Grounded Action Research: A Method For Understanding IT in Practice

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Abstract

This paper shows how the theory development portion of action research can be made more rigorous. The process of theory formulation is an essential part of action research, yet this process is not well understood. A case study demonstrates how units of analysis and techniques from grounded theory can be integrated into the action research cycle in order to add rigor and reliability to the theory formulation process.

1 Introduction

The purpose of this paper is to describe a means for refining and improving the action research method. Action research embodies a strategy for studying change in organizations. This strategy involves the formulation of a theory, intervention and action-taking in order to introduce change into the study subject, and analysis of the ensuing change behavior of the study subject. One extension that could improve many future action research studies is a rigorous, reliable approach to theory formulation.
Action research is one of several qualitative research methods used in the field of information systems (Galliers and Land, 1987, Galliers, 1990). Such qualitative research is important for studying complex, multivariate, real-world phenomena that cannot be reduced for study with more positivist approaches. Action research is especially important in situations where participation and organizational change processes are necessary (Baskerville and Wood-Harper, 1996).

Action research should be very important for the study of information systems development (ISD) because of its orientation toward change. Ultimately, ISD is one of the essential elements in the change process for modern organizations. The viewpoints of ISD as an essential in organizational change processes vary (Markus and Robey 1989). ISD can be viewed as a source or a stimulus for change (e.g., Keen, 1981), a "technological imperative." It can be viewed as an enabling factor or facilitator of change (e.g., Davenport and Short, 1990), an "organizational imperative." It can be viewed as the result of change (e.g., Klein and Hirschheim, 1989), an "emergent perspective." The nuances of these various perspectives are not important for our purposes. As a collection, however, they make it clear that ISD has fundamental links with organizational change. A research method oriented toward change is very valuable to the scientific discipline of information systems.

Although valuable, action research studies have gained only limited attention in the information systems research literature (Lau, 1997). Peter Checkland (Checkland, 1981) and others (e.g., Wood-Harper, 1985, Mathiassen et al. 1991) have drawn attention to this methodology, particularly in Britain and Northern Europe. The Scandinavian tradition has incorporated action research ideals into "cooperative systems design" (e.g., Bjerknes and Bratteteig, 1987, Andersen et al. 1986). But world-wide, action research is eclipsed by more traditional social science methods like case studies, experiments and sampling surveys (Galliers, 1990). In the U.S., for example, action research is used in fewer than one percent of the top-quality information systems published research (Orlikowski and Baroudi, 1991). If change is such an essential element of ISD, and action research is the one practical research method that is fundamentally based on organizational change, why have so few top researchers adopted the approach?

We suggest that action research methods may be refined to improve their ability to contribute rigorously to information systems research. In particular, we discovered that theory development is one area where action research methods can be made more powerful. Much of the literature on action research currently assumes that theory evolution and exposition will occur as a natural consequence of problem formulation.

In this paper, we study a more rigorous treatment of the theory-formulation component in action research. Our approach to improving this rigor involves merging some of the techniques of grounded theory (Glaser and Strauss 1967) with the theory formulation steps in action research. The result is a "theory-rigorous" and powerfully improved action research method.

To make this article accessible and coherent, our scope includes a review of basic concepts of action research, a review of the units of analysis and theory development techniques of grounded theory, a description of the conflation of these two approaches, an information systems case study as supporting evidence, and a discussion of the implications for improving information systems research and practice. We must exclude (for reasons of length) extensive treatment of the philosophy of science that underlies qualitative research methods like grounded theory and action research, in-

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*In our view, this improvement is not reciprocal, i.e., grounded theory stands unchanged as a suitable qualitative research technique in settings where researcher intervention is not a primary goal of the research.
depth tutorials on these two techniques, and the detailed findings (substance) of the case study.
Detailed treatments of all of these subjects can be found in our references.

This paper is organized into six major sections. Following this introduction, the next two
sections review the basic tenets of action research and the relevant elements of grounded theory.
Section four explains how we integrated the techniques for grounded theory into action research to
create "grounded" action research. In section five, a case study illustrates how this method has been
used successfully to study problems in ISD. Finally, in section six, we will suggest implications for
practice and some future research directions.

2 Action Research

Action research is a clinical research method that is founded upon a qualitative, post-positive
research presumes that complex social systems cannot be reduced for meaningful study, nor can
sociologic experiments ever achieve repeatability. The fundamental contention of action research is
that a complex social process can be studied best by introducing changes into that process and
observing the effects of these changes. During action research, researchers not only observe
phenomena, they intervene and participate in the subject under study. This means that the data is
collected in much the same way as ethnographic encounters or a participative case study. However,
in the process of action research there are further motives to "contribute both to the practical
concerns of people in an immediate problematic situation (as well as to the goals of social science)
by joint collaboration within a mutually acceptable ethical framework." (Rapoport 1970, p. 499)

Blum (1955) explains the essence of action research as a simple two stage process. First, the
diagnostic stage involves a collaborative analysis of the social situation by the researcher and the
subjects of the research. Hypotheses are formulated concerning the nature of the research domain.
Second, the therapeutic stage involves collaborative change experiments. In this stage changes are
introduced and the effects are studied.

2.1 Components of Action Research

However, in order to achieve scientific rigor, additional structure is usually imposed upon action
research projects. The most prevalent description (Susman and Evered, 1978) details a five phase,
cyclical process. The method first requires the establishment of a client-system infrastructure or
research environment. Then, five identifiable phases are iterated: (1) diagnosing, (2) action planning,
(3) action taking, (4) evaluating and (5) specifying learning. Figure 1 is a diagram of this action research structural cycle. We will review the details of each of these phases in the context of the case study that follows.

2.2 Problems with Action Research Theory Treatment

One key aspect of this method is the role of theory. At the beginning of the research, researchers draw upon existing theory as foundations upon which to plan and take action. Following the evaluation of the outcomes of each cycle, this theoretical framework may be reinforced, withdrawn or modified to reflect the realities of action-taking. It is this evolution of theory that constitutes the scientific contribution of action research.

Despite the critical importance of theory-evolution to the scientific rigor of action research, little attention has been devoted to the exact processes by which such theories are cyclically developed during the course of action research. Argyris, Putnam & Smith (1985) carefully distinguish "espoused theory" from "theory-in-use," and describe criteria for good theory-in-use. But beyond this simple two-level model, most of the action research literature seems to assume that plain deductive logic will operate satisfactorily during the theory-evolution activities of the action researcher. This may be a key area for refining action research methods. Rather than assume this logical positivist view as an underpinning for its theory development, we favor an approach more consistent with the phenomenology, existentialism and hermeneutics (Susman & Evered 1978) that underlie action research. Techniques such as those used in grounded theory permit the theory to emerge naturally in an unpredictable research environment:

"The problem with action research arises from the fact that it cannot be wholly planned and directed down particular paths . . . [The researcher] may express his research aims as hopes, but cannot with certainty design them into his 'experiments'.

Figure 1. The action research cycle.
He has to be prepared to act to whatever happens in the research situation; he has to follow wherever the situation leads him or stop the research." (Checkland, 1981, p. 153)

3 Grounded Theory
Some qualitative approaches, such as ethnography, have discovered more clearly defined units of analysis that support rigorous techniques for expressing and adjusting theory (cf. Agar, 1986). In particular, the grounded theory method defines units of analysis that could provide a rigorous theory development technique for action research. The reason why the grounded theory units of analysis are particularly well-suited for integration with action research is because they are suitable for holding data collection, analysis and theory formulation in a reciprocal relationship. This relationship harmonizes well with the action research cycle. Our research indicates that these elements of grounded theory can be embedded into the action research cycle, forming a "theory-grounded" action research study.

Grounded theory began as a "constant comparative method" that alternated theory-building and the comparison of theory to reality. This is the basis of the grounded theory discovery process in Glaser and Strauss (1967) and the more recent version in Strauss and Corbin (1990). Our work is based on the more recent version. [1]

Grounded theories are inductively discovered by careful collection and analysis of qualitative empirical data. That is, this method does not begin with a theory, and then seek proof. Instead, it begins with an area of study and allows the relevant theory to emerge from that area (Strauss and Corbin, 1990, p. 23).

"The goal of field research is to develop a theory that is 'grounded,' that is, closely and directly relevant to the particular setting under study. Using the grounded-theory approach, the researcher first develops conceptual categories from the data and then makes new observations to clarify and elaborate these categories." (Frankfort-Nachmias and Nachmias, 1992, p.284)

3.1 Components of Grounded Theory
According to Strauss and Corbin (1990), analysis in a grounded theory approach is composed of three groups of coding procedures called open, axial and selective coding. Open coding is the process of identifying, naming and categorizing the essential ideas found in the data. Axial coding develops a deeper understanding of the relationships in the phenomena underlying data through the process of connecting various data categories that were determined during coding. Selective coding develops the theory that best fits the phenomena by identifying a story that reveals the central phenomenon (the core issue or “core” category) under study. These procedures do not entirely occur as a sequence, but each overlaps the others and iterates throughout the research project. The approach mitigates problems inherent in "ex post facto hypothesizing" by an analysis process that continuously validates theoretical concepts against newly-collected empirical data.

Figure 2 gives an overview of the coding structures. At the left of the diagram are observed phenomena such as social behavior or speech. Open coding labels these events producing concepts that are grouped to form categories. Axial and Selective coding links categories that eventually form into a story line that becomes the Core Category (Grounded Theory). The coding procedures will be reviewed in more detail in the context of the case study below.
3.2 Action Research and Grounded Theory Incompatibilities and Compatibilities

Action research and grounded theory cannot be completely integrated. The field of phenomena under study is too limited and goal-directed to permit full use of a comparative method like grounded theory. Some grounded theory essentials, like theoretical sampling, serve only limited purposes where an interventionist strategy presents a possibly unpredictable range of events that must be considered as a population. Also action research will typically commence with a practical problem that will suggest predefined categories and concepts. Essentially, a narrow core category and story line are predefined at the beginning of the research (grounded theory core categories usually emerge later in the research). Since this core category may evolve or dissolve during the action research, early stages of grounded theory coding must be reoriented toward learning about, adjusting, and possibly replacing this predefined core category. Typically a grounded theory project is unfettered with such initial predilections and is initially oriented toward exploratory discovery of this first theoretical framework.

Grounded theory, like action research, is a highly collaborative process. The use of a grounded theory units of analysis and techniques for developing the theory within an action research framework adds rigor to the process without detracting from the clinical nature of that framework. Lyytinen (1987) characterizes "the discipline urged upon grounded theorists" as pushing "such
investigators towards a high degree of rigor in the handling and interpretation of data." Yet this grounded theory rigor is compatible with the character of action research:

Grounded Theory:

"Grounded formal theory is more trustworthy for consultations because both laymen and sociologists can readily see how its predictions and explanations fit the realities of the situation. This is strategically important [because] a layman will not accept a theoretical explanation unless he can readily see how it explains his situation and gives him a sound basis for corrections and future predictions. . . . The transferability of formal theories to diverse substantive areas is seldom done in sociological consultation because most formal theories are ungrounded, and therefore not trusted by either sociologists or laymen when they face 'real-life circumstances.'" (Glaser and Strauss, 1967, p. 98-99)

Action Research:

"The criterion by which the research was judged internally was its practical success as measured by the readiness of actors to acknowledge that learning had occurred, either explicitly or through implementation of changes." (Checkland, 1981, p. 253).

4 Integrating Grounded Theory Techniques Into Action Research

This refinement of the action research method involves integrating certain grounded theory activities in the phases of action research primarily in two ways. First, grounded theory notation (e.g., memos and diagrams) is used to represent the theory-data during the action research cycle. Second, grounded theory coding becomes the essence of the evaluating, learning and diagnosis phases of action research.

The observations regarding these phases must be captured for open coding, e.g., by selectively transcribing audio taped materials (cf. Strauss and Corbin, 1990, p.30). In the very early stages, such as the setting of the client-system infrastructure, recording may be impractical. However, field notes can be used to capture critical data regarding the authority and expectations expressed by the host organization to the researchers and host practitioners. These expectations may form the research question component, and may also suggest initial categories, or even core categories. This idea will be further illustrated in the case study below.

The diagnosing phase should also be captured in field notes and transcripts and then open coded. This exposes the perceived primary problems for further analysis. During this phase, the memos should receive an initial round of axial and selective coding to further develop any initial core category and an initial story line about the problem situation. This core category embodies the basic theory underlying action planning.

During the action planning activity, coding memos are maintained and open coding continues as the collaborative team operationalizes a scheme of organizational actions that should relieve or improve these primary problems. Careful attention is kept on the core category and connecting subcategories as means for determining both the desired future state for the organization and the changes that would bring about this state.

The action taking stage is a period where observations will produce additional field notes and transcripts. Open coding will also continue. The memos regarding the outcomes of the action are particularly important.
The collaborative researchers and practitioners continue their memo-based data collection as they undertake the evaluating of the outcomes. Code memos document a growing understanding of the effects of the action on the problems. Importantly, they must specify the learning by continued axial and selective coding of both old and new data to determine if a new core category, or story line will emerge from the process. If the results of the action do not reflect a satisfactory outcome, then this adjusted story line becomes the foundation for a new diagnosis stage leading to a further iteration of the action research cycle.

The action research cycles reach a termination point when the categories reach saturation. This means the evaluating and learning phases produce little change to any of the categories, especially the core category.

5 A Case Study in Grounded Action Research

In this section we describe an action research study used to triangulate (Fielding and Fielding, 1986) a research program and raise the impact of the findings to a higher practical and scientific level (cf. Mason’s "iso-episteme curves", 1991). The program consisted of a survey and an action research study. We only discuss this study from a methodological perspective, see Pries-Heje and Malmborg, 1992) for a full report on the substance of the research.

The research topic in this case dealt with methods and tools to improve problems that exist in software product development. The topic was initially explored using an interview survey of twelve firms in the U.S. and Denmark. This initial study identified eighteen major problems and five "high-impact" tools that could potentially resolve the majority of these problems (Pries-Heje, 1993).

One of the five high-impact tools was notable because it was commercially unavailable to practitioners. This was a tool for problem structuring and design discussions. The research method then shifted to action research to discover if such a theoretical tool was practical, i.e., could be specified for practice.

The client was a small research organization formed to develop a highly sophisticated window-oriented user interface management system (UIMS). This organization had varied periodically in its formality, going through informal periods where only part-time work took place, and at other times became formal with several full-time participants. The project lasted over six calendar years and consumed six person-years of labor. All of the programming and testing took place during the final year of the project, during which there were two full-time project members.

In initializing action research, the client-system infrastructure is the specification and agreement that constitutes the research environment. It provides the authority, or sanctions, under which the researchers and host practitioners may specify actions. It also legitimates those actions with the expectation that eventually these will prove beneficial to the client or host organization. This case's infrastructure was created during this final year of the project. The client was approached with the results from the interview survey and expressed an interest in experimenting with a prototype of the "missing" problem structuring tool. This prototyping project formed the client-system infrastructure in which action research and grounded theory techniques developed in concert.
The prototype was used to study how practitioner needs would evolve through experience with a problem structuring and design rationale tool. The prototype of a design rationale tool was implemented using hypertext authoring software (Pries-Heje and Malmborg, 1992). The initial prototype implemented an entity-relationship model shown in Figure 3 [2]. Problems, solutions, arguments and goals were implemented as HyperCards, and this allowed the designers to view connected Problems, Solutions and Arguments in an Issue-net. (Conklin and Begeman, 1988 used the terms "issues" and "solutions" for problems and goals.) Furthermore, Goals were used to generate Arguments (cf. Lee, 1990).

From an action-research/grounded-theory perspective, this means that the action research begins as a second-stage research project. More importantly, it means that certain categories could be coded from the interview-survey research findings and the literature search. These initial categories are shown in Table 1 and are denoted as categories I1-I4. Each category is a class of related concepts (labelled events). The table also notes a brief summary of the argument underlying the category. The argument represents the rigorously detailed thread linking these categories to concepts discovered in the underlying data. The appendix illustrates how these arguments represent the development of these categories by describing the full derivation of one of these categories. The process follows the observation of phenomena, the open coding that names these phenomena as concepts, and the categorization of these concepts. Category F5 (see Table 2), the evolution of situated solutions from scenarios, provides this detailed example.

Grounded theory analytical techniques for discovering concepts, arguments and categories centralize on "theoretical sensitivity", the capacity of the researcher to understand the concepts underlying the data, to separate the pertinent from that which isn't, and the ability to give meaning to the data. Theoretical sensitivity techniques include adjusting one's thinking out of confines of technical literature and personal experience, avoiding standard ways of thinking about phenomena, clarifying or debunking assumptions made by people who appear in the data, etc. However, other sense-making techniques are useful here (cf. Weick 1996) such as the use of the frames, goals, strips, and "breakdown" encounters suggested by Agar (1986).

In addition to the categories derived from the text, there were also the four additional categories established as entities for the initial prototype. Also the entity-relationship diagram can be viewed as a grounded-theory diagram, since it captures the set of relationships in a fashion rather like connecting subcategories. There was also a rough form of a core category regarding the use of a problem-structuring and design-rationale tool in a software design process.
5.1 First cycle evaluating

After the actions are completed in an action research project, the collaborative researchers and practitioners undertake the evaluating of the outcomes. This includes a determination of whether the theoretical effects of the action were realized, and whether these effects relieved the problems. Where the change was successful, the evaluation must critically question whether the theory-inspired action, among the myriad routine and non-routine organizational actions, was a substantial causal factor in the success. Where the change was unsuccessful, the theory must be corrected for the next iteration of the action research cycle (including the adjustment of the hypotheses).

In this case, the initial prototype was evaluated in two sessions that each included two designers and a researcher. During the first session the team discussed the existing project mechanism for problem recording (called a "problem-list" or "problem-catalog"). The team decided to structure this problem-list such that these problems could be represented in the prototype as problems, solutions, arguments and goals. In the second session, the designers examined an Issue-net of these problems as represented by the prototype. Data was collected in the form of the researcher's field notes, diagrams, and an audio tape of each of the three-hour sessions. The audio tape was then transcribed.

Table 2. Initial Categories.

<table>
<thead>
<tr>
<th>Number</th>
<th>Category</th>
<th>Argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>A design rationale tool is useful during a development process</td>
<td>Partly for a faster identification of problems, and partly to structure the design discussions (Conklin &amp; Begeman 1988)</td>
</tr>
<tr>
<td>I2</td>
<td>It pays to use a design rationale tool to check the consistency between options, both during and at the end of the development process.</td>
<td>Early detection of problems using a design rationale tool resulted in substantial savings at NCR (Yakemovic &amp; Conklin 1990)</td>
</tr>
<tr>
<td>I3</td>
<td>A design rationale tool is highly qualified to document and record a design rationale, with a focus on maintenance.</td>
<td>One of the real difficult problems in maintaining software developed by others is to figure out why decisions were made as they were Parnas &amp; Clements 1986)</td>
</tr>
<tr>
<td>I4</td>
<td>A design rationale tool is best used by only one person from a project group, e.g., as a kind of summary tool.</td>
<td>Design rationale tool was used successfully by one person at NCR (Yakemovic &amp; Conklin 1990), but not very successfully in groups or distributed parallel use (Rein &amp; Ellis 1991)</td>
</tr>
</tbody>
</table>
Table 2. Categories that emerged from the first cycle.

<table>
<thead>
<tr>
<th>Number</th>
<th>Category</th>
<th>Argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>It is central that one can change or further develop issues.</td>
<td>It was demonstrated that issues never were fixed. Solutions could turn into issues, or be split into arguments at a later point in time.</td>
</tr>
<tr>
<td>F2</td>
<td>Definition and clarification of new terms and ideas will happen throughout the project.</td>
<td>It was demonstrated that definitions in the project was changed again and again, when new decisions or definitions shed new light on the old ones.</td>
</tr>
<tr>
<td>F3</td>
<td>Unsolvable problems arise during the design process.</td>
<td>At a given point in the design process lack of insight make some problems unsolvable.</td>
</tr>
<tr>
<td>F4</td>
<td>Solutions to unsolvable problems often arise unexpectedly.</td>
<td>It was demonstrated that new decisions or definitions in relation to other problems may later make the unsolvable problem solvable</td>
</tr>
<tr>
<td>F5</td>
<td>Scenarios (small examples of expected use) were very important in the design process, and were used to identify goals.</td>
<td>Scenarios lead to situated solutions that are perpetually brought up into a general framework.</td>
</tr>
<tr>
<td>F6</td>
<td>The implementation solution may be different from the solution originally designed by the designers.</td>
<td>It was demonstrated that the cost (measured in time or money) of implementing a solution changed the preferred solution from the design to the implementation phase</td>
</tr>
<tr>
<td>F7</td>
<td>A single solution often solves many problems, it is typically a &quot;solution-package&quot; rather than a solution.</td>
<td>At any time in the project several issues were up for debate. The preferred solution in a discussion often solved two, three or several of the issues</td>
</tr>
<tr>
<td>F8</td>
<td>Because the problem catalog was inconvenient, an index card system replaced it.</td>
<td>It was demonstrated that Index cards easily can be resorted and grouped for implementation purposes</td>
</tr>
</tbody>
</table>
5.2 First cycle learning

In action research, the activity of specifying learning is usually an ongoing process, although this learning must be formalized as a concluding stage in the action research cycle. The knowledge gained in the action research (whether the action was successful or unsuccessful) can be directed to three audiences. First, what Argyris and Schön (1978) call "double-loop learning," the restructuring of organizational norms to reflect the new knowledge gained by the organization during the research. Second, where the change was unsuccessful, the additional knowledge may provide foundations for adjusting the theory in preparation for further action research intervention. Finally, the success or failure of the theoretical framework is important to the scientific and practitioner community for suggesting a theoretical basis for future organizational settings. Yin (1989) suggests this form of "generalization to theory" provides the external validity for scientific knowledge defined by a single case.

From grounded theory we use explicit units of analysis (concept, property, and category), coding procedures and also a rigorous notation. Memos and diagrams record the observations and analyses during the coding procedures. Memos contain the coding products, summary notes, directions for further work, and records of concepts that are potentially sensitive in possible theories or story lines. Diagrams provide visual representations of the relationships between concepts or categories.

This rigorous qualitative notation is continuously coded by the researchers. The goal of open coding is to reveal the essential ideas found in the data. Open coding involves two essential tasks. One task is labelling phenomena. This task involves decomposing an observation into discrete incidents or ideas. (The term "observation" is used in its scientific sense, meaning it might refer to some event the researcher observes or it might also refer to any other qualitative data such as a paragraph or a sentence in a text.) Each discrete incident or idea receives a name or label that represents the phenomenon. These names represent a concept inherent in the observation. The second essential open-coding task is discovering categories. Categorizing is the process of grouping concepts that seem to pertain to the same phenomena. Categories are classifications of concepts, i.e., groups of related concepts. Categories are characterized according to their location along various dimensions. This set of dimensional locations are called properties. For example, duration could be a property of the category "testing." The dimension of duration might run from "short" to "long."

In this case, the initial memos were structured as half-page photocopies of the field notes and transcriptions. The open coding notes were then handwritten onto the blank half of the memos. Theoretical memos were used to record the development of eight new categories F1-F8 (see Table 2) that emerged from these two initial sessions of open coding.

The goal of axial coding is to develop a deeper understanding of how the categories relate to each other. Axial coding involves two tasks further developing the categories and properties. The first task connects categories in terms of a sequence of relationships. This sequence flows from causal conditions, phenomenon, context, intervening conditions, action-interactional strategies, to consequences (Strauss & Corbin, 1990, p. 99). The second task turns back to the data for validation of the relationships. This return gives rise to the discovery and specification of the differences and similarities among and within the categories. This discovery adds variation and depth of understanding that is necessary for the next stage, selective coding.

In this case, the axial coding done during this initial learning phase was very sketchy because so little data was available. However, the analysis yielded three vague connecting categories. These
were (1) commentary on the functionality of the prototype, (2) input to the Issue-net, and (3) comments on the development process in the project.

This learning also led to a change in the initial category I3. Category I3 had to be changed to reflect the understanding that there are two different design rationales. The "internal" rationale is for the use of the designers, and uses the language of the developers (technical terms and highly-developed jargon). The "external" rationale is highly simplified, uses general language, and must be organized in a totally different manner for ease of understanding.

5.3 First cycle diagnosis
In action research, diagnosing corresponds to the identification of the primary problems that are the underlying causes of the organization's desire for change. This involves self-interpretation of the complex organizational problem, not through reduction and simplification, but rather in a holistic fashion. This diagnosis will develop and apply a certain theoretical framework that regards the nature of the organization and its problem domain.

The goal of selective coding is to develop the theory that best fits the phenomena being studied. Selective coding involves two tasks. The first task is to identify a story, a descriptive narrative that reveals the central phenomenon (the main problem) under study. Sometimes this broad central phenomenon must be named, other times an existing category will be clearly central. Either way, a "core" category emerges. The second task is that of systematically relating this core category to other categories, validating those relationships, and filling in categories that need further refinement and development.

As mentioned earlier, these coding procedures overlap and iterate until the theory becomes conceptually adequate. This adequacy is attained when every category has become theoretically saturated. Theoretical saturation means that no new data regarding the category can be seen to emerge during further iterations of the coding procedures.

In this case, the entity-relationship diagram evolved in response to three areas of deeper understanding. First, the initial concept of "goals" had to be divided into two concepts: "requirements" and "visions". In grounded-theory terms, this means the goals category was divided into a requirements category and a visions category. Second, a new many-to-many relationship arose from a deeper understanding of the important role of scenarios and the recognition that a single solution would affect multiple problems. This means a connecting category between scenarios and problems was changed or axially re-coded. Third, there were different levels of scenarios. Some scenarios were very broad while others were highly specialized. Scenarios should have been modelled with an optional one-to-many relation to broad "super-scenarios." This means a new category arises
Figure 4. The second entity-relationship model for the prototype.

in the concept of super-scenarios. The revised diagram is shown in Figure 4. In response to this diagnosis, the team decided to engage in a new prototype cycle.

5.4 First cycle action planning
In action research, researchers and practitioners then collaborate in the next activity, action planning. This activity specifies organizational actions that should relieve or improve the primary organizational problems. The discovery of the planned actions is guided by the theoretical framework, which indicates both some desired future state for the organization, and the changes that would achieve such a state. The plan establishes the target for change and the approach to change.

In this case, the interaction with the computer-based prototype appeared to have little benefit vis-a-vis the contents of the Issue-net. Since the high-labor hypertext programming provided little return benefit in new learning, the plan shifted to “paper-prototypes.” When properly used, such paper artifacts can prove as effective as computer-based implementation (cf. Ehn, 1989). The proposed paper-prototypes would reflect the new entity-relationship diagram.

5.5 First cycle action taking
In action research, action taking then implements the planned action. The researchers and practitioners collaborate in the active intervention into the client organization, causing certain changes to be made.

In this case, a paper prototype was created that used printed documents to convey the way the new entity-relationship diagram structured the Issue-net and captured the problem catalog. This involved 12 output schemes that simulated computer-based output. For example there was a matrix combining a requirements dimension with a solutions dimension. Each cell in this matrix contained arguments for solutions in relation to requirements.
5.6 Second research cycle

The action research cycle can continue, regardless of whether the action proved successful or not, to develop further knowledge about the organization and the validity of relevant theoretical frameworks. As a result of the studies, the organization thus learns more about its nature and environment, and the constellation of theoretical elements of the scientific community continues to benefit and evolve.

In this case, the second cycle consisted of one two-hour session. The open coding of this session led to a change in category F8 (see Table 2). This category evolved to include the need for a variety of viewpoints on the list of problems. For example, the designers need to view any one problem and ask for a list of problems that are directly connected or indirectly connected through a common solution or scenario. The rough subcategories remained unchanged, but the entity-relationship diagram evolved in two ways. First, a new entity (and category) was created by grouping requirements and problems into a single new entity. Second, a new relation erupted between visions and requirement-problems. (See Figure 4.) In grounded-theory terms, this relation regards the emergence of a new connecting category during axial coding.

5.7 Third research cycle

The third cycle consisted of two sessions, one five-hour session and a second three-hour session. The five-hour session consisted of a designer exercising the prototype while the researcher took notes. There was no transcript. Two new categories T1-T2 arose in this session. These are shown in Table 3.

Figure 5. The third entity-relationship diagram.

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Table 4. Connecting categories arising in the third cycle.

<table>
<thead>
<tr>
<th>Number</th>
<th>Category</th>
<th>Link categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Entities and relationships in the data model that forms the basis for the tool</td>
<td>F5 and F7</td>
</tr>
<tr>
<td>2</td>
<td>Functionality of the tool</td>
<td>F1 and F6</td>
</tr>
<tr>
<td>3</td>
<td>Lessons on the use the tool</td>
<td>I1, I2, I3, I4 and T2</td>
</tr>
<tr>
<td>4</td>
<td>Lessons on the design process</td>
<td>F2, F3, F4, F6, F8 and T1</td>
</tr>
</tbody>
</table>

The three-hour session was transcribed. No new categories emerged and only one minor change arose. The change regarded the proactive view of the single solutions mentioned in category seven as "solution packages." After the conclusion of this process formal axial coding of the categories was completed. The original three connecting categories evolved substantially. The new connecting categories are shown in Table 4.

During the third cycle, it seemed that very little learning was emerging from the research. Most of the categories had remained unchanged, and could be considered to be saturated. This provides the rationale for concluding the research project.

Table 3. New categories emerging during the first part of the third cycle.

<table>
<thead>
<tr>
<th>Number</th>
<th>Category</th>
<th>Argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Using the entity-relationship model rigorously stimulates creativity and opens up new perspectives.</td>
<td>It was demonstrated that when designers were forced to use the model rigorously it actually gave birth new ways of representing and seeing things.</td>
</tr>
<tr>
<td>T2</td>
<td>Actually, the organizational project members need interaction at least twice a day.</td>
<td>Although tasks to be solved were delegated it was demonstrated that interaction was needed anyhow to clarify minor details that did not turn up before one were in the middle of implementing</td>
</tr>
</tbody>
</table>
5.8 Case discussion

The foregoing description summarizes an exploratory exercise in using grounded theory techniques and units of analysis to better structure the theory development within an action research project. Several aspects of this case illustrate the boundaries of the integration of grounded theory into action research. For example, it is unusual to commence grounded theory with partially-defined categories, sub-categories and a core-category. In fact, during the early stages of the study, it was unclear whether categories I1-I4 were assumptions, hypotheses or, as described here, pre-defined categories. The role and meaning of the entity-relationship diagram from the grounded theory perspective emerged retrospectively. It originally seemed to be part of the phenomena under study or perhaps even the core category itself. In fact, this diagram embodies categories from open-coding and subcategories plus connecting categories from axial-coding. This particular aspect of the case confused the analysis. Moreover, the impact of a roughly formed set of categories, including a core category, seemed to limit the usefulness of selective coding.

Consider, however, that this case may illustrate how the action research approach typically will change the role of grounded-theory's elements. For example, it seems impractical to obtain transcriptions and code the initial construction of any client-system infrastructure. This may mean that every action research project begins, from a grounded-theory perspective, with certain predefined categories and perhaps even a predefined core category. Since this contradicts a grounded theory tenet that a theory must be allowed to wholly emerge from the open coding, this "grounded action research" method does not purely retain the "grounding" for its theory. This contradiction suggests that, since grounded theory is a complete research method in its own right, action research must use grounded theory components selectively. The resulting hybrid is action research, but does not constitute canonical grounded theory. From this case, it appears that selective coding will be less useful that open and axial coding. However, other action research studies may require more intensive use of selective coding when the initial core category proves incorrect or inadequate.

Some aspects of the merger of action research and grounded theory analysis techniques are very appealing. For example, the concept of saturation of categories is an appealing mechanism for determining the exit point for an action research project. The memos and diagrams provide a high degree of rigor and embody a multi-threaded "chain of evidence" that is important in achieving reliability in qualitative research (Yin, 1989).

This research arises in an interpretive case involving participant observation. A certain depth-of-learning has been achieved, but this approach is most obviously limited by its contextual links and its allowance for researcher subjectivity. Its contextual nature means repeatability is impossible, and the subjectivity suggests that the findings are only one of many possible interpretations. Its theoretical elements might be strengthened and extended by research founded in a different model, such as a more positivist field experiment.

6 Conclusions and Implications

Grounded action research is a means for improving and refining the practice of the action research method. This method seems to be an ideal approach for studying change in organizations. It could be improved by rigorous attention to the formulation of theory, perhaps increasing the appeal of this method in information systems as a major research approach. Techniques borrowed from grounded theory can improve the theory-rigor in action research.

Future research is needed to explore such aspects as the role of selective coding in action research. However, perhaps the most dramatic implications of this research regard ISD methods that
are based on action research. Chief among these is the soft systems methodology (SSM) of Checkland (1981, Checkland & Scholes, 1990). In the current state of SSM the "theory" of the system is based on a logical and a cultural stream of investigation. The logical stream focusses on the core purpose of activities as represented by root definitions. Modelling language is developed from the "verbs" and transformations identified by root definitions. The cultural stream arises from pictorial representations of the problem situation along with intervention, social system and political system analyses.

In some situations, SSM might profit from a rigorous mechanism for tracing the development of root definitions. Heuristics, such as the CATWOE keyword, are useful for constructing these definitions, but these are less ideal for such tasks as the reconstruction of alternative root definitions that were considered but discarded. The addition of grounded theory techniques to SSM might link the "concept" unit of analysis with the SSM "activity." Activities could be coded and categorized to develop core categories (i.e., root definitions). A chain of evidence would come into existence in SSM. Root definitions and the ensuing models could then be shown to emerge from the data.

Action research claims highly practical results, but these results may be even more dramatic with more rigorous attention to theory development. Yin (1989) argues that qualitative research based on limited samples do not seek the same sort of generalizability as that sought by survey research or experiments. Surveys and experiments generalize on the basis of a sample to a population. Yin suggests that limited-case qualitative research can only be generalized to theory, not to a population. What this means is that the generalizability, and hence the widest possible practical usefulness of action research, lies in its ability to develop ideas that generalize a case to its general theory. It is this general theory that can then be applied to a population, thus completing the generalization process (Baskerville, 1996). Because some grounded theory techniques can dramatically improve the rigor and reliability of the theory in action research, it could really improve the generalizability of the findings of action research. From this perspective the use of grounded theory techniques and units of analysis within action research holds promise for improving the scientific and practical potential of this highly accessible research method.

Endnotes

[1] Early work in Grounded Theory (Glaser and Strauss, 1967) differs from later work (Strauss and Corbin, 1990) in subtle but essential ways, e.g., constant comparative method becomes more event-oriented than group-oriented making the theoretical sampling process more event-oriented than subject-oriented. Importantly, the coding process is more rigorous in the latter version, with the consequence that categories emerge from concepts that develop in the coding process. These differences are important because action research is highly compatible with the later work in grounded theory, but less so with the earlier work.

[2] Figures 3-4 are adapted from their original hand-drawn form as used in the research. The notation for Figures 3-4 is based on Finkelstein (1989). Relation names are implied, the large cross in Figure 4 denotes an exclusive-or relationship. The optionality and existence notation (zeros and ones on the relationships) were dropped because they became irrelevant (in the opinion of the participants) in comparison to the large changes of entities.
References


Blum, F. (1955) "Action research - a scientific approach?" Philosophy of Science 22 (January) pp. 1-7.


Appendix

Purpose of appendix: Illustrating the development of categories by describing the full derivation of one of these categories from observed event through concept to category.

Category chosen: Category F5 from Table 2: "Scenarios (small examples of expected use) were very important in the design process and were used to identify goals. These goals are used to bring about evaluations of solutions."

This appendix follows the structure of the diagram in Figure 2 of the main text of this paper. That is, we work from observed phenomena such as social behavior or speech (the left of the diagram), developing open coding labels for these events producing concepts and grouping these to form categories.
A.1 Observed event
The following three examples are chosen from a 44-page transcript of the first meeting in the first action research cycle. The concepts (conceptual labels placed on utterances or events) are written beside the excerpts from the transcripts. These concepts emerged during coding.

[Interviewer has asked: Where did the goals come from? One of the project members answers:] ... We found these along the way... It has to do with the way we normally work; a lot of small scenarios pop up, and then we test our various solutions using those scenarios. This gives us a true picture of whether or not it will work in real life. And when we have found a solution that works, then we invent a new scenario that shows that it does not work. Until we cannot think of any more scenarios. (The project leader chuckles in the background)... All those goals - operator goals and application goals have emerged from the scenarios we have set up. At last, the scenarios begin to merge, and then they are easier to handle.

[Project member explaining the development process pointing at documentation:] ... Here, the scenario is quick recording of invoices (illustrates recording). Tick-Tick-Tick. Enter. Next invoice... And this then bumps into a problem in the other scenario, the potentiometer scenario.

[Interviewer:] But how will the two scenarios lead to goals?

[Project leader:] It is a goal in itself to be able to handle both scenarios. The problem is to find a way to do this, such that we won't have to make one system for invoices and another for process control.
Which color should a field have? This was one of the first problems, we solved. MB [= Project member] spoke out clearly: well those attributes, as we call them, must be formulas. "Well, now, let's not make this too complicated" (Project leader said). And then he came up with some examples. We reached the conclusion relatively quickly that it was formulas. They can actually solve this problem of... it proved that those formulas must be able to do a lot more than I had dreamed of. So you might say that some of the scenarios, some of the application examples say, well, you must also be able to do this and that. And this still goes in general. It is not just a few special problems that you must be able to solve like this or like that, it is perpetually brought up in a general framework. It is a general mechanism which can be used for lots of things.

A.2 From concepts to categories
In an iterative process all the identified concepts were grouped in more than 100 different groups. For example, at this stage, some of the groups, related to the transcripts and concepts above, were:

1) Goals are used to evaluate proposed solutions.
2) Goals are generalizations of scenarios.
3) Scenarios are small use examples.

After the first meeting the three groups, along with others, were grouped together in a category called: "Solution evaluation uses visionary goals identified through scenarios."

A.3 Second meeting in the first research cycle
At the second meeting the researcher asked specifically about scenarios and their relation to goals, visions, requirements and solutions. Written documentation from the project was studied, too. A short example from the transcript of the second meeting is shown below.

[Project leader:] We talked a lot about scenarios before ... meaning practical examples. In reality they are behind everything. It is our imagination and visualization of these examples that drives our work forward.

The concepts from the first and second interview and from the coding of written documentation were then grouped into a revised category (F5) with the following description: Scenarios (small examples of expected use) were very important in the design process and were used to identify goals. These goals are used to bring about evaluations of solutions.