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RESEARCH ESSAY

# RIGOR IN INFORMATION SYSTEMS POSITIVIST CASE RESEARCH: CURRENT PRACTICES, TRENDS, AND RECOMMENDATIONS[1]

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## Abstract

*Case research has commanded respect in the information systems (IS) discipline for at least a decade. Notwithstanding the relevance and potential value of case studies, this methodological approach was once considered to be one of the least systematic. Toward the end of the 1980s, the issue of whether IS case research was rigorously conducted was first raised. Researchers from our field (e.g., Benbasat et al. 1987; Lee 1989) and from other disciplines (e.g., Eisenhardt 1989; Yin 1994) called for more rigor in case research and, through their recommendations, contributed to the advancement of the case study methodology. Considering these contributions, the present study seeks to determine the extent to which the field of IS has advanced in its operational use of case study method. Precisely, it investigates the level of methodological rigor in positivist IS case research conducted over the past decade. To fulfill this objective, we identified and coded 183 case articles from seven major IS journals. Evaluation attributes or criteria considered in the present review focus on three main areas, namely, design issues, data collection, and data analysis. While the level of methodological rigor has experienced modest progress with respect to some specific attributes, the overall assessed rigor is somewhat equivocal and there are still significant areas for improvement. One of the keys is to include better documentation particularly regarding issues related to the data collection and analysis processes.*

**Keywords**: Case study research, methodological rigor, positivism, research design

[1]Allen Lee was the accepting senior editor for this paper.

## Introduction

Research methods are at the basis of the production of knowledge in any given field (Pinsonneault and Kraemer 1993b). "Research methods shape the language we use to describe the world, and language shapes how we think about the world" (Benbasat and Weber 1996, p. 392). Different trends in research topics and philosophical perspectives have led to a wider diversity in research methods and, more specifically, to the emergence of qualitative methods in information systems (IS) research (Lee and Liebenau 1997; Trauth 2001; Wynn 2001). There is a growing tradition to use qualitative research approaches to study information technology (IT) phenomena (e.g., Romm and Plinski 1999; Trauth and Jessup 2000), and case study research figures among those qualitative methods that have been recognized as having gained acceptance over the past decade in the IS field (Benbasat et al. 1987; Benbasat and Weber 1996; Klein and Myers 1999; Orlikowski and Baroudi 1991).

Although there are numerous definitions, Yin (1994) defines the scope of a case study as follows:

> A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (p. 13).

Case research is, therefore, useful when a phenomenon is broad and complex, when a holistic, in-depth investigation is needed, and when a phenomenon cannot be studied outside the context in which it occurs (Benbasat et al. 1987; Bonoma 1985; Feagin et al. 1991; Yin 1994). The case research strategy allows for a great deal of flexibility and individual variation (Cavaye 1996a). Case research, in its versatility, can be used with any philosophical perspective, be it positivist, interpretivist, or critical. It typically combines several qualitative data collection methods such as interviews, documentation, and observations, but can also include quantitative data such as questionnaires and time series.

Case research gained respect in our field for several reasons. First, the case research method is particularly well-suited to IS research, since the object of our discipline is information systems in organizations, where interest shifted to organizational rather than technical issues (Benbasat et al. 1987). Second, having access to and reporting on real-life IT experiences, case researchers allow both academia and practice to keep up with the rapid changes occurring in the IT world as well as in organizations. Third, holistic investigation, which represents a key characteristic of case research, suits well our need to understand the complex and ubiquitous interactions among organizations, technologies, and people. In this regard, the access to and use of a wide range of data collection methods, both qualitative and quantitative, bring richness and flexibility to the overall research process, making case research particularly well designed for the study of a complex phenomenon such as IT. Fourth, in-depth case investigations open the way to new ideas and new lines of reasoning and pinpoint the opportunities, challenges, and issues facing IT specialists and managers. Finally, case research is widely used for exploration and hypothesis generation, but can also be used for providing explanations and for testing hypotheses (Benbasat et al. 1987; Cavaye 1996a; Yin 1994), all of which contribute to the development of knowledge in our field.

Notwithstanding the relevance and potential value of case research in the IS field, this methodological approach was once considered to be one of the least systematic (e.g., Stone 1978). Toward the end of the 1980s, a few IS researchers, preoccupied with the rigor (or lack thereof) of case research in our field, started to evaluate the usefulness and methodological soundness of IS case studies. One of the earliest contributions was that of Benbasat et al. (1987), who surveyed the case study literature published in four journals and one major conference proceedings for the period 1981 through 1985 and evaluated the cases based on a number of guidelines associated with the case design and data collection process. They recommended that case researchers should provide clearer descriptions of

where their topics fit into the knowledge building process; detail the case selection criteria; and provide more information about the data collection process. Another key contribution was made shortly after by Lee (1989), who provided an overview of, and responded to, the methodological problems involved in the study of a single case and summarized what a scientific methodology for IS case studies does, and does not, involve. Lee also demonstrated how to make controlled observations and deductions as well as how to allow for replicability and generalizability with the use of a single case.

Researchers from other disciplines have also contributed to the growth of qualitative research in general, and to case research in particular. For instance, Eisenhardt (1989) proposed a roadmap for building theories from positivist case study research and IS researchers have illustrated how this methodological framework can serve as a useful guide in conducting case research in our field (e.g., Paré and Elam 1997; Peterson et al. 2000; Sarker and Lee 2002). Other researchers have offered a series of methods to help fieldwork cycle back and forth between thinking about existing data and generating strategies for collecting new, often better, data (Kuzel et al. 1994; Mays and Pope 1995; Miles and Huberman 1994; Yin 1994). Several approaches have also been proposed to code, organize, and analyze qualitative data (Miles and Huberman 1994; Seidel and Kelle 1995). Finally, a number of software packages have been developed and commercialized to support the work of qualitative researchers (Fielding and Lee 1998; Kelle 1995; Weitzman and Miles 1995).

In this article, the primary question that we attempt to answer is, "To what extent has published *positivist case research in IS* actually adopted and implemented the attributes that leading case research methodologists have identified as contributing to rigor in such research? The extent to which actual, published positivist case research has, or has not, embraced these attributes is a necessary factor for us to consider when assessing the extent to which published positivist case research in IS has, or has not, achieved rigor. Achieving a higher level of rigor is required in scientific research. If positivist case research in IS wants to be considered a premier-class methodology and to add to the growth of knowledge in our field, it has to pass the tests of scientific rigor.

Since standards of quality vary with the assumptions of each philosophical tradition (Anderson et al. 2001; Jensen and Rodgers 2001; Klein and Meyers 1999), it was decided to restrict our assessment to positivist case studies. Two main reasons motivated this decision. First, positivist case research, which includes both descriptive and theoretically grounded case studies (Orlikowski and Baroudi 1991), represents the dominant paradigm in IS case research (see the next section). Second, early recommendations formulated by researchers are most suitable to the positivist paradigm. In this regard, Klein and Myers (1999, p. 68) posit that the principles or guidelines formulated by Benbasat et al. (1987), Lee (1989), and Yin (1994) have become *de facto* standard in positivist case studies.

The present review helps identify trends and patterns in our use of case study research and, hence, serves as an instrument to reflect, as a research community, on our progress. It also allows us to pinpoint areas where more work needs to be done. In short, our intent is not to achieve any goal as grandiose as a definitive assessment of any specific case article or positivist case research in general, but instead to gauge the extent to which positivist case research in IS is taking advantage of, or ignoring, the valuable methodological insights or guidelines of leading case methodologists.

A major finding of our exhaustive, empirical examination of published positivist case studies over the period 1990 through 1999 is that a large portion of them have actually ignored the state of the art of case research methods that have been readily available to them. Notable examples are that only 42 percent of all case study articles in our database have posed clear research questions; only 58 percent have provided information about their data collection methods; and only 23 percent have elucidated their data analysis process. These and

other important attributes of rigorous positivist case research are no secret. We believe the widespread practice in which many positivist case researchers have ignored fundamental attributes of the state of the art of case research methods to be nothing short of disappointing.

The paper is organized as follows. The following section describes the research method, namely how the journals and articles were selected along with the basic characteristics of the articles assembled. Next, we present the attributes used to assess the rigor of positivist case research; the coding process is then explained. This is followed by a presentation and discussion of the results of our analysis. The last section summarizes our findings and presents our final recommendations.

## Journal and Article Selection

Journal selection was undertaken with careful consideration. Our intent was to assure a wide representation of case research conducted in IS. In making this selection, we used those journals considered in the review by Benbasat et al. (1987) as well as the evaluations of top-ranked journals by Hardgrave and Walstrom (1997) and by Whitman et al. (1999). As a result, we selected the following seven major IS journals: *European Journal of Information Systems; Information & Management; Information and Organization* (formerly *Accounting, Management and Information Technology*); *Information Systems Research; Information, Technology & People; Journal of Management Information Systems;* and *Management Information Systems Quarterly.*[2, 3]

Each journal review started with the table of contents, and extended to the abstracts, the keywords, and the articles themselves. Each candidate article was compared to a set of characteristics of case research aligned with both Yin's (1994) definition (presented above) and Benbasat et al.'s list of key characteristics of case study research:

- a contemporary phenomenon is examined in a real-life context or setting
- one or few entities (person, group, organization, technology) are examined
- the complexity of the unit is studied intensively
- the phenomenon of interest is not isolated from its context, especially at the data analysis stage
- no controlled observation that involves manipulation is involved

Although case research shares many characteristics with other qualitative methodologies (e.g., natural setting as source of data; researcher as key instrument of data collection; data collected as words; focus on participants' perspectives), the objectives and challenges inherent to each tradition, as well as the criteria by which to judge their quality, are quite different (Cresswell 1998; Lau 1997). For this reason, we carefully excluded those studies that made use of other related qualitative methodological approaches, such as grounded theory (e.g., Macredi and Sandom 1999), ethnography (e.g., Orlikowski 1991), and action research (e.g., Braa and Vidgen 1999).

[2]According to Trauth (2001), *Information and Organization* and *Information Technology & People* represent the two most prominent journals publishing qualitative research in the IS field.

[3]Although *Communications of the ACM* was included in previous evaluative studies (which surveyed the IS case literature in the 1970s and 1980s), it was decided not to consider it in the present research. Two reasons motivated this decision: (1) *Communications of the ACM* radically changed its primary vocation in the early 1990s to become a leading *professional magazine* in the computing field as stated in the editorial statement found on the journal website; (2) an exhaustive search revealed that a very small number of case articles were published in *Communications of the ACM* between 1990 and 1999. For these reasons, we strongly believe that not considering *Communications of the ACM* does not influence the overall assessment of positivist case study research in IS.

Field studies conducted in one or a few organizational settings (e.g., Rowe and Struck 1999; Wijayanayake and Higa 1999) where quantitative data (e.g., questionnaires, time series, Q-sort) are gathered and analyzed in isolation from the organizational context were also excluded from the present review.

The initial selection process produced a total of 261 articles using case research methodology for the period 1990 through 1999. A preliminary assessment of this group of articles proves itself to be interesting and, hence, deserves some attention. All 261 studies were classified according to journal names and publication dates. As shown in Table 1, the number of case articles differs widely from journal to journal over the period 1990 through 1999. A relatively small number of case study articles were published in *Information Systems Research* (6 percent) while about one out of ten articles (11 percent) published in *Information and Management*[4] and *Journal of MIS* used the case research approach. On the other hand, in *Information Technology & People, MIS Quarterly, European Journal of Information Systems,* and *Information and Organization*, more than one out of five published articles used the case study methodology (29 percent, 26 percent, 23 percent, and 21 percent, respectively).

Despite the fact that the actual number of case research articles published in the selected journals slightly increased over the last decade, we observe in Table 2 that the actual proportion of published articles in IS journals using case research has been relatively stable (around 15 percent), with the notable exception of 1996. The proportion of case study articles published in the 1990s has also been stable based on comparisons with previous reviews in the field. For instance, Hamilton and Ives (1982) observed that 12 percent of all articles published in 15 journals (IS and non-IS) between 1970 and 1979 used case research methodology. For their part, Vogel and Wetherbe (1984) reported that approximately 15 percent[5] of the articles published between 1977 and 1983 in 15 journals (IS and non-IS) were case study articles. More recently, Orlikowski and Baroudi (1991) analyzed a total of 155 articles from four major IS journals and observed that approximately 14 percent of all articles published between 1983 and 1988 used a case study approach.

Among the total number of case articles included in our database, 51 articles did not use case research as a *primary* methodology. In most of these studies, authors typically propose new and innovative systems development approaches and briefly illustrate them in real-life settings (e.g., Clemons and Weber 1998; Elofson and Konsynski 1991; Zviran 1990). In other studies, a field survey or an experiment is first conducted (considered as the primary method) followed by the presentation of one or several short illustrative case studies (e.g., Cox and Ghoneim 1996; Reinig et al. Nunamaker 1997-1998). Given the small amount or complete lack of information related to the case method in these studies, it was decided not to consider them in subsequent analyses, leaving us with a population of 210 "pure" IS case study articles (see Tables 1 and 2).

Next, we classified these articles as positivist, interpretive, or critical using criteria proposed by Cavaye (1996a), Devers (1999); Orlikowski and Baroudi (1991), and Yin (1994). The three philosophical traditions differ mainly in terms of their assumptions about the sources and development of knowledge, the nature of physical and social reality, and the relationship between theory and practice (Orlikowski and Baroudi 1991). Following Orlikowski and Baroudi, we first found it useful to distinguish within the positivist paradigm those studies where researchers were working within a

[4]This ratio is quite similar to the period 1981 through 1985, where 10 percent of the articles published in *Information and Management* were case study articles (Benbasat et al. 1987).

[5]Vogel and Wetherbe split their sample into two subsamples: the publications from the 20 most prolific universities and the other 82 universities. They found that case study research represented 20.3 percent of all publications of the first group and 14.3 percent of all publications of the second group.

**Table 1. Number and Proportion of Case Articles per Journal**

| Journal | Total number of articles (a) | Number of articles using case research (b) | % of articles using case research (b/a) | Number of articles using case research as primary method (c) | % of case articles using case research as primary method (c/b) | Number of articles using positivist case research as primary method (d) | % of articles using case research as primary method that are positivist (d/c) |
|---|---|---|---|---|---|---|---|
| *European Journal of IS* | 193 | 44 | 23% | 35 | 80% | 31 | 89% |
| *Information and Management* | 541 | 57 | 11% | 48 | 84% | 47 | 98% |
| *Information and Organization* | 109 | 23 | 21% | 13 | 57% | 6 | 46%[a] |
| *Information Systems Research* | 188 | 12 | 6% | 11 | 92% | 8 | 73% |
| *Information Technology & People* | 112 | 32 | 29% | 28 | 88% | 20 | 71% |
| *Journal of MIS* | 323 | 34 | 11% | 27 | 79% | 26 | 96% |
| *MIS Quarterly* | 225 | 59 | 26% | 48 | 81% | 45 | 94% |
| **Total** | **1691** | **261** | **15%** | **210** | **80%** | **183** | **87%** |

[a]Although his objectives and method were different, Mingers (2003) also found a large number of positivist studies in *Information and Organization* for the period 1995 through 2000.

**Table 2. Number and Proportion of Case Articles per Year**

| Year of publication | Total number of articles | Number of articles using case research | % of case articles | Number of articles using case research as primary method | % of case articles using case research as primary method | Number of articles using positivist case research as primary method | % of articles using positivist case research as primary method that are positivist |
|---|---|---|---|---|---|---|---|
| | (a) | (b) | (b/a) | (c) | (c/b) | (d) | (d/c) |
| 1990 | 140 | 22 | 16% | 17 | 77% | 15 | 88% |
| 1991 | 148 | 17 | 11% | 14 | 82% | 14 | 100% |
| 1992 | 158 | 17 | 11% | 14 | 82% | 13 | 93% |
| 1993 | 169 | 18 | 11% | 15 | 83% | 14 | 93% |
| 1994 | 186 | 28 | 15% | 23 | 82% | 20 | 87% |
| 1995 | 176 | 29 | 16% | 25 | 86% | 23 | 92% |
| 1996 | 189 | 41 | 22% | 35 | 85% | 31 | 89% |
| 1997 | 166 | 25 | 15% | 22 | 88% | 19 | 86% |
| 1998 | 181 | 35 | 19% | 25 | 71% | 18 | 72% |
| 1999 | 178 | 29 | 16% | 20 | 69% | 16 | 80% |
| **Total** | **1691** | **261** | **15%** | **210** | **80%** | **183** | **87%** |

theoretical perspective from those where the researchers' intentions were merely descriptive. On the one hand, in descriptive case research, investigators attempt no theoretical interpretation of the phenomena; rather, they present what they believe to be straightforward, objective, factual accounts of events to illustrate some issue of interest. Similar to Orlikowski and Baroudi, we used a single criterion for considering a case study as descriptive or illustrative based on what the investigators had implicitly or explicitly stated in their exposition.

Based on the work of Devers (1999), of Lincoln and Guba (1985), and of Orlikowski and Baroudi (1991), we then identified the criteria to classify a theoretically-grounded case study as being positivist. The adoption of a positivist perspective is accompanied by a broad commitment to the idea that the social sciences should emulate the natural sciences (Lee 1989). Epistemologically, positivist studies are premised on the existence of *a priori* fixed relationships within phenomena capable of being identified and tested via hypothetico-deductive logic and analysis. Causal relationships, which are the basis for generalized knowledge, can predict patterns of behavior across situations. Ontologically, positivist research assumes an objective physical and social world that exists independently of humans. The researcher is seen to play a passive, neutral role, and does not intervene in the phenomenon of interest. Keeping in spirit with this set of beliefs, a theoretically grounded positivist case study is likely to be conducted with the ideas of establishing appropriate measures (qualitative and/or quantitative) for the constructs being studied; establishing or testing causal relationships; determining the domain to which the study's findings can be generalized; and demonstrating that the inquiry is value-free. The criteria for judging the quality of such positivist studies, in opposition to interpretive and critical case studies, are related to the traditional validity and reliability tests used in the natural sciences (Yin 1994). Specifically, the primary criteria for classifying a theoretically-grounded case article as *positivist* were the following:

- adoption of a positivist perspective clearly stated in the study
- evidence of formal research hypotheses or propositions
- evidence of qualitative and/or quantitative measures of variables or constructs
- explicit purpose of theory testing or theory building
- concern for validity and reliability issues as used in the natural sciences

The results clearly indicate that positivism represents the predominant philosophical tradition in IS case research, accounting for 87 percent of the 210 surveyed articles (see Tables 1 and 2). Interpretive and critical case studies represented 12 percent and 1 percent of the case articles, respectively. Although the present review concentrates on positivist case research, it is interesting to note that the plea for a mix of philosophical perspectives (Lee 1991; Orlikowski and Baroudi 1991) in IS case research has been heard. Indeed, findings reveal that an increasing number of interpretive and critical case studies have been published over the years. Precisely, interpretive research emerges as a growing strand in IS case research, representing 18 percent of all case studies published after 1995.

## Assessing Rigor of IS Positivist Case Study Research

As a first step, a list of attributes for evaluating rigor in positivist case research needed to be developed. The list presented in Table 3 was established based on the work of Benbasat et al. (1987), Eisenhardt (1989), Lee (1989), and Yin (1994), all of whom have had a strong influence on the conduct of case study research in our field.[6] Together these authors offer a set of guidelines and operational attributes that bring

[6]According to the ISI Web of Knowledge (http://isi4.isiknowledge.com/), as of February 2003, Benbasat et al. (1987), Eisenhardt (1989), and Lee (1989) have been cited 107, 640, and 52 times, respectively.

rigor to positivist case research. While most of the attributes in our list are relevant to all positivist case studies, some were targeted at a specific group of studies, be it exploratory, explanatory, or descriptive in nature. For instance, a clean theoretical slate represents a design criterion in exploratory case research only (Eisenhardt 1989), that is, those studies aimed at defining questions, proposing new constructs, and/or building new theories. Explanatory cases, on the other hand, are suitable for doing causal studies, mainly to test theories. In this particular context, then, the use of rival theories becomes relevant (Lee 1989; Yin 1994).

Descriptive and exploratory case studies represented 61 percent and 30 percent of the positivist case studies, respectively; while explanatory studies accounted for a mere 9 percent of all case studies in our database. Traditionally, case research had been used exclusively for descriptive and exploratory purposes (Stone 1978) and this ideology seems to still be pervasive today. Increasingly, however, authors have adapted case research to test hypotheses (e.g., Brown 1999; Johnston et al. 1999; Lee 1989; Sambamurthy and Zmud 1999), and it is bound to become more prevalent since hypothesis testing represents a major goal of IS research today. Consistent with the findings of Benbasat et al., we found that the IS case studies we surveyed did not provide clear descriptions of where their topics fit in the theory-building process. The research purpose pursued in most studies had to be derived by the authors using the definitions provided by Yin (1994) as a guide.

As shown in Table 3, our list of attributes is divided into three main areas. The first area, *research design,* refers to the attributes associated with the design of the study, such as the nature of research questions, the theoretical foundations, as well as the criteria adopted for selecting the cases. The second area, *data collection,* is basically concerned with the overall quality of the data collection process. It considers the choice of data collection methods, both qualitative and quantitative, and how they are applied along with the tactics for enhancing reliability and validity (e.g., data triangulation, use of case study protocol and database). Finally, the third area, *data analysis,* is concerned with the description of the process as well as with the use of preliminary techniques (e.g., field notes, coding of raw data, data displays), and dominant modes of data analysis (e.g., empirical testing, explanation-building).

Whereas some researchers might consider our listing of attributes to constitute a template for "how to do" positivist case studies, other researchers could claim that the state of the art of positivist case research has not yet settled down, and that more fieldwork needs to be done to synthesize, make consistent, and make more operational the many different insights or guidelines of positivist research that Benbasat et al., Eisenhardt, Lee, and Yin have offered. A middle position would be that our listing of attributes, garnered from the works of experienced case research methodologists, nonetheless provides a *framework* that we intend to be helpful to researchers as well as journal reviewers and editors. In other words, we caution readers who intend to do positivist case research not to use our listing of attributes as a formula or recipe, but instead as a listing of what the state of the art of positivist case research deems to be major considerations.

Prior to assessing the articles included in our database, a coding scheme (see Appendix A) was developed and validated using the following steps. First, five articles were randomly selected and jointly coded by the two authors. From this preliminary step, small adjustments were made in order to increase the clarity and precision of the initial coding scheme. Next, using a stratified random sampling strategy, we identified 20 additional articles from the seven journals, all of which we coded independently. An inter-rater agreement rate of 89 percent was obtained from this process, which is substantial (Landis and Kock 1977). All disagreements were discussed and reconciled, and minor changes were made to the coding scheme. Finally, using the revised coding scheme, the two authors coded an equal number of the remaining articles in the database. In total,

**Table 3. Attributes Used to Assess IS Positivist Case Studies**

| | Authors | Descriptive | Exploratory | Explanatory |
|---|---|---|---|---|
| **AREA 1: RESEARCH DESIGN** | | | | |
| Clear research questions | 1, 2, 3 | X | X | X |
| A priori specification of constructs | 3 | | X | |
| Clean theoretical slate | 3 | | X | |
| Theory of interest | 2, 4 | | | X |
| Predictions from the theory | 2, 4 | | | X |
| Rival theories | 2, 4 | | | X |
| Multiple-case design | 2, 3, 4 | X | X | X |
| Nature of single-case design | 2 | X | X | X |
| Replication logic in multiple-case design | 3, 4 | X | X | X |
| Unit of analysis | 1, 2 | X | X | X |
| Pilot case | 2 | X | X | X |
| Context of the case study | 1, 2 | X | X | X |
| Team-based research | 1, 3 | X | X | X |
| Different roles for multiple investigators | 1, 3 | X | X | X |
| **AREA 2: DATA COLLECTION** | | | | |
| Elucidation of the data collection process | 1 | X | X | X |
| Multiple data collection methods | 1, 2, 3, 4 | X | X | X |
| Mix of qualitative and quantitative data | 1, 3 | X | X | X |
| Data triangulation | 1, 2, 3, 4 | X | X | X |
| Case study protocol | 1, 2 | X | X | X |
| Case study database | 1, 2 | X | X | X |
| **AREA 3: DATA ANALYSIS** | | | | |
| Elucidation of the data analysis process | 1, 2, 3 | X | X | X |
| Field notes | 2, 3 | X | X | X |
| Coding and reliability check | 2 | X | X | X |
| Data displays | 2 | X | X | X |
| Flexible & opportunistic process | 1, 2, 3 | X | X | X |
| Logical chain of evidence | 1, 2 | X | X | X |
| Empirical testing | 2, 4 | | | X |
| Explanation building | 2 | | X | |
| Time series analysis | 2 | | | X |
| Searching for cross-case patterns | 3, 4 | X | X | X |
| Use of natural controls | 4 | | | X |
| Quotes (evidence) | 1, 2 | X | X | X |
| Project reviews | 2 | X | X | X |
| Comparison with extant literature | 3 | | X | |

1 = Benbasat et al. (1987); 2 = Yin (1994); 3 = Eisenhardt (1989); 4 = Lee (1989)

53 attributes were coded for each surveyed article. The coding of an article started with the method section, but was enlarged to the whole paper if the method section was missing or an attribute was not clearly mentioned. When specific words were not used, we searched between the lines for evidence of the attribute. For instance, one article had no method section, but had an interview guide in the appendix from which we were able to assess some attributes. As a final remark, it is worth noting that our assessment of positivist case study research presented below was performed on the basis of the information reported, explicitly or implicitly, in the surveyed articles, not on the basis of what was actually done by case researchers.

# Results

## *Area 1: Research Design*

### Clear Research Questions

Defining the research questions represents one of the most important steps to be taken in any empirical study (Benbasat et al. 1987; Eisenhardt 1989; Mays and Pope 1995; Miles and Huberman 1994). Table 4 shows that fewer than half (42 percent) of the case study articles specified clear research questions. This is rather disappointing since a clear research question expresses the essence of an inquiry, allows one to easily link a study to its practical and theoretical contributions, and is the backbone of a solid research design (Mason 1996). Interestingly, Table 5 shows that clear research questions are predominately stated in exploratory case studies (67 percent) compared to explanatory (41 percent) and descriptive (29 percent) case studies.

One of the key criteria for the appropriate use of the case study method is the type of research questions posed. Yin (1994) explains that case study research is most likely to be appropriate for *how* and *why* questions because these deal with operational links needing to be traced over time, rather than mere frequencies of incidence. In the 76 studies with clear research questions, *how* questions were the most frequent followed by *what* and *why* questions. Case studies which address a *what* question are most appropriate when the purpose of the study is to explore a new phenomenon (Yin 1994). Our findings support this contention. Indeed, *what* questions were most frequently posed in exploratory case research.

### *A Priori* Specification of Constructs and Clean Theoretical Slate (Exploratory Case Studies)

With respect to the issue of using existing theoretical constructs to guide theory-building research, Eisenhardt (1989) argues that *a priori* specification of constructs can help to shape the initial design. Although early identification of possible constructs can be helpful, it is equally important to recognize that it is tentative in theory-building case research. As Eisenhardt stressed, "no construct is guaranteed a place in the resultant theory, no matter how well it is measured" (p. 536). Importantly, Eisenhardt suggests that theory-building research must begin as close as possible to the ideal of no theory under consideration and no hypotheses to test since preordained theoretical perspectives may bias and limit the findings. Our results are encouraging since about four out of five exploratory case studies (n = 54) followed both of Eisenhardt's recommendations (see Table 5).

### Theory of Interest, Predictions from Theory, and Rival Theories (Explanatory Case Studies)

Prior theorizing constitutes an essential input in explanatory case design (Lee 1989; Yin 1994). Markus' (1983) "Power, Politics, and MIS Implementation," which has already been considered as an exemplary study in IS (Lee 1989), represents a very good example of an explanatory single-case study in our field. By presenting and contrasting three rival theories of resistance (people-determined, system-determined, and interaction theory), Markus lays out her orienting frame and

**Table 4. Case Study Design Attributes Over Time**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N (all positivist case studies) | 15 | 14 | 13 | 14 | 20 | 23 | 31 | 19 | 18 | 16 | 183 |
| Clear research questions | 4 (27%) | 4 (29%) | 5 (38%) | 5 (36%) | 8 (40%) | 9 (39%) | 13 (42%) | 11 (58%) | 9 (50%) | 8 (50%) | 76 **(42%)** |
| Multiple-case design | 3 (20%) | 4 (29%) | 8 (62%) | 6 (43%) | 8 (40%) | 7 (30%) | 18 (58%) | 6 (32%) | 6 (33%) | 8 (50%) | 74 **(40%)** |
| Team-based research | 8 (53%) | 10 (71%) | 12 (92%) | 11 (79%) | 17 (85%) | 14 (61%) | 22 (71%) | 14 (74%) | 11 (61%) | 13 (81%) | 132 **(72%)** |

**Table 5. Case Study Design Attributes per Research Purpose**

| | Descriptive | Exploratory | Explanatory | Total |
|---|---|---|---|---|
| N (all positivist case studies) | 112 **(61%)** | 54 **(30%)** | 17 **(9%)** | 183 |
| Clear research questions | 33 **(29%)** | 36 **(67%)** | 7 **(41%)** | 76 (42%) |
| A priori specification of constructs | | 42 **(78%)** | | |
| Clean theoretical slate | | 44 **(81%)** | | |
| Theory of interest | | | 17 **(100%)** | |
| Predictions from theory | | | 16 **(94%)** | |
| Rival theories | | | 5 **(29%)** | |
| Multiple-case design | 38 **(34%)** | 28 **(52%)** | 8 **(47%)** | 74 **(40%)** |
| Unit of analysis | 6 (5%) | 6 (11%) | 2 (12%) | 14 **(8%)** |
| Pilot study | 0 (0%) | 4 (7%) | 0 (0%) | 4 **(2%)** |
| Team-based research | 76 (68%) | 43 **(80%)** | 13 (76%) | 132 **(72%)** |
| Different roles for investigators | 1 (1%) | 4 (7%) | 3 (18%) | 8 **(4%)** |

clearly specifies what factors she will and will not investigate. Markus properly derives several propositions from the three rival theories and then compares the deductions (the predictions) of each against empirical observations. The propositions, besides reflecting important theoretical issues, also begin to tell researchers where to look for relevant evidence.

Hence, rigorous explanatory case research presumes that the theory of interest is stated explicitly in the first place and that predictions following from the theory are also explicitly stated (Lee 1989). Our results are encouraging with regard to these two desired attributes. Indeed, all of the explanatory case studies (100 percent) included in our database stated explicitly the theory of interest

while 94 percent stated clearly the various predictions deducted from the theory itself (see Table 5). As discussed above, another valuable approach for explanatory case studies is the consideration of rival propositions and the analysis of the evidence in terms of such rivals (Lee 1989; Yin 1994). As shown in Table 5, only 29 percent percent of all explanatory case studies considered rival theories in their design (e.g., Pinsonneault and Kraemer 1993a).

### Multiple-Case Design

Another central issue in case research design is the decision to include one or more cases in the project. A frequent criticism of case study research is that its dependence on a single case renders it incapable of providing a generalizable conclusion.[7] Case study research is not sampling research (Benbasat et al. 1987; Lee 1989; Yin 1994) and a single case can be sufficient to disconfirm an existing theory if its predictions do not hold (Markus 1989). Selecting cases must be done so as to maximize what can be learned in the period of time available for the study. Tables 4 and 5 reveal that 60 percent of all studies included a single case while 40 percent adopted a multiple-case design strategy. Given that comparisons among sites may help demonstrate the influence of variability in context (Pettigrew 1989) and therefore yield more general research results than single cases (Benbasat et al. 1987; Yin 1994), this result may appear rather disappointing. However, as shown in Table 5, an encouraging finding was that exploratory (52 percent) and explanatory (47 percent) case studies have made a greater use of multiple-case design than descriptive (34 percent) cases.

### Nature of Single-Case Design and Replication Logic in Multiple-Case Design

As Yin (1994) stressed, most research efforts require multiple cases, but single cases are useful in specific instances. It is thus important to investigate how cases are selected. Cases are usually chosen because of their substantive significance or theoretical relevance (Ragin 1999). In a single-case design approach, a case should be selected on the basis that it is critical (a case which has the conditions that allow the test of a theory) (e.g., Pinsonneault and Kraemer 1993a), extreme or unique (a case so rare that any single case is worth analyzing) (e.g., El Sawy and Bowles 1997), or revelatory (a case that was previously inaccessible to scientific investigation) (e.g., Cross et al. 1997).

According to Yin (1994), in a multiple-case design, the selection should follow a literal replication logic (conditions of the case lead to predicting the same results) or a theoretical replication logic (conditions of the case lead to predicting contrasting results). Two studies on business process reengineering illustrate the proper use of these strategies. On the one hand, Stoddard and Jarvenpaa (1995) adopted a theoretical replication approach to study the tactics of three organizations' reengineering initiatives which varied in terms of the expected change outcomes. On the other hand, Broadbent et al. (1999) used a literal replication strategy in an exploratory case analysis of four firms from two industries to understand how IT contributes to success in implementing reengineering. The aim was to demonstrate that the phenomena were not industry-specific.

As shown in Table 6, only 15 percent of all single-case studies were explicit in terms of the selection criteria. Weick (1984) observed that the reader is often left to wonder about the representativeness or uniqueness of a case. Like Benbasat et al., we could posit that most single cases were presumably chosen based on availability. In multiple-case designs, however, the results were somewhat more encouraging since 32 percent of these articles provided explicit information regarding the case selection process. This represents a major improvement compared to the previous review, which revealed that "*none* of the multiple-case studies clearly stated the site selection objectives, i.e., whether the investigator pursued a literal or a theoretical replication" (Benbasat et al. 1987, p. 381). Furthermore, we observed that theoretical

[7]Lee and Baskerville (forthcoming) take a contrary position.

**Table 6. Case Selection in Single- and Multiple-Case Design**

| | Single-Case Design | Multiple-Case Design |
|---|---|---|
| N (all positivist case studies) | 109 | 74 |
| Unique or extreme case | 10 (9%) | |
| Revelatory case | 4 (4%) | |
| Critical case | 1 (1%) | |
| Critical and revelatory case | 1 (1%) | |
| Not specified | 93 **(85%)** | 50 **(68%)** |
| Literal replication logic | | 9 **(12%)** |
| Theoretical replication logic | | 15 **(20%)** |

replication was adopted more widely than literal replication (20 percent versus 12 percent).

### Unit of Analysis

The next component of case design is related to the fundamental problem of defining what the *case* is (Yin 1994). Table 5 shows that only 8 percent of all articles in our database clearly specified the unit of analysis (e.g., Leidner and Jarvenpaa 1993; Webster 1998). This finding is consistent with Benbasat et al., who observed that "the unit of analysis...was not provided in *many* of the published works" (p. 380, emphasis added). This illustrates another fundamental problem of doing case research in IS because the specification of the unit of analysis, be it a specific technology, a systems development approach or methodology, or a particular type of organization, is critical if we want to understand how the case study relates to a broader body of knowledge. This is even more critical with explanatory and exploratory case studies since, as Markus (1989) noted, the practical significance of the findings for the theory rests on the study of the appropriate unit of analysis. In an exploratory case study, a clear definition of the unit of analysis helps define the boundaries of a theory, which in turn set the limitations in applying the theory. In an explanatory case, a clear definition corroborates that the unit of analysis under study is consistent with the boundaries of the theory being tested.

### Pilot Case

When the research is highly exploratory, a pilot study may help researchers to determine the appropriate unit of analysis, to refine the data collection instruments, and/or to familiarize the researcher with the phenomenon itself (Yin 1994). We observed (see Table 5) that only four studies out of the whole group (2 percent, all of which are exploratory in nature) specified the execution of a pilot case. For instance, Zinatelli et al. (1996) adopted such a tactic in their exploration of the factors influencing the sophistication and success of end-user computing in eight small businesses. This study instructs us on how a pilot case can be used to refine data collection plans and gain insights into the basic issues being studied.

### Context of the Case Study

A detailed description of the research context is necessary to assess the credibility of the research results and to determine their generalizability (Benbasat et al. 1987; Yin 1994). Several aspects of the research context are important. The first relates to the setting: a detailed account describing where the research was conducted and

**Table 7. Context of IS Positivist Case Research**

| | Number and Proportion of Case Articles |
|---|---|
| N (all positivist case articles) | 183 |
| *Description of the site(s)* | 173 **(95%)** |
| Case period | 59 **(32%)** |
| Longitudinal design | 28 **(15%)** |
| Time spent on site by the researcher(s) | 35 **(19%)** |
| Nature of data (retrospective, on-going, both) | 125 **(68%)** |

the specific period of time under investigation. Other key aspects are related to the moment data was collected in relation to the time the events occurred, whether there were one or more data collection periods, whether the researcher was able to gain sufficient access and spend enough time to develop an intimate understanding of the setting and the phenomenon of interest, and whether the researcher collected data during the course of the events (on-going) or *a posteriori*.

As shown in Table 7, case researchers were not very explicit about the context surrounding their research. First, we found that while most case researchers (95 percent) described to some extent where their research was conducted (site description), only 32 percent stated the specific period of time (case period) under investigation. Providing the latter information is important since the case period defines the frame of reference under which phenomena are investigated (Pettigrew 1989). Second, we found that a relatively small proportion of case studies (15 percent) were longitudinal in nature (i.e., had multiple data collection points). Newman and Sabherwal (1996) conducted such a longitudinal study to examine how changes in commitment affected six decisions made during the development of one large system over a 17-year time period. Longitudinal studies are needed because phenomena studied in IS case study research (e.g., implementation success or failure, technology impacts, and effects of IT management decisions) are dynamic in nature, evolve over time, and produce effects that can best be observed over time (Benbasat et al. 1987). The longer a phenomenon is being investigated, the greater the chances that patterns, continuities, and discontinuities will be identified, adding depth to our understanding (Pettigrew 1989; Weick 1984). Findings are often time-bound and potentially confounded with time (Laudon 1989). We then reiterate the claim by Benbasat et al. that the small proportion of longitudinal studies represents another shortcoming in IS positivist case research. Finally, we noted that only 19 percent of the articles reported how much time the researcher(s) had spent on site (e.g., Horner Reich and Kaarst-Brown 1999; Stoddard and Jarvenpaa 1995), while 32 percent of the surveyed case articles provided no information about the nature of the data being collected, be it retrospective (e.g., Romm and Pliskin 1999), on-going (e.g., Webster 1998), or both (e.g., George 1996). Only 11 percent of all case studies reported the gathering of on-going data while 40 percent of the cases were retrospective in nature. However 17 percent reported gathering both retrospective and on-going data.

### Team-Based Research and Different Roles for Multiple Investigators

The analysis of case data represents a challenge even for the most experienced researcher. Case data usually comes from a multiplicity of sources and forms (Miles and Huberman 1994) and its sheer volume, lack of structure, and richness

make the analysis process difficult and complex. Working with a research partner may thus provide invaluable assistance (Benbasat et al. 1987). The work of a team of researchers can capture greater richness and foster greater confidence in the findings (Eisenhardt 1989; Patton 1999). Romm and Pliskin (1999) provide a good illustration of how multiple researchers can collaborate to maximize reliability. Indeed, they were both involved in all data analysis activities and were able to reach agreement whenever findings or their interpretation were in dispute.

Table 5 shows that 72 percent of the case studies included in our database were conducted by a team of researchers; this proportion reached 80 percent for exploratory case studies.[8] Peffers and Hui (2003, Table 2) found that the proportion of multiple authored papers had increased significantly in IS journals in the last 15 years to reach 62 percent for the period 1997 through 2001.[9] Results from this study and our own seem to indicate that IS researchers, including case researchers, see the advantages of team-based research.[10] Indeed, different strategies can be used with multiple investigators. During fieldwork, for instance, a two-person team can visit the organization and interview key actors, so that the case is investigated from different perspectives (Eisenhardt 1989). Multiple researchers can also analyze the data independently and compare findings (Patton 1999). Another interesting strategy is to assign researchers different roles (e.g., one handles the interviews while another observes and takes notes) in order to encourage the development of different views or perspectives that can then be contrasted (Eisenhardt 1989). As shown in Table 5, only 4 percent of all of the case studies reported the adoption of different roles by different investigators including research assistants (e.g., Lederer et al. 1990; Newman and Sabherwal 1996).

## Area 2: Data Collection

### Elucidation of the Data Collection Process

It was quite astonishing to observe that 42 percent of all case studies in our database did not elucidate how data was collected (see Table 8). This represents a serious deficiency since

> a clear description of the data sources and the way they contribute to the findings of the research is an important aspect of the reliability and validity of the findings [in case research] (Benbasat et al. 1987, p. 381)

As shown in Table 9, we also observed that descriptive case studies (53 percent) most frequently omitted data collection methods and procedures while this proportion dropped to 26 percent for exploratory case studies and 18 percent for explanatory research. A descriptive case study is usually considered less demanding than an exploratory or an explanatory one. Little theory is said to be needed, causal links do not have to be made, and analysis is minimal. However, even under these conditions, the reader must be able to tell what sources of information were used and judge the reliability of the information. The omission of such information undermines the credibility of descriptive case studies.

Yin (1994) identifies several sources of qualitative evidence in case research including interviews, documentation, direct observation, and physical artifacts. Quantitative observations, mostly in the form of questionnaire or time series data, can also be gathered in case studies (Benbasat et al. 1987; Eisenhardt 1989). Considering only the articles

[8]The number of authors was used as a proxy for the number of researchers on the team. This is not a perfect measure since other actors, such as graduate students and research assistants, could also be involved in a research project without having their names appear in the list of authors.

[9]Peffers and Hui considered 10 IS journals and examined all types of empirical articles, not only case studies.

[10]For the sake of comparison, our data reveals that the proportion of multi-authored papers for the period 1997 through 1999 is the same as that for the period 1990 through 1999.

**Table 8. Data Collection Attributes Over Time**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N (all positivist case studies) | 15 | 14 | 13 | 14 | 20 | 23 | 31 | 19 | 18 | 16 | 183 |
| Elucidation of the process | 5 (33%) | 6 (43%) | 6 (46%) | 8 (57%) | 13 (65%) | 13 (57%) | 21 (68%) | 13 (68%) | 10 (56%) | 12 (75%) | 107 **(58%)** |
| N (data collection elucidated) | 5 | 6 | 6 | 8 | 13 | 13 | 21 | 13 | 10 | 12 | 107 |
| Multiple data collection methods | 3 (60%) | 3 (50%) | 5 (83%) | 7 (88%) | 9 (69%) | 10 (77%) | 17 (81%) | 11 (85%) | 8 (80%) | 10 (83%) | 83 **(78%)** |
| Qualitative and quanti-tative data | 0 (0%) | 1 (17%) | 2 (33%) | 5 (63%) | 5 (38%) | 3 (23%) | 5 (24%) | 5 (38%) | 3 (30%) | 4 (33%) | 33 **(31%)** |
| Data triangulation | 3 (60%) | 1 (17%) | 3 (50%) | 4 (50%) | 1 (8%) | 4 (31%) | 3 (14%) | 5 (38%) | 3 (30%) | 5 (42%) | 32 **(30%)** |

**Table 9. Data Collection Attributes per Research Purpose**

| | Descriptive | Exploratory | Explanatory | Total |
|---|---|---|---|---|
| N (all positivist case studies) | 112 | 54 | 17 | 183 |
| Elucidation of the process | 53 **(47%)** | 40 **(74%)** | 14 **(82%)** | 107 (58%) |
| N (data collection elucidated) | 53 | 40 | 14 | 107 |
| Multiple data collection methods | 37 (70%) | 34 **(85%)** | 12 **(86%)** | 83 (78%) |
| Qualitative & quantitative data | 12 (23%) | 16 **(40%)** | 5 **(36%)** | 33 (31%) |
| Data triangulation | 6 **(11%)** | 18 (45%) | 8 (57%) | 32 **(30%)** |
| Case study protocol | 0 (0%) | 4 (10%) | 1 (7%) | 5 **(5%)** |
| Case study database | 1 (2%) | 3 (8%) | 2 (14%) | 6 **(6%)** |

**Table 10. Variety of Data Collection Methods in IS Positivist Case Research**

| Data Collection Methods | Number and Proportion of Case Articles* |
|---|---|
| N (data collection elucidated) | 107 |
| Interviews | 102 **(95%)** |
| Documentation | 68 **(64%)** |
| Observation | 34 **(32%)** |
| Questionnaires | 29 **(27%)** |
| Artifacts | 13 **(12%)** |
| Time series | 4 **(4%)** |

*The total is greater than 107 since several studies used multiple data collection methods.

that elucidated the data collection process (n = 107), we observed that a vast majority (95 percent) of the articles included in this subgroup (see Table 10) used interviews as a data collection method. Interestingly, interviews represented the primary data collection method in 88 percent of these articles. This is consistent with the observations by Benbasat et al. that case data were primarily collected through face-to-face semi-structured interviews. Among those who used interviews (n = 102), we noted that only 13 percent reported their sampling strategy (e.g., snowball, convenient, random, quota sampling) and 39 percent, their use of an interview guide. We also observed that fewer than 38 percent of these same studies (n = 102) reported how many people were interviewed while only 24 percent mentioned the number of interviews conducted. Finally, interviews were tape-recorded and transcribed in about one third of the studies in this subgroup (n = 102) while only 4 percent reported some form of pre-test or validation of the interview guide (e.g., Cavaye 1996b; Webster 1998). In short, the apparent lack of information about the sampling strategy in positivist case studies might prohibit the reader from understanding the limits of the conclusions that are drawn from such research.

Among those studies that provided information about the data collection process (n = 107), reviewing existing documentation was also widely used (64 percent) while direct observation was carried out in only 32 percent of all studies (see Table 10). We noticed that most authors usually did not elaborate on how both of these data collection methods were used and how they contributed to the findings. Benbasat et al. formulated this same observation. Quantitative data in the form of questionnaires were used in 27 percent of all case studies, while artifacts (12 percent) and time series data (4 percent) were used even less frequently. This last finding about time series is not surprising since only a small proportion (15 percent) of the case articles in our database had adopted a longitudinal design. Overall, we observed that the degree of detail about the data collection process was not revealing in most case studies. We must therefore reiterate Benbasat et al.'s (1987) message that

> a clear description of data sources and the way they contribute to the findings of the research is an important aspect of the reliability and validity of the findings (p. 381)

It is worth mentioning that Kirsch and Beath (1996) offer an excellent example of how tables can be effectively used to summarize information about the data collection process in case research.

### Multiple Data Collection Methods and Mix of Qualitative and Quantitative Data

A major strength of case study data collection is the opportunity to use many different sources of evidence to provide a richer picture of the events and/or issues than would any single method (Sawyer 2001; Yin 1994). In the specific context of this review, a multi-method approach to research involves several data collection techniques, such as interviews and documentation, organized to provide multiple but dissimilar data sets regarding the same phenomena (Gallivan 1997; Jick 1979; Mingers 2001). As shown in Tables 8 and 9, 78 percent of those studies that described the data collection process reported the use of multiple data collection methods. This represents an improvement in IS case study research over the past decade since Benbasat et al. observed that *about half* of the case studies included in their sample used multiple data collection approaches. In addition to using multiple data collection methods, the specific use of a combination of quantitative (e.g., questionnaires) and qualitative (e.g., interviews) data sources is often advocated (e.g., Kaplan and Duchon 1988; Patton 1999; Reichardt and Cook 1978). As Eisenhardt stressed, quantitative data

> can keep researchers from being carried away by vivid, but false, impressions in qualitative data, and it can bolster findings when it corroborates those findings from qualitative evidence (p. 538)

Table 8 shows that only 31 percent of all articles providing information about their data collection process (n = 107) reported the use of a mix of qualitative and quantitative methods. Interestingly, Table 9 reveals that explanatory and exploratory case studies tend to rely more heavily on both multiple data collection methods and a mix of qualitative and quantitative data than do descriptive ones. As a final remark, we note that Kirsch and Cummings (1996) provide an insightful example of how both types of data can be combined to provide a richer look at the phenomenon under investigation.

### Data Triangulation

The most important advantage of using multiple sources of evidence is the development of converging lines of inquiry (Patton 1999; Yin 1999). The process of combining multiple data sources is called triangulation (Jick 1979). Any finding or conclusion in a case study is likely to be much more convincing and accurate if it is based on several different sources of information. Among the articles providing information about their data collection process (n = 107), we observed that fewer than one-third (30 percent) of the studies reported using some form of data triangulation and that this tactic is least practiced in descriptive case studies (see Tables 8 and 9). These findings are once again in line with those of Benbasat et al., who showed that triangulation was *rarely* used in case research. One of the very few case studies which clearly demonstrates how triangulation was actually achieved is reported in Zack (1993). This study also illustrates how tables can be effectively used to synthesize the various data sets (interviews, observation, questionnaires) supporting the findings.

### Case Study Protocol and Case Study Database

The goal of reliability is to minimize the errors and biases in a study. The general way to do this is to conduct the case research so that another investigator could repeat the procedures and arrive at the same conclusions. One prerequisite for allowing other investigators to repeat an earlier case study is documentation of the procedures followed. Yin (1994) proposes two tactics to ensure reliability, namely, the use of a case protocol and the development of a case study database.

A case study protocol contains more than the interview or survey instruments. It should also contain procedures and general rules that should be followed in using the instruments and is created prior to the data collection phase. Table 9 demonstrates that the use of a case study protocol was reported in a very small proportion (5 percent) of those studies that provided infor-

mation about the data collection process (n = 107) (e.g., Leidner and Jarvenpaa 1993). A case study database usually contains the following elements: raw material (including interview transcripts, researcher's field notes, documents collected during data collection, and survey material); coded data; coding scheme; memos and other analytic material; and data displays (e.g., Kirsch and Cummings 1996). There was no mention of such a database in 94 percent of the case studies (n = 107) (see Table 9).

## *Area 3: Data Analysis*

### Elucidation of the Data Analysis Process

As Eisenhardt stressed, analyzing data is "both the most difficult and the least codified part of the process" (p. 539). It was, therefore, important to first assess the extent to which case researchers elucidated the data analysis procedures. In order to do so, we classified each article in the database as providing either "no information," "a brief description," or "a clear and detailed description" of the analytic procedures and/or rules followed. Examples of clear and detailed descriptions of analytic procedures and rules are presented in Brown (1999), Kirsch (1997), and Sabherwal and Tsoumpas (1993).

As shown in Table 11, we counted a large number of articles (77 percent) with no explanation of how data was analyzed, while 15 percent provided a brief description of the data analysis process, and 9 percent provided a clear and detailed description of analytic procedures. This represents another serious shortcoming since a clear descripion of the analytic strategies and/or procedures allows the external observer to better understand the findings. In addition, since positivism considers qualitative data to be vulnerable to subjective interpretation and to surpass human ability to compile, a clear description of the data analysis process allows us to judge whether or not the results are the fruit of a systematic and rigorous process. On a more positive note, we observed that the proportion of cases with no explanation of how data was analyzed decreased during the second half of the past decade (from 83 percent in the period 1990 through 1994 to 72 percent in the period 1995 through 1999).

### Field Notes, Coding, Data Displays, and Flexible and Opportunistic Process

A striking feature of case study research is the frequent overlap of data analysis and data collection (Eisenhardt 1989; Miles and Huberman 1994; Yin 1994). Miles and Huberman proposed a series of methods to help fieldwork cycle back and forth between thinking about existing data and generating strategies for collecting new, often better, data. Much information in case research is often revealed in casual conversation and needs to be recorded in the form of field notes (Van Maanen 1988). Field notes should be as complete as possible and include not only verbal information but nonverbal communication and descriptions of the context of the conversations. It was a surprise to observe that only 5 percent of all articles reported the use of field notes by case researchers (e.g., Goldstein 1990; Leidner and Jarvenpaa 1993). As shown in Table 12, such practice was mainly reported in exploratory case research.

In qualitative methods, including case research, coding represents another tool to support researchers during early analysis. Codes are especially useful tools for data reduction purposes and having a coding scheme in an appendix helps to facilitate a replication or an extension to a given study and allows the reader to see the logical link between the theoretical model and the codes. Systematic coding also provides a means to avoid bias and validate interpretations through inter-rater reliability techniques. Only 12 case study articles (7 percent) reported the use of some form of coding (see Table 12). Of these 12 articles, four (33 percent) made their scheme (or part of it) available in the manuscript and five (42 percent) mentioned that the scheme was validated. Keil (1995) and Webster (1998) represent clear and detailed examples of coding in positivist case research and both reveal the results associated with inter-rater reliability tests.

**Table 11. Elucidation of the Data Analysis Process Over Time**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N (all positivist case studies) | 15 | 14 | 13 | 14 | 20 | 23 | 31 | 19 | 18 | 16 | 183 |
| No information provided | 13 (87%) | 14 (100%) | 9 (69%) | 10 (71%) | 17 (85%) | 15 (65%) | 25 (81%) | 13 (68%) | 14 (78%) | 10 (63%) | 140 **(77%)** |
| Brief description of the process | 1 (7%) | 0 (0%) | 2 (15%) | 3 (21%) | 2 (10%) | 5 (22%) | 3 (10%) | 5 (26%) | 3 (17%) | 3 (19%) | 27 **(15%)** |
| Detailed description of the process | 1 (7%) | 0 (0%) | 2 (15%) | 1 (7%) | 1 (5%) | 3 (13%) | 3 (10%) | 1 (5%) | 1 (6%) | 3 (19%) | 16 **(9%)** |

**Table 12. Data Analysis Attributes per Research Purpose**

| | Descriptive | Exploratory | Explanatory | Total |
|---|---|---|---|---|
| N (all positivist case studies) | 112 | 54 | 17 | 183 |
| Elucidation of the analysis process | 14(13%) | 21 (39%) | 8 (47%) | 43 **(23%)** |
| Field notes | 2 (2%) | 7 (13%) | 0 (0%) | 9 **(5%)** |
| Coding | 2 (2%) | 5 (9%) | 5 (29%) | 12 **(7%)** |
| Data displays | 52 (46%) | 35 (65%) | 13(76%) | 100 **(55%)** |
| Flexible and opportunistic process | 1 (1%) | 4 (7%) | 0 (0%) | 5 **(3%)** |
| Logical chain of evidence | 12 **(11%)** | 18 **(33%)** | 5 (29%) | 35 **(19%)** |
| Empirical testing | | | 11**(65%)** | |
| Explanation building | | 32 **(59%)** | | |
| Time series analysis | | | 2 (12%) | |
| N (multiple-case design) | 38 | 28 | 8 | 74 |
| Searching for cross-case patterns | 20 (53%) | 18 **(64%)** | 7 **(88%)** | 45 **(61%)** |
| N (all positivist case studies) | 112 | 54 | 17 | 183 |
| Use of natural controls | | | 0 **(0%)** | |
| Quotes | 30 (27%) | 26 **(48%)** | 5 (29%) | 61 **(33%)** |
| Project reviews | 8 (7%) | 13 (24%) | 6 (35%) | 27 **(15%)** |
| Comparison with conflicting literature | | 6 **(11%)** | | |
| Comparison with similar literature | | 20 **(37%)** | | |

Visual displays are an important part of qualitative analysis (Yin 1994). Displaying data is a powerful means for discovering connections between coded segments (Crabtree and Miller 2000). Data displays also transmit synthesized information to the reader, which can help demonstrate the chain of evidence and ultimately the findings. Miles and Huberman present in great and helpful detail, a cornucopia of possible displaying matrices that can be created from textual data based on sorted codes. In the present review, we observed that 55 percent of all the case articles directly presented or reported the use of one or more data displays (see Table 12). The effective use of data displays is illustrated in several studies including Kirsch and Beath (1996) and Zack (1993).

Overall, our findings reveal that positivist case research published in the 1990s did not provide much information about the adoption of preliminary data analysis techniques and tools including field notes, coding, and data displays. This represents another serious deficiency since technical rigor in analysis is a major factor in the credibility of qualitative findings (Patton 1999).

Last, overlapping data collection with data analysis not only gives the researcher a head start in analysis but, more importantly, allows researchers to take advantage of flexible data collection. Indeed, a key feature of qualitative research, in general, and case research, in particular, is the freedom to make adjustments during the data collection process. As shown in Table 12, only five case studies (3 percent) in our database have explicitly discussed the flexible and/or opportunistic nature of the data collection and data analysis phases.

### Logical Chain of Evidence

To increase the reliability of the information presented in a case study, a key principle to be followed is the maintenance of a logical chain of evidence (Benbasat et al. 1987; Yin 1994). As Yin (1994) explained, the principle is to allow an external reviewer or observer to follow the derivation of any evidence from initial research questions to ultimate case study conclusions. Furthermore, the observer should be able to trace the steps in either direction (from conclusions back to initial research questions or from questions to conclusions). The process should be tight enough so that evidence presented in the case report is assuredly the same evidence that was collected during the data collection process. When this is achieved, a case study has addressed the methodological problem of determining internal validity.

In order to assess whether the authors of a case report had maintained a chain of evidence, we evaluated the extent to which we were able to move from one portion of the case study to another, with minimal cross-referencing to methodological procedures and to the resulting evidence. Hence, for all of the articles included in our database, we were able to trace the steps from initial research questions to conclusions in only 19 percent of them (see Table 12). This proportion varies from 11 percent for descriptive case studies to 33 percent for exploratory case studies.

### Modes of Analysis: Empirical Testing, Explanation Building, and Time Series

How data are analyzed and interpreted represents another key question in positivist case research. Linking raw data to findings can be done in a number of ways, but none has become as precisely defined as the assignment of subjects and treatments conditions in laboratory experiments. Yin (1994) suggests that every case investigation should have a general analytic strategy, so as to guide the decision regarding what will be analyzed and for what reason. Moreover, a data analysis strategy is even more important in the context of an exploratory or explanatory case study since the goal of the investigations is to develop or test theories.

Knowledge is built through the incremental testing of existing theories in order to verify the relations

among variables within a particular set of boundary constraints and/or assumptions. Empirical testing basically involves the confrontation of observations from the field with hypotheses deduced from a theory (predictions). In quantitative research, well-known standardized statistical analysis methods (e.g., analysis of variance or regression) have helped researchers confirm or disconfirm hypotheses. In qualitative research, such as case study research, the researcher faces the necessity to test "verbally stated evidence" against "verbally stated propositions" (Lee 1989), making the endeavor risky and more difficult. Considered as one of the most desirable strategies for explanatory case analysis, Yin's (1994) pattern-matching is a form of empirical testing for qualitative data. Degrees-of-freedom analysis, another empirical-testing technique particularly well suited to test theories from case data, is also based on pattern-matching (Campbell 1975; Wilson and Woodside 1999). Basically, a pattern-matching logic compares an empirical pattern with a predicted one and internal validity is enhanced when the patterns coincide.

A second data analysis strategy presented by Yin (1994), called explanation-building, is also considered a form of pattern-matching in which the analysis of the case study is carried out by *building* a textual explanation of the case. This implies that it is most useful in exploratory case studies (e.g., Cavaye and Christiansen 1996; Newman and Sabherwal 1996). A third and final strategy presented by Yin (1994) is time series. Time series analysis requires the gathering of a large number of data points and involves the identification of patterns over time (e.g., Nault and Dexter 1995).

Table 12 reveals that 11 out of the 17 explanatory case studies (65 percent) included in our database used a form of "pattern-matching" empirical testing as a dominant mode of analysis while two explanatory case studies (12 percent) used time series analytic procedures. Further, 59 percent of all of the exploratory case studies used some form of explanation-building as a dominant mode of analysis.

**Searching for Cross-Case Patterns**

Coupled with within-case analysis is cross-case search for patterns. The tactics here are driven by the fact that, in the positivist realm, people are considered poor processors of information (Eisenhardt 1989). They leap to conclusions based on limited data, they are overly influenced by the vividness or by more elite respondents (Miles and Huberman 1994), or they sometimes inadvertently drop disconfirming evidence (Nisbett and Ross 1980). Thus, the key to good cross-case comparison is counteracting these tendencies by looking at the data in many divergent ways.

Several tactics are proposed by Eisenhardt and by Miles and Huberman that may be applied to all types of case studies. An example of such a tactic is to select categories or dimensions, and then to look for within-group similarities coupled with intergroup differences. The research problem or the existing literature can suggest dimensions, or the researcher can simply choose some dimensions. Table 12 shows that cross-case patterns were searched in 61 percent of all multiple-case studies included in our database (n = 74) and this analytic approach was most widely adopted in explanatory (88 percent) and exploratory (64 percent) case studies.

**Use of Natural Controls (Explanatory Case Studies)**

When testing hypotheses, researchers from the natural sciences observe the influence of one variable on another variable "where the potentially confounding influences of all other factors are somehow removed or 'controlled for'" (Lee 1989, p. 35). Since such controls are impossible in single-case research, Lee proposes to utilize what he calls *natural controls*. He explains and illustrates the concept of natural controls using Markus' (1983) exemplary case study. This example refers to a particular accountant who, after moving from his position in corporate accounting to controller in one of the divisions, changes from being an advocate of a financial

information system to one of its resistors. By making such controlled observation, Markus falsifies the people-determined theory, which predicts no change in behavior where there is no change in people factors. We were unable to detect the use of natural controls as defined by Lee (1989) in any of the nine explanatory single-case studies included in our database.

#### Quotes

The use of quotes in a qualitative write-up is a way to "bring in the voice of participants in the study" (Creswell 1998, p. 170). The quality of the work, the relationship between the researcher and the participants, and the appropriate use of data to support the conclusions are all portrayed through the choice and appropriate use of quotes (Fetterman 1998). Quotes present compelling evidence allowing the reader to reach an independent judgment regarding the merits of the analysis (Yin 1994). Surprisingly, quotes were presented in only one-third of all case studies, a majority of which were exploratory in nature (see Table 12).

#### Project Reviews

When using the project review strategy, the researcher solicits research subject or participant views of the credibility of interpretations and findings (Devers 1999; Patton 1999; Yin 1994). It is a procedure used to corroborate the essential facts and evidence presented in the case report (Schatzman and Strauss 1973). Notwithstanding its importance, this practice was reported in only 15 percent of all of our case articles. The adoption of this tactic is illustrated in Cavaye and Christiansen (1996), Goldstein (1990), and Levine and Rossmoore (1993).

#### Comparison with Extant Literature (Exploratory Case Studies)

When building theories from case research, it is of utmost importance to compare the emergent concepts, theory, or hypotheses with the extant literature. Examining literature that conflicts with the emergent theory is likely to enhance confidence in the findings and "forces researchers into a more creative, framebreaking mode of thinking than they might otherwise be able to achieve" (Eisenhardt 1989, p. 544). Literature discussing similar findings is important as well because it ties together underlying similarities in phenomena normally not associated with each other. The result is often a theory with stronger internal validity, wider generalizability, and higher conceptual level. Notwithstanding the potential benefits associated with such a tactic, Table 12 reveals that only 11 percent of all exploratory case studies related their findings to conflicting literature while 37 percent of them discussed similar literature. In short, tying the emergent constructs, hypotheses, or theories to extant literature is crucial in theory building since the results usually rest on a small number of cases. In this situation, Eisenhardt argues, "any further corroboration of internal validity or generalizability is an important improvement" (p. 545).

### *Summary of Key Findings*

Table 13 presents a synthesis of the key findings and trends of this survey of case study research, identifying where progress has been made in the application of positivist case methodology in the IS field over the past decade, and providing some suggestions for further improvement.

Our exhaustive assessment reveals that while modest progress has been made with respect to some specific attributes or criteria, the findings are somewhat disappointing and there are still significant areas for improvement. In particular, the following six key findings should engage further reflection and action among the IS research community:

- Little progress has been made over the years in several areas and, thus, some of our key findings are consistent with the observations made by Benbasat et al. For instance, a majority of studies included a single case, most of which were presumably chosen based on

**Table 13. Summary of Findings, Trends, and Recommendations for Further Improvement**

| Criteria | Findings and Trends | Overall Assessment | Recommendations for Further Improvement |
|---|---|---|---|
| **Research Design** | | | |
| Clear research questions | 58% of all case studies in our database did not state the initial research questions. | +/– | More attention should be paid to the definition of initial research questions given that, without a research focus, it is easy to become overwhelmed by the volume of qualitative data often collected in case research. Without a clear research question, it is more difficult for the reader to understand the focus of the study and how it relates to a larger domain or area. |
| | *How, what,* and *why* were the most widely used types of research questions, respectively. As expected, *what* questions were mostly adopted in exploratory case studies. | + | |
| *A priori* specification of constructs and clean theoretical slate | A large proportion of exploratory case studies (about 80%) have followed Eisenhardt's recommendations, namely, to specify *a priori* a set of constructs and to adopt a clean theoretical slate. | + | Exploratory case researchers must continue to define *a priori* constructs in order to help them make sense of occurrences, ensure that important issues are not overlooked, and guide their interpretation and focus when conducting theory-building research. |
| Theory of interest, predictions from theory, and rival theories | Virtually all explanatory case studies in our population stated the theory of interest as well as the various predictions following from the theory itself. However, less than one-third of all explanatory studies in our population considered rival theories in order to increase predictive power. | +/– | Explanatory case researchers are encouraged to seek those alternatives that most seriously challenge the design of their study. Such an approach is likely to increase the internal validity of results. |
| Multiple-case design | About 60% of all case studies in our database collected and analyzed data about a single case. Exploratory and explanatory case studies made a greater use of multiple cases than did descriptive ones. | +/– | More studies with multiple cases are needed in order to develop and test more robust theories. Multiple cases also have the potential to yield more compelling evidence. |

**Table 13. Summary of Findings, Trends, and Recommendations for Further Improvement (Continued)**

| Criteria | Findings and Trends | Overall Assessment | Recommendations for Further Improvement |
|---|---|---|---|
| Nature of single-case design and replication logic in multiple-case design | A vast majority of single-case studies (85%) were not explicit in terms of the case selection criteria and were presumably chosen based on availability. | – | Case selection (single and multiple) must have clear rationales. Researchers must specify whether cases are chosen because of their substantive significance or theoretical relevance. |
| | 68% of all multiple-case studies did not provide clear information about the replication logic. Nonetheless, this represents a major improvement since the early 1980s. | + | |
| Unit of analysis | Only 8% of all case articles clearly specified the unit of analysis. This represents no improvement since the early 1980s. | – | Researchers must specify the unit of analysis to allow readers to understand how the case study relates to a broader body of knowledge. |
| Pilot case | Only 2% of all case studies mentioned the conduct of a pilot study. | – | Pilots must be used more widely because they may reveal inadequacies in the initial design and hence they may help refine the design and the data collection plans. Importantly, pilots provide insights into the issues being studied. |
| Context of the study | Case researchers were not explicit about the context of their study (case period, time spent at site, nature of data, etc.). Most case research was cross-sectional in nature. | – | More information about the context is needed to increase the credibility of the results and to determine whether they are generalizable. Contextual information also helps the external observer to get a better sense of the "big picture." |
| Team-based research and different roles for multiple investigators | While almost three out four case studies were conducted by a team of researchers, only 4% of all studies reported the adoption of different roles by different investigators (including research assistants). | +/– | Team-based case study research must be encouraged so as to increase the creative potential of each study and to enhance confidence in the findings. Case researchers must be more explicit about the different roles assigned to investigators. |

**Table 13. Summary of Findings, Trends, and Recommendations for Further Improvement (Continued)**

| Criteria | Findings and Trends | Overall Assessment | Recommendations for Further Improvement |
|---|---|---|---|
| **Data Collection** | | | |
| Elucidation of the data collection process | 42% of all case studies did not elucidate how data were collected. Descriptive cases most frequently omitted data collection plans and procedures.<br><br>Interviews represented the most widely used data collection method in case research. However, researchers rarely described how interviews were conducted (sampling, number of interviews and interviewees, profile of interviewees, transcription, use, and validation of an interview guide, etc.). While reviewing documentation was used in several studies, most authors did not elaborate on how documents were used in the analysis and how they contributed to the findings. | – | A clear description of the data sources and the way they contribute to the findings is an important aspect of the reliability and validity of case findings.<br><br>Case researchers could effectively use tables to summarize information about the data collection process. |
| Multiple data collection methods and mix of qualitative and quantitative data | 78% of all case studies that provided information about data collection used multiple data collection methods while only 31% used a mix of qualitative and quantitative methods. | + | Case study research offers the opportunity to use many different sources of evidence. Seizing this opportunity represents one of the intrinsic advantages of the case methodology. |
| Data triangulation | Data triangulation was not widely adopted (30%) in cases included in our database. | – | Data triangulation must be more widely used in positivist case research in order to increase the internal validity of the findings. |
| Case study protocol and case study database | The existence of a case study protocol or case study database was rarely mentioned (in 5% and 6% of the cases, respectively). | – | These tools are designed to increase the reliability of the findings in positivist case research and must be applied in a larger proportion of studies. |

**Table 13. Summary of Findings, Trends, and Recommendations for Further Improvement (Continued)**

| Criteria | Findings and Trends | Overall Assessment | Recommendations for Further Improvement |
|---|---|---|---|
| **Data Analysis** | | | |
| Elucidation of the data analysis process | Less than 10% of all surveyed case articles provided a clear and detailed description of the data analysis plans, procedures, and rules. | – | Clear descriptions of the analytic procedures used allow the reader to better understand the findings and judge the extent to which they are the fruit of a systematic and rigorous process. |
| Field notes, coding, data displays, and flexible process | Field notes and coding of raw data were used in a very small percentage of case studies. Visual displays were more widely used (55%) to support the analysis of case data. Further, only five case articles discussed the flexible and opportunistic nature of the research process. | – | Case researchers should make greater use of these tools since technical rigor in analysis is a major factor in the validity of qualitative findings. |
| Logical chain of evidence | We were able to trace the steps from initial questions to conclusions in only 19% of all case studies. This proportion is superior in exploratory and explanatory case studies when compared to descriptive case research. | – | In order to increase the reliability and internal validity of their findings, case study researchers must provide the external observer with sufficient relevant information so s/he can follow the derivation of any evidence from initial questions to ultimate conclusions and vice-versa. |
| Empirical testing, explanation building, and time series analysis | Empirical testing was the dominant mode of analysis adopted in explanatory case research while 59% of all exploratory case studies used some form of explanation-building. However, almost none of the studies in our population were explicit in regard to the dominant mode of analysis chosen. | – | Positivist case researchers must be more explicit about how data is analyzed. The adoption of an explicit and appropriate mode of analysis is likely to increase the validity of the findings. |

**Table 13. Summary of Findings, Trends, and Recommendations for Further Improvement (Continued)**

| Criteria | Findings and Trends | Overall Assessment | Recommendations for Further Improvement |
|---|---|---|---|
| Cross-case patterns | Cross-case patterns were searched in 61% of all multiple-case studies included in our database. Explanatory and exploratory case studies made a much wider use of this practice than descriptive cases. | + | Case study researchers are encouraged to continue to go beyond initial impressions, especially through the use of structured and diverse lenses on the data. Cross-case searching tactics are likely to enhance the probability that the investigators capture the novel findings that may exist in the data as well as the internal validity of the findings per se. |
| Use of natural controls | Natural controls were not detected in any of the explanatory single-case studies. | – | Following Lee (1989), we encourage case researchers to actively apply their ingenuity to derive predictions that take advantage of natural treatments either in place or likely to occur. |
| Quotes | Quotes were found in only one-third of all case studies. | – | Sufficient quotes must be presented in case reports so that an external observer can reach an independent judgment regarding the merits of the analysis. |
| Project reviews | Project reviews were reported in only 15% of all surveyed case studies. | – | Project reviews, whether under the form of a formal presentation to key actors or a review of the case report itself, must be more widely used by case researchers to corroborate the evidence presented in the case report. |
| Comparison with extant literature | Only 11% of all exploratory studies related their findings to conflicting literature while 37% discussed similar literature. | – | Comparison of findings with both conflicting and similar literature increases the confidence in the case findings (generalizability and internal validity). Hence, this practice must be more widely applied in exploratory case research. |

availability. As another example, many case researchers did not elaborate on how data were collected and how data collection methods contributed to the findings. Finally, as in the early 1980s, data triangulation was reported in a very small proportion of case articles. Even when it was reported, case researchers were silent about how such a process was actually achieved.

- Compared to the findings by Benbasat et al., noteworthy improvements have been made in only two areas, namely, the use of multiple data collection methods and the specification of the case selection criteria (replication logic) in multiple-case design.

- Descriptive case studies lag far behind explanatory and exploratory studies with respect to several attributes. As a clear indication of this, explanatory and exploratory case studies were much more explicit in regard to the data collection and data analysis processes. Explanatory and exploratory case studies also made much greater use of multiple cases, relied more heavily on multiple data collection methods as well as on a combination of qualitative and quantitative data, and searched more for cross-case patterns. This is especially unfortunate because descriptive case studies appear to be the dominant type of case study performed.

- Exploratory case researchers have followed both of Eisenhardt's suggestions to use existing theoretical constructs to guide theory-building research and to begin as close as possible to the ideal of no theory under consideration. However, only a small proportion of these cases related their findings to conflicting and similar literature as Eisenhardt prescribed.

- As Lee (1989) suggested, explanatory case researchers stated explicitly the theory of interest as well as the various predictions derived from the theory. However, it appears that they did not take advantage of natural controls in order to increase the internal validity of the findings.

- Of all three areas considered here, namely, design issues, data collection, and data analysis, the last is the least documented in positivist case research. Indeed, a large number of cases provided no explanation on how data was analyzed and only a minority provided information about the use of preliminary data analysis techniques and tools including field notes, coding, and data displays.

## Discussion and Concluding Remarks

Our results confirm that "case study is remarkably hard, even though case studies have traditionally been considered to be 'soft' research" (Yin 1994, p. 16). For instance, we found it astonishing that more than four out of 10 case study articles in our database made no attempt at describing the data collection process. Another telling point is that only 9 percent of all case studies in our population provided clear and detailed information about how their data were analyzed. While exploratory and explanatory case studies do perform better, descriptive case studies do not get high grades for rigor. Although we agree that rigor may not be the first and only criterion that should be taken into consideration when reviewing a descriptive case study, a minimum of information regarding key design issues must be provided if one wants to be able to distinguish scientific descriptive cases from journalistic work (Yin 1994).

While the data clearly show that there has been modest improvement in some areas, actual positivist case researchers in IS often ignored or largely ignored the guidelines provided by experienced case research methodologists such as Benbasat et al., Eisenhardt, Lee, and Yin. For the further maturation of our field, we believe that a careful consideration of the recommendations listed below is likely to enhance the overall rigor of

positivist case studies as well as help external observers and the IS community as a whole make an informed judgment about case articles and their respective findings. Specifically, for each of the areas considered in the present review, we encourage positivist case researchers to:

- Area 1: Design Issues
  - identify clear research questions
  - specify clear rationales for single case selection as well as for multiple case selection
  - take advantage of pilot cases in order to help refine the design and the data collection plans
  - conduct more longitudinal case studies and, thus, exploit the richness of the various data collection methods when examining phenomena as they unfold
  - consider rival or alternative theories in order to increase the validity and predictive power of explanatory case studies

- Area 2: Data Collection
  - provide detailed information with respect to the data collection methods (e.g., interviews, questionnaires, direct observation, etc.) and procedures (e.g., sampling strategies, number of interviews and interviewees, use of an interview guide, instrument validation, etc.)
  - effectively use tables to summarize information about the data collection process
  - triangulate data in order to increase internal validity of the findings and provide clear explanations on how the triangulation process is achieved

- Area 3: Data Analysis
  - provide clear descriptions of the analytic methods and procedures (especially the dominant mode of analysis) and provide external observers with sufficient relevant information so they can follow the derivation of evidence from initial research questions to conclusions and vice-versa
  - make greater use of preliminary data analysis techniques and tools including fields notes, coding, and data display as a means of reflecting on the data
  - present sufficient quotes so that external observers can reach an independent judgment regarding the merits of the analysis
  - compare findings with extant literature (both similar and conflicting) in exploratory case research so as to increase the confidence in the findings

Two considerations should be kept in mind when interpreting the results of the current study. First, in order to make comparisons possible, this review maintains a spirit similar to the review by Benbasat et al. (1987); however, we do not pretend to have replicated their work. Adjustment for journal selection as well as for sampling procedures was necessary to represent a more recent era. Second, as mentioned earlier, our assessment was performed on the basis of the information reported, explicitly or implicitly, in the case articles, not on the basis of what was actually done by case researchers. The apparent lack of rigor may be due to the challenge associated with publishing qualitative research while facing such pragmatic issues as the constraint of page length (Trauth 2001). There is an ever-existing tension between the desire for detail and the need for brevity. When the data being analyzed are words, not numbers, more space is generally needed to explain the methodology, results, and criteria for evaluating those results. A major question is whether *good* and *rigorous* case research is amenable to the journal format (Inui and Frankel 1991), and if so, whether there are changes in conventions or practices that would make it easier for readers to assess the quality of the case research published in them. In that matter, Mays and Pope (1995) delineate a number of practices that journals could explore to address space constraints (i.e., making the full transcript of the raw data available to the reader on computer disk (now on the Web) or presenting sequences from the original data accompanied by detailed commentary from the researcher). They also suggest a strategy that qualitative researchers could use to reduce their data to a format amenable to journals (i.e., search for ways to reduce

the data, including quantitative summaries of the results), although they acknowledge the potential limitations of this approach. More recently, Benbasat and Zmud (1999) recommended that all methodological details be placed in an appendix in papers addressed to practitioners.

It is worth reiterating at this point that whereas we would regard the implementation of the attributes presented in Table 3 to be a favorable sign, we caution researchers against treating this list as a cookbook recipe for how to do a rigorous positivist case study. The attributes may certainly contribute to rigor, but they do not guarantee it. Furthermore, because the state of the art of case research is still developing, new attributes or standards will likely emerge to join (or perhaps even replace some of) those currently known. Hence, we emphasize that we are posing these attributes for the specific task of gauging the extent to which the practice of positivist case research in IS has implemented the state of the art of case research methodology, where we regard the extent of the implementation to be an important measure of the extent to which published case research in IS has achieved rigor.

Another interesting by-product of our study consists of the number of case articles published in the period 1990 through 1999. One might think that, given that the percentage of published case articles has not grown over the past decade, case methodology is not as accepted as we might otherwise believe. We feel this is not an appropriate conclusion for a number of reasons. For one thing, previous reviews are not necessarily clear on what guidelines were used for selecting case study articles and, hence, it is not clear whether or not an increase in proportion of publications has actually occurred. Furthermore, for IS researchers, it has historically been more difficult to publish findings of qualitative studies in IS journals, particularly when the studies have employed exclusively qualitative research methods (Lee 2001). In some schools, doctoral students and young faculty members are discouraged from using case research because of, among other reasons, the amount of time involved (for fiction that rings true, see Applegate and King 1999). Again, this does not necessarily mean that case research has not gained wider acceptance, but more likely that a significantly greater number of researchers are not pursuing it. Last, because IS researchers have become more familiar with reviewing case studies, and understanding the case study methodology itself, we may be more critical of manuscripts based on this methodology. While difficult, if not impossible, it would be of utmost interest to investigate the rate of submission of case studies to top IS journals to see if there has been an increase in the acceptance of case research over time in our field.

Although this review has considered a large number of attributes, future assessments of IS case research could include others, such as different forms of triangulation including methods and investigator triangulation (Patton 1999), and reporting aspects including clarity, structure, coherence and effective use of quotes (Kuzel et al. 1994; Stake 1995). Some other basic characteristics of case study research, through a typology (Jensen and Rodgers 2001) or presentation styles (as the one by Van Maanen [1988] for ethnography), could also be investigated. Certainly, not all positivist case studies must implement the same set of positivist case research attributes; however, we strongly recommend that, in the future, the authors of all positivist case studies (1) explicitly identify attributes that they themselves consider to be salient to their case study and (2) actually show how their case research implements these attributes. If this is done, then editors and reviewers who are considering a particular case study for publication could see for themselves that the identified criteria are appropriate and sufficient or could suggest specific additional criteria for the authors to consider.

Importantly, adhering to all of the rules of positivist case research does not necessarily make a case study good *de facto*. This study has focused on rigor but *rigor is just one of many aspects of high quality case research.* Other key aspects of quality could be considered in the future. Relevance and contribution to new knowledge, to name but two, could be investigated through per-

forming a citation analysis, investigating award winning cases, or surveying researchers about their perceptions of some published case studies. Seminal case papers could be inventoried, and the characteristics that make them highly relevant and/or significant could be identified. Comparisons of different aspects of high quality research could also be performed with reference disciplines or other business-related fields that also use case research.

In short, it is clear that current research standards have evolved and are more demanding of case researchers than they were in the early 1980s. Case researchers face the challenges of designing a study in a systematic and manageable yet flexible manner and integrating the results into a coherent document (Marshall and Rossman 1995). Again, in the future, positivist IS case research needs to be better documented as a way to help us learn, get meaningful results, and develop a cumulative body of knowledge in our field. The IS discipline as a whole can only greatly benefit from increased rigor in positivist case research.

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# Appendix A

## Coding Scheme

| Areas | Attributes | Values |
|---|---|---|
| Area 1 : Research Design | Clear research questions | Yes or No |
| | Types of research questions | How, Why, What, Who, etc. |
| | A priori specification of constructs | Yes or No |
| | Clean theoretical slate | Yes or No |
| | Theory of interest is stated | Yes or No |
| | Predictions from theory are stated | Yes or No |
| | Use of rival theories | Yes or No |
| | Number of cases | 1, 2, 3, 4.... |
| | Nature of single-case design | Unique or extreme, revelatory, critical, or not specified |
| | Replication logic in multiple-case design | Literal, theoretical, or not specified |
| | Unit of analysis | Yes or not specified |
| | Use of a pilot case | Yes or not specified |
| | Site description | Yes or No |
| | Case period | Yes or not specified |
| | Longitudinal design | Yes or not specified |
| | Time spent on site | Number of months or not specified |
| | Nature of data | Retrospective, on-going, retrospective and on-going or not specified |
| | Number of authors | 1, 2, 3, 4... |
| | Different roles for multiple investigators | Yes or not specified |

| Areas | Attributes | Values |
|---|---|---|
| Area 2 : Data Collection | Elucidation of the data collection process | Yes or No |
| | Interviews | Yes or No |
| | Sampling strategy (interviews) (up to two) | Convenient, snowball, random, whole population, quota, or not specified |
| | Number of interviewees | Number or not specified |
| | Number of interviews | Number or not specified |
| | Use of an interview guide | Yes or not specified |
| | Pre-test of interview guide | Yes or not specified |
| | Documentation | Yes or No |
| | Questionnaires | Yes or No |
| | Observation | Yes or No |
| | Time series | Yes or No |
| | Artifacts | Yes or No |
| | Data triangulation | Yes or not specified |
| | Case study protocol | Yes or not specified |
| | Case study database | Yes or not specified |
| Area 3 : Data Analysis | Elucidation of the data analysis process | Not specified at all, briefly described, or clear and detailed explanations |
| | Field notes | Yes or not specified |
| | Coding of raw data | Yes or not specified |
| | Coding scheme available | Yes or No |
| | Validation of coding scheme | Yes or not specified |
| | Inter-rater reliability test | Yes or not specified |
| | Inter-rater agreement ratio | Ratio or not specified |
| | Data displays | Yes or No |
| | Flexible and opportunistic process | Yes or not specified |
| | Logical chain of evidence | Yes or No |
| | Empirical testing | Yes or No |
| | Explanation building | Yes or No |
| | Time series analysis | Yes or No |
| | Search for cross-case patterns | Yes or No |
| | Use of natural controls | Yes or No |
| | Quotes in case report | Yes or No |
| | Project reviews | Yes or not specified |
| | Comparison with conflicting literature | Yes or No |
| | Comparison with similar literature | Yes or No |