Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems

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Information Science
REFERENCE

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Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Research methodologies, innovations, and philosophies in software systems engineering and information systems / Manuel Mora ... [et al.], editors.
p. cm.
Includes bibliographical references and index.
ISBN 978-1-4666-0179-6 (hardcover) -- ISBN 978-1-4666-0180-2 (ebook) -- ISBN 978-1-4666-0181-9 (print & perpetual access) 1. Software engineering. 2. System engineering. 3. Research--Methodology. 4. Information technology. I. Mora, Manuel, 1961-
QA76.758.R467 2012
005.1--dc23
2011044987

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 11
Models for Interpretive Information Systems Research, Part 1:
IS Research, Action Research, Grounded Theory – A Meta-Study and Examples

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ABSTRACT

Interpretive research designs are increasingly being applied in Information Systems (IS). This chapter is a meta-research study that briefly explains the concepts of positivism, interpretivism, and qualitative and quantitative research, before overviewing the advent of interpretive IS research. The chapter then presents two interpretive models that can serve as research designs for postgraduate studies and ad-hoc research. Action research, which originated in the social sciences, involves longitudinal studies, in which the researcher participatively investigates products or interventions that address real-world problems over several cycles, in a reflective and responsive way. Grounded theory can serve as a research method, as well as a full research design, since it can be integrated into other models as an analysis approach. Grounded theory is applied to generate themes, patterns, and theories from continuous collection, coding, and analysis of contextual data. The patterns and grounded theories emerge inductively, and are expanded and refined as further data is gathered.

INTRODUCTION

Research designs based on the interpretive paradigm, can serve well as approaches for the design and development of artifacts within the discipline of Information Systems (IS). This chapter overviews research paradigms, then introduces two approaches applicable to interpretive IS research. In the current computing milieu – with its emphasis on interactivity, user-centricity, and usability – inquiry processes originating from the human

DOI: 10.4018/978-1-4666-0179-6.ch011

sciences are relevant to IS. Interpretive research is also used in educational-technology research, where interpretive goals investigate how artifacts function by addressing and interpreting phenomena of domain processes, human performances, and innovations in complex contexts. This chapter relates particularly to research on human and contextual aspects of computing, and highlights research designs appropriate for the subset of IS that incorporates e-learning systems, which users must be able to use easily before they can even begin to learn.

Different research designs have varying structures and procedures to guide the research process, and are appropriate for different kinds of computing applications. This chapter forms Part 1 of a discourse entitled 'Models for Interpretive Information Systems research'. It discusses and graphically illustrates two approaches, *action research* and *grounded theory*, explaining how they can be used as research designs and giving examples of studies where they were applied. Part 2 of the discourse, in Chapter I.7b, considers three models from the family of design- and development research, namely: *development research*, *design-science research* (so called in IS), and *design-based research* (so termed for educational technology research).

Interpretive research, which originated in the behavioural social sciences, is increasingly applied in Information Systems (IS). Research design and -paradigms in IS have been receiving focused attention over the past two decades (Baskerville, 1999; Baskerville and Wood-Harper, 1996, Cockton, 2002; De Villiers, 2005b; Glass, Ramesh and Vessey, 2004; Klein and Myers, 1999; Myers, 2004; Pather and Remenyi, 2004; Roode, 2003; Walsham 1995a; 1995b; Wood-Harper, 1985). This meta-research study suggests various underlying theoretical frameworks to guide the research and development process, providing cohesion and internal consistency. It is not focused primarily on major business systems, but more on small-scale systems for personal computing. The fact that researchers and practitioners are taking cognizance of social responsibility (Du Plooy, 2003); human factors, and behavioural aspects, is in line with the current emphasis on the human-computer interaction (HCI) concepts of user-centricity and usability. This study outlines the positivist and interpretivist research paradigms and suggests models to operationalise interpretive research. Influences from positivism cannot be excluded, as research methodology continues to evolve and develop, and 'mixed methods is another step forward, utilizing the strengths of both qualitative and quantitative research' (Creswell, 2009: 203).

Examples are given to illustrate each research model/design, several of which come from the domain of e-learning. The chapter should be useful to postgraduate students undertaking research in IS or e-learning for their masters or doctoral studies, as well as to faculty who facilitate teaching and learning processes.

Research Paradigms: Positivist and Interpretivist

Different research paradigms are based on different philosophical foundations and conceptions of reality (Cohen, Manion and Morrison, 2005; du Poy and Gitlin, 1998; Lincoln and Guba, 1985; Olivier 2004). Each paradigm is implemented by distinctive methodological strategies.

The *positivist* paradigm holds that knowledge is absolute and objective and that a single objective reality exists external to human beings. Positivism is equated with the scientific method, whereby knowledge is discovered by controlled empirical means, such as experiments. Positivist research aims for an exact, value-free representation of reality. Research results should be reliable, consistent, unbiased, and replicable by other researchers. Positivist research is operationalised mainly (yet not exclusively) by quantitative methods, where data comprises numbers and measures, analysed by

statistical methods. Studies are usually hypothesis-driven and results can be used for prediction.

Interpretivism aims to find new interpretations or underlying meanings and permits the accommodation of multiple correct approaches and findings, mediated by time, context and researcher. Related terms are naturalistic and ethnographic (Cohen, Manion and Morrison, 2005; Lincoln and Guba, 1985). Inquiry is value-related, leading to subjective findings that may vary between researchers. It is an appropriate view for studies of complex human behaviour, documents, and social phenomena.

Interpretive approaches and methods have become accepted in IS (Klein and Myers, 1999; Roode, 2003; Walsham, 1995a; 1995b; Vannoy and Salam, 2010). Klein and Myers believe that interpretive studies provide deep insight into IS phenomena, helping the IS research community to understand human thought and action in social and organizational contexts. In the context of educational technology, Reeves (2000) explains that interpretive goals determine how things work by describing and interpreting phenomena regarding domain processes, performances and innovations. Interpretivism lends itself mainly to qualitative studies. Where positivism tests hypotheses, interpretivism investigates research questions focused on understanding phenomena in natural settings using verbal data. Qualitative data collection and analysis produce findings related to intricate details where values and human experiences are relevant. The ability to interpret data is important and 'the researcher is an instrument' (Leedy and Ormrod, 2001:147). Reliability is a fit between the findings recorded and occurrences in natural settings. Research methods are often triangulated by using multiple methods of data collection.

Research Methods: Qualitative and Quantitative

Mertens (1998) describes qualitative research as a naturalistic, interpretive, multi-method science. It involves case studies, interviews, observation, textual analysis and ethnographic data, which provide insights into organizational practices and human interactions. Creswell (2009) recommends that qualitative researchers should consider applying strategies such as narrative analysis, phenomenology, ethnography, case studies and grounded theory.

Quantitative methods include survey designs and experiments. A survey can capture numeric descriptions of trends or opinions from a sample of a population. Experiments are controlled studies that test the effect of a treatment or intervention on a group (Creswell, 2009). Statistical analysis can be undertaken on quantitative data. Cohen, Manion and Morrison (2005) caution researchers that when statistical processing is intended, it impacts on the layout and structure of the raw data. For example, the design of a questionnaire should support data entry and subsequent analysis by computer, therefore decisions should be taken upfront with regard to which statistical tests will be used for analysis.

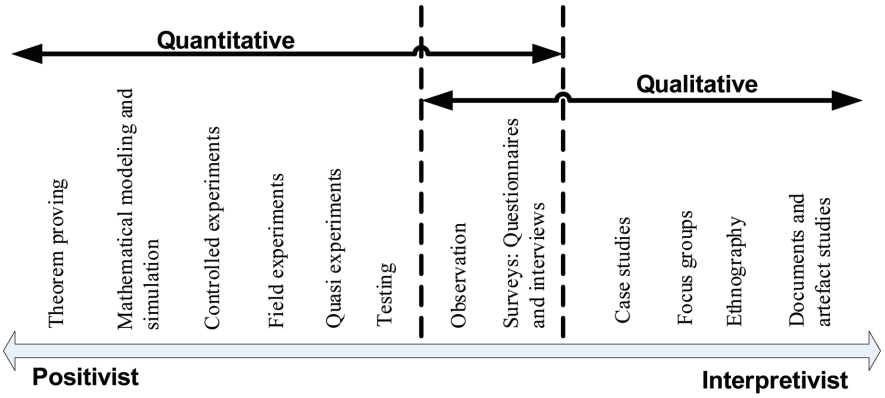
Qualitative and quantitative methods are not mutually exclusive. Many studies require eclectic inquiry methods, i.e. mixed methods research (Creswell, 2009) to cover the terrain and triangulate. Qualitative research can be exploratory, with its findings used to formulate hypotheses for subsequent quantitative analysis and verification. Conversely, when quantitative studies precede qualitative components, their findings can be extended in the subsequent qualitative research, for example, interviews.

Figure 1 shows common research methods on a Positivist–Interpretivist axis, tending from quantitative to qualitative, yet with an overlap.

INTERPRETIVE INFORMATION SYSTEMS RESEARCH

IS is a multi-perspective discipline with scientific, technological, engineering, organizational,

Figure 1. Research methods/strategies (de Villiers, 2005a)



managerial, and societal aspects, which requires plural research methods (Wood-Harper, 1985). The subdiscipline of human-computer interaction (HCI) (Preece, Rogers and Sharpe, 2007) has become prominent, highlighting the end user, and adding dimensions of psychology, culture, linguistics, ergonomics, graphical design, and marketing. The increasing power and stability of technology has pushed information systems into multiple domains, requiring reflective practices and reorientation (Pather and Remenyi, 2004).

Since the 1990s, there has been a tendency in IS to take cognizance of human behaviour and to use evaluative approaches. Walsham (1995b) examined IS research journals from 1992 onwards, four each from the UK and USA, and noted the advent of interpretive studies. In an analysis of computing research from leading journals, Glass, Ramesh and Vessey (2004) coded 628 papers from Computer Science (CS), 369 from Software Engineering (SE), and 488 from Information Systems. Sixty seven percent of the IS papers used evaluative approaches. The research methods applied in IS were field studies (27%), laboratory research involving humans (16%), and case studies (13%). Sixty three percent of the IS work related to behavioural aspects, versus only 2% and 8% of the CS and SE cases, respectively. The editorial policy of the MIS Quarterly has shifted, calling explicitly for interpretive or integrated, as well as positivist, approaches (O'Donovan and Roode, 2002; Walsham, 1995b;). In an editorial for the South African Computer Journal, Roode, (2003:1) personally requested acknowledgement of 'interpretivist research on a semi-equal footing with positivist research', thus supplementing the accepted scientific method with relevant non-positivist forms of scholarly research

Hirschheim and Klein (2000) discuss the internal and external views of IS research. The internal view identifies fragmentation, primarily due to the paradigm tension between interpretivists and positivists. The external view relates to the gap between IS research and external expectations, suggesting that the research, at that time, was not sufficiently relevant to practice. Research outputs represented *ad hoc* findings, yet lacked generality and did not broaden theoretical constructs. Where possible, IS research should be based on underlying, yet explicit, theoretical frameworks or conceptual models to provide internal continuity and cohesion. Pather and Remenyi (2004) propose critical realism as a bridge to the gap between positivist and interpretivist paradigms, using both qualitative and quantitative techniques. De Villiers (2005b) suggests approaches and methods that primarily implement the ethos of the interpretive school, such as design research, action research and grounded theory. In recent work, Vannoy and Salam (2010) applied grounded theory as an

interpretive research approach to investigate how top managers used organisation-wide information systems in their competitive actions to sustain their companies' leading positions.

This chapter suggests two practical, yet methodologically- and theoretically sound approaches, which are relevant to postgraduate studies, as well as to basic-, *ad hoc*- and contract research. *Action research* and *grounded theory* both originated in the social sciences, yet are relevant to current computing research where effective interaction design is important in societies increasingly geared to the end-user. There is recognition of the 'human-factors' aim of HCI to generate interactive user-centric computing, sound usability, and empowerment of domains beyond business systems, for example, applications for e-learning/e-training and for bridging the digital divide. Acknowledging that computing has human and sociological, as well as technological and computational dimensions, research methods from the interpretive paradigm have a definitive role to play. Du Plooy (2003) stresses the importance of acknowledging human and social factors in the development of information systems. Preece, Rogers and Sharpe (2007) distinguish between the usability and the user experience (UX) of software. User experience, in particular, requires interpretive and qualitative analysis, and approaches are being proposed to measure it (Schulze and Krömker, 2010).

Research terminology includes overlapping, interrelated or exclusive terms, some of which are listed to explain how they are used in this study:

- **Paradigm:** The underlying philosophy and assumptions that form the foundation to one's approach and methodology (in this study: the *interpretive*, rather than positivist, stance).
- **Model:** the underlying research approach used to guide and operationalise a study: the approaches suggested here being *action research* and *grounded theory*.
- **Methods:** practical means/strategies/techniques for data collection: each approach has its own set of methods and instruments, usually multiple methods and/or hybrid methods.
- **Methodology:** A set of methods used in a process of inquiry.
- **Empirical:** Based on the results of experiments and/or observations; not based on theory.
- **Epistemology:** Theory of the grounds of knowledge, relating to how knowledge is produced; basis of claims to knowledge.
- **Ontology:** The science of the essence of being; closely related to one's view of reality.
- **Substantive:** Having a separate and independent existence, not merely inferential or implicit.

The next sections describe, discuss and illustrate two approaches/models and their application in interpretive IS research. Each research design has associated methods and techniques to operationalise it and is illustrated by real-world examples, some of which relate to research by the author, her colleagues, and postgraduate students.

ACTION RESEARCH

Definition and Origins

The action research (AR) approach (Baskerville, 1999; Baskerville and Wood-Harper, 1996; Cohen, Manion and Morrison, 2005; Zuber-Skerrit, 1992) emanates from action-based social psychology and encompasses various research and intervention methods. Its founder, Kurt Lewin, contended that complex societal phenomena could not be investigated under laboratory conditions and used AR to study post-World War 2 social disorders among veterans (Baskerville, 1999; du Poy and Gitlin, 1998; Wood-Harper, 1985). Zuber-Skerrit

(1992) defines AR in higher-education as inquiry into issues encountered when students learn. Its participative, practitioner-researcher approach lends itself to research in educational technology, where an evolving intervention or product is investigated over several cycles.

Commencing with the identification of a problem or situation that calls for action, AR functions as an agent for change. Based on features compiled from publications by Baskerville, 1999; Dick, Passfield and Wildman, 1995; du Poy and Gitlin, 1998; McIntosh, 2010, and Zuber-Skerrit, 1992; action research is:

- *Cyclic*: Systematic, action-oriented, iterative stages recur in a longitudinal time frame, generating knowledge for further action.
- *Participative*: Clients, end users, participants and researcher collaborate closely as co-researchers or as practitioner-researchers examine their own work.
- *Qualitative*: Operates more via verbal aspects than by numbers; emphasizes transformation in social settings.
- *Reflective*: Observation followed by critical reflection on the process and outcomes of each cycle, and is used in designing subsequent steps and events with a view to improvement.
- *Responsive*: It reacts and adapts flexibly to findings from previous cycles.

In a seminal parallel from the professional disciplines, Schön (1987) defines reflective practice, or reflection-in-action, as the professional artistry that occurs when skilled practitioners tackle work-related activities, going beyond rigid rules of inquiry, and generating new rules in uncertain situations. Furthermore, the reflective practitioner is both a participant in the process and a critic who observes and analyses. Similarly, AR aims to improve practice and advance knowledge.

Epistemology and Philosophy of AR

Action research has an interpretive ethos, incorporating social and ethnographic enquiry based on views and actions of participants, making it emancipatory research. It is a holistic approach, which includes ideographic enquiry, acknowledging the uniqueness of each setting (Baskerville, 1999). When AR originated, the collection of precise quantitative data was emphasized, yet it was recognised that AR operated under a differing qualitative epistemology and, although it can be less rigorous than other approaches, it is acknowledged as a human-focused process that generates reliable knowledge.

Distinctive characteristics of AR are its longitudinal time framework and the in-depth involvement of researcher as participant. Moreover, it focuses more on refinement of existing processes or products than on new developments. Furthermore, in many cases there is no attempt to construct theory or models.

Action research has been applied in IS since the 1980's and 1990's (Wood-Harper, 1985; Baskerville and Wood-Harper, 1996; Baskerville, 1999). With reference to the use of AR in educational- technology systems, publications have been appearing since the 1990s (Zuber-Skerrit, 1992; Dick, Passfield and Wildman, 1995). The trend continues and AR has become an accepted form of research for studies on e-learning. For example, Wang and Chen (2009) describe the use of action research methods in the development of an e-learning masters degree programme in Taiwan, comprising six courses and associated curricular. Their AR approach involved five stages and the developed courses/curricular were modified in the light of the findings. Moreover in Australia, Russell (2009) used action research for her research methodology and methods as she investigated strategies applied by university lecturers who adopted e-learning in their professional roles. Russell developed a conceptual framework for analysing university teaching and learning

as a complex adaptive system. The application area of the study was the Innovative Teaching and Educational Technology (ITET) Fellowship Programme, which ran over a 5-year period and gave her the opportunity to undertake an AR study in four phases, using a variety of data collection methods.

Research Processes and Methods

The process comprises a series of cycles that feed into each other and employ a variety of research methods. The methods can be repeated from one iteration to the next or, alternatively, different methods can be used in different iterations. Du Poy and Gitlin (1998) state that although AR integrates methods from both the experimental and interpretive traditions, all AR research must be conducted within the natural context.

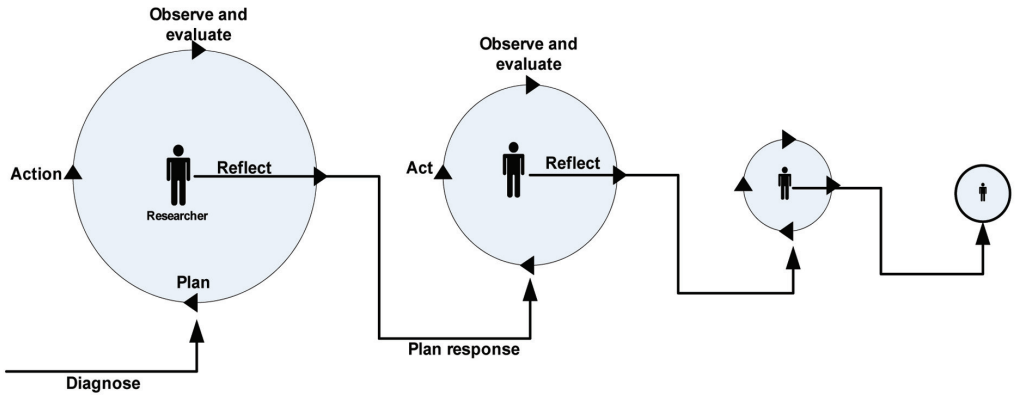
For Kock (2004) AR holds threats that may reduce rigour and validity. One is the complexity of analyzing broad bodies of data, where rich contexts make it difficult to separate distinct constructs. As an antidote, he advocates the integration of action research with grounded theory (next section) where the coding process identifies categories, relationships between them, and supports grouping. Another threat results from the natural context, which – though an advantage – reduces the researcher's control over the environment and subjects. Third, the close researcher involvement can result in subjective bias in interpretation. These threats, however, can be countered by multiple cyclic iterations.

The action research process is graphically depicted in Figure 2 as a series of cycles which close in as a solution is attained. The researcher occupies a central, participative, and influential position. This model forms a useful framework to guide and monitor the progress of a research project.

Application and Example

AR is increasingly used for scholarly research in IS, and is a valid approach for applied fields (Myers, 2004). Baskerville (1999) asserts that it generates research relevant to the complex and multivariate nature of IS, due to its basis in practical action and potential for solving practical computing problems. In the 1980s, AR techniques were applied by Peter Checkland in systems analysis, as he developed soft systems methodology (Baskerville, 1999). Trevor Wood-Harper addressed the tensions between theory and practice and between traditional scientific research and the sociological approaches, by introducing AR to the IS community with his seminal paper, Research Methods in Information Systems: Using Action Research (Wood-Harper, 1985).

Figure 2. Action research model (de Villiers, 2007)



Baskerville lists forms of IS action research: prototyping, soft systems methodology, action science, participant observation, fieldwork, and process consultation. To this list, the present author adds investigation of evolving solutions in their context of use, e.g. e-learning systems and customised interfaces, where designers conduct research into their own products. Derntl and Motschnig-Pitrik (2004) also advocate AR for producing e-learning solutions.

A participative action research approach was used to design, develop, evaluate and refine an e-learning tutorial called *Relations* over a longitudinal time frame in the School of Computing at the University of South Africa (UNISA). The teaching and learning of a complex section in theoretical computer science in a distance-education context was supplemented with *Relations,* which interactively teaches mathematical skills relevant to computing, by alternating instructional and practice functionality (de Villiers, 2004; de Villiers, 2007). *Relations* offers support in a complex cognitive domain, in which learners must acquire specialized skills. It required particular expertise on the part of the system designer to interactively present computational learning content in a creative, yet effective, way that motivates and engages learners. Animated development is used to demonstrate complex concepts and learners are challenged in exercises. Students' answers are judged and diagnostic feedback is provided.

In line with Figure 2, the system was formatively and summatively evaluated by various usability evaluation methods (UEMs) and improved in successive studies by complementary use of various evaluation techniques and triangulated data (de Villiers, 2004; de Villiers, 2007). The initial UEMs were: questionnaire surveys, interviews, heuristic evaluation and a post-test, each of which had particular strengths. The designer reflected on the findings and responded with iterative refinements to *Relations*' functionality, learning content and usability. Heuristic evaluations by experts were valuable sources of critique and innovative suggestions. For optimal evaluation, an HE team should include experts with subject matter skills and experts with usability expertise. Questionnaire surveys among end-users, i.e. students, were particularly useful with regard to educational aspects. They confirmed the value of the detailed feedback to exercises, showing that the time spent in developing it, was worthwhile. The first questionnaire survey provided particularly useful information, as it identified problems that were fixed immediately. Open-ended questions elicited qualitative responses to supplement information from Likert options. Unanticipated aspects that emerged were probed further in semi-structured interviews, following up on problems and identifying features that fostered learning and engagement. Finally, in a mixed methods approach, post-tests gave quantitative measures that could be statistically analysed.

When UNISA obtained a usability laboratory with sophisticated monitoring and recording technology, *Relations* underwent usability testing sessions (Masemola and de Villiers, 2006; de Villiers, 2009). The aim was more to investigate students' actual learning experiences with the e-learning tutorial, than to evaluate the target system itself. Nevertheless, as a secondary outcome, further problems were identified in *Relations*, indicating the value of formal usability testing as a cycle in the action research process. As a user-based method, usability testing is comprehensive and focused, allowing researchers to observe intricate and detailed aspects of users' interaction with the system, whereas surveys, another user-based method, provide more general information.

The participative action research process of designing, developing, evaluating and refining the e-learning tutorial resulted in improvements to its functionality, learning content and usability. The designer and developers of *Relations* used technology, not for its own sake, but rather to motivate learners and to illustrate concepts in ways that enhance cognition. Technology was the medium and not the message (de Villiers, 2005a).

The AR approach required reflection and taught the designer and development team a great deal – not just about *Relations*. They also learned generic principles for designing e-learning and grasped the complementary roles of different evaluation methods used iteratively. The action research design thus led to a dual outcome as, in subsequent ventures, the generic lessons learned and the principles that emerged, were transferred by School of Computing researchers to a series of studies of a different e-learning system, called *Karnaugh* (Becker and De Villiers, 2008; Adebesin, De Villiers and Ssemugabi, 2009; de Villiers, 2009).

GROUNDED THEORY

Definition and Origins

In the grounded theory (GT) approach (Cockton, 2002; Glaser and Strauss, 1967; Glaser, 1992; Leedy and Ormrod, 2001), theory and models are generated inductively from the analysis of contextual data, as themes and patterns emerge. There is no testing of *a-priori* theories. GT originated from sociology, where attitudes to phenomena (initially, the phenomenon of death) were investigated by Glaser and Strauss. GT was extended to research in education, medicine, economics, and anthropology (Strauss and Corbin, 1990), while Cockton (2002; 2004) applied it in the design of computing interactions. By the definition of categories, properties and relationships, GT can account for variation in behaviour. It provides a conceptual grasp of substantive areas, which evolves and is modified to fit as findings and new data emerge. Patterns are detected and interpreted within activities and events. The data may be quantitative, qualitative or both, but for qualitative studies, it is vital that data collection, coding, analysis and interpretation are systematic. Mobility occurs between data collection and analysis. A grounded theory emerges inductively through ongoing co-variant collection and analysis, and is adjusted, expanded and refined, (Lincoln and Guba, 1985).

As with AR, there is a parallel in the professions. 'Emerging patterns' have an analogy in Christopher Alexander's classic patterns in architecture and town planning, which form practical architectural languages, as physical and social relationships articulate themselves (Alexander, Ishikawa and Silverstein, 1977). Within a pattern language, it is possible to densify, i.e. to find added meaning by integrating overlapping patterns.

Epistemology of GT

Researcher bias and subjectivity may influence conceptualization and interpretations. However, grounded theory has mechanisms to counteract this, such as constant comparison, saturation and core relevance (Glaser, 1992). Furthermore, data collection, analysis and presentation should be linked at each step, adjusting naturally to one another.

The Glaser model posits contentiously that, to avoid preconceptions and forcing, there is little initial need to review literature. Once the emerging theory is sufficiently grounded, literature reviews in the field can commence and be related to the new work. In new fields, Glaser views the researcher as a pre-empting pioneer, producing general theories to be integrated with the literature. According to Urquhart (2002), however, the originator's actual position on avoiding existing literature is not rigid.

As an analysis method, GT can be combined with other research approaches. Kock (2004) proposes integrating grounded theory with action research. A model proposed by van Merwe and de Villiers (2011) articulates and motivates an integrated research framework that combines elements of the grounded theory method with activity theory in a partial grounded theory approach. The framework is relevant for the study of online collaborative interactions and discussion forums.

Over the past ten years interest has increased in the use of GT in IS research. As a qualitative, inductive method based on the systematic collection and analysis of data, GT supports the development of theory grounded in empirical observation (Urquhart, Lehmann and Myers, 2010). Cathy Urquhart, Hans Lehmann and Michael Myers overview the evolution of GT from 1967 to the 21st century, with a view to leveraging the grounded theory method to build theory in IS research. They synthesize a framework of five guidelines for conducting and evaluating GT studies in IS. The first three address ways of achieving adequate conceptualization for the emerging theory, while the fourth and fifth help to establish the scope of the theory by providing guidance on its level and how it could be integrated with existing literature. The five, respectively, are;

1. Constant comparison;
2. Iterative conceptualization;
3. Theoretical sampling;
4. Scaling up; and
5. Theoretical integration.

Research Processes and Methods

Urquhart (2002) refers to the grounded theory method' (GTM) to distinguish the methododology from the emergent theory. GTM literature provides guidance on how to code qualitative data. Covariant data collection and analysis (from social science) entail initial interviews and fieldwork, which after transcription, coding, and analysis delimit the field and prompt theoretical sampling and densifying (Glaser, 1992). Other methods are observation, document analysis, and videotaping to reflect perspectives of the object of study (Strauss and Corbin, 1990). Back-and-forth mobility occurs between data collection and analysis, with analysis driving further collection. Patterns are identified as the researcher systematically codes, compares, analyses and records. Constant comparative coding (Glaser and Strauss, 1967; Glaser, 1992) is the validation process whereby observations and behaviours are compared with core categories and properties, then coded into categories. The conceptual model is reviewed, modified and expanded in the light of the new data, and new concepts are integrated into the emerging theory. When multiple behaviours indicate similar patterns and properties, saturation has occurred. When disconfirming evidence occurs, revisions are required. In this way the emerging theory is inductively discovered, bounded and confirmed. As the researcher encounters confirming cases, negative cases, and discrepancies, the theory with the most confirming cases emerges as robust (Lincoln and Guba, 1985).

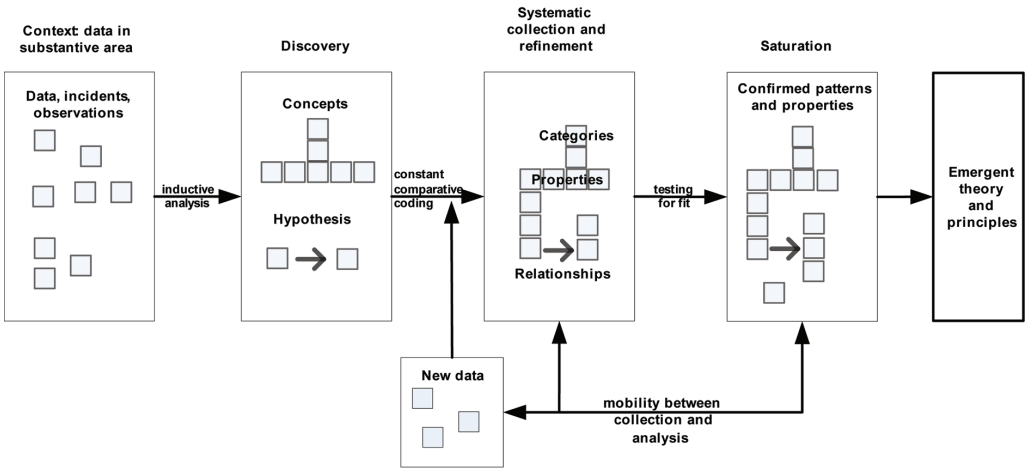
Figure 3 portrays the processes and concepts of GT, serving as an underlying framework for research processes which investigate phenomena to determine their underlying theory.

Application and Example

Orlikowski's (1993) landmark paper in the MISQ describes a project in which a GT research approach was used to study organizational experience in the adoption and use of CASE tools. Findings were used to develop a theoretical framework conceptualizing organisational change and social issues for cases where installation involves both new technologies and inherent change. GT was a relevant approach, because of its emphasis on contextual elements, process management, and human actions. Urquhart (2002) proposes GTM for the analysis of qualitative data in IS research and highlights its use in interpretive studies.

Cockton (2002; 2004) discusses the applicability of grounded theory to computable interactions, and explains how, as theories and themes emerge, corresponding models can be defined and implemented using an HCI contextual approach. Such models could include personas, scenarios and sequence models, where the persona represents a stereotypical user and the scenario a stereotypical usage. It is a rich and relevant context-centered

Figure 3. Model of grounded theory emergence (de Villiers, 2005b)



approach, which takes users' goals and aspirations into account, aiming for higher relevance. The models are used in design to generate prototypes on which the fit between context of use and interaction surfaces can be tested. Thus grounded theory research in IS investigates data, resulting in theory, which leads to models, which lead in turn to innovative grounded designs or design models, which satisfy fit-to-context (Cockton, 2004).

GT has been applied beyond information systems and management systems, and has been used in investigating web-based systems. In a study to establish factors that influence the adoption and diffusion of semantic web technology, Joo (2011) used a grounded theory approach for research into the usage of semantic web approaches within organizations. Transcripts of interviews were analysed by open coding and five factors were identified with relation to the adoption and diffusson of the Semantic Web.

The GT process can be applied in studies that focus on the extraction of design guidelines and evaluation criteria by analysis of practice in substantive areas, synthesizing them into theoretical proposals, which are further refined, tested and ratified by use. Glaser's (1992) concept of pre-emption is appropriate in the emerging Southern African technological domains where innovative work is underway in, for example, the design of non-standard interactive environments, such as development software for the formerly disadvantaged, emergent information systems or communities of practice, culturally-sensitive environments, accessibility for both the physically challenged and indigenous peoples, and contextualized e-learning and e-training. In an innovative approach focusing on context, UNISA academics, Van der Merwe, Van der Merwe and Venter (2010), combined selected aspects of grounded theory with activity theory and applied the approach in content analysis of online discussion forums for mathematics teachers from both advantaged and formerly disadvantaged backgrounds. The data of the advantaged situation was treated as a case and the data of the disadvantaged as a case. The cases were analysed separately, after which the results were compared.

Standard GTM techniques of open- and axial coding, respectively, were used to open the data for further analysis through application of activity theory (AT) techniques. In the first phases, open coding was employed to identify concepts, while in the second, axial coding was used to discover categories from similar concepts in each case. In the next stage, Van der Merwe *et al* (2010) used AT-techniques to reconstruct the opened data

in new ways, grouping concepts in categories of best-fit, with the relevant categories used to identify sub-cases or 'activity systems' within each case. Instead of using the GT-technique of selective coding to identify the core category, they applied a variant of GT and grouped related categories into classes, which defined distinct units for activity theory analysis. The classic AT framework of subjects, rules, community, division of labour, objects and goals, provided the necessary scaffolding to decompose class data in context, by way of a chronological report in rich narrative format. With each additional class-decomposition-and-comparison exercise, further insight was gained into previous classes and categories. Within-case data was interpreted and put together in new data views by mapping it to relevant theoretical frameworks and/or quantitative inputs. This forced them to regularly revisit the raw data in order to confirm and/or expand the evolving holistic view. In back-and-forth mobility between data collection and analysis, they adopted a cyclic process of GT open coding, axial coding and decomposition within activity systems. Connections between class categories, concepts and activity systems were integrated as part of their interpretation phase – bringing meaning, coherence and saturation to the categories, and

Table 1. Summary of action research and grounded theory

Properties	Action research	Grounded theory
Goals	Development of interventions to solve practical problems; Practical, contextual and locally relevant. Advancement of local knowledge without necessarily constructing generalisable theory or principles (though theory maybe an outcome).	Theory that emerges from the data; Inductive generation of grounded theories and models, as themes and patterns emerge through ongoing covariant collection and analysis of contextual data.
Distinct features	Evolving products/interventions investigated over several cycles in longitudinal time frames; Reflective and responsive to findings of previous cycles. In-depth central involvement of researcher-practitioner (researcher and practitioner are often the same person). Analysis of varied data in natural contexts (not lab settings) using various research methods. *Limitations*: Due to the natural setting and limited control, there is a threat of low rigour and validity. Close researcher involvement can lead to subjective bias. *Counteraction*: Multiple cyclic iterations aim to overcome the limitations.	Identification of categories, properties, relationships, which are expanded and refined through constant comparison as new data emerges in further sampling. Saturation occurs when multiple behaviours indicate similar patterns and properties; and new themes no longer emerge. Data may be quantitative, qualitative or mixed. *Limitations*: Researcher bias and subjectivity may influence conceptualization and interpretation. The Glaser variant of grounded theory excludes initial literature reviews, suggesting rather that reviews should commence after the new theory is sufficiently grounded. *Counteraction*: Validation by constant comparative coding; inductive bounding and confirmation of emerging theory.
Processes	Cyclical phases: plan, act, observe and reflect. Phases feed into each other. Participative: collaboration between researcher, practitioners and end-users. Use of a variety of research methods, e.g. different ones in different cycles; Emancipatory: AR as a change agent.	Term 'grounded theory method' (GTM) used to distinguish methodology from the emerging theory. Covariant data collection and analysis, e.g of interviews, textual data, and video data. Patterns identified via systematic coding, comparison, analysis and recording. Electronic tools, e.g. Atlas-ti can assist in coding. Mobility between data collection and analysis, as analysis drives further collection.
	Both AR and GT have iterative phases	
Application	Development of new technologies, materials or products in naturalistic contexts (in this study, in the context of education).	A data analysis technique that can be synergistically integrated with various research models, e.g. action research, activity theory, etc.

developing linkages between the destabilizing tensions discovered within each activity system (i.e. when an activity system was out of balance). The above process was repeated for each polar case. Apart from the novel insertion of activity theory to maintain a situation of balance in the system, the research processes are in line with those shown in Figure 3.

Finally, to consolidate the reconstruction process in line with Glaser (1992), Van der Merwe *et al* (2010) undertook a literature study after the research to strengthen the theoretical grounding of the findings. This also served to avoid an over-emphasis on inductive reasoning, whereby theoretical sensitivity could be ignored in favour of 'creativity' that leads to 'alternative shaping of observation and explanation, rather than an *ex post facto* discovery of explanatory ideas' (Katz, 1983: 133-134).

CONCLUSION

This chapter formed Part 1 of a study of models for interpretive information systems research. After considering positivism, interpretivism, and interpretive IS research, the study moved on to a discourse on the research designs of action research and grounded theory. The two differ in their nature and purpose, in that AR is a holistic research design, incorporating various research methods, while GT is a comprehensive and iterative approach for data analysis that can be used in the context of other models. AR and GT can be synergistically combined, by using GT for analysis within one or more of the AR cycles. Table 2 summarises their main features. Their limitations/disadvantages were reported in the course of the chapter, but are repeated in the table.

Both of these models have underlying theoretical and methodological frameworks, as well as repertoires of strategies to guide the research process, offering structure and cohesion in a research venture. Part 2 of this study is a separate chapter, which addresses development research, design-science research, and design-based research. The contribution to knowledge of the two chapters lies in their articulation of five interpretive research designs, and in the presentation of examples to illustrate application of research models in practice. Future research could be conducted on implementation of the models, with a view to further application in IS studies and in the domain of e-learning systems. Such studies could confirm, refine or extend the work reported in these two chapters.

NOTE

An earlier version of part of this chapter appeared as an article "Interpretive Research Models for Informatics: Action Research, Grounded Theory, and the Family of Design- and Development Research", *Alternation* 12,2 (2005) 10 - 52, and is re-used here with the permission of the publisher, CSSALL (

The present version is based on a reduced form of the article in *Alternation*, augmented with new content.

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