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

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Chapter 13

Using Grounded Theory Coding Mechanisms to Analyze Case Study and Focus Group Data in the Context of Software Process Research

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ABSTRACT

The primary aim of this chapter is to outline a potentially powerful framework for the combination of research approaches utilizing the Grounded Theory coding mechanism for Case Study, and Focus Groups data analysis. A secondary aim of this chapter is to provide a roadmap for such a usage by way of an example research project. The context for this project is the need to study and evaluate the actual practice of software development processes in real world commercial settings of software companies, which utilized both case study and focus group techniques. This research found that grounded theory coding strategies are a suitable and powerful data analysis mechanism to explore case study and focus group data.

INTRODUCTION

While both the case study and focus group methods have become widely accepted in information systems (IS) research over the last two decades, Grounded Theory research is still a distinct minority method for IS research. Grounded theory has been used by IS researchers since the mid-1990s (Orlikowski 1993; Hansen & Kautz 2005; Coleman & O'Connor 2007). It is becoming increasingly popular in IS research, as there is a widely held belief that it is a reliable method for investigating social and organisational phenomena.

The general goal of grounded theory is to generate theories derived from data in order to understand the social context. It is a "qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon" (Strauss 1990, p.24). Hekkala (2007) indicates that grounded theory has been used in IS research as a method (by, among others, Urquhart 2002; Jones and Hughes 2004) but that it has also been sometimes used as a methodology (by researchers including Orlikowski 1993; Goulding 2002; Goede and de Villiers 2003). Hekkala (2007) states that those who use it either as method or as a methodology do not soundly and logically demonstrate and justify their use of this theory for either of those purposes.

A methodology refers to the entire research process, from the identification of one or more research questions and the selection of a research strategy through to the formulation of the findings and results, in which the entire process is based on philosophical assumptions (ontology and epistemology). This view of the two terms coincides with Avison and Fitzgerald's (1995) definitions: a methodology is a collection of procedures, techniques, tools and documentation which is based on some philosophical view; otherwise it is merely a method, like a recipe. A case study strategy which includes grounded theory analysis under interpretative assumptions would therefore be classed as a methodology. The aim of this chapter is to argue that grounded theory can be combined with case study and focus groups to construct a compatible research methodology.

CASE STUDY

According to Yin (2003) case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clear" (p. 23). Case study is usually seen as a specific research strategy (Eisenhardt, 1989; Yin, 2003). The underlying idea for case research is said to be the many-sided view it can provide of a situation in its context. "The intense observation made in case studies gives opportunities to study different aspects and put these in relation to each other, to put objects in relation to the environment where they operate" (Halinen and Törnroos, 2005). Instead of statistical representativeness, case studies offer depth and comprehensiveness for understanding the specific phenomenon (Easton, 1995, p. 475). They give a possibility to be close to the studied objects (firms), enabling inductive and rich description. Case research is particularly welcome in new situations where only little is known about the phenomenon and in situations where current theories seem inadequate (Eisenhardt, 1989; Yin, 2003). It is also a strong method in the study of change processes as it allows the study of contextual factors and process elements in the same real-life situation.

Case studies can be used to accomplish various aims. Yin (1989, p. 16) separates exploratory, descriptive and explanatory cases. Eisenhardt (1989, p. 535) acknowledges description but stresses the role of cases in generating and, also, testing a theory. Stake (1994) defends the value of intrinsic cases, where a rich description of a single case, in all its particularity and ordinariness, is seen valuable as such. In the management and marketing literature, theory generation from case study evidence has been the most discussed type of case research. Its basis can be found from Glaser and Strauss (1967) and the ideas of later writers (e.g., Eisenhardt, 1989; Yin, 1989; Miles and Huberman, 1994).

Feagin et al., (1991) pointed out that case studies are multi-perspective analyses. This means that the researcher considers not just the voice and perspective of the actors, but also of the relevant groups of actors and the interaction between them. This aspect is a salient point in the characteristic that case studies possess. They also added that case study is also known as a

triangulated research strategy where the triangulation can occur with data, investigators, theories, and even methodologies. Moreover, case studies could generate a detailed insight of the case, its complex relationship and processes (Yin, 2003). Furthermore, Oates (2006) claimed that a case study will help the researcher produce data in a situation where the researcher has little control over the events compared to action research and ethnography.

According to Tashakkori and Teddie (1998), the case study research method helps researchers in understanding in more detail the phenomenon associated with topic under investigation. They stated that this is due to the investigation being done in many stages and that it indirectly helps researcher acquired a richer understanding of the case.

Alison and Merali (2007) added that the case studies method is suitable to capture the knowledge and views of the practitioners. Yin (2003) reported that case study design is suitable with a research question that start with 'how' and 'why' question is being asked about a contemporary set of event over which the investigator has little or no control. Because 'how' and 'why' question are explanatory and usually should be studied over time in replicated case studies or experiments.

FOCUS GROUPS

Focus groups emerged as a research method in the 1950's in the social research as researchers expanded the open ended interview format to a group discussion (Templeton, 1994). A focus group may be defined as "a group of individuals selected by researchers to discuss and comment on, from personal experience, the topic that has been a subject of the research" (Powell and Single, 1996 p. 499). In addition this method could activate forgotten details of experiences and also generate data better through a wide range of responses. Focus group interviews are also a method to

study attitudes and experiences; to explore how opinion were constructed (Kitzinger, 1995) and to understand behaviors, values and feelings, (Patton, 2002). According to Powell and Single (1996), the advantage of focus groups is the ability to help the researcher in identifying quickly a full range of perspectives held by respondents.

Focus groups are carefully planned discussion, designed to obtain the perceptions of the group members on a defined area of interest. There are typically between 3 and 12 participants and the discussion is guided and facilitated by a moderator who follows a predefined structure so that the discussion stays focused. The members are selected based on their individual characteristics as related to the session topic. The group setting enables the participants to build on the responses and ideas of the others, which increases the richness of the information gained.

Focus groups are a form of group interview that capitalizes on communication between research participants in order to generate data. Although group interviews are often used simply as a quick and convenient way to collect data from several people simultaneously, focus groups explicitly use group interaction as part of the method. This means that instead of the researcher asking each person to respond to a question in turn, people are encouraged to talk to one another: asking questions, exchanging anecdotes and commenting on each other's experiences and points of view. The method is particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they think that way.

The benefits of focus group are that they produce candid, sometimes insightful, information and the method is fairly inexpensive and fast to perform (Widdows, et al 1994). However, the method shares the weaknesses of many other qualitative methods - biases may be caused by group dynamics and sample sizes are often small – and, therefore, it may be difficult to generalize the results (Judd et al, 1991). According to Powell

and Single (1996), the advantage of focus group is the ability to help the researcher in identifying quickly a full range of perspectives held by respondents. They added that focus groups expand the details that might have been left out in an in-depth interview. Kruger and Casey (2000) support that the focus group technique is a proper way to understand and explore how people think and feel about the issues. They also added that focus groups elicit data that allows a better understanding of the differences between groups of people.

DATA ANALYSIS IN CASE STUDY AND FOCUS GROUPS

Case study data analysis generally involves an iterative, spiraling or cyclical process that proceeds from more general to more specific observations (Creswell, 1994). Data analysis may begin informally during interviews or observations and continue during transcription, when recurring themes, patterns, and categories become evident. The challenges of analyzing interview and focus group interview data lies in making sense of the substantial amount of data, identifying significant patterns and construction of a framework to communicate the essence of what the data reveals (Denzin et al., 2000). Elo and Kyngas (2008) claim that content analysis is a method that is suitable to analyze the written verbal or visual communication transcripts. Hsieh and Shanon, (2005) in their explanation regarding qualitative contents analysis have defined qualitative content analysis as "the subjective interpretation of the content of the text data through the classification process of coding and identifying themes or patterns" (p. 1278). Therefore a major challenge for the researcher is the choice of a suitable and justifiable mechanism to analyze case study data.

Focus group sessions produce mainly qualitative information – transcripts of structured or freeform discussions and debate amongst participants. The data analysis and reporting of

focus group studies can use the methods used in qualitative data analysis (Miles and Huberman, 1984) (Patton, 1990) (Taylor and Bogdan, 1984) (Myers, 2004).

The challenges of analyzing the interview and focus group interview data lies in making sense of the substantial amount of data, identifying significant patterns and construction of a framework to communicate the essence of what the data reveals (Denzin et al., 2000). Therefore, in order to analyze these data, researchers have applied a quantitative content analysis approach (Elo and Kyngas, 2008). Elo and Kyngas (2008) claimed that content analysis is a method that is suitable to analyze the written, verbal or visual communication transcripts. Hsieh and Shanon, (2005) in their explanation regarding qualitative contents analysis have defined qualitative content analysis as the subjective interpretation of the content of the text data through the classification process of coding and identifying themes or patterns.

GROUNDED THEORY

A grounded theory design is a "systematic, qualitative procedure used to generate a theory that explains, at a broad conceptual level, a process, an action, or interaction about a substantive topic." (Creswell, 2011). Grounded Theory was first established by Glaser and Strauss (1967). The theoretical foundations of grounded theory stem from Symbolic Interactionism, which sees humans as key participants and 'shapers' of the world they inhabit. Grounded theory was created from the 'constant comparative' method, developed by Glaser and Strauss, which alternated theory building with comparison of theory to the reality unveiled through data collection and analysis. The emphasis in grounded theory is on new theory generation. A theory, according to Strauss and Corbin (1990), is "a set of well-developed categories (e.g. themes, concepts) that are systematically interrelated through statements of relationship to

form a theoretical framework that explains some relevant social, psychological, educational, nursing or other phenomenon". This manifests itself in such a way that, rather than beginning with a pre-conceived theory in mind, the theory evolves during the research process itself and is a product of continuous interplay between data collection and analysis of that data (Goulding, 2002). According to Strauss and Corbin (1998), the theory that is derived from the data is more likely to resemble what is actually going on than if it were assembled from putting together a series of concepts based on experience or through speculation.

As the objective of the methodology is to uncover theory rather than have it pre-conceived, grounded theory incorporates a number of steps to ensure good theory development. The analytical process involves coding strategies: the process of breaking down interviews, observation, and other forms of appropriate data into distinct units of meaning which are labeled to generate concepts. These concepts are initially clustered into descriptive categories. They are then re-evaluated for their interrelationships and, through a series of analytical steps, are gradually subsumed into higher-order categories, or one underlying core category, which suggests an emergent theory.

Because of its interpretivist emphasis and its ability to explain socio-cultural phenomena, grounded theory has been primarily used in the fields of sociology, nursing and psychology from the time of its establishment in the late 1960s. Since then, however, it has widened its reach into the business sector and latterly into the IS field, where it has been used to explain intentions, actions, and opinions regarding management, change and professional interactions. Silva and Backhouse (1997) support its use, arguing that, "qualitative research in information systems should be led by theories grounded in interpretive and phenomenological premises to make sense and to be consistent". Myers (2004) believes that grounded theory has gained growing acceptance in IS research because it is a very effective way

of developing context-based, process-oriented explanations of the phenomena being studied.

Probably the best example of the use of grounded theory in the IS field is (Orlikowski, 1993). This study showed how grounded theory could be used to explain the impact on two organisations that implemented CASE tools to support their software development activity. The use of grounded theory in Orlikowski's study enabled a focus on the contextual issues surrounding the introduction of CASE tools as well as the role of the key actors instigating, and at the receiving end of, their adoption.

A number of researchers have used grounded theory to look at a diverse range of socio-cultural activities in IS. Baskerville and Pries-Heje (1999) used a novel combination of action research and grounded theory to produce a grounded action research methodology for studying how IT is practiced. Others have used the methodology to examine the use of 'systems thinking' practices (Goede and de Villiers, 2003), software inspections (Carver and Basili, 2003) (Seaman and Basili, 1997), process modelling (Carvalho, et al, 2005), requirements documentation (Power, 2002) and virtual team development (Sarker et al, 2002). Hansen and Kautz (2005) used grounded theory to study the use of development practices in a Danish software company and concluded that it was a methodology well suited for use in the IS sector.

Coding is the key process in grounded theory (Strauss and Corbin 1990). It begins in the early stages after the first interviews for data collection. Strauss and Corbin (1990) assert that the coding procedures in grounded theory are neither automatic nor algorithmic - "we do not at all wish to imply rigid adherence to them" (Strauss and Corbin 1990, p.59). In other words, flexibility may be necessary in certain circumstances. This process comprises three coding steps:

Open Coding and Analysis

From the interview transcripts the researchers analyse the data line-by-line and allocate codes to the text. The analytical process involves coding strategies: the process of breaking down interviews and observations into distinct units of meaning which are labelled to generate concepts. The codes represent concepts that will later become part of the theory. The codes themselves provide meaning to the text and may be created by the researchers, or may be taken from the text itself. A code allocated in this way is known as an in-vivo code. In-vivo codes are especially important in that they come directly from the interviewees, do not require interpretation by the researche, and provide additional ontological clarification or context-description. From the initial interviews, a list of codes emerges and this list is then used to code subsequent interviews. At the end of the sampling process a large number of codes should have emerged.

Axial Coding

Axial coding is the process of relating categories to their subcategories (and) termed axial because coding occurs around the axis of a category linking categories to subcategories at the level of properties and dimensions. This involves documenting category properties and dimensions from the open coding phase; Identifying the conditions, actions and interactions associated with a phenomenon and relating categories to subcategories.

Selective Coding

Selective coding is the process of integrating and refining the theory. Because categories are merely descriptions of the data they must be further developed to form the theory, the first step is to identify the central, or 'core' category around which the theory will be built. As the core category acts as the hub for all other identified categories, it must

be central in that all other categories must relate to it and it must appear frequently in the data.

GROUNDED THEORY CODING IN CASE STUDY AND FOCUS GROUPS ANALYSIS

A variety of data generation methods can be used in case study methodologies such as interviewing, questionnaires, observation or/and document analysis. The aim of case studies is to generate a detailed insight of the case, its complex relationship and processes. Given our desire to determine what is happening in actual practice in relation to software process in companies, we promote the usage of multiple case studies utilizing in-depth interviews in order to ascertain process practices which should reveal both direct and indirect data (Kvale, 2007). However, given the potential limitations and bias of the multiple single interview perspective and the fact that software development is a team based activity, we promote the usage of Focus Groups as a complimentary data acquisition mechanism to the interview approach.

In order to analyze both interview and focus group data we promote the usage of the three coding techniques of Grounded Theory methodology: open coding, axial coding and selective coding (Straus and Corbin, 1998). These data analysis methods also have been recommended in qualitative data research (Patton, 2002) in order to guide researchers in analyzing the qualitative method more systematically. We argue that there is a need for a systematic approach to analyzing case study data from interviews and focus groups and that the grounded theory coding approach is a suitable approach and one that adds value in terms of academic rigor of approach and provides for validity in terms of traceability from initial data coding to final result. In defense of this approach it is worth noting that Halaweh et al (2008) comments that a major difference between the case study and grounded theory is that the latter details

the procedure of data analysis, while the analysis process proposed by Yin (1994) including pattern matching and explanation building is not as rigorous for analyzing an interpretive case study data as the procedures and techniques provided by Strauss and Corbin (1990). One of the main criticisms of the case study is related to the analysis of huge qualitative data where there is no standard analysis approach (Darke et al. 1998).

In such a mechanism the qualitative data from the interview and focus group was transformed into transcripts and organized according to the pattern which emerge during the analysis. This data was used as an input to the coding procedure in order to refine the abstract constructs and define the concept and categories. In order to assist researchers in analyzing qualitative data, three coding techniques proposed by GT methodology: open coding, axial coding and selective coding (Straus and Corbin, 1998) have been applied. These data analysis methods also have been recommended in qualitative data research (Denzin et al 2000; Patton, 2002) in order to guide researchers in analyzing the qualitative method more systematically. Social scientists (Miles et al., 1994; Patton, 2002) acknowledge that data collecting and analysis in qualitative inquiry are integrative, iterative, synergistic and interactive in nature.

Based on the prior experience (Coleman and O'Connor, 2007) of the researchers in applying grounded theory coding, we utilized the Atlas.Ti software tool (Muhr, 1997). This is a tool designed specifically for use with grounded theory and allows for the linking, searching and sorting of data. It enables the researchers to keep track of interview transcripts, manage a list of codes and related memos, generate families of related codes and create graphical support for codes, concepts and categories. It also supports the axial and selective coding process as proposed by Strauss and Corbin (1998), which is used in this study. Having installed the software, the interview transcripts from the preliminary study stage were entered into the Atlas database. Having the ability to assign

Table 1. Sample codes as assigned using Atlas TI

Autonomous work	Work independently
Self-Learning	Open Environment
Open Communication	Informal Communication

and allocate codes with quotations from multiple interviews speeded up the process dramatically and eased data management significantly. It also created an easier 'visual plane', which enabled clearer reflection and energized proposition development. A sample list of codes from this stage is contained in Table 1.

The next section describes a study combining multiple case studies, utilizing both interview and focus groups to describe the actual practice of software development processes in the real commercial setting of software companies Basri and O'Connor, (2010a, 2010b), where the three coding techniques of grounded theory methodology were integrated as part of the data analysis phase.

EXAMPLE APPLICATION OF APPROACH

This section presents an example of applying the methodology proposed above to a research project that was conducted in the domain of software process, software process improvement (SPI) and software process maintenance and evolution.

Software Process Improvement and Knowledge Management

Software Process Improvement (SPI) aims to understand the software process as it is used within an organisation and thus drive the implementation of changes to that process to achieve specific goals such as increasing development speed, achieving higher product quality or reducing costs.

A software process essentially describes the way an organization develops its software products

and supporting services, such as documentation. Processes define what steps the development organizations should take at each stage of production and provide assistance in making estimates, developing plans and measuring quality. There is a widely held belief that a better software process results in a better software product, which has led to a focus on SPI to help companies realize the potential benefit. SPI models (Chrissis et al, 2003) developed to assist companies in this regard, purport to represent beacons of best practice. Contained within the scope of these models, according to their supporters, lies the road to budgetary and schedule adherence, better product quality and improved customer satisfaction. Translating these benefits into practice has, however, proved challenging. Opponents believe that these models operate primarily at a theoretical level, are too prescriptive and bureaucratic to implement in practice and require a subscribing company to adapt to the models rather than having the models easily adapt to them. Although commercial SPI models have been highly publicized and marketed, they are not being widely adopted and their influence in the software industry therefore remains more at a theoretical than practical level.

In the modern business environment where software development is becoming more complex, increased reliance upon knowledge processes to resolve problems is very important. Several researchers reported that software development processes have always been knowledge intensive (Dingdoyr et al., 2005). Bjornson and Dingsoyr (2005) stated in their review that proper management of organizational knowledge is important in SPI efforts and it is a major factor for success. Mathiassen and Pourkomeylian (2003) in their survey on practical usage of Knowledge Management (KM) to support innovation in a software organization claims that KM and SPI are very closely related. Mathiassen et al., (2002) and Bjornson and Dingsoyr (2008) emphasized that knowledge creation and sharing are among the

important principles that must be adopted by an organization in order to succeed in SPI.

In addition, in terms of managing project team knowledge, Kettunen (2003) in his study emphasized that with appropriate KM methods, problems that could impact process improvement such as possible lack of competencies, missing work instructions and others imperfect processes could be identify. Therefore it can be seen that KM and SPI have a strong relationship and one that can potentially influence the success of software projects.

The SPI KM Study

For this study the focus is on how software process and SPI is practiced within the Very Small Entities (VSEs) (Laporte et al, 2008). In particular the research is concerned with the process of software development knowledge management and team issues in supporting the software process and process improvement. We set out to answer two major research questions:

- RQ1: What is the current status of Software Process Improvement among Irish software VSEs?
- RQ2: How software knowledge in Irish Software VSEs should be managed in order to maintain and evolve software process?

Since the present research aim is to study and evaluate the research situation rather than being involved in providing a specific solution to the situation, the case study method was chosen as the most suitable for this situation. According to Tashakkori and Teddie (1998), the case study research method helped researchers in the understanding of the research study phenomenon. They stated that the research investigation can be done in many stages and indirectly helps the researcher acquire a richer understanding.

The present research used a multiple case studies research method. Yin (1994) points out

that multiple case studies will help researchers prevent the possibility of misrepresentation and also ensures validity and reliability of data collection. There are two main methods in the data collection process that have been used; face to face interview and focus group interviews.

The face to face interview approach was used in this study in order to discuss topics in depth, to get respondents' candid discussion on the topic and to be able to get the depth of information required for the research context. According to Kvale (2007), interview reveals both direct and indirect data. Direct data are responses that subjects provide to direct questions, they are spoken responses. For this data collection phase, the researchers have interviewed 11 respondents from 4 identified software companies which fall under the VSEs category. The focus group interview approached was used in this study because team members develop the software and the existing team interactions helped to release inhibitions amongst the team members. In addition this method could activate forgotten details of experiences and also generate data better through a wide range of responses. Focus group interviews were also chosen because it was the most appropriate method to study attitudes and experiences; to explore how opinion were constructed (Kitzinger, 1995) and to understand behaviours, values and feelings, (Patton, 2002). According to Powell and Single (1996), the advantage of focus group is the ability to help the researcher in identifying quickly a full range of perspectives held by respondents

For the interviews and focus groups, respondents have been divided into 2 categories; the managers and the software development team. For the manager's we applied a face to face interview method and for the software development team we adopted the focus group interview method. All interview sessions were approximately 40-90 minutes in duration and were recorded with the respondents' permission. Furthermore, in order to guide the interviewer to gather specific data during an interview session, an interview guide

(Taylor and Bodgan, 1984) (for both individual and focus groups) was developed. The interview guide included closed and open-ended questions and some related notes about the direction in which to drive the interview under difference circumstances.

The data analysis process consisted of having all the individual interviews and focus group interviews analyzed and coded as per the grounded theory coding mechanism discussed previously. This process involves the development of the codes, code-categories and inter-relationship of categories which is based on the GT process and coding strategy.

The challenge of analyzing the interview and focus group data lies in making sense of the substantial amount of data, identifying significant patterns and constructing a framework to communicate the essence of what the data reveals (Denzin et al., 2000). Therefore in order to analyze this data, the researchers a applied quantitative analysis approach (Elo and Kyngas, 2008). Hsieh and Shanon, (2005) in their explanation regarding qualitative contents analysis have defined qualitative content analysis as "the subjective interpretation of the content of the text data through the classification process of coding and identifying themes or pattern". Therefore for the current research, the qualitative data from the interview and focus group were transformed into transcripts and organized according to the pattern emerging during the analysis. These data were used as an input to the coding procedure in order to refine the abstract constructs and define the concept and categories. In order to assist researchers in analyzing qualitative data, three coding techniques proposed by GT methodology: open coding, axial coding and selective coding (Straus and Corbin, 1998) have been applied. These data analysis methods also have been recommended in qualitative data research (Denzin et al 2000; Patton, 2002) in order to guide researchers in analyzing the qualitative method more systematically. The Atlas.Ti software

also was used to help in coding the interview text and linking this code on the semantic network.

We applied the coding processes for the data collection as follows:

Open Coding

From each transcribed interview transcript, researchers have analysed the text using line by line or incident by incident coding before allocating open or initial code to the text. For this activity researchers have followed Charmaz (2006) initial codes approached which was done by using gerunds as this process will help the researcher to detect the process and stick to the data. She also recommended to consider the following questions in order to guide researchers to create an open code:

- What is the data a study of?
- What does the data suggest?
- From whose point of view?

After open code have been assigned and created, lists of open code then are sorted into categories based on how different codes are related and linked. These emergent categories are used to organize and group initial codes into a meaningful cluster. This process involved the breaking down of interview data and focus group data into discreet parts, closely examined and compared for similarities and differences. Open codes that were found to be conceptually similar or related were grouped under more abstract categories based on their ability to explain the SPI, knowledge, team and standard issues which are the main unit of analysis (Elo and Kyngas, 2008). Then all these open codes were linked and grouped based on similar issues on the broad categories that represent the unit of analysis. Some of the open codes allocated in this way are known as an ''in vivo'' code. In-vivo codes are especially important in that they come directly from the interviewees, do not require interpretation by the researcher

and provide additional ontological clarification or context-description.

Axial Coding

Axial coding is the process of relating codes (including categories and properties) to each other into subcategories (Strauss and Corbin, 1998). In this process all the general categories in open coding process were grouped under higher ordering headings. The purpose of grouping data were to reduce the number of categories by merging those similar into broader higher categories. In addition the merging process provides a mean for describing the situation to increase researcher understanding and to generate more knowledge. The process was continued with the abstraction process (Kohlbacher, 2006). The purpose of the abstraction process is to detail the categories by identifying the subcategories and how they link to one another. Subcategories with similar occurrence and incidents are grouped together as categories and categories are grouped as core categories. The abstraction process is an iterative process and continues as far as it is reasonable. In general this activity is termed axial because coding occurs around the axis of a category linking categories to subcategories at the level of properties and dimensions. This involves documenting category properties and dimensions from the initial coding phase; identifying the conditions, actions and interactions associated with a phenomenon and relating categories to subcategories.

Selective Coding

The third coding process in the analysis of qualitative data is the selective process. Selective coding is the process of selecting the core category, systematically relating it to other categories, validating those relationships and filling in categories that need further refinement and development. In this process, the first step is to identify the main or 'core' category that relates to the collected data.

The core category acts as the hub for all other identified categories. In this part, the researcher using the Atlas.Ti tool is creating a network diagram based on the abstraction process result as in the axial coding phase. The network diagrams were isolated in the beginning and merged at the end of the process. The merging network diagram helped researchers to produce inter-related network diagrams that present as a theoretical network diagram for the current research study.

Based on the detailed analysis process as described above and using an Atlas.Ti tool, we produced and identified 11 main related categories that shape the software process improvement environment in VSEs. Figure 1 illustrates the categories which consist of: staff background, business operation, working style, management style, team structure and process, learning and sharing process, communication process, documentation process, development process, technology and development method and software quality standard. Based on the analysis, these categories are the main categories and variables that have an influence on the software development process environments in VSEs.

DISCUSSION

The overall main data analysis process of this research has adopted the qualitative contents analysis approach which involved several data coding approaches. In order to ensure the systematic data coding process, researchers adopted the GT coding approach which involved open, axial and selective coding. These processes are vague in the beginning and become more specific and focused at the end. In addition, GT method helps researchers to gather detailed results, produce the resulting pattern and enhance researchers understanding on the whole research situation. Moreover uses of the systematic coding process has assisted the researchers in producing a result pattern which has helped to answer the research questions and hypothesis. Overall the processes have supported researcher in producing and validating the research theoretical diagrams as identified in the early stages of the present research.

This chapter has made both theoretical and practical contributions. In particular this chapter has provided theoretical development in methodology. In particular, it has explained and justified

Figure 1. The overall main category diagram
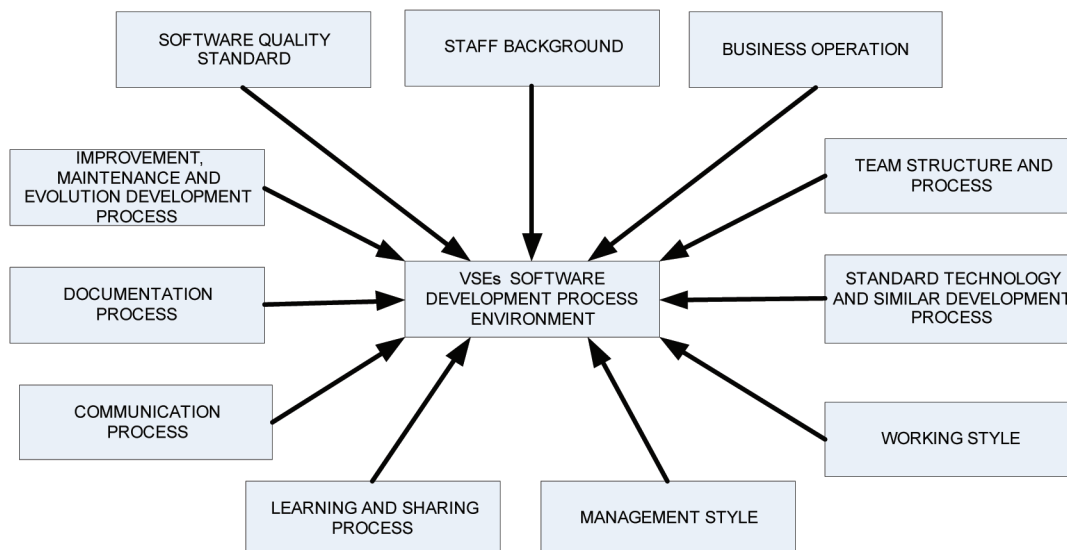
the use of grounded theory coding mechanisms in conjunction with case study research. Secondly, this chapter provides an example of applying this approach to research that has been conducted in the area of software process.

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KEY TERMS AND DEFINITIONS

Case Study: An empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clear.

Focus Group: A group of individuals selected by researchers to discuss and comment on, from personal experience, the topic that has been a subject of the research.

Grounded Theory: A systematic, qualitative procedure used to generate a theory that explains, at a broad conceptual level, a process, an action, or interaction about a substantive topic.

Knowledge Management: Set of the inter-dependent activities aimed at developing and properly managing organization knowledge.

Software Process: Defined as "A set of activities, methods, practices and transformations that people use to develop and maintain software and the associated products.

Software Process Improvement: Analyzing a software process as it is used within an organization and thus drive the implementation of changes to that process to achieve specific goals such as increasing development speed, achieving higher product quality or reducing costs.