Positivist, Single Case Study Research in Information Systems: a Critical Analysis

Graeme Shanks
Department of Information Systems,
The University of Melbourne,
Melbourne, 3010, Australia.
Phone: +61 03 8344 1577, Fax:+61 03 9349 4596
g.shanks@unimelb.edu.au

Anne Parr
School of Business Systems,
Monash University,
Melbourne, 3999, Australia.
Phone: +61 03 9905 2437, Fax:+61 03 9905 5159
Anne.Parr@infotech.monash.edu.au

Abstract

Positivist, single case study is an important research approach within the information systems discipline. This paper provides detailed definitions of key concepts in positivist, single case study research and carefully analyses the conduct and outcomes of the Sarker and Lee study that examined the role of social enablers in Enterprise Resource Planning (ERP) systems implementation, and was presented at the International Conference on Information Systems in 2000. A number of key issues about positivist, single case studies are identified, including the need for a clear and deep understanding of key concepts including theory, proposition, hypothesis and hypothesis testing; the need for clearly defined concepts in theories being tested; the need for hypotheses not propositions when undertaking empirical research; the importance of explicit boundaries for theories; the distinction between single case studies and single experiments; and the problem of easy refutation of strong hypotheses using specific and unique cases. Despite these issues, positivist, single studies provide a sound and systematic approach for conducting research and are an important component of pluralist research programs within information systems.

Keywords

Information systems research, case study, positivism

1. Introduction

Use of the case study research approach is widespread in the information systems community. The case study approach is multi-faceted and may be applied and used in a number of different ways (Cavaye 1996, Darke, Shanks and Broadbent 1998). Case studies can be undertaken from a positivist or interpretivist paradigm, may be deductive or inductive, may involve single or multiple cases using literal or theoretical replication and may use qualitative and quantitative data. This paper focuses on one particular style of case study research, the positivist, single case and deductive type.

This type of case study research is well documented, with methodological guidelines published by Benbasat, Goldstein and Mead (1987), Lee (1991) and Yin (1994). Recently Suprateek Sarker and Allen Lee have published two papers using a strictly positivist, single case and hypothetico-deductive research approach (corresponding to "justifying" research in March and Smith's (1995) taxonomy and the "consensus" ontology in Deetz's (1996) taxonomy) that raise a number of interesting issues for the information systems community. The papers examine the role of social enablers in Enterprise Resource Planning (ERP) systems implementation (Sarker and Lee 2000) and three competing theories-in-use of Business Process Redesign (BPR) (Sarker and Lee 2002). Both papers are based on the same case study data, and are reported in a rigorous manner including proposition formulation, validity and reliability of the study and deductive testing of the propositions.

The first of these papers is of particular interest as it develops three propositions partly based on previous work of the authors of this paper (Parr, Shanks & Darke 1999) and refuted two of the propositions. The purpose of this paper is to examine in detail how Sarker and Lee conducted their study, to raise several important issues about how positivist case studies should be designed and conducted, and to suggest that a pluralist approach to information systems research may be the preferred path forward (Mingers 2001).

The paper is structured as follows. The next section discusses the positivist paradigm and presents precise definitions for key concepts including theory, proposition, hypothesis and hypothesis testing. The following section describes positivist case studies and how they may be conducted. This section is followed by a brief description of the outcomes of the study on critical success factors for ERP systems implementation by Parr et al. (1999) and how they were used in the case study of Sarker and Lee (2000). The next section presents several key issues that emerge from this case study and the paper concludes with a discussion of the place for positivist case studies in information systems.

2. The Positivist Paradigm: Theories, Propositions, Hypotheses and Hypothesis Testing

A paradigm is a set of beliefs about the nature of social reality, that is, the nature of the "world" and the individual's place in it (Guba and Lincoln 1994). Guba and Lincoln note that a paradigm has three dimensions:

- What is the form and nature of reality (the ontological question)?
- What is the relationship between the researcher and what can be known (the epistemological question)?
- How does the researcher find out whatever they believe can be known (the methodological question)?

It is critical to remember that paradigms are assumptions that are not subject to proof. They are human constructions that are neither right nor wrong: proponents must argue for their utility (Guba and Lincoln 1994).

The positivist paradigm has the following positions with regard to the three dimensions:

1. An objective reality is assumed which can be systematically and rationally investigated through empirical investigation, and is driven by general causal laws that apply to social behaviour. This is sometimes called naïve realism (the ontological position) (Guba and Lincoln 1994).

2. The researcher and the phenomena being investigated are assumed to be independent, and the researcher remains detached, neutral and objective. Any reduction in independence is a threat to the validity of the study, and should be reduced by following prescribed procedures (the epistemological position).

3. General theories are used to generate propositions that are operationalised as hypotheses and subjected to empirical testing that is replicable. Hypotheses should be testable and provide the opportunity for confirmation and falsification. This is the essence of the scientific method (the methodological position).

In the following discussion about theory, proposition, hypothesis and hypothesis testing we assume a positivist position.

2.1 Theories

A theory is a system of ideas that abstracts and organises knowledge about the social world (Neuman 2000). There are many types of theory including implicit (preconceptions, biases and values etc.) and explicit theory (sets of organised concepts and their interrelationships) (Miles and Huberman 1994). There are highly abstract theoretical frameworks, and focused mid-range theories more suited to empirical work (Neuman 2000). For empirical studies conducted using a positivist, deductive case approach mid-range, explicit theories are relevant. Dubin (1978) notes that this type of theory has three main elements:

- A set of well-defined *concepts* (or units);
- Laws of *interaction* (or interrelationships between the units);
- A *boundary* within which the theory holds.

For a full discussion of these elements see Dubin (1978), but for the purposes of this paper an example will be used to explain their meaning. Darke (1997) developed a theoretical framework for understanding viewpoint development within requirements acquisition and modelling that comprises four concepts, four laws of interaction and a clearly articulated boundary. We will adapt and use part of this theoretical framework to explain Dubin's elements of a theory.

Dubin (1978, p51) notes that each of the concepts in a theory must be well defined and there must be a limited number of them, to allow testing of the theory in several related contexts. Two concepts in Darke's theoretical framework are "Viewpoint Development Role" and "Viewpoint Representation". The viewpoint development role concept defines the extent to which viewpoints are used within the requirements definition process and Darke (1997) provides three values: supporting requirements acquisition, supporting requirements modelling or supporting both phases of the requirements definition process. The viewpoint representation concept concerns the nature of representation used in defining the viewpoint and Darke (1997) provides three values: formal, semi-formal and informal.

Laws of interaction may be associational (the categorical interactions of Dubin (1978)), sequential (the sequential interactions of Dubin (1978)), and causal (the determinant interactions of Dubin (1978)). These three forms of interaction build on each other, so the associational laws are the most basic form of interaction. A stronger form of interaction is sequential (which subsumes associational), and the strongest from is causal (which subsumes sequential). Furthermore, causal interactions may be necessary or necessary and sufficient. Darke (1997) identifies an associational, bi-directional law of interaction between the concepts "Viewpoint Development Role" and "Viewpoint Representation". The law of interaction is "Different viewpoint representations are used during different viewpoint development roles". The two concepts and the law of interaction may be represented using a diagram as shown in Figure 1.

The boundary of the theoretical framework specifies the portion of the world within which the concepts and laws of interaction hold. Darke (1997) specifies the boundary as viewpoint development within the domain of requirements definition.

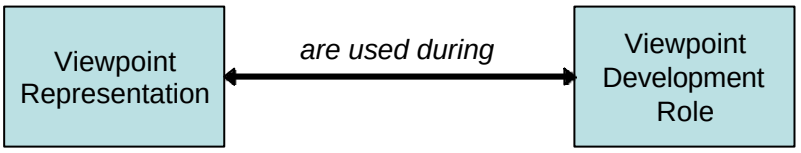

Figure 1 (Part of) the Viewpoint Development Theoretical Framework (Darke 1997)

2.2 Propositions

Predictions about the world are made using propositions, that is, conclusions that may be deduced logically from the theory. Propositions link the *values* of units. Propositions in the viewpoint development theoretical framework will therefore link specific values of viewpoint representation with specific values of viewpoint development role. Dubin (1978) notes that the most usual form of propositions is the "*if … then …*" format. Darke (1997) identifies two propositions in her study:

- *If* representation techniques are informal or semi-formal *then* they are used during the requirements acquisition viewpoint development role.
- *If* representation techniques are semi-formal or formal *then* they are used during the requirements modelling viewpoint development role.

2.3 Hypotheses

A hypothesis is an empirically testable statement that is generated from a proposition. Terms in propositions belong to the abstract world of theory. Each of the terms must be assigned an empirical indicator. These empirical indicators are then substituted into the proposition to form a corresponding hypothesis. Once hypotheses have been generated they may be used in empirical studies.

Empirical indicators for informal representation techniques are text, rich pictures and animations. Empirical indicators for semi-formal representation techniques include data flow diagrams (DFDs), unified modelling language (UML) diagrams and entity relationship

diagrams. Empirical indicators for requirements acquisition include elicitation, understanding and elaboration of information system requirements. Hence, a hypothesis (H1) generated from the first proposition and expressed in a form suitable for refutation is:

H1 Text, rich pictures, animation, DFDs, UML diagrams and ER diagrams are used during elicitation, understanding and elaboration of information system requirements.

The hypothesis is clearly in a form that can be empirically tested. It is expressed in terms that support collection and analysis of empirical data in contrast to the proposition that is expressed in terms of the theoretical framework. Terms used in the hypothesis are “things observable” (Dubin 1978, p205). One proposition may generate many hypotheses; in fact H1 above could have been expressed as multiple hypotheses, each linking a pair of concept values.

2.4 Hypothesis Testing

Hypotheses are tested by comparing their predictions with observed data. Observations that confirm a prediction do not establish the truth of a hypothesis. The deductive testing of hypotheses involves looking for disconfirming evidence to falsify hypotheses (Lee 1989). Falsified hypotheses are then refined based on the reasons for falsification and subjected to further empirical testing.

3. The Positivist Approach to Case Study Research in Information Systems

A case study is "an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" and it "relies on multiple sources of evidence" (Yin, 1994, p. 13). Case study research investigates pre-defined phenomena but does not involve explicit control or manipulation of variables: the focus is on in-depth understanding of a phenomenon and its context (Cavaye, 1996). Case studies typically combine data collection techniques such as interviews, observation, questionnaires, and document and text analysis. Both qualitative data collection and analysis methods (which are concerned with words and meanings) and quantitative methods (concerned with numbers and measurement) may be used (Yin, 1994, p. 14). Case research may involve inductive theory building or have clear a priori definitions of variables to be studied and the ways in which they can be measured (Benbasat et al., 1987; Yin' 1994, p. 34).

Case study research needs to be distinguished from the use of case studies as teaching devices, where the purpose is to illustrate particular situations and provide a framework for discussion amongst students (Yin, 1994, p. 10). Teaching cases do not necessarily include a complete or accurate description of actual events, as case study details and materials may be changed in order to better illustrate a specific point. The criteria for developing high quality teaching cases are very different from those for producing high quality case study research (Yin, 1994, p. 2).

Case study research can be used to achieve various research aims: to provide description of phenomena, develop theory, and test theory. Case study research has often been associated with description and with theory development, where it is used to provide evidence for hypothesis generation and for exploration of areas where existing knowledge is limited (Cavaye, 1996). Approaches such as grounded theory (Glaser & Strauss, 1967), in which

theoretical concepts and propositions emerge as the researcher gathers data and investigates phenomena, may be used to develop theory.

The use of case study research to test theory requires the specification of theoretical propositions and related testable hypotheses derived from an existing theory. The results of case study data collection and analysis are used to compare the case study findings with the expected outcomes predicted by the hypothesis (Cavaye, 1996). The theory is either validated or else found to be inadequate in some way, and may then be further refined on the basis of the case study findings.

Case study research has been used within both the positivist and the interpretivist philosophical traditions (Cavaye, 1996; Doolin, 1996). Case study research within the positivist tradition is designed and evaluated according to the criteria of the natural science model of research: controlled observations, controlled deductions, replicability, and generalisability (Lee, 1989). Although manipulation of variables in the experimental sense is not possible in case study research, theoretical constructs can be defined and empirically evaluated and measured, and naturally occurring controls can be identified (Lee, 1989; Cavaye, 1996). Literal and theoretical replication in multiple case study research provides for generalisability of case study research findings (Lee, 1989; Yin, 1994, pp. 46-51).

3.1 Rigour in Positivist Case Study Research

Validity and reliability in positivist case study research involves using clearly defined methodological guidelines for ensuring construct validity, internal validity, reliability and external validity (Lee 1989, Yin 1994) (for further discussion of validation in information systems research see Boudreau, Gefen and Straub (2001)).

Construct validity concerns the issue of whether empirical data in multiple situations leads to the same conclusions, and is improved by using multiple sources of evidence (to essentially provide multiple data points for the same phenomenon), having key informants review the case study report (to improve the accuracy of case study data) and establishing a chain of evidence (so a reader can trace the chain of evidence) (Yin 1994).

Internal validity concerns the issue of whether empirical data provides information about the theoretical concept, and is achieved by using pattern matching to ensure that case study data cannot be explained by rival theories with different independent variables in the hypotheses (Yin 1994).

Reliability concerns the stability and consistency of the study over time and is ensured by creating and maintaining a case study database and developing a clear case study protocol (Yin 1994).

External validity concerns the generalisability of the findings of the study and is ensured by selecting a "typical" case (a single case that is representative of a large number of other cases) and selecting a case that is likely to confirm the hypotheses, so that disconfirming evidence can be considered decisive (Markus 1989).

4. The Positivist Case Study of Sarker and Lee (2000)

The positivist case study reported by Sarker and Lee was published in the International Conference on Information Systems (ICIS) in 2000 and concerns the role of "social enablers" in ERP implementation. Three propositions that identify necessary conditions for

ERP implementation success are synthesised from relevant literature, and then subjected to empirical testing using a positivist, single case study approach.

4.1 Propositions and the link to the Parr et al. (1999) study

The three propositions are:

"P1 ERP implementation can be successful only if there is a strong and committed leadership guiding the initiative" (Sarker and Lee 2000, p416)

"P2 ERP implementation can be successful only if there is open and honest communication among the stakeholders" (Sarker and Lee 2000, p416)

"P3 ERP implementation can be successful only if the implementation team is empowered and balanced" (Sarker and Lee 2000, p416)

One of the key references used in the synthesis of the three propositions was a paper co-authored by the authors of this paper (Parr et al. 1999). In that paper the scope of the ERP implementation project was defined as the configuration and implementation of the ERP software package, and success was defined as the project meeting budget and time constraints. Critical success factors for successful ERP implementation were elicited from interviews with 10 consultants each of whom had extensive experience in ERP Implementation. The only critical success factor elicited from all interviewees was "management support": other critical success factors were supported with varying degrees of strength.

As reported by Sarker and Lee (2000), *management support* (or strong and committed leadership) was clearly identified by all interviewees as a necessary condition for ERP implementation success. Hence, proposition one is strongly supported by the Parr et al. (1999) study. However, *communication* was identified as a necessary condition by only 50% of interviewees. The second proposition was only weakly supported by the Parr et al. study. A *balanced team* was identified by 80% of interviewees as a necessary condition for successful ERP implementation; the support for *empowered decision makers* was not as strong. The third proposition combines these two critical success factors and therefore support from the Parr et al. study is supported but not nearly as strongly as management support (in the first proposition).

Sarker and Lee divide their ERP implementation process into three phases, of which only the second phase corresponds to the scope of ERP implementation used by Parr et al. in their study. The first phase concerns changes to the organization prior to implementing the ERP software and the third phase concerns enhancements to the ERP system by adding a further module.

4.2 The Case Study

The case study reported in Sarker and Lee (2000) involved implementation of several modules of an ERP system in a medium sized manufacturing company, with offices throughout the United States of America and subsidiaries in Great Britain, Germany and Australia. Data collection included interviews with 17 people in various roles in the firm, attendance at several meetings associated with the ERP implementation, and access to documents about the company background and the ERP implementation project from 1996 to 1997.

Great care was taken to ensure rigor in the conduct of the case study. The guidelines listed previously in this paper were followed closely and reported clearly. For example, pattern matching in qualitative data analysis was used to ensure internal validity by matching predictions derived from propositions with patterns found in the data.

Success in ERP implementation was defined as:

> "we consider implementation to be successful if different stakeholders state or indicate through actions that such was the case" (Sarker and Lee 2000, p 419).

Sarker and Lee note that the concept of success is complex, no universally defined criteria exist and criteria vary with the phase of implementation.

Deductive testing of each proposition was reported by listing evidence from relevant empirical data and justifying a conclusion. Proposition P1 (strong and committed leadership) was validated, proposition P2 (open and honest communication) was refuted, and proposition P3 was refuted.

Based on these results, Sarker and Lee note the contradiction between the literature and the empirical evidence from the case study. They conclude that their case study presents a challenge to future ERP researchers to investigate the interactions between the three conditions used in the propositions and whether strong and committed leadership can compensate for the absence of the other social enablers.

5. Key Issues in Positivist Case Study Research

A number of key issues emerge from the conduct of the positivist case study reported by Sarker and Lee (2000).

5.1 Concepts in the theory should be well defined

Sarker and Lee do not propose a "theory" per se; they simply formulate three propositions. However, there is an implicit theory that includes two concepts: Key social enablers and ERP implementation success. There is one interaction in the theory: "social enablers are necessary for ERP implementation success". There are three units for key social enablers: strong and committed leadership, open and honest communication, empowered and balanced team.

Dubin (1978) notes that concepts in a theory should be well defined and if a theory is to be used in another context, the same concepts need to be used. While there is some discussion about each of the three social enablers and reference to relevant literature, Sarker and Lee do not provide a synthesised and precise definition for these concepts. A greater concern is the definition provided for ERP implementation success, relying on stakeholders indicating "through [their] actions that such was the case". Parr et al. (1999) define success in ERP implementation to be "the meeting of budgetary and time constraints". This is clearly different to the definition of success offered by Sarker and Lee, and questions the basis of the literature synthesis.

5.2 Propositions should be converted to hypotheses before they are empirically tested

Propositions are predictions about the world that may be deduced logically from theory. Values of concepts that appear in propositions should be operationalised before empirical testing can be conducted. Each of the values must be assigned an empirical indicator. These empirical indicators are then substituted into the proposition to form a corresponding hypothesis. Once hypotheses have been generated they may be used in empirical studies.

In their case study, Sarker and Lee test propositions. They need to identify empirical indicators for strong and committed leadership, open and honest communication, empowered and balanced team, and ERP implementation success. For example, two empirical indicators for "success" as defined by Parr et al. (1999) are that the project is completed on time and within budget. Direct testing of propositions reduces the rigour of the study and leads to imprecision in findings.

5.3 The boundary of the theory should be consistent with other referenced studies

The boundary of the case study is defined by the three phases of ERP systems implementation: changes to the organization prior to implementing the ERP software, implementing the ERP software, and enhancements to the ERP system. This is inconsistent with the scope of the factors necessary for ERP implementation success identified by Parr et al. (1999). Parr et al. limited their study to implementing the ERP software, or phase two only of the Sarker and Lee study. Interestingly, case study data from phase two of the Sarker and Lee study does not provide strong evidence to refute any of the three propositions. When synthesizing propositions from the literature, care should be taken to ensure the scope of the studies are the same or very similar.

5.4 A single case is not the same as a single experiment

Positivist, single case studies have been compared to experiments. The argument presented is that the output of a single experiment is not generalisable beyond the set of empirical circumstances encountered in the experiment (Lee 1989). Additional experiments with different empirical circumstances that confirm the theory strengthen and extend the generalisability of the theory. Similarly, no theory would be generalisable on the basis of a single case study; generalisability is strengthened when the theory is tested on other empirical circumstances (Lee 1989).

This argument ignores the fact that experiments can be carefully designed with controls and random assignment of participants to different treatment groups. These experimental designs and statistical analysis techniques are intended to strengthen the generalisability of experimental outcomes. In an experiment each participant is subjected to a treatment and separately measured. A single case study is very different. Participants are separately interviewed in data collection but their responses are consolidated at "unit of analysis" level. For example, in Sarker and Lee's (2000) case study, the concept of ERP implementation success is determined for each phase of the process of ERP implementation by consolidating evidence from several participants. They each contribute to a single view of "success".

5.6 In a single case strong hypotheses can be readily refuted

Hypotheses can be of various strengths, developed from propositions where the interactions are associational, sequential, causal (necessary, or necessary and sufficient). Hypotheses that are associational in nature are relatively weak, and confirmatory or disconfirmatory evidence of various strengths can be found in nearly all case study situations. However, hypotheses that are causal in nature are more easily refuted. For example, there are so many different and unique circumstances in which ERP implementation projects either succeed or fail that the selection of a specific and unusual case might be used to refute a hypothesis that holds in nearly all other cases. Sarker and Lee may have inadvertently selected an ERP implementation that was representative of few other implementations. Hypotheses involving causal interactions that are both necessary and sufficient would be easily refuted by selecting specific case situations. Furthermore, if multiple positivist case studies were conducted, and in only one was disconfirming evidence found, a strong argument could be made to not change the hypothesis. This is similar to handling type I and II errors found in the statistical analysis of experiments.

5.7 Consider a Move to Post-positivism

The ontological, epistemological and methodological positions of positivism have been questioned for some time by philosophers, psychologists and historians of science (Hastorf, Hanson, Kuhn). Post-positivism relaxes the strict philosophical positions of positivism and takes into account our imperfect knowledge of reality and our inability to be objective and detached particularly in social situations. Guba and Lincoln (1994) offer the following three amendments to the dimensions of positivism in defining post positivism:

1. An objective reality is imperfectly knowable (critical realist ontological position).
2. A subjective researcher can only know about reality to a degree of probability (modified dualist epistemological position).
3. A modified experimental method is used including hypothesis refutation using both quantitative and qualitative methods (modified experimental methodological position)

One key difference is the notion of imperfectly knowable reality with uncertainty associated with what can be known. Propositions therefore need to have a degree of “uncertainty” about them, particularly in the associations between concepts. In the Parr et al. (1999) study, only the association between management support and success was agreed by all interviewees to be a critical success factor. The associations between the other critical success factors and success clearly had some uncertainty about them and that needs to be represented in associated propositions. Similarly, data collected by Sarker and Lee has some uncertainty about it that needs to be recognised in their analysis.

6. Conclusion

The issues discussed in the previous section are of great significance for information systems researchers and for reviewers assessing positivist, single case research. They suggest some important guidelines for information systems researchers undertaking positivist, single case research:

1. A full understanding of the positivist paradigm and the concepts of theory, proposition, hypothesis and hypothesis testing is vital;

2. Concepts used in any theory must be unambiguously defined in considerable detail;

3. For empirical testing, hypotheses must be used. Concepts in propositions must be operationalised to form hypotheses ready to be used in empirical study;

4. When developing theory by synthesising previous concepts, special care must be taken to ensure that the boundaries of the existing and developed theories are consistent;

5. Generalisation from positivist, single case studies is inherently different from generalisation from single experiments;

6. The overall utility of positivist, single case studies is problematic in that a single, unique and unrepresentative case study could be used to refute almost any strong hypothesis. This is an argument about the limitations inherent in positivist, single case studies, rather than an argument that they should not be undertaken;

7. Information systems researchers should consider a move to post positivism, relaxing the philosophical positions of strict positivism, recognising that reality is imperfectly knowable and there is inherent uncertainty in what we can know.

The critical analysis of only one example of positivist, single case study research is a limitation of this paper. Further research will involve more extensive analysis of other positivist, single case studies. Our analysis has important implications for researchers undertaking positivist, single case studies and the issues highlighted should be seen as an enhancement to the key references cited earlier in the paper. Despite these issues, positivist, single studies provide a sound and systematic approach for conducting research and are an important component of pluralist research programs within information systems (Mingers 2001).

References

Benbasat, I, Goldstein, DK & Mead, M (1987), The Case Research Strategy in Studies of Information Systems, *MIS Quarterly*, vol. 11, pp. 369-386.

Boudreau M-C, Gefen, D & Straub, DW (2001), Validation in information systems research: A state-of-the-art assessment, *MIS Quarterly,* vol. 25, no. 1, pp. 1-16

Cavaye, ALM (1996). Case Study Research: A Multi-faceted Research Approach for IS, Inform*ation Systems Journal*, vol. 6, pp. 227-242.

Darke, P (1997), *Viewpoint Development in Requirements Definition*, unpublished PhD Thesis, Monash University.

Darke, P, Shanks, G & Broadbent, M (1998), Successfully Completing Case Study Research: Combining Rigour, Relevance and Pragmatism", *Information Systems Journal*, vol. 8, pp. 273-289.

Deetz S (1996), Describing differences in approaches to organization science: Rethinking Burrell and Morgan and their legacy, *Organization Science,* vol. 7, no. 2, pp. 191-207

Dubin, R (1978), *Theory Building*, Free Press, New York.

Guba, EG and Lincoln, YS (1994), Competing Paradigms in Qualitative Research, in NK Denzin and YS Lincoln (Eds.) *Handbook of Qualitative Research*, Sage Publications, Thousand Island, pp. 105-117.

Hanson, NR (1958), *Patterns of Discovery*, Cambridge.

Hastorf, AH (1950), The Influence of Suggestion on the Relationship Stimulus Size and Perceived Distance, *Journal of Psychology*, vol. XX1X, pp.195-217.

Kuhn, T (1970), *The Structure of Scientific Revolutions*, University of Chicago Press.

Lee, AS (1989), A Scientific Methodology for MIS Case Studies", *MIS Quarterly*, vol. 13, pp. 33-50.

March ST & Smith, GF (1995), Design and natural science research on information technology, *Decision Support Systems*, Vol. 15, pp. 251-266

Markus, L (1989), Case Selection in Disconfirmatory Case Studies", in J Cash and M Lawrence (Eds.) *The Information Systems Research Challenge*, 1, Harvard Business School, pp. 20-26.

Miles, MB & Huberman A.M. (1984), *Qualitative Data Analysis: A Sourcebook of New Methods*, Sage Publications, Newbury Park.

Mingers, J (2001). Combining IS Research Methods: Towards a Pluralist Methodology", *Information Systems Research*, vol. 12, no. 3, pp. 240-259

Neuman, WL (2000), *Social Research Methods – Qualitative and Quantitative Approaches*, 4th ed., Allyn and Bacon.

Parr, A, Shanks, G & Darke, P (1999), Identification of necessary factors for successful implementation of ERP systems, in O Ngwenyama, LD Introna, MD Myers and JI DeCross (Eds.) *New Information Technologies in Organisational Processes*, Boston: Kluwer Academic Publishers, pp. 99-119.

Sarker, S & Lee, AS (2000), Using a Positivist Case Research Methodology to Test Three Competing Theories-in-Use of Business Process Redesign", *Proceedings of the International Conference on Information Systems*, Brisbane (January).

Sarker, S & Lee, AS (2002), "Using a Positivist Case Research Methodology to Test Three Competing Theories-in-Use of Business Process Redesign", *Journal of the Association for Information Systems*, vol. 2, no. 7 (January).

Yin, RK (1994), *Case Study Research: Design and Methods*, (2nd edition), Sage Publications, Thousand Oaks.