researcher: 1) management of the data, and 2) analysis of the data. The following sections describe the activities related to managing and analyzing the data.

3.5.1. Overall Strategy for Processing Qualitative Data

In qualitative research, the researcher gives primacy to the data, not to pre-existing or pre-defined variables or hypotheses. In general, a researcher works from the data through a process of induction to determine the categories, patterns, and working hypotheses. Developing coding categories can be accomplished by examining the data for regularities, patterns, and topics and using words or phrases to represent the topics and patterns (Bogdan and Biklen, 1992). The purpose of coding the data is to "facilitate the search for patterns and themes" in the data (Patton, 1990, p. 384).

For this study, the preliminary conceptual model provided a "sensitizing framework" (Patton, 1990, p. 216) for data collection and data analysis. The preliminary conceptual model not only assisted in organizing and orienting the study and data collection, it also assisted in the development and application of coding categories in the data. The data analysis was inductive in the sense used by Patton, the "inductive application of sensitizing concepts...to examine how a particular concept is manifest in a particular setting or among a particular group of people" (Patton, 1990, 391). For example, the preliminary conceptual model included "input" as one of the model's components. Analyzing the data inductively implies that the concept of "input" needed to be grounded in the data, and further that the data provided a way of establishing the characteristics, parameters, and other attributes of that construct.

As the analysis proceeded using the systems model to provide coding categories, the researcher also identified (inductively) instances in the data that comprised coding categories beyond those provided by the systems model. In the revised conceptual model presented in Chapter 5, components such as *relevant environment* and *mediating mechanisms* emerged through the data analysis and assisted in describing Z39.50 evolution.

3.5.2. Data Management and Preparation for Analysis

Data collection resulted in the accumulation of a large amount of data, primarily qualitative. Data collected during the research took a number of forms: transcripts of interviews, documents, summaries/abstracts of documents, and researcher memos. The majority of data was in machine-readable format (e.g., interviews will be tape recorded and then transcribed). Prior to formal

analysis of the data, the researcher put in place several data management procedures to organize and stabilize the various types of data.

FolioViews (Folio, 1994), a full-text database management software program, served as the primary tool for data management. The program allowed the creation of one or more databases to store and manage the data collected. FolioViews has hypertext capabilities that allowed the researcher to link between various data instances. It also provided the ability to code and index the data. Integrating the various research activities and products (e.g., raw data, coding, codebook development, recording methodological decisions, reflective memos) provided the basis for an “audit trail” (Guba, 1981, p. 87).

The primary source material gathered from the various archival repositories consisted of reports, meeting agendas and minutes, correspondence, and standardized forms used by various individuals. To the extent possible, the researcher made copies (electronic or paper) of relevant documents for his research files. When source material was in machine-readable form (e.g., ZIG meetings), the entire document was stored in FolioViews. If no copy was made, the researcher summarized salient points from the document. The researcher created document inventory records and logged them in a FolioViews database. These records contained a unique document identifier, date of the document, archival source, author of document, a short summary, and an indication whether the research file contained a copy of the document. Figure 3–2 provides examples from the documentary evidence database.

In addition to maintaining an online and searchable inventory of the approximately 400 primary source materials and documents, the researcher physically organized the documents according to two primary facets: topical or organizational association, and chronology. The primary source material was foundation for developing the historical reconstruction of Z39.50 evolution, and this organization provided an efficient way to analyze and compile information for the reconstruction reported in Chapter 4.

For the guided interviews, the researcher recorded the majority of interviews and then transcribed the tape of each interview. Although this was a time consuming process, the richness of many of the interviews warranted such an effort. For research such as undertaken in this study, Lofland and Lofland (1995, p. 88) suggest that “it is generally not necessary for you to transcribe every word, exclamation, or pause that occurs in an interview.... You do not need a verbatim transcription of everything the interviewee said...” The primary rule for transcription in this study was: transcribe and/or summarize the portions of the interview that are relevant to the research. The rule allowed the researcher flexibility in transcribing verbatim or summarizing sections of the interview. Verbatim transcription was essential to get the interviewees exact words related to standards development and specifically Z39.50 development. The general rule allowed the researcher to determine the level of effort in the transcription based on a sense of what data would be useful in subsequent analysis.

In cases where interviewees did not want the conversation recorded, the researcher wrote up detailed notes of the interviewers as soon as possible after the interview was conducted. Appendix C contains selections from two interviews; one is a transcription from a recorded

interview and the other is the researcher's write-up from a non-recorded interview. After the researcher transcribed the interviews, he stored these in another FolioViews database for subsequent analysis.

Figure 3-2
Document Inventory Record Examples

DocID: 1
Document Date: 2/2/79
Source: LC/MA
Author: SHM Copy in File?: Yes
Official form recommending that work begin on developing "American National Standard Computer Network Protocol for Library and Information Science Applications." The form provides for: Name of Recommended Standard, Purpose, Scope, Applicability, Users/Beneficiaries, Potential Funding Sources, Suggested Subcommittee Members. States that the source of the draft standard "should be based on the applications protocol developed by an NCLIS sponsored task force and published in A Computer Network Protocol for Library and Information Science Applications.

DocID: 280
Document Date: 8/23/88
Source: LC/MA
Author: PRH Copy in File?: No
Publication information — published by Transaction Publishers. Letter from Pat Harris to RD, August 23, 1988 telling him that the mss. was sent to Transaction for editing and publishing. RD's responsibilities include: review and approve the galley proofs and approve all editorial changes to the manuscript. Time schedule will not allow consultation with the people who worked on the development of the standard (i.e., SC D).

DocID 381
Document Date: 1/11/95
Souci: LC/MA
Author: Copy in File? Yes
Minutes from the eighteenth meeting of the ZIG held at Stanford University Hotel, Palo Alto, CA sponsored by RLG, on January 11-13, 1995. Attendance list attached.

Field notes from the observations of the ZIG meetings were in machine-readable form and contained descriptions of the meeting, activities and processes, participants, and observer comments. The researcher created another FolioViews database for these field notes. Other documents and records from the meetings (e.g., attendance lists, agendas) were inventoried similar to the primary source and documentary evidence as described above.

Finally, the researcher identified a range of published accounts of Z39.50 and its development, or other documents related to its development. These documents included articles, books, and technical reports in both paper and electronic formats. The researcher managed these using conventional bibliographic control procedures (i.e., citation).

3.5.3. Data Analysis

The researcher collected data from various sources and used the data management tools and procedures in preparation for analysis. As appropriate for an exploratory and descriptive study in which the study's design evolved over the course of the research, there was not a clearly defined line between data collection, data analysis, and preliminary write-up of findings. For example, simply in choosing primary source documentary evidence (i.e., data collection) involved analysis and determination of relevance.

In the first phase of analysis, the researcher concentrated on documenting the development of Z39.50. Primary source materials and documentary evidence were the basis for the historical reconstruction of Z39.50 reported in Chapter 4. This was a logically prior step for developing a holistic understanding of Z39.50 development. In effect, the researcher analyzed the data to address Study Objective 1 (O1) and Research Question 1 (RQ1) through the historical reconstruction.

O1: Identify and describe the context within which Z39.50 development occurred and discover the important factors that enabled or constrained its development.

RQ1: What are the activities, entities, processes, and forces, and the contexts that influenced, enabled, or constrained Z39.50 development?

Based upon that solid foundation, the researcher proceeded to analyze the data to address the second study goal and, in particular, Study Objective 2 (O2) and Research Question 2 (RQ2):

O2: Revise and refine the preliminary conceptual model of information technology standards development to reflect Z39.50 development.

RQ2: What are the components of a systems-theoretic conceptual model that reflects Z39.50 development?

The intention was to evolve the preliminary model to provide the basis for a holistic understanding of Z39.50 development and address second study goal. The preliminary model provided a framework for analyzing the interview data.

3.5.3.1. Analysis of Primary Source Material

Analysis of the primary source material for developing a historical reconstruction of Z39.50 development focused first on outlining the chronology of that development. The primary source materials had a high credibility since they included official records of the standards work for Z39.50 such as meeting minutes and summaries, correspondence, and reports. The researcher had organized and inventoried the primary source material (described above). He then examined each of the documents and recorded in chronological order in a FolioViews database entries for all documents. Each entry included a summary of salient points from the document, and each entry linked back to the database document inventory record (Figure 3-2).

While developing the chronology, the researcher examined the documents in detail and summarized selected documents in topical areas of the Z39.50 development. For example, the early years of Subcommittee D work was well-documented, and in the FolioViews database, the researcher recorded additional details about each meeting including participants, discussions, etc. Appendix D contains selections from the FolioViews database illustrating the chronology and the more detailed summary resulting from analysis.

The result of this effort was a database comprising approximately 150 pages of detailed information selected from the primary source material. This provided the basis for drafting a preliminary historical reconstruction. That reconstruction became the first draft of Chapter 4. As noted in Chapter 4, the researcher's intention was to focus on description of Z39.50 development with little analysis and interpretation. Thus, the level of analysis performed on the primary source material described here was sufficient to develop the reconstruction.

3.5.3.2. Analysis of Guided Interviews

The primary source materials provided authoritative data on Z39.50 development, and from that data, the researcher began to develop a preliminary understanding of the development. The guided interviews allowed the researcher to “interact” with the data sources in a way that was not possible with the primary source materials. The interviews allowed the researcher to hear from participants in the standards work and gain their understanding and interpretation of Z39.50 development. The researcher used the interviews to explore issues surrounding the development as well as gain a more complete understanding of some of the events documented in the primary source material.

To address the second study goal, the researcher used the preliminary conceptual model as a basis for framing an understanding of Z39.50 development. The revised conceptual model that resulted from the study represents a way of understanding Z39.50 development. The findings presented in Chapter 5 reflect the results of the analysis of the interview data, a re-analysis of the historical reconstruction, and revisions to the preliminary conceptual model that together provide a basis for understanding Z39.50 development.

The researcher approached the analysis of the guided interviews from the perspective of the concepts and categories of the systems-theoretic preliminary conceptual model. An initial coding approach (see Appendix G) that was purely inductive (i.e., not using the systems model concepts as categories) did not efficiently assist in data reduction for answering the research questions. Systems concepts, therefore, became coding categories for the interview data. The data provided meaning for the categories. In addition, the researcher developed additional coding categories beyond the systems model to capture data related to aspects of Z39.50 development not adequately coded in systems concepts (e.g., *mediating mechanisms*).

Coding data is a form of content analysis, which Patton (1990, p. 381) suggests as the “process of identifying, coding, and categorizing the primary patterns in the data.” The labeling of units of data with codes and developing a code book or data index is one of the steps in content analysis.

Miles and Huberman (1994, p. 56) define codes as “tags or labels for assigning units of meaning to the descriptive or inferential information compiled during the study.” The indexing of the data through the use of codes was a way of reducing and organizing the data for subsequent analysis. In effect, this analysis organized the data in such a way that Research Question 2 could be answered. FolioViews allowed the researcher to assign codes to specific chunks of data and then provided retrieval of all instances of data with specific codes

Chapter 2 indicated general definitions of the basic components of a system, namely, inputs, processes, outputs, feedback, and environment. The components of the conceptual framework, however, were without meaningful and specific content prior to the analysis. The analysis served to identify instances in the data that refer to these components. This process grounded the system components in the data about Z39.50 development and served to inductively characterize and operationalize Z39.50 development in systems terms. This process of data analysis defined and described components in the preliminary conceptual model specific to Z39.50 development.

In addition to the system codes, the researcher in addressing Research Question 1 used two additional codes to identify instances in the data of Constraining and Enabling Factors affecting Z39.50 development.

Since this research was exploratory as well as descriptive, data analysis also promoted discovery. The discovery aspect became paramount when the researcher determined that the preliminary conceptual model did not adequately accommodate certain aspects of Z39.50 development. Specifically, as reported in Chapter 5, changes in system goals, and changes in stakeholders and participants, were not represented conceptually in the preliminary model. The researcher introduced two additional categories, Mediating Mechanisms and Relevant Environment, that emerged in the data analysis and that addressed his emerging understanding of needed refinements in the conceptual framework. Figure 3–3 lists the codes (with definitions) used in analysis of the interview data.

The procedure for coding first involved reading through transcripts in the FolioViews database. As the researcher encountered a data instance that illustrated or illuminated a particular code, specific words or sentences would be highlighted and assigned a code. The researcher moved through the 20 interviews assigning all codes that applied to the data. See Appendix E for sample coded sections of interviews.

After a first pass through the data, the researcher used FolioViews to compile all instances of a single code and then do a printout of the data instances. The researcher then reviewed all data instances of a particular code to assess the commonality and differences between the instances. The result of this was twofold. First, the researcher developed a clearer understanding of the extent of data instances covered by code (e.g., what were common to all instances of inputs, what unique aspects existed, etc.). Second, the researcher would at times need to revise the coded sections (e.g., removing a code from a data instance).

3.5.3.3. Researcher Memos

A qualitative research approach encourages the researcher to document his activities, intellectual advances, and methodological choices. In part, documenting the study as it unfolded provided the basis for an audit trail. Memoing was particularly useful during data analysis. For example, Lincoln and Guba (1985, p. 342) suggest that writing memos about coding categories can help to uncover properties of that category and to develop rules for assigning subsequent data to the category. Memos also served as a mechanism for self-reflection by the researcher. As the researcher explored connections in the data and possible patterns, he documented his ideas in the memos. A separate FolioViews database contained researcher's memos. Appendix F contains a selection of the researcher's memos that illustrate the various purposes they served.

Figure 3-3
Analysis Codes for Interview Data

- *Constraining Factors*: Specific decisions, events, activities, or processes that negatively affected development in terms of slowing the development, blocking forward progress, or otherwise hindering the evolution of the standard.
 - *Enabling Factors*: Specific decisions, events, activities, or processes that positively affected development in terms of encouraging forward progress or otherwise helping the evolution of the standard.
 - *Environment*: Any entity or force outside of the standards work system that could potentially have an influence on the evolution of the standard (compare with relevant environment)
 - *Feedback*: Information or messages directed at the standards work system in response to an output of the system
 - *Goals*: Specific statements (implicit or explicit) reflecting a purpose or objective of the standards work system
 - *Inputs*: Anything subject to transformative processes and activities of the standards work system such as problems and requirements
 - *Mediating Mechanisms*: A range of human actions, decisions, and discrete events that, together over time, effect essential changes in the environment (i.e., delimiting the relevant environment) and the entire system
 - *Outputs*: The result of transformative processes and activities of the standards work system such as a draft standard or simply increased understanding
 - *Participants*: Individuals directly involved in the standards work
 - *Process*: A operation which transforms an input into an output
 - *Relevant Environment*: A subset of the broader environment that contains the entities and forces that at any given time provide inputs, receives outputs, or in other ways interact with and influence the standards work system
 - *Stakeholders*: Organizations that have an interest in the outcome of the standards work system
-

3.6. Quality and Trustworthiness of the Study

A fundamental concern in any research study is to incorporate appropriate mechanisms that assure the researcher and reader of the quality of the research, its process, and its findings. The assumptions and characteristics of qualitative naturalistic inquiry as a research paradigm suggest a

set of criteria for establishing quality. Following Guba (1981, pp. 79–80) and Lincoln & Guba (1985, pp. 289–331), this study addressed quality in terms of trustworthiness related to his criteria:

- *Credibility*: Assuring the truth value of the findings and accommodating the need to understand, in a holistic manner, a complex phenomenon
- *Transferability*: Addressing the applicability of the findings but acknowledging that the research focus is the idiographic (i.e., the particulars of the case) rather than the nomothetic (i.e., lawlike generalizations),
- *Dependability*: Assuring the methods and methodological choices of the emergent research design are documented for external inspection
- *Confirmability*: Assuring the neutrality of the researcher to establish the degree to which the findings of an inquiry are a function solely of the respondents and conditions of the inquiry and not of the biases, motivations, interests, perspectives, and so on of the inquirer.

The following sections describe steps the researcher took to build a foundation for trustworthiness and quality in the study.

The study also presented methodological challenges because of the scope of the study, the complexity of the phenomenon, and data available for analysis and interpretation. While the researcher took appropriate steps listed below to assure trustworthiness, Section 3.7 addresses the methodological challenges and issues encountered in the study.

3.6.1. Quality of Data Sources

The researcher was keenly aware throughout the study that high-quality data was the foundation upon which to document and build an understanding of Z39.50 development. Several procedures assisted in collecting appropriate, high quality data.

For the documentary evidence, the researcher used primary source materials from established repositories of Z39.50 documents. Official records such as meeting minutes, reports, and correspondence provided the researcher with authoritative data upon which to document Z39.50's historical development.

Another procedure used for ensuring authoritative data was purposeful sampling of individuals for guided interviews. The researcher identified knowledgeable respondents and sources to ensure the authority of the data. Purposeful sampling enabled the researcher to choose individuals who had recognized authority by virtue of their roles or positions in Z39.50 development.

The final primary source of researcher-collected data was participant observation of ZIG meetings. Attendance at these meetings provided first-hand observations of standards work in process.

3.6.2. Systematic Collection and Management of Data

After identifying the potential high-quality sources of data, the researcher implemented systematic data collection activities. Aligned with data collection were procedures to manage the resulting large quantity of data. Several specific activities assisted in maintaining quality control during data collection:

- *Prolonged engagement*: The researcher regularly attended meetings of the ZIG, beginning in 1993 as a participant in the process, and since 1994 more formally as a participant observer for purposes of this study. This allowed the researcher to collect and analyze data from one meeting and become sensitive to systematic patterns of interaction in the Z39.50 standards work. Through regular attendance, the increasing familiarity of the researcher with ZIG participants reduced potential researcher effects on the phenomenon and its participants.
- *Persistent observation*: Prolonged engagement with the ZIG also enabled the researcher to develop an understanding of essential characteristic in the phenomenon through persistent observation.
- *Recording and transcription of interviews*: The choice to tape record the majority of interviews ensured that the researcher had dependable data instead of relying on post-interview write-ups of the interviews.
- *Collection of primary source material*: The repositories of documentary evidence contained information directly related to Z39.50 and much information that was either tangential or entirely unrelated to its development. The researcher based selection of primary source material on numerous criteria. In many cases a document's connection to Z39.50 was clear (e.g., minutes from a meeting of Subcommittee D). As the researcher's understanding about events and individuals related to Z39.50 evolved, his ability to discern useful primary material improved.
- *Purposeful sampling*: In addition to identifying authoritative sources for data, purposeful sampling enabled the researcher to maximize the range of information collected. One of the intentions of purposeful sampling was to collect sufficient data to provide rich detail about Z39.50 development.
- *Collection of detailed descriptive data of the context*: A primary concern was to develop detailed descriptions of Z39.50 development and the context in which that development occurred. This was particularly important because of the systems-based conceptual model that directed the researcher to look at the environment as the context for the system of standards work as essential for understanding the characteristics and operation of the system. The researcher collected detailed descriptive data through the interviews, observations, and examination of primary documentary evidence.
- *Data management controls*: The researcher implemented data management procedures such as logging primary source material documents into databases and physical files, building a database of transcribed interviews in which all details of the interviews were stored, and maintaining inventories of data collected. This assisted in preserving the data and providing systematic access to them.

These research activities and procedures safeguarded the quality of the data collected by assuring rigor in the collection, processing, and management of the data.

3.6.3. Analysis of Data and Development of Findings

As the researcher collected and processed the data, several procedures assisted in analyzing the data to ensure credibility and dependability of the data and findings.

- *Triangulation:* The researcher used multiple sources of data and several methods of data collection. Section 3.4 explained that different sources of data provided different types of information (e.g., official, personal interpretation, direct experience). Triangulating data sources and collection techniques supported a holistic perspective on a phenomenon. Triangulation also directed the researcher to find corroborating evidence in the different sources of data to assure the accuracy of facts and interpretations. Triangulation was a procedure to reduce researcher bias since substantiation for claims were linked to data instances from multiple sources.
- *Documenting methods and methodological choices:* At the outset of the study, the researcher prepared a systematic design to guide the research. The design focused on multiple sources of data, appropriate data analysis activities, and a preliminary conceptual model to frame the research. Throughout the study the researcher documented data collection and analysis activities, clearly indicating the source of data, its collection method, data management and preparation, and analysis. That documentation is a basis for an audit trail would enable an external reviewer to examine the processes by which the researcher collected and analyzed the data. This provides accountability for how the research was carried out.
- *Grounding findings in data:* The study's method of iteration between data collection, analysis, and synthesis directed the researcher to move between data, coding, findings, and back to the data. The use of FolioViews for data management enabled the integration of the data, the coding, and the memoing. The transcripts of interviews, field notes from observations of meetings, and summaries of documentary evidence were available to reference when developing findings and provided a mechanism to link the findings to the data.

A key goal in the analysis was to ensure that the data supported the findings and conclusions arrived at by the researcher.

3.6.4. Assessing the Accuracy and Credibility of Findings and Conclusions

Qualitative research assumes that data collection, data analysis, and the research findings are mediated and/or constructed by the researcher. The role of the researcher was central in this study's data analysis and synthesis, and member checks served as a useful procedure to check the credibility of the results and to protect from researcher constructions that did not reflect the phenomenon adequately or accurately. A member check is a procedure in which the researcher

returns to participants in the study to discuss with them the researcher's emerging and evolving understanding. The researcher used member checks on numerous occasions to verify accuracy of data, to discuss interpretations of the data, and to present preliminary findings and conclusions from the study.

The researcher discussed with various individuals involved in Z39.50 standards his unfolding understanding (i.e., construction) of the Z39.50 process. These informal conversations occurred primarily at ZIG meetings, the ZIG meeting debriefing interviews, and when the researcher had other opportunities to talk with people involved with Z39.50 development.

A second, more formal, member check involved an individual who had been a key participant throughout most of Z39.50's evolution. She reviewed a draft of the historical reconstruction presented in Chapter 4. Comments and clarifications from the review assisted the researcher in refining and improving the quality of that historical account.

An opportunity for the researcher to present preliminary findings and conclusions from the research to a meeting of the Board of Directors and the Standards Development Committee of the National Information Standards Organization in January 1998 served as a third occasion for member checking. Several of the meeting attendees had participated directly or indirectly in Z39.50 development (e.g., members of the ZIG, a member of the original Subcommittee D, and the executive director of NISO). In addition, all Board members had a long history of standards development and could respond to the findings and conclusions based on their experience. Their response to the analysis of Z39.50 development and the revised conceptual model was very positive and provided face validity to the study's findings and conclusions by experts in standards development.

3.6.5. Incorporating and Accounting for the Researcher's Experience and Knowledge of Z39.50 Development

The researcher began this study with substantial experience with Z39.50 and its development process as well as perceptions of how Z39.50 had developed. The pre-existing knowledge and previous experience were useful in improving the study. In fact, the complexity of Z39.50 development and the type of research conducted required a knowledge and sensitivity not only to construct a methodologically appropriate study but also to synthesize the multiple facets of Z39.50 into a coherent understanding.

Specifically, the researcher's basic technical knowledge about Z39.50 enabled him to communicate with Z39.50 experts. His past experience provided a basis for understanding nuances and subtleties in the phenomenon under investigation. His previous experience informed a sensitivity that assisted the researcher in understanding and observing aspects of the standards process that might otherwise have gone unnoticed.

The researcher's previous experience had brought him in contact with many of the key participants (organizations and individuals) in Z39.50 development. Knowledge and familiarity with some of the players assisted the researcher in identifying authorities to interview. In

addition, the participants' knowledge of the researcher and his credibility in the Z39.50 community resulted in expressions of interest in assisting the study by providing access to documents and records, and by their willingness to be interviewed. His involvement with Z39.50 and with NISO was the basis on which NISO invited him to present preliminary findings at a meeting of the NISO Board of Directors.

The researcher's previous experience also posed threats to the study. In qualitative research, the researcher should enter the study with an openness to finding out what the phenomenon is about. Pre-existing concepts and assumptions can blind the researcher and act as a filter that inhibits him from seeing important and salient details in the phenomenon. Such researcher bias threatens the credibility of the data and the overall trustworthiness of the study. Naturalistic research assumes that the researcher constructs findings based on an in-depth interaction of the researcher and the researched. Lincoln and Guba (1985) suggest that the researcher should strive for a stance of "neutrality" that can lead to research data that is reliable, factual, and confirmable (p. 300). The procedures discussed in Section 3.6 limited these threats to the study.

In this study, the researcher attempted to accommodate the stance of neutrality *and* the past experience and pre-existing knowledge. The researcher's preliminary conceptual model reflected his level of understanding and assumptions of standards development at the outset of the study (e.g., standards development is a phenomenon comprising activities, entities, processes, and forces interacting in a complex and dynamic manner and moving to some goal or objective). Another procedure for dealing with his assumptions was to enumerate those at the beginning of the study. Several of the fundamental assumptions were:

- Standards development is a multi-dimensional social process involving a variety of stakeholders who each see problems from their own perspective.
- Standards development is not simply concerned with technical considerations, but is influenced by economic/market considerations, level of knowledge of how to do something, political considerations, and other factors beyond simply writing technical specifications.
- The role of implementors in Z39.50 development indicates a new and effective mechanism for information technology standards development.
- Standards development is comprised of activities, entities, forces, and process, and their interrelationships within specific contexts.
- Identification and understanding the roles and motivations of stakeholders in standards development is essential in understanding how the standards evolve.
- Understanding the context from which a standard emerged is critical to understanding its development.

Patton (1990, p. 473) points out other factors related to the researcher that can distort the findings of a study:

- Effects of the researcher on the phenomenon
- Effects of the phenomenon on the researcher
- Researcher competence.

In the case of potential “effects of the researcher on the phenomenon,” the past experience of the researcher with Z39.50 helped minimize these effects. The researcher had been active in standards development work for several years and had observed the processes and people involved in Z39.50 work. The researcher’s prolonged engagement reduced the possibility of the researcher having a direct effect, for example, on the actual working of a ZIG meeting. In the case of the individual interviews, the effect of the researcher on the interviewee was less controllable since the interviewee will be responding to the researcher as a respondent in a research study. The researcher employed accepted interviewing practices such as asking neutral (e.g., non-leading) questions, using an interview guide, and asking the interviewees to speak from personal experience to minimize adverse researcher effects.

Qualitative research assumes that the researcher will be affected by what is being studied. The iterative nature of data collection, analysis, synthesis implies that the researcher is continually learning and understanding more about the phenomenon. As the primary instrument for data collection and analysis, the researcher *should* change over the course of the research. In this study, the researcher identified gaps in the data or new leads to follow based on previous data collection, analysis, and synthesis. His evolving understanding over the course of the study enabled him to purposefully sample to collect needed information. However, prolonged engagement with Z39.50 allowed the researcher to maintain a sensitivity to a broader range of events, activities, and behaviors of the people involved. The researcher was less likely to be unduly affected by singular events to the detriment of data collection and analysis.

Patton’s final factor, that of researcher competence, was addressed in several ways. First, the researcher designed a systematic study that included specific procedures for data collection, data management, and data analysis. Adhering to the rigor of the study enhanced the quality of the research findings. Second, the researcher had knowledge of and experience with the data collection activities used in this research. Third, and to some extent most critical, the researcher’s experience with and knowledge of standards development and Z39.50 provided the foundation for dealing with the complex technical information related to Z39.50 development and that were essential for the interviews, the participant observations, and understanding the primary source materials.

3.7. Methodological Challenges and Issues

Overall, the qualitative research approach and case study design was appropriate for this exploratory and descriptive study of Z39.50 development. The results of the research achieved the goals of the study, namely, to document and provide a foundation for a holistic understanding of Z39.50’s complex development.

The procedures described in Section 3.6 were essential to ensure the quality and trustworthiness of the data and findings. In the course of the study, however, a number of methodological challenges and issues arose. Several of these deserve special attention.

3.7.1. Scope of Study

At the outset, the researcher was optimistic about adequately addressing the 16-year history of Z39.50 development. As the researcher went deeper into data collection and analysis, the more complex and detailed Z39.50 appeared. The preliminary conceptual model served as a framework for bounding the object of study, yet the intersection of Z39.50 development with so many other activities and events made the boundary of the case appear increasingly permeable. Chapter 4 was an exercise in continually refining what was relevant to document and what needed to be merely mentioned or entirely omitted.

For example, parallel to Z39.50 development in the U.S. was an international effort to define an information retrieval protocol. Participants in U.S. efforts were involved in the international effort, and no doubt it influenced Z39.50 development. Another example was the range of activities involved with developing lower level networking protocols at the international level in the Open Systems Interconnection work as well as in the U.S. with the work on Internet protocols. These both could be considered as part of the broader socio-technical environment that had effect on the system of standards work. Attempting to determine what was in scope and out of scope for the study was an ongoing challenge.

The researcher continued to refine the focus of the research during the study, keeping in mind the study goals and objectives. As a result, the researcher reconceptualized standards development as standards work and focused on the prominent influences and interactions affecting the standards work.

As described in Chapter 5, Z39.50 development can be characterized as evolutionary with specific stages defined by goals of the standards work system, participants, and other criteria. The research was successful to the extent it provides a coherent and holistic understanding of the complexity of Z39.50 development during the 16-year period of study. Subsequent research on more limited time periods of its development would now be useful to flesh out the details.

3.7.2. Primacy of Documentary Evidence in Research

The researcher relied most heavily on primary source materials in the form of documentary evidence for both documenting and understanding the complexity and intricacies of Z39.50 development. At the outset of the study, the researcher had assumed that interview and observation data would take precedence over the documentary evidence. Instead, the researcher found that the former sources of data supplemented the latter.

For all periods of Z39.50 development, there are documentary sources of evidence in the form of meeting summaries, minutes, reports, correspondence, and so forth. There were instances where the availability of documentary evidence was not extensive, but overall, authoritative official records provided a basis for reconstructing Z39.50 development and laying a groundwork for understanding.

The participant observation was limited to only one period, namely a two-year period in which the ZIG was the primary agent for standards work. The guided interviews provided rich detail both for historical information and more current standards work. Convenience of access to current participants in Z39.50 standards work, however, made them more likely candidates for the interviews. The participant observation and guided interviews resulted in detailed information but limited to selected periods in the 16 years of standards work.

Even with the primacy of the documentary evidence, and the quality of data provided by that source of data, there were methodological challenges. The researcher continually had to interpret and reinterpret the contents of that evidence. In addition, the researcher confronted an ongoing selection process—what to include in the report and what to omit, what level of detail to include and when to summarize. The facts of the documentary evidence do not speak unambiguously. Two cases illustrate these issues.

The researcher requested a key participant, as part of a member check, to review the historical reconstruction of Z39.50. In several instances, the reviewer suggested that the researcher's report did not tell the entire story, and in addition, that the entire story would not be found in records or documentary evidence. In other instances, the reviewer suggested that the researcher's interpretation was not exactly accurate. While the researcher acknowledged the reviewer's expertise, he also recognized that reviewer's interpretation was just that, an interpretation of a historical event. The insights of qualitative research was helpful in understanding that while participants might agree on a specific event occurring, the meaning of that event for different participants may differ.

A second example illustrates another problem with interpreting or drawing conclusions from the documentary evidence. In an informal discussion with a participant in Z39.50 development, the researcher made a comment about a document authored by the participant and asked why he had been commissioned to write the document. The participant replied that he had not been commissioned but rather submitted an unsolicited document to a stakeholder organization during the formative years of protocol development. The researcher had assumed on the basis of a cover memo attached to the document that it had been commissioned by the organization. Clarifying this substantially altered the researcher's understanding of a series of events.

It is prosaic, but nonetheless true, that using primary source material is like detective work. The researcher has substantial evidence but the meaning of the evidence is not always clear. Specifically, the evidence does not speak unambiguously nor subject to a single interpretation. Corroborating evidence was vital, but such evidence was not always available. Instead, the researcher kept in mind that the goal was a holistic understanding of Z39.50 development, and in the process of creating that understanding, certain "facts" drawn from the documentary evidence are open to interpretation.

3.7.3. Content Analysis and Coding of Interview Data

The research design had anticipated approximately 20 guided interviews with key participants or stakeholders in Z39.50 development as sources of data. The researcher conducted these interviews, and they provided rich detail on a range of topics related to Z39.50 and, more generally, standards development. The use of interview protocols assisted the researcher in asking comparable questions in the interviews. What amazed the researcher was the range of answers, the examples used, and the form of the answers. In addition, the interviewer used the interviews to discover new information about Z39.50 development. The interviews served this purpose well.

The result, however, made the analysis of the interviews problematic. The researcher had assumed that with this number of interviews it would be possible to discover patterns and regularities. He approached the data systematically, guided by the literature on qualitative/naturalistic data analysis (e.g., Miles and Huberman, 1994; Glaser and Strauss, 1967). Given the complexity of Z39.50 development, and the perspectives of the interviewees, the researcher found he assigned discrete codes to incidents and topics mentioned in a single interview but never mentioned again. After coding five of the interviews, the researcher had a code book consisting of nearly 75 codes. Using this method, the researcher applied only about 30% of the existing codes to more than one data instance. See Appendix G.

The researcher suggests for an exploratory study such as this that addressed a complex phenomenon of many years' duration, this original approach to content analysis was not effective. If one is studying a phenomenon that is better defined and more limited in scope, the type of coding pursued initially in this study may be appropriate. He reviewed the needs of the study and the research questions. Based on that review, he determined that a simplified coding system would address the interview data (see Section 3.5.3.2.) to analyze sufficiently for purposes of this research. The researcher revised his coding strategy to focus on coding categories based on systems components while at the same time inductively analyzing the data to determine additional categories.

3.8. Summary

This chapter has discussed and summarized how the researcher executed this study. The original proposal for this research identified the primary components of the study, including the research strategy, study design, and methods and strategies for data collection, management, and analysis. The researcher used a multi-method approach in the study to address the complexity of Z39.50 development. The result of multiple sources of data and data collection techniques was an extremely large data repository. Although he used procedures to ensure data quality and integrity, managing and analyzing the wealth of data about Z39.50 development was difficult.

The researcher faced unanticipated methodological issues and challenges. While the researcher had anticipated that the study design would evolve, he had planned for the guided interview data to be key in understanding Z39.50 development. This turned out to be an incorrect assessment

because the interviews resulted in data addressing so many different aspects of Z39.50 that the data did not lend themselves to the coding scheme with which the researcher initially started. Methodologically, the researcher depended on the documentary evidence as the primary source of data for developing findings and conclusions. That evidence became the foundation for developing the historical reconstruction of Z39.50 development reported in Chapter 4. This historical reconstruction was critical in laying the groundwork for a holistic understanding of Z39.50 and the finding reported in Chapter 5.

Another goal of the study was to develop a deep understanding of the complex phenomenon of standards development through an exploratory and descriptive case study of Z39.50. The data collected and analyzed provided evidence for the findings reported in Chapter 5. In addition, the study served to explore the utility of a systems–theoretic preliminary conceptual model. This was done in part to lodge the study in a theoretical or conceptual framework, something that most of the literature on standards development has lacked. In addition, the data collected allowed the researcher to refine and evolve the preliminary model to one which more adequately described and represented Z39.50 development. The analytical process from the data to model building, however, was not simply a matter of discovering patterns in the data that could inform the model. Methodologically, the researcher can link the model to the data, but tracking the complex analytical steps has been difficult.

For accomplishing the original goals of the study, the research strategy was appropriate but extremely challenging. Laying the methodological and conceptual groundwork for a holistic understanding of a complex social process of standards development was a non–trivial task. The amount of data necessary for a comprehensive understanding went well beyond what the researcher anticipated. While the study did answer the study’s research questions, the researcher would like to think that a more important contribution is the foundation this study provides for subsequent research on Z39.50 and future research on other standards efforts.