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Using a grounded theory approach for exploring software product management challenges

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ABSTRACT

The traditional requirements engineering (RE) research paradigm, along with most engineering research and practice, is commonly seen to belong to the philosophical tradition of positivism, which construes knowledge as accruing through the systematic observation of stable and knowable phenomena. Consequently, RE methods tend to ignore social issues. However, due to the dominant role of the human being in RE, there has been an increasing need to rely on research methods of the social sciences, arts, and humanities for RE related findings. This paper illustrates one example of how social aspects in RE have been explored with a research method adopted from social sciences research tradition. Drawing heavily on the research reported in the doctoral thesis of the principal author, we describe in this paper: (1) how a study using a grounded theory approach was designed and conducted for exploring market-driven requirements engineering (MDRE) challenges in seven companies, (2) how the analysis eventually proceeded toward a proposed theory, and (3) our experiences of using a grounded theory approach within the discipline of RE.

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1. Introduction

The traditional requirements engineering (RE) research paradigm, along with most engineering research and practice, is commonly seen to belong to the philosophical tradition of positivism, which construes knowledge as accruing through the systematic observation of stable and knowable phenomena (Potts and Newstetter, 1997). Consequently, RE methods tend to ignore social issues (Goguen, 1993). Yet, the research challenges faced by the RE community are distinct from those faced by the general software-engineering community. According to Cheng and Atlee (2007), this is due to the fact that requirements reside primarily in the problem space, whereas other software artifacts reside primarily in the solution space. That is, "RE deals with defining precisely the problem that the software is to solve (i.e. defining what the software is to do), whereas other software engineering activities deal with defining and refining a proposed software solution" (Cheng and Atlee, 2007).

During recent years, criticism against the dominant position of the positivist perspective in RE has increased. As an example, Hinds (2008) argues that the "positivist perspective is at best detrimental, and at worst antithetical to the activity of engineering requirements". There is notable and growing awareness of the need to take into account social and contextual factors in RE (Potts and Newstetter, 1997). In order to address social and contextual factors in RE, we first need to understand current practices and their challenges. According to Davis and Hickey (2002), this is a task that many RE researchers fail to accomplish. As a result, the researchers risk creating new knowledge that has no practical value (Davis and Hickey, 2002). In a similar vein, Gause (2004) has argued that, due to the dominant role of the human being in RE, we need to rely more heavily on research methods of the social sciences, arts, and humanities for our findings. We must be tolerant and even encouraging of all forms of discovery within RE and embrace any form of research that offers even hints of promise (Gause, 2004).

This paper illustrates one example of how social aspects in RE have been explored with a research method adopted from social sciences research traditions. The paper reports, on a detailed level, (1) how a study using a grounded theory approach was designed and conducted for exploring market-driven requirements engineering (MDRE) challenges in seven companies, (2) how the analysis eventually proceeded toward the proposal of a theory, and

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(3) the experiences of using a grounded theory approach within the discipline of RE. The paper focuses on describing the research activities and experiences of the study. A more complete description of the study and its results can be found in the doctoral thesis, *Making Sense of Software Product Requirements* (Jantunen, 2012).

Due to the fact that this study was conducted within the interpretive research tradition, researchers were considered as knowledge workers, needing to confront with potentially conflicting demands. In their role as *instrument* they relied on their personal experience and subjective engagement with phenomena in the field to generate insights, whereas in their role as *scientist* they needed to convince the scientific community of the trans-situational and reliable nature of these very phenomena (Schulze, 2000). In this paper, the researcher's role as an instrument has primarily been conducted by the principal author, while the second author has been actively participating in the role of the scientist. For these reasons, this paper follows a *confessional* writing style through the voice of the principal author, exposing the researcher, and rendering his actions, failings, motivations, and assumptions open to public scrutiny and critique (Schulze, 2000).

The remainder of this paper is organized as follows. Section 2 describes how the research problem and research questions were initially shaped for this study. Section 3 then describes how the research setting was designed for the study. Section 4 provides an overview to the grounded theory approaches. Section 5 describes, on a practical level, the data collection and management. Details of data analysis that led to the development of a theory proposal are described in Section 6. Section 7 compares the proposed theory with related work. Section 8 discusses how a grounded theory could be assessed and, finally, Section 9 reveals our experiences while conducting the study.

2. The research problem and its shaping – a personal view

This section describes factors that have affected the choice of study, discusses their role in shaping the research problem and, finally, determines initial research questions for the study. It is written in the first person as these observations were discovered personally by the principal author as this process moved forward.

If I had to single out the most significant factor motivating this study, I would say that it was my past professional experience. For this reason, it was necessary to first address portions of my professional history and beliefs. This was important not only because it narrowed down the research topics I was motivated to study. It was also the starting point to address my prejudices in developing the research results. As Suddaby (2006) has argued: "in grounded theory approaches, researchers must account for their positions in the research process. That is, they must engage in ongoing self-reflection to ensure that they take personal biases, world-views, and assumptions into account while collecting, interpreting, and analysing data".

During my career, I have turned from a person firmly believing in the efficiency of current and recent past software development processes into a one that is critical and doubtful. In my past professional life, I remember often wondering why so many important product-related design decisions were left to be made by the software developers. To me, this was rather odd because the software developers almost never visited the customers and thus did not know well their customer's intended use of the products. It appeared to me that in the quest of being efficient, the organization actually systematically ignored most of the knowledge it possessed. I had gradually started to believe that, on occasion, the way we develop software products fits poorly with the design challenge. We seem to have a tendency to take software development processes for granted and accept them to be 'the professional way' without much criticism. These experiences motivated me to try to develop a better understanding of current software development practices and their shortcomings in the development of commercial products.

Research became reality only after the motivation met the opportunity. The research opportunity emerged in the form of the Global Network Management (GNM) research project that attempted to (1) investigate how a company can create and maintain successful business in a global environment that is based on technology, knowledge and partnerships, and (2) increase possibilities for successful business by transferring the research results to the companies in the form of best practices (GNM project, 2006). Being part of the GNM research project, I was restricted and guided by the project-level objectives. From the GNM project's four research themes, my focus was on research & development (R&D) and product management while investigating their relation to partner network management and business. These responsibilities in the GNM project fit well with my motivation to understand why current software development approaches do not seem to work well, at least, in certain situations.

My motivations and the boundaries set by the GNM project situated this study within the discipline of requirements engineering (RE), which operates at different levels, including the organizational, product and project levels, and is concerned with the critical problem of designing the right software for the customer (Aurum and Wohlin, 2005). Since my past professional experiences have made me critical and doubtful of the efficiency of existing software development approaches, I have started to believe that there are much more human nuances in software development than are currently acknowledged. This is why I decided to focus on human behavior in software development. Taking into account the factors affecting this study, the research problem was hence initially broadly defined as: *human aspects in software product companies' requirements engineering activities*.

"Even though there is merit in open-mindedness and willingness to enter a research setting looking for questions as well as answers, it is impossible to embark upon research without some idea of what one is looking for and foolish not to make that quest explicit" (Wolcott, 1982, p. 157). Hence, I took the suggestion by Miles and Huberman (1994, p. 25) to start with some general research questions. General research questions allow more clarity of what is in the current situation, generally speaking, of greater interest. They make the implicit explicit without necessarily freezing or limiting our vision Miles and Huberman (1994, p. 25).

When deriving initial research questions from the research problem statement, I focused on three constraints originating from the research problem definition. First, the research problem statement implied that I was working with companies offering a *software product*. This suggested that I needed to understand mechanisms of just how companies gather information about the markets and how they utilize the gathered information in their product development. Second, the emphasis on *human aspects* suggested focusing on human interaction in order to understand how collaboration occurs in the companies and how information is shared with different parties. Third, *requirements engineering activities* led me to investigate companies' current requirements engineering practices and the resulting challenges of following them.

Taking these considerations into account, my initial set of research questions came to be as follows:

1. How can the role of human interaction be described in the organizations' attempt to position their software product in the marketplace?
   a. How do software product development organizations develop understanding regarding the market?
   b. How do software product development organizations utilize the developed understanding of the market in their product development?

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