

A Methodological Leg to Stand On: Lessons Learned Using Grounded Theory to Study Agile Software Development

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Abstract

We are engaged in a qualitative research project to understand how people manage the process of software development. This study uses Grounded Theory as its method of inquiry and we have learned much about what is and what is not Grounded Theory. This paper presents lessons learned from our early use of Grounded Theory.

1. Introduction

The rise in interest in agile software development with mantras such as “people trump process” [1] and a manifesto declaring “individual and interactions over process and tools” [2] means software engineering research and specifically software process engineering must take a greater interest in behavioral research. Of the five qualitative methods elaborated by Creswell [3], Grounded Theory [4, 5, 6] is a research method employed in a number of software engineering studies.

We are currently engaged in a qualitative research project to understand how people manage the process of software development. We are using Grounded Theory as our method of inquiry and we have learned much about what is and what is not Grounded Theory. Like many other researchers who have claimed to follow Grounded Theory and even produce a Grounded Theory, we discovered we had only borrowed a few Grounded Theory practices and did not follow Grounded Theory as a comprehensive method. At best, this means the legitimacy of good research can be easily challenged, and at worst we are giving theory status to hearsay and anecdotal stories. This paper presents our lessons learned during two early studies, the First Report, and the Pilot Study with the hope of

better informing researchers and reviewers what differentiates Grounded Theory from what may sometimes only be called journalism.

2. What is Grounded Theory?

Grounded Theory is a research method that discovers theory from data [4]. The goal is to understand the action in a substantive area from the point of view of the actors involved [7 pp 115]. The method is “grounded” because a theory is systematically obtained from a broad array of data through a rigorous process of constant comparison. Grounded Theory is different from logico-deductive methods of inquiry because rather than develop a theory and then systematically seek out evidence to verify it, researchers using Grounded Theory set out to gather data and then systematically develop a mid-level substantive theory derived directly from the data [4 pp 4].

3. Which Version of Grounded Theory?

What confuses most novice Grounded Theory researchers is there is not one, but at least three similar, yet distinct research methods that claim the name grounded theory. Differences of opinion between the Grounded Theory co-discoverers burst into full view with Barney Glaser’s publication of *Emergence versus Forcing: Basics of Grounded Theory Analysis* [8] which decried Straus and Corbin’s approach. Later Kathy Charmaz attempted to clarify some of grounded theory’s ontological and epistemological ambiguities by publishing *Constructing Grounded Theory* [6].

As software engineering researchers conducting a qualitative study, the philosophical arguments behind the different Grounded Theory methods should not

concern us other than to be aware there are multiple flavours of Grounded Theory. What is important for us is to be clear which method we chose and not mix methods.

This is where we made one of our first mistakes when in our First Report we cited Strauss and Corbin and yet we patched together different practices from Glaser and from Charmaz. We were simply unaware there were a variety of “competing” methods and our methodology section simply stated like many others that we were following Grounded Theory.

For our main study we have decided to follow the Glaserian approach for one very pragmatic reason; there are more Glaserian resources available to us in terms of mentors, seminars, and websites.

4. The Research Problem

Grounded Theory is a method for discovering the real problem that exists for the participants in a substantive area rather than what professional researchers may believe is their problem. Therefore, in a Grounded Theory study the researcher works with a general area of interest rather than with a specific problem [9]. This does not mean there is no specific problem, but as Glaser writes “This problem and its processing will emerge in the initial stages of the research. And it will emerge if it is not derailed by what the researcher thinks is relevant beforehand and forces it on the study” [7 pp 116].

Our First Report did not have a specific research question. Unfortunately, this resulted from a lack of thoughtful design rather than intent. In the First Report we opportunistically took advantage of data collected and just coded it. In contrast, our Pilot Study had a strong preconception that coordination is the real problem in software development and we used this problem to guide our research design. In retrospect, this preconception led us away from the problems that were more relevant to the participants.

For our main study we are working with a very broadly defined problem statement of “how do software developers manage the process of software development?”

5. Constant Comparison

The heart of grounded theory is the constant comparison method of data analysis where new data is compared with previous. Constant comparison is facilitated by the concurrent and iterative collection of

data and analysis. This differentiates Grounded Theory from waterfall-like methods of inquiry where all data is collected during a data collection phase and then analyzed during an analysis phase. The constant comparison method enables researchers to adjust their questions as the ongoing analysis begins to reveal the key concern and problem the participants are resolving. The developing theory guides the inquiry. Without constant comparison there is no Grounded Theory.

Our First Report did not follow the constant comparison method because we opportunistically analyzed previously gathered data by simply categorizing the data without comparing the incident represented by the data with previously coded instances in the same category. In our Pilot Study, we iteratively and concurrently collected and analyzed data. Like our First Report, we simply categorized data rather than compare incidents, the only difference was we were doing it iteratively. The experience gained in our Pilot Study is helping to inform the design of the main study and not to assume constant comparison is merely iterative collection and analysis of data.

6. Data Collection

We collected data in our pilot study using a semi structured interview. Unfortunately some research methodologists are critical of relying exclusively or mainly on interview data [10] because interview data only provides a superficial and recollective description of a phenomena. Social life must be studied through first hand observation which means going into the field and immersing oneself in the environment. Participant observation therefore becomes an important mainstream data collection method rather than a mere supplement to interviews.

In our Pilot study we relied almost completely on interview data until we realized the importance of other data collection techniques. We tried to compensate for this deficiency by capturing our recollection of participants. For the design of our main study we plan to make greater effort collecting data through participant observation and preparing a participant observation guide.

For the Pilot Study we used semi-structured interviews and prepared an interview guide with a set of “guiding questions” However, most of the questions became irrelevant as we began to pay more attention to the concerns of the subject rather than our specific interview questions. In retrospect, some of our early

attempts to bring the participant back to the interview question resulted in us ignoring a potentially interesting line of investigation had we chosen to pursue it. While it is important to remain disciplined and focused in our data collection we must remember that grounded theory is an exploratory method that discovers how the participant handles a problem that is important to them. Our interview protocol must be suitably exploratory as well.

Morse [11] is critical of the use of semi-structured interviews and recommends an unstructured interview protocol because data from semi-structured interviews rarely contain the continuous in-depth stories that the retrospective accounts from unstructured interviews do. According to Morse “the narrative form with events told as they unfold is best suited for grounded theory data” [11 pp 4]. For the design of our main study we took Morse’s advice and designed a much less structured interview protocol.

7. Analysis

While the various Grounded Theory flavours have developed their own specific analysis practices and nomenclature they follow the same basic approach of fracturing and integrating. Line by line coding fractures the data to explore all possible aspects of the issues and ideas in the data and to develop descriptive codes as labels for the meanings of these issues and ideas [12 pp 253]. Categories and their properties emerge and these categories are integrated into relationships from which theory emerges.

With both our First Report and our Pilot Study we blissfully deceived ourselves that by simply discovering reasonable in-vivo codes and then reducing and integrating those codes into categories that we were following good Grounded Theory practices. What we failed to do was to follow constant comparative analysis and compare incidents in the new data to the existing categories. We did not provide ourselves with the opportunity to challenge ourselves that we may be forcing the data into pre-conceived concepts.

The most serious transgression we committed in both our First Report and Pilot Study is failing to select a core category or clearly describe the core category within the theory. The core category is that pattern of behavior which is most related to all other categories and their properties in the theory which explains how the participants resolve their main concern. Selecting a core category and building theory around the core category is necessary for the generation of

parsimonious theory that is relevant and feasible, and hence it conveys functions of “integration, density, saturation, completeness and delimiting focus” [8 pp 75].

8. Theoretical Sampling

In any research project sampling strategies and the adequacy of the selected sample impact the scientific validity and reliability of the study. For a grounded theory study, the population under study is the set of concepts that constitute the phenomena and not the set of individuals experiencing the phenomena. Therefore the sampling strategy must discover sufficient concepts to develop a conceptually dense substantive theory. Grounded Theory employs theoretical sampling where the analysts jointly collect, code, and analyze his data and decides what data to collect next and where to find them in order to develop his theory as it emerges” [13 pp 36]. Theoretical sampling is a critical practice supporting the development of an emerging theory that is tightly intertwined and supportive of iterative and concurrent collection of data.

Theoretical sampling means it is difficult to articulate in a Grounded Theory proposal when it will be done because there is no “N”, just sampling for saturation and completeness [7]. Data collection continues until all categories are saturated, that is, when further collection of data indicates no new categories or the need for the expansion of existing categories and all data fits into the existing categories.

Our First Report did not employ a sampling strategy, we simply re-used data that had been acquired for another study and coded it. For our pilot study, we initially started with purposeful sampling and selected three participants to interview. These participants were chosen because of their willingness to participate in our study and also because in our opinion they had a good sense of what was happening on their project and were able to articulate this. We can make a weak claim to theoretical sampling because during our analysis of the collected data we noticed the emergence of a category “management expectations”. We decided to expand this category by inviting a C-level manager to participate in our Pilot Study. The data we were able to collect was both enlightening and helped us expand the category.

9. Does it Need to be a Grounded Theory?

The constant comparison analysis makes Grounded Theory a time consuming tedious process. There are many alternative approaches to analyzing qualitative

data and theory generation besides Grounded Theory. Alternatively, reporting research in a descriptive study is a valuable and often overlooked option [14]. The use of Grounded Theory practices can help a researcher make sense of the large volumes of data collected during a qualitative study. Many of the supposed Grounded Theory papers we reviewed as part of this study demonstrate the value of content analysis because even though they do not present a Grounded Theory, they offer a rich description of a phenomenon.

10. Final Word: It Isn't Easy

A Grounded Theory is not an inventory of concepts annotated with quotes from research participants. A Grounded Theory is an integrated set of categories that explain the process of how the research participants resolve what is of concern to them. We have learned several lessons from our investigation into Grounded Theory that should guide how we design and report Grounded Theory research:

- There are multiple variants of Grounded Theory and we must be clear about which variant we are following.
- The researcher begins with a general area of interest rather than with a specific problem.
- The constant comparative method is one of the key components of grounded theory and is much more than iterative collection and analysis of data.
- Exclusive use of semi-structured interviews does not do justice to grounded theory. Including interviews, document analysis, and participant observation is more desirable for data collection.
- There is no theory without a core category that accounts for a "pattern of behavior that is relevant and problematic to those involved" [13 pp 93].
- Theoretical sampling means the emerging theory guides the sampling process and we can only plan in advance initial purposive sampling.
- A Grounded Theory explains how people resolve their main concern. The core category is often a process.
- It is useful to employ Grounded Theory practices to manage, categorize, and describe data. It is not acceptable to claim that all description constitutes theory.

If people truly trump process then we need research methods that help us understand how people interpret their situation and Grounded Theory is an excellent method for this. However if we are not rigorous in our application of Grounded Theory or do not raise our expectations of what is claimed as a Grounded Theory then we be offering journalism as research. Worse, we

may be missing the real problems and their management that are the real concern to the developer in the cubicle.

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12. References

- [1] A. Cockburn, "People and Methodologies in Software Development," in *Faculty of Mathematics and Natural Sciences*. vol. Doctor Philosophiae Oslo: University of Oslo, 2003.
- [2] AgileAlliance, "Manifesto for Agile Software Development," 2001.
- [3] J. W. Creswell, *Qualitative Inquiry and Research Design: Choosing Among the Five Traditions*. London: Sage Publications, 1997.
- [4] B. G. Glaser and A. Strauss, *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago, Illinois: Aldine, 1967.
- [5] A. Strauss and J. Corbin, *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Second Edition*: Sage Publications 1998.
- [6] K. Charmaz, *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis* Thousand Oaks: Sage, 2006.
- [7] B. G. Glaser, *Doing Grounded Theory: Issues and Discussions*. Mill Valley, California: Sociology Press, 1998.
- [8] B. G. Glaser, *Emergence vs Forcing: Basics of Grounded Theory Analysis*. Mill Valley, California: Sociology Press, 1992.
- [9] A. M. McCallin, "Designing a grounded theory study: some practicalities," *Nursing in Critical Care*, vol. 8, pp. 203-208, 2003.
- [10] D. Silverman, "The Quality of Qualitative Health Research: The Open-ended Interview and its Alternatives," *Social Sciences in Health*, vol. 4, pp. 104-118, 1998.
- [11] J. Morse, "Situating Grounded Theory Within Qualitative Inquiry," in *Using Grounded Theory in Nursing*, R. S. Schreiber and P. N. Stern, Eds. New York: Springer Publishing Company, 2001.
- [12] Y.-H. Jeon, "The application of grounded theory and symbolic interactionism," *Scandinavian Journal of Caring Sciences*, vol. 18, pp. 249-256, 2004.
- [13] B. G. Glaser, *Theoretical Sensitivity*. Mill Valley, California: Sociology Press, 1978.
- [14] M. Sandelowski, "Whatever happened to qualitative description?," *Research in Nursing & Health*, vol. 23, pp. 334-340, 2000.