The University Of Sheffield.

A Study of Knowledge Construction in Virtual Product User Communities

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Information School

The University of Sheffield

By

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October 2014

Abstract

In this research the virtual product user community is defined as a producer sponsored customer aggregation existing on the Internet to share usage experience and to collaboratively find technical solutions to problems with specific brand products. Such groups have a variety of benefits to members and organisations, one being that they are a knowledge resource for product users to look for solutions to specific problems with products and identify how to use them effectively. They are also a platform for the producer to communicate with its customers, to collect market intelligence, and to incorporate users' innovative insights and problem solving skills. However, how knowledge is constructed and shared in such groups has been rarely studied. Previous literature that focuses on cognitive development and critical thinking stages in a formal online learning context may offer some relevant insights and methodologies but requires translation to the new context, and is not likely to provide a comprehensive understanding of this area. Accordingly, this thesis aims to explore knowledge construction in virtual product user communities.

The philosophical basis of the research design was constructivism and interpretivism. A qualitative research methodology was adopted. Dozens of discussion threads of theoretical interest were chosen from a typical virtual product user community on the Dell User Support Forum (and from the Dell Idea Storm Community) and were analyzed through a qualitative content analysis method. In addition, semi-structured interviews with 20 community members of the Dell User Support Forum were conducted via e-mail. A deductive thematic analysis method was used for analysing the interview transcripts. More threads were chosen from a range of other virtual product user communities for content analysis in order to explore the influences of attributes such as language, national culture and technology platform on knowledge construction.

A new content analysis tool, which is based on a combination of prior codes and new categories identified from the data, was created, in order to analyze the knowledge construction embedded in the discussion of technical problems. The research identified five types of key knowledge construction episodes that make up the knowledge building process and which are characterised by low-level cognitive engagement. A knowledge construction model which represents knowledge building in reality was developed. Furthermore, problem description episodes, non-constructive episodes, and moderation episodes were identified and their relations clarified. The problem description episodes were found to facilitate knowledge

construction by providing knowledge about the problem and knowledge about its context. Following from this the peer advisor could diagnose the cause of technical problems and propose tailored solutions ideas based on the users' experiential knowledge. The moderation episode can offset the negative influence of non-constructive episodes, maintaining social order and promoting knowledge contribution. The findings illustrate that knowledge construction needs collective contribution through various types of participation by community members at different knowledge levels. The influences of contextual attributes of a virtual product user community, including communication technology, sponsorship, national language and culture, moderation, and discussion topics, on knowledge construction, were all explored in this research. Models of different types of knowledge transfer across the boundaries between the virtual product user community and the organization, highlighting the role of moderators, were constructed.

Besides the above findings, this research identified and defined this specific type of online community on the Internet, i.e. the virtual product user community. In addition, it provided a content analysis tool which is tailored to the purpose of examining low-level critical knowledge construction, which complements existing analytical frameworks, derived from formal learning contexts. The study mainly contributes to the general area of information and knowledge management, specifically knowledge construction in the virtual product user community and other low-level cognitive engagement contexts. It provides a theoretical basis for practices in managing online communities, and offers useful suggestions for educators in designing and managing formal online learning communities.

Acknowledgement

First of all, I would like to express my gratitude to my supervisor Dr. Andrew Cox for his kind advice, great patience, and support throughout the thesis writing process. His guidance always helps me get through the mist of my research project. I would also like to acknowledge my appreciation of the help from Professor Nigel Ford, my second supervisor, who gives me lots of insightful suggestions throughout my research process. I wish to thank all of the research students in the lab 224 and staffs in Information School. Their support is also essential for completing this report. Many thanks go of the study's participants for their time, valuable opinions, and suggestions. Outside academia, I would like to thank Professor Yichang Ao, Professor Xiulan Yang, Ms. Xiaoxi Li, Dr. Lucy Zhao, and Dr. Dennis Baker for their kind help and suggestions for improving my life. Thanks and love also to my parents, for raising me and supporting my academic dream.

Table of Content

List of Figures

List of Tables

Chapter 1 – Introduction

1.1 Introduction

This thesis investigates the knowledge construction activities conducted through collaborative efforts of peer users in one specific type of online community, consisting of product users, i.e., the virtual product user community. The main body of the thesis presents the overall research aims; a literature review of relevant theories about online community, existing knowledge construction frameworks and so on; a description of the methodological research approach of the research; and the findings and conclusions.

In this section, the research background and its significance are presented; then the research objective and related research questions, including both the main question and sub-questions, are stated. The overview of the whole report structure is presented in the last section.

1.2 Research Background & Significance

The concept of online community has existed for more than a quarter of a century since the first one "The Well" (http://www.well.com) was built in 1985 (Ridings & Gefen, 2004). One of the most commonly cited definitions of virtual community is given by Rheingold (1993), who depicts online communities as social aggregations which emerge from the Internet when enough people conduct public discussions and create sufficient feeling to form webs of personal relationships. Online communities have evolved into various types, each with its own character and population in subsequent decades of development. As both the number and variety of online communities expand, many Information Science researchers have conducted research on them (Lee et al., 2003). They have published many articles on most types of virtual communities, such as virtual communities of practice (Bourhis et al., 2005; Dube´ et al., 2005; Collison, 1999; Botkin,1999) ; networks of practice (Faraj & Wasko, 2001; Brown & Duguid, 2000; Faraj & Wasko, 2001; Andriessen,2005); interest communities (Plant, 2004; Wenger, 2002; Andriessen, 2005); open source software communities (Gläser,2001; von Hippel & von Krogh, 2003; Perens, 1998; Lakhani & Hippel (2003); and learning communities (Henri & Pudelko, 2003; Garrison et al., 2000; Gunawardena, at al., 1997; Newman et al., 1996; 1997).

However, there are far fewer studies on virtual product user communities compared to the large quantity of articles and books on other types of community, especially formal learning

communities, in what are sometimes called computer supported collaborative learning (CSCL) environments or virtual communities of practice in the formal organizational context. There is an immense knowledge gap about this type of community; they are not even clearly defined yet. A virtual product user community is a producer sponsored customer aggregation existing on the Internet to share usage experience and to collaboratively find technical solutions to problems with specific brand products. It is understandable that formal online learning communities and virtual communities of practice can obtain organizational support to some extent and have clear aims for their establishment. In contrast, virtual product user communities lack organized structure; members lack familiarity with each other, and sufficient support from top management in business organizations. These features themselves can partially explain why both organizations and researchers put less stress on these communities. Another reason that there are so few studies of this type of community is due to confusing them with brand communities and consumption communities. In fact, as will be shown in this research, despite some common features, virtual product user communities differ from the above two types of community in participation objectives, sponsorship aims, knowledge behaviours, community culture, leadership strategies, and so on.

It can be seen, then, that the topic of virtual product user communities requires more research attention in order for us to understand it theoretically and to fully develop and utilize its potential practically. The virtual product user community can potentially bring lots of value to both its members and the company sponsoring it. It provides a platform for the product users to share their knowledge and thus to have better usage experiences and collaboratively solve technical problems. In addition, it can also foster customer loyalty to the brand (Anderson, 2005; McAlexander, et al., 2002), and create effective communication between the company and customers (Jang, et al., 2008). More importantly, taking Dell IdeaStorm Community as an example, it also enables the organization to collect market information and innovative insights about the product, and incorporate community members' innovation capacities and problem solving skills into the organizational knowledge system (Lilien et al., 2002). Virtual product user communities are also considered to be one of the most important resources for the enterprise to absorb knowledge on product usage and applications, and design defects and product design (Anderson, 2005). More and more companies are starting to use virtual product user communities to gain competitive advantage over their competitors. Given the above reasons, the researcher has chosen this type of community as the main research object.

The key subject associated with virtual product user communities is knowledge construction, through which its members solve their problems and improve their product usage (Anderson, 2005), and provides valuable innovative knowledge on product development and marketing strategy for the manufacturers (Wurster & Evans, 1997). Although there is much literature and research on knowledge construction, a large portion of these studies focus on students' knowledge construction in CSCL contexts (Gunawardena et al., 1997; Newman, 1996; Garrison et al., 2000; Bullen, 1997) and employees' knowledge building in organization-supported virtual communities within the organizational boundary (Bourhis, et al., 2005; Wenger & Snyder, 2000). As for collaborative knowledge construction in the virtual product user community, only very limited research has been conducted to investigate this phenomenon.

In spite of common characteristics of online communities, the knowledge construction pattern in the virtual product user community has its own unique attributes which differ from other online communities, due to contextual differences; membership differences; structural differences; different offline influences; facilitation differences; objective differences; and so on. Its uniqueness needs to be carefully explored in order to better define it, understand its knowledge construction processes, and propose more tailored moderation and facilitation strategies. This research aims to fill this research gap. To achieve this goal, the whole research project focuses on knowledge construction within the virtual product user community and thus to find better leadership strategies to foster it.

1.3 Research Aim & Questions

The aim of this research is to investigate the nature of knowledge construction within virtual product user communities. Accordingly, the core research question of this study is: how do people collaboratively build knowledge in a virtual product user community?

To better understand the way virtual product user community members build knowledge, the following research questions will be investigated:

(a) What is a virtual product user community and what are its attributes?

(b) How is knowledge constructed in discussion threads published in a virtual product user community?

(c) What are the contextual factors influencing community members' knowledge construction?

(d) How does knowledge flow between the virtual product user community and the organization?

1.4 The Research Journey

The whole research project is organised in six stages and this research progress is illustrated as follows:

Stage one: Identifying the Research Questions

In the first stage, the research proceeded in the following order:

1. Locate the research on exploring knowledge sharing and construction in the virtual product user community.

2. Conduct a literature review and identify the research gap. This includes the areas of virtual communities, knowledge and knowledge creation, existing knowledge construction frameworks and tools used in the Computer Support Collaborative Learning (CSCL); knowledge sharing and knowledge transference across boundaries; and leadership and moderation in the virtual community. In the later stage of this research project, it is identified that virtual communities and existing knowledge construction analytical frameworks in the CSCL context are the core literature for this research project.

3. Research Design. At this stage, the researcher developed a research methodology, including identifying data resources, data collection and data analysis methods.

The research question, the research methodology, and the literature have continuous interactions with each other in the first stage. Consequently, the research question and sub-questions were formed through this process.

Stage Two: Creating an Analysis Framework & Knowledge Construction Model

In the second stage, the researcher needed to develop a content analysis framework for the virtual product user community because the existing analytical frameworks and tools found in the literature are mainly rooted in the formal online community (CSCL context) and aimed at studying high-level cognitive engagement. This stage was also divided into two steps.

1. A content analysis framework of knowledge construction and a knowledge construction model were developed through content analysis of a theoretically interesting thread on the Dell User Support forum, which is taken to be a typical product user community. This forum

focuses on solving common technical problems with laptops through peer user support, and sharing knowledge of better usage. Many technical solutions are identified through users' collective efforts on this forum. The forum is attached to the company's website and is managed by company appointed moderators. Therefore, it is considered to be a typical product user community that meets the need of the research goal. In order to fully explore potentially interesting patterns, a comprehensive analysis of this thread was conducted from different angles and dimensions, including a participation dimension, an interaction dimension and a knowledge construction dimension.

2. The content analysis framework was tested and elaborated by analysing more selected threads from the Dell User Support Forum (and the technical solution-oriented discussion threads in Dell IdeaStorm Community). As new sub-categories emerged, the relationship between prior sub-categories were also adjusted and identified. Accordingly, the main categories in this analytical framework were also adjusted. During this process, the knowledge construction model was also tested and confirmed.

Stage Three: The Thematic Analysis of Interview Analysis

Interview data was collected and analysed through thematic analysis at this stage. The categories in the knowledge construction analytical framework were evaluated. The relationships among these categories were further clarified through thematic analysis of interview data. In addition, other research issues which cannot be obtained from thread analysis were also added to the findings, including community members' perceptions of the moderator's roles, community cultures, and so on. These factors are believed to have a strong influence on knowledge construction activities.

Stage Four: The Application of the Analysis Framework in other Virtual Communities & Online Groups

The workability of the analytical framework was tested by being applied to other contexts with varying key variables. At the same time the knowledge construction model was also evaluated when being applied in these virtual communities and online groups. Furthermore, the effects of these key variables of virtual communities on knowledge construction were also examined.

Stage Five: The Synthesis of Findings at Stage Two, Stage Three & Stage Four

These three sections of findings were combined and synthesized in order to have a thorough understanding of knowledge construction patterns, the relationships between the categories included in the analytical framework, and influences from contextual attributes.

Stage Six: Discussion & Conclusion

The findings were compared with ideas in the existing literature to explore differences and the various reasons behind this. The conclusion of the whole thesis is also given at this stage.

1.5 Structure of the Report

The following is an outline of the content of this report:

Chapter 1: Introduction. This chapter has introduced the research background and significance of this project, defined the research aim and questions, and reported the research journey.

Chapter 2: Literature Review. This chapter draws on the literature to provide theoretical foundations and concepts used in the study. The first section of this chapter critically reviews the literature on various types of virtual communities and their features in order to guide the defining of the nature and attributes of virtual product user community investigated in this research. The second section introduces the existing knowledge construction analytical frameworks for exploring knowledge building, cognitive development, and criticality in the CSCL context. These frameworks are considered to supply a lens for studying collaborative knowledge building in the virtual product user community. The third section is about moderation which has strong effects on knowledge construction in virtual communities.

Chapter 3: Research Methodology. This chapter describes research methodology issues in the research, including research philosophy and approach; research methodology and design; data collection and data analysis methods; and ethical issues in the research.

Chapter 4: Content Analysis of Online Discussions of Virtual Product User Analysis. This section presents up- to- date discoveries from content analysis of one selected discussion thread transcript produced by a group of virtual product user community members. This transcript is mainly analyzed in three dimensions, namely the participation dimension, the interaction dimension, and knowledge construction dimension. The initial findings are established in this chapter, including the creation of an initial content analysis framework for

exploring knowledge construction, identification of knowledge construction model and strategy in the virtual product user community.

Chapter 5: Content Analysis of More Threads in the User Support Forum. This chapter aims to elaborate the content analysis framework developed in the above chapter. The new sub-categories related to knowledge transference are indentified. The knowledge construction model and strategy are evaluated and confirmed. In addition, the patterns of transfer of different types of knowledge are also explored.

Chapter 6: Content Analysis of the Threads in Dell IdeaStorm Community. The newly developed content analysis framework is completed after more sub-categories are added through analysing the technical solution-oriented and idea-oriented discussion threads in this stage. In addition, the relationship between its categories is also clarified. The knowledge construction model and strategy are also confirmed. The knowledge transfer patterns across the boundary between the Ideastorm Community and the organization are illustrated.

Chapter 7: Thematic Analysis of Interview Data. The categories in the newly developed content analysis framework are evaluated by the findings from thematic analysis of interview data. The relationship between these categories is further clarified by interview data. Some patterns hidden from the online discussion contents, including the experiential nature of active user community members and exact solution identification method, are revealed by the narratives of interviewees. The community members' perceptions towards the moderator and community culture are also added to the research.

Chapter 8: Content Analysis of Threads in Other Types of Online Communities. This chapter mainly explored the influences of key attributes of virtual communities on knowledge construction. In addition, the validity of the newly developed analytical framework is also tested in different types of virtual communities and online groups.

Chapter 9: Conclusion and Synthesis of the Findings. This chapter is mainly about synthesis of the findings reported in chapters of four, five, six, seven, and eight. The findings from content analysis of discussion threads data and thematic analysis of interview data in all research stages are combined and integrated to illustrate the relationship of knowledge construction elements, knowledge construction process under the contextual influences of the virtual product user community.

Chapter 10: Discussion. The findings are related to the existing literature in this chapter. The comparison between the newly developed knowledge construction model and Nonaka & Takeuchi's (1995) SECI model is discussed. The comparison of this newly created content analysis frameworks and exiting ones in the CSCL context is also provided in order to highlight its theoretical basis. A macro view of knowledge construction is also depicted: the relationship between tacit, situated, and ambiguous nature of knowledge and knowledge construction patterns; the mutual influences between question type, interaction type, and knowledge construction type; and the contextual attributes' influences on knowledge construction.

Chapter 11: Conclusion. This chapter summarizes how the research questions proposed in this study were answered. The theoretical, methodological, and practical contributions generated from this research project are also summarized. The study's limitations and future recommendations are also presented.

Chapter 2 – Literature Review

2.1 Introduction

This chapter introduces the relevant literature to provide definitions of concepts used in the study and to explain existing frameworks that can be drawn on to conduct the study. As the research questions of this thesis focus on the nature of the virtual product user community, knowledge construction within it, and influencing factors, it respectively introduces existing literature about virtual communities; knowledge and knowledge creation, knowledge construction analytical frameworks; and leadership/moderation of virtual communities that can influence knowledge construction activities.

The chapter starts by introducing the concept of virtual community, including its definition, existing classifications and criteria for defining different types of virtual communities, and describes relevant already defined virtual communities in work/knowledge sharing areas. This section helps us to understand the nature of the virtual product user communities under investigation and locates their position among various virtual community types, and enables us to find ideas that can be used for establishing the definition of a virtual product user community. More specifically, this section aims to show that there is a type of community called a product user community which is different from other communities on the Internet. In the later stages of this research, the researcher will attempt to demonstrate that this is a genuinely different type of community from those similar communities identified in the literature. In order to achieve this goal, a way of distinguishing different types of communities is needed. Thus, Porter's (2004) taxonomy will be highlighted.

The following section provides a comprehensive introduction to concepts of knowledge, knowledge classifications, organizational knowledge creation models, and so on. In addition, the knowledge construction is also differentiated from other knowledge processes, including knowledge sharing and knowledge transfer. Therefore, by clarifying the necessary concepts of knowledge and knowledge creation, this section builds a solid basis for exploring how knowledge is constructed in the asynchronous online discussion threads in the virtual product user community.

The chapter next introduces the existing literature about knowledge construction within virtual communities. However, there is little literature which talks about the detailed and concrete knowledge construction process in the online discussion contents except in online

communities of formal learning. Thus, the existing analytical frameworks and tools created for exploring knowledge construction embedded within students' online discussion contents in a CSCL context are the ones that are introduced. More specifically, these tools mainly focus on the cognitive development and critical thinking in the discussions of online formal learning.

The last section introduces the literature of leadership and moderation which is often considered to greatly influence knowledge construction in virtual communities, especially virtual communities of practice.

2.2 Literature Review: Virtual Communities

2.2.1 Introduction

Since the first online community, "The Well" (http://www.well.com), was founded in 1985 (Ridings & Gefen, 2004), thousands of diverse types of virtual communities and social networking sites have emerged each year. There are various types of virtual communities with varying purposes and attributes. In response, many researchers have attempted to define the term virtual community and different types of online communities from different perspectives. There have been many attempts to classify these online communities or to determine exhaustive classifying criteria.

In order to enable a better understanding of the nature of the virtual product user community, this chapter discusses the main definitions, attributes and classifications of different virtual communities. In addition, several relevant types of virtual communities which are considered to share similarities in specific aspects with virtual product user community are also explored, including virtual communities of practice, virtual consumption communities and brand communities.

2.2.2 Online Community

When remote communication technology is used as a mediation tool for interaction, a community can be extended beyond geographic limitations and become virtual. Computer-mediated communication enables people to locate and interact with others having similar interests, thus virtual communities are formed and sustained (Hiltz & Wellman, 1997). Consequently, this creates a "social aggregation that emerges from the Net when enough

people carry out those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace" (Rheingold, 1993b:5).

2.2.2.1 Definition of online community

As for the definition of an online community (/virtual community), there are varying statements by researchers (Wenger et al., 2002; Etzioni, 1999; Rothaermel & Sugiyima, 2001; Cothrel& Williams,1999; Chiu et al., 2005; Cox, 2008; Porter, 2004; Baym, 2000; Ridings et al., 2002). However, it is widely accepted that the virtual community needs to be traced back to the definition of community in sociology (Etzioni, 1999; Rothaermel & Sugiyima, 2001).

Wenger et al. (2002) define the term "online community" from a practice perspective, as a group consisting of individuals with similar concerns, or a set of problems about a specific topic (Wenger et al., 2002). Cothrel & Williams (1999: 55) define it as "a group of people who use computer networks as their primary mode of interaction". This definition simply stresses the interaction mode that the online community adopts, without considering other factors. Later, the same authors improved their definition to refer to groups of people engaging in many-to-many online interactions arranged around common interests (Williams & Cothrel, 2000). Virtual communities are also defined as "online social networks in which people with common interests, goals, or practices interact to share information and knowledge, and engage in social interactions" (Chiu et al., 2005: 1873). Ridings et al. (2002: 273) offer a more thorough definition of virtual community as "groups of people with common interests and practices that communicate regularly and for some duration in an organized way over the Internet through a common location or mechanism". Cox (2008) concludes that a virtual community is a group of individuals with the same interest, who are not necessarily closely bounded to accomplish a common enterprise. Gray (2004) further points out that individuals in the online community collectively establish the meaning of their practice, and develop the sense of their professional identity.

Based on the synthesis of existing definitions made by researchers from multiple disciplines, Porter (2004:4) proposes a comparatively comprehensive definition of virtual community as "an aggregation of individuals or business partners who interact around a shared interest, where the interaction is at least partially supported and/or mediated by technology and guided by some protocols or norms". This definition contains most key elements proposed by other researchers, namely, interacting aggregations of people, shared interests, technology

mediation, and norms (Lee et al., 2003; Preece, 2000). Porter (2004) states that his definition substantively improves on previous ones in four aspects: 1) It is more inclusive than others for its recognition that communities include individuals and/ or business allies; 2) It is more inclusive in its acknowledgement that the virtual community can be completely virtual or partially virtual (i.e. members' relationships are sometimes facilitated by face-to-face communication); 3) It is more inclusive in admitting that interaction in the virtual community can be mediated by any technology rather than solely through computer technology (e.g. mobile technology); 4) It is more inclusive in having of roles, protocols, policies and/or norms as part of the definition. The way in which Porter (2004) defines the virtual community can also shed light on the definition of the virtual product user community in this research. It suggests some key parameters in distinguishing virtual product user communities from other types of virtual communities, namely business organizations and their relationship with community members, virtual interaction features, and the communication technology in use.

2.2.2.2 Different Types of Online Communities

Many researchers have attempted to classify the increasing number of online communities which meet different needs and attract different groups of people, in order to enhance a better understanding towards them (Lazar & Preece, 1998; Leimeister & Maloney-Krcmar, 2003; Hummel & Lechner, 2002; Kim, 2000; Preece & Maloney-Krichmar, 2003; Ridings et al., 2002; Kozinets, 2002; Hagel & Armstrong, 1997; Henri & Pudelko, 2003; Constance, 2004; Porter, 2004)

Lazar & Preece (1998) suggest that online communities can be differentiated by four dimensions by their attributes, such as goals, interests, intense interaction, shared activities, size, anonymity levels, sources of revenue, etc.; by their supporting software, such as listservs, newsgroup, IRC, MUD, web-based bulletin, and team rooms; by their relations to physical communities, such as frequent face-to-face contact, government generated, education related, online scholarly community, and so on; and boundedness, such as tightly and loosely organised networks, with or without, organization intranets.

Based on the categorization by Lazer & Preece (1998), many researchers contribute other ideas to the classification of online communities. Leimeister & Maloney-Krcmar (2003) suggest that the source of revenue to support online communities, such as subscription revenue, membership revenue, or usage-based revenue, is another factor that should be taken

into consideration when making classification of these online communities. Meanwhile, in some online communities sponsored by organizations, such as communities consisting of customers, their revenue is usually part of the routine expenditures of the organizations (e.g. the HP User Support Forum). Preece & Maloney-Krichmar (2003) add communication supporting software that different online communities rely on, such as mailing lists, usenet news, discussion forms, chat rooms, immersive graphic environments, and e-groups. Kim (2000) suggests that areas of common interest of the online community members, like health, work, politics, sports and the leisure, are the goals of those online communities.

The virtual product user community explored in this research appears to belong to the genre of "interest or knowledge" according to Hummel & Lechner's (2002) classification. Some members in the virtual product user community share knowledge about technical solutions to the products' problems they meet; and some participate in the discussions out of interest.

The members in virtual product user communities form social aggregations around specific products which they use or have an interest in on the Internet. They mainly interact on discussion forums or web-based bulletins, and other communication tools are also adopted to facilitate their interaction, such as mailing Listservs or messaging functions provided by the forum. Their main motivations for participating in the virtual community include interest, sharing product information and usage experience, along with solving the technical problem they meet. As for their relation to physical communities, members do not have face-to-face communication in most cases. However, the companies can organize off-line activities for online active users, in order to promote intimacy with the virtual product user community. Virtual product user communities are initiated by commercial organizations, and thus have organizational sponsorship. It appeared to the researcher in the initial stages of the study that the members are loosely tied to each other in general. This attribute needs to be justified by empirical data. Its boundedness in relation to the organization will also be explored at a later stage.

2.2.3 Relevant Types of virtual Communities

In order to present similarities and differences between virtual product user community and other theoretically relevant online communities, the following sections introduce virtual communities of practice, consumption communities, and online brand communities: those groups most similar to them among established virtual community types.

2.2.3.1 Virtual Community of Practice

Wenger at al. (2002: 4) define the community of practice (CoP) as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis." In brief, "…they're groups of people informally bound together by shared expertise and passion for a joint enterprise" (Wenger & Snyder, 2000:139). The CoP is defined by Botkin (1999: 241) as "highly informal groups of people that develop a shared way of working together to accomplish some activity. Usually such communities include people with varying roles and experience".

Cox (2008) states that CoPs involve people engaging in professional activities and work practices, not in leisure time or entertainment activities. Members in a community of practice have a similar domain of expertise and voluntarily exchange knowledge about their shared practices (Gray, 2004). McDermott (2003a) also states that a community of practice is related to work, and focuses on professional activities and skills.

The community of practice has been often promoted in organizations as a tool to achieve competitive advantage and facilitate organizational learning (Boland & Tenkasi, 1995; Brown & Duguid, 1998; Davenport & Prusak, 1998). Codified knowledge and formal training tend to be abstract, theoretical and decontextualized, and thus cannot fully satisfy the high demand for practice in many working circumstances. Moreover, situated working practice highly depends on context and requires continuous improvisation. Therefore, it is necessary for individuals to participate in a collective practice for "joint sense making, learning from others' experiences, and accessing distributed know-how" (Faraj & Wasko, 2001:3).

Another aim of establishing a community of practice is to develop the member's expertise and to share knowledge (Wenger & Snyder, 2000). Through participation in communities of practice, people can "…learn the intricacies of their job, explore the meaning of their work, construct an image of the organization, and develop a sense of professional self." (Grey, 2004:23). The activities in CoP not only involve acquisition of technical skills, but also of the informal and social aspects of knowledge, knowledge creation and sharing. Furthermore, individuals in the CoP can learn to play a role and become familiar with the "…community's practices, language, viewpoints, and behaviours" (Grey, 2003:23).

With information and communication technology (ICT) to support the interaction between community members, the community of practice becomes more and more virtual (VCoPS). This enables its members to be free from the constraints of time and space (Bourhis, et al., 2005). "A CoP is called 'virtual' when its members use ICT as their primary mode of interaction" (Dube´ et al., 2005: 147). Many corporations have already implanted a virtual CoP for its staff, and the related research proves that a successful virtual CoP can bring great benefits to those organizations with respect to increased knowledge capital, social capital, organizational learning and reduced knowledge distribution costs (Daniel et al., 2002; Lesser & Everest 2001; Salmon, 2000; Garret et al., 2007).

2.2.3.2 Differences between Virtual CoPs and Virtual Product User Communities

The following contents are claims about differences between virtual CoPs and virtual product user communities. They still need to be proved by empirical data in the findings later in the thesis.

Both the VCoPs and virtual product user communities are informal groups of people. However, the members in VCoPS are usually within organizations and bound together for professional activities and working practices. Members in CoPs share a closer connection and create more distinct identities. CoPs are groups who "share a common identity, history, and purpose" (McDermott, 1999b: 4). VCoPs mainly focus on work and their members work in a similar domain. Virtual product user communities are mainly related to the experience of using the same single brand products. Their members are mainly product users who are from various organizations and have varying occupational backgrounds. This creates much looser connections between members in virtual product user communities.

VCoPs are mainly installed within the organizations and serve the organization's purposes of achieving competitive advantage as the facilitation tool for organizational learning. They are also established for developing member's expertise through sharing and constructing new knowledge. Andriessen (2006:6) states that it "is often directed at developing best practices". The producer's establishment purpose of a virtual product user community is to reduce costs in user support, collect marketing information, and incorporate users' problem solving skills and innovation capacity. Members in virtual product user communities mainly participate for sharing knowledge about best usage experience and solving technical problems.

2.2.3.3 Virtual community of consumption

Virtual communities of consumption can be considered as specialized consumer knowledge reservoirs with the facilitation of the Internet (de Valck et al., 2009). They focus on consumption related interests (Kozinets, 1999). They are defined as "affiliated groups whose online interactions are based upon a shared enthusiasm for, and knowledge of, a specific consumption activity or related group of activities" (Kozinets, 1999:254). This type of virtual community is closely related to purchasing behaviours, including information seeking before the purchase decision and communicating consumption experience after purchase. Thus, a "virtual community of consumption represents substantial social networks of consumer knowledge and companionship that affect consumer behavior" (de Valck et al., 2009: 185).

Furthermore, it has been suggested that the virtual community is one effective platform to enhance innovation through the involvement of more actors and the augmentation of interaction richness among those actors (Wurster & Evans, 1997). The customer is a unique knowledge resource for the company to collect information on product usage patterns, product applications, design defects and product improvement insights (Anderson, 2005; Bennett & Gabriel, 1999; Chase, 1997). The customers in virtual communities of consumption can also benefit from knowledge sharing on product use (Anderson, 2005). Hagel & Armstrong (1997) argue that the virtual community can meet customer needs in four aspects: interests, relationship building, transactions, and fantasies.

The following contents are claims about differences between the virtual community of consumption and the virtual product user community. Again they still need to be proved by empirical data in the findings. The virtual community of consumption differs from the virtual product user community in the following aspects: 1) Its members are mainly consumers with a shared enthusiasm for a particular consumption activity rather than a specific brand product. Virtual product user community members are mainly users of the same brand products, and they are not necessarily assembled out of a common enthusiasm for this brand product. 2) The virtual community of consumption is centred on purchasing behaviours. Thus its knowledge is mainly about purchasing information and consumption experience. The virtual product user community is mainly related to usage experience and technical solutions. Its discussion contents are mainly about solving technical problems within the products and sharing best usage experience after purchasing.

2.2.3.4 Online Brand Community

The concept of brand community was initially defined by Muniz & O'Guinn (2001: 412) as "a specialized, non-geographically bound community, based on a structured set of social relationships among admirers of a brand". Amine & Sitz (2004:64) proposed a relatively more complete definition as follows: brand community is

> "a self-selected, hierarchical and non-geographically bound group of consumers that share values, norms, and social representations and recognize a strong feeling of membership with each other members and with the group as a whole on the basis of a common attachment to a particular brand."

Despite the acknowledgement of some common attributes with consumption-related communities, Anderson (2005) argues that the brand community differs from them in its sponsorship and management by the producer (i.e. being sponsored and managed by the producer for a marketing purpose) and its functions as a communication channel and sometimes product distribution channel for the product provider. Muniz & O'Guinn (2001) further point out that this specific community is unique in centring on a branded product or brand service.

McAlexander & Schouten (1998) state that brand community may consist of a group of members who are enthusiastic devotees of particular brand products. It is formed by band users named "active loyalists", who are "committed, conscientious-almost passionate" (Gruen& Ferguson, 1994:3) and "a brand community would designate a group of consumers gathered around a particular brand (attachment cause, disaggregate level)." (Amine & Sitz, 2004:4).

The online brand community supported by web technology is gradually becoming an effective relationship marketing communication channel and relationship linkages between the devoted customers and firms are becoming stronger (Anderson, 2005). It is an effective relationship marketing tool for its connection among consumers through the benefit of community (Muniz & O'Guinn, 2001). Both online and offline brand community activities should be considered as the promotion of relationship development and customer involvement (McAlexander, et al., 2002).

Jang et al. (2008) state that the online brand community can be generally classified into two groups, according to their hosting types: consumer-initiated communities, which are

voluntarily built by the devoted customers; and company-initiated communities, which are launched by the company, i.e. the brand owner. The advantage of company initiated online brand community is that it can usually provide authentic product information. However, unfavourable opinions from customers have more possibility of being filtered out compared with those in consumer initiated online brand communities. A consumer initiated community can provide balanced information about the product, like the strengths and weaknesses of the product or usage experience, but it has a limited ability to render detailed specifications of the product (Jang et al., 2008).

The following contents are claims about differences between the brand community and the virtual product user community. They still need to be proved by empirical data in the findings. The brand community mainly differs from the virtual product user community in the following aspects: 1) Its members are enthusiastic admirers of a specific brand (i.e. "active loyalists") rather than ordinary consumers. In addition, its members have a strong sense of identity and strong feelings towards the community and each other, due to a common attachment to the same brand. Thus, in contrast to the virtual product user community, there is a closer link between its members and the stronger community sense in the brand community; 2) It is focused on a relation to a specific brand, so it mainly serves the sponsor's relationship marketing purpose. The virtual product user community is mainly created for peer user support, and to absorb user's problem-solving skills and innovative insights; 3) The brand community can be initiated by companies or brand enthusiasts. In contrast, the virtual community is initiated and sponsored by the producer. Thus, this allows the implantation of leadership through formally appointed moderators of varying levels by the company in the virtual product user community.

2.2.3.5 Consumer's Engagement in New Product Development

One important attribute of virtual communities consisting of customers is the external knowledge resources for firms in marketing and new product development. Thus, this section mainly discusses consumers' capacity to be external knowledge resources for enterprises and to engage in innovation through virtual communities.

New product development (NPD) consists of all activities involved in conceiving, designing, producing and delivering products to the market through the efforts to solve a steady stream of problems (Clark & Fujimoto, 1991; Myers & Marquis, 1969).

Customers working in various areas have been one of the sources of external knowledge and information resources for firms through providing of new ideas, involving the R&D process, by testing and supporting the products (Nambisan, 2002). Moreover, the customer orientated design concept in new product development places the action of capturing accurately the needs of the customers at the heart of the design process (Cooper & Kleinschmidt, 1995). Ernst (2002) further points out that customers participating in new product development projects resemble the lead users and incline them to maintain a long term close relationship with the company.

Customers' needs for the products and their knowledge obtained from the actual usage of products enables them the potential external knowledge resource for new product development (Clausing, 1994; Cooper & Kleinschmide, 1995; Leonard-Barton, 1995; von Hippel, 1988; Thomke & von Hippel, 2002; Wikstr¨om, 1996). In addition, some customers with a strong innovation orientation can also develop their own new products (Franke & Shah, 2001; Prahalad & Ramaswamy, 2000; Ulwick, 2002; von Hippel, 2002); such users are described as the lead users. These innovative customers can play active roles in online communities (Kozinets, 1999; Lynn et al., 1997; McAlexander et al., 2002; McWilliam, 2000; Sawhney & Prandelli, 2000). Customers working in different fields with differing expertise meet each other, exchange knowledge on product usage, and discuss ideas for product improvement and design in a virtual community that focuses on specific product.

Kristensson et al. (2004) discovered that new product ideas suggested by the common product users are more innovative and valuable than those proposed by professional R&D staff, whilst the professional product designers create technically reliable ideas. The new product development process can be promoted through interacting with users and draw advantage from the competent user-knowledge management (Hsieh & Chen, 2005).

The rapid development web-based technologies provide convenient and economical methods to integrate thousands of geographically distributed customers with new products. Customers with high expertise and a strong interest in innovation usually interact with each other in virtual communities (Kozinets, 2002; McAlexander et al., 2002). Hence, the online communities consisting of these customers can serve as aggregations of collective expertise and knowledge (Bagozzi & Dholakia, 2002). This means the virtual customer community has a great potential to contribute innovative ideas and knowledge to new product development (Prahalad & Ramaswamy, 2004; Urban & Hauser, 2004).

> "Customers are invited to actively participate in the creation of new products by generating and evaluating new product ideas, elaborating a detailed product concept, evaluating or challenging it, discussing and improving optional solution details, selecting or individualizing the preferred virtual prototype, testing and experiencing the new product features by running simulations, getting information about the new product or just consuming it" (Füller, 2006:639).

2.2.4 Conclusion

With the aim of showing the existence of a virtual product user community and its distinction from other similar virtual product user communities in this research, a comprehensive literature review is conducted in this section. The definitions of virtual community and its classifications, including classification criteria discussed in this section, help to understand the virtual product user community under investigation in this research. Additionally, these contents, especially Porter's (2004) definition of virtual community, has also shed light on defining a virtual product user community in the concluding chapter.

A few virtual communities with similar attributes are also discussed and compared, namely virtual communities of practice; virtual communities of consumption; and brand communities. Part of these comparisons is based on online community attributes concluded in Porter's (2004) Five Ps, namely, purpose, population interaction structure, profit model, platform, and place.

In order to make the attribute "purpose" more salient in these virtual communities, its content has been slightly changed, from, originally "the content of interaction", to "the purpose of the establishment". Other attributes, including degrees of formalization (Collison, 1999; Botkins, 1999); knowledge, network structure, motivation of participation, contract value (Collision, 1999); control, composition (Collision, 1999); defined membership (Collison, 1999; Brown & Duguid, 2001; Allee, 2000); and openness of networks (Brown & Duguid, 2001) are also compared across these online communities. This can pave the way for the exploration of knowledge sharing and construction in the virtual product user community when its attributes are clarified and differentiated from other similar virtual communities. This is because different attributes of online communities can have effects on community members' knowledge construction patterns.

Table 2-1 Comparison of Relevant Online Communities

Community Type / Attributes	Virtual Community of Practice	Virtual Community of Consumption	Online Brand Community
Purpose of Establishment	share expertise and knowledge; develop best practices	collect innovative ideas and insights on new product development and usage patterns	relationship marketing tool; promote brand loyalty, mediate knowledge exchange among users
Population interaction structure	small-group weak &/or stressful ties in online boards Strong &/or stressful ties in user group	public Weak ties in online boards	public strong ties in online boards
Profit model	No tangible revenue-generation for the owner (intangible benefits include promoting expertise of employees and solve technical problems)	Reduce costs of customer support and improve products	Promote the brand
Platform	online discussion boards	online discussion boards	online discussion boards
Place	only partially virtual with combination of face-to-face communication	completely virtual (offline activities is advised)	completely virtual (offline activities is advised)
Degree of Formalization	low formality	formal/ informal	formal/ informal
Knowledge Activity	sharing knowledge / create	use knowledge & create knowledge	Distribute news and promotional material

	knowledge		
Network Structure	many –to-many	many-to-many	one-to-many many-to-many
Motive of participation	passion, work	interests; relationship building, transactions; fantasies	love of brand, share consumption & usage experience
Control	with facilitation and sponsorship from organizations	Not known in the literature (could be user-initiated community)	organization-initiated community (with sponsorship) user-initiated band community
Openness of Network	internal network(intra-organizational)	Inter-organizational or open-Internet	linkage between the organization and customer community (organization- initiated brand community) internal / open-Internet (user-initiated brand community)
Contract Value	Limited contract value	Limited contract value	Limited contract value
Defined Membership	Open for new members; shifting relationships and membership	Open for new members; shifting relationships and membership	Open for new members; shifting relationships and membership
Composition	Both experts and novices	Both experts and novices	Both experts and novices

2.3 Literature Review: Knowledge and Knowledge Creation

2.3.1 Introduction

This section includes comprehensive introductions to knowledge and its nature, its classifications, knowledge creation and organizational knowledge creation models, and a comparison between knowledge construction, knowledge transfer and knowledge sharing. It

helps to understand what knowledge is and how knowledge is created in general. In addition, this section also clarifies the terms that will be used in this research. Therefore, it can pave the way for exploring knowledge construction in virtual product user communities.

Firstly, the definitions of knowledge and the nature of knowledge are discussed. In order to define knowledge, the distinction between knowledge, information and data is initially introduced for the long debate about the question concerning the nature of knowledge. It is followed by critical analysis of various influential definitions of knowledge and its nature.

In the third section, the influential classifications made by Polanyi (1965), i.e. explicit knowledge and tacit knowledge, is introduced. Moreover, the attributes of tacit knowledge and its importance for organizational, competitive advantage and for knowledge creation are discussed. Cook & Brown's (1999) classification of knowledge into four types, namely, explicit/tacit knowledge and individual/group knowledge is also included. It builds the basis for individual-level knowledge creation & social-level construction of knowledge in the next section. In the following section, these two types of knowledge creation are differentiated from each other and their relations discussed.

The fourth section is mainly about introducing the SECI model, which is about organizational knowledge creation. It is further developed by adding two elements of "ba" and "knowledge assets". At the end of this section, a broader model, the unified knowledge creation model, which incorporates elements of the SECI knowledge process, ba, knowledge assets, knowledge vision and leadership, is presented and discussed.

In the fifth section, the evaluation of the SECI model is presented. It is mainly criticized for its sole basis in Japanese management culture; neglecting conflicts in the knowledge creation process; operationalization and operationality problems; lack of clarity and precision; and so on.

The last section discusses knowledge sharing, knowledge transfer, and their differences from knowledge construction. This helps to better understand the research subjects and also helps clarify the terms that will be used in this research.

2.3.2 Knowledge & the Nature of Knowledge

There has been a long and heated debate about the question as to what knowledge is (Fernie, et al., 2002). In order to better understand this question, many researchers have distinguished

knowledge from data and information (Choo, 1998; Nonaka & Takeuchi, 1995; Davenport & Prusak, 1998).

However, there is a consensus that all of these three "involve interaction with human" (Fernie, et al., 2002:178). The main difference between them is the degree of reflection of "human involvement with and, the processing of the reality at hand" (Bell, 1999: lxi-lxiv). Bell (1999: lxi-lxiv) considers data as "an ordered sequence of items or events", and information provides a context for the arrangement of items and thus shows the relations between them; knowledge involves a personal judgement of the significance of the items and events within a particular context. Similarly, Zack (1999) concludes definitions of data, information, and knowledge as follows: data represents the facts or observations without context, and this makes it not directly meaningful; information is the outcome of placing data within a context, usually as a message; knowledge is what people believe or value, according to the accumulated information (and or messages), which are meaningful, organized and obtained from communication, experience and inference. Hence, according to the extent of human involvement with and interpretation of reality, data, information, and knowledge can be arranged on a single continuum (Bell, 1999).

Similarly, Tsoukas & Vladimirou (2001) suggest that knowledge differs from information in its presupposing of values and beliefs, and its involvement with action. Other researchers also have a similar view towards knowledge's strong connection to action: knowledge can affect action (Wigg, 1997; Leonard & Sensiper, 1998; Davenport & Prusak, 1998). From this perspective, Tsoukas & Vladimirou (2001: 976) claim that knowledge is "the individual's ability to draw distinctions within a collective domain of action, based on an appreciation of context or theory, or both". Bell (1999:175) defines knowledge as "a set of organized statements of facts or ideas, presenting a reasoned judgement or an experimental result, which is transmitted to others through some communication medium in some systematic form". Both of these two definitions acknowledge the personal nature of knowledge.

Nonaka & Tajeuchi (1995:58-59) also stress its relevance to human involvement by making the following statement:

> "Information is a flow of messages, while knowledge is created by that vey flow of information, anchored in the beliefs and commitment of its holder. This understanding emphasizes that knowledge is essentially related to human action."

Based on the agreement on the characteristics of knowledge in the above definitions, Davenport & Prusak (1998:5) further define knowledge as follows:

> "Knowledge is a flux mix of framed experiences, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms."

This definition highlights the dynamic nature of knowledge: knowledge is a "framework", as an outcome and the process, for "incorporating new experiences and information" (Tsoukas & Vladimirou, 2001: 974). However, it is criticized for failing to differentiate knowledge from information. In addition, it does not clarify the relations of values and contextual information with individuals' minds (Tsoukas & Vladimirou, 2001). One point worth noticing is that it agrees with the character of knowledge mentioned in the above definition: human involvement with reality; relevance of experience; and embedded personal evaluations and beliefs. In addition, it stresses the knowledge's personal nature and organizational nature. Brown & Duguid (1998: 91) also state that "while knowledge is often thought to be the property of individuals, a great deal of knowledge is both produced and held collectively". This is to say that knowledge exists at both the individual and organizational level.

Taking account of this, Tsoukas & Vladimirou (2001: 979) further improve their definition of knowledge: "Knowledge is the individual ability to draw distinctions within a collective domain of action, based on an appreciation of context or theory, or both". This definition indicates the relationship between individuals and collective action, and also stresses the importance of context. Polanyi (1975:44) also strongly stresses the personal character of knowledge and its contextual dependence: "All knowing is personal knowing-participation through indwelling". Thus, knowledge is always based on the context. Knowledge is context-specific, due to its dependence on a specific time and space (Hayek, 1945). From a cognitive perspective, the character of knowledge is usually abstract, task specific, and problem-solving oriented (von Krogh et al., 1994). Similarly, the knowledge creation process is also context-specific, relating to participants and participation patterns (Nonaka et al., 2000).

Thus, to conclude, knowledge's nature can be generalized as following: it is relevant with human's high-level involvement with reality in term of interpreting reality, processing reality by action; it has presuppositions of values and beliefs; it has a personal nature and can also

exist at the organizational level; it is context dependent; it is usually abstract, task-specific and problem-oriented; it can be generated through the medium of information (Baumard, 1999).

2.3.3 Explicit & Tacit Knowledge

Polanyi (1965) firstly drew the distinction between tacit knowledge and explicit knowledge. This is one of the most influential and generally accepted distinctions of knowledge (Fernie et al., 2003). In his classification, explicit knowledge is mainly about "know-what", which can be easily articulated and codified in formal language, like patents and manuals, and stored in media: "This systematic knowledge is readily communicated and shared through print, electronic methods and other formal means" (Smith, 2001: 315).

2.3.3.1 The Nature of Tacit Knowledge

Polanyi (1967:4) describes tacit knowledge as follows: "I shall reconsider human knowledge by starting from the fact that we know more than we can tell". Tacit knowledge is an embodied form of knowledge, is quite personal and informal, and depends on the context (Sternberg, 1997). This causes difficulty in its expression, formalisation and communication (Nonaka, 1991). Tacit knowledge accounts for a large portion of human knowledge: for example, skills and know-how, which are very difficult to articulate or transfer in codified forms.

Tacit knowledge also has a practical feature (Sternberg, 1994). According to Nonaka (1991:98), tacit knowledge is similar to know-how, because "tacit knowledge consists partly of technical skills-the kind of informal, hard-to-pin down skills captured in the term 'know-how'". Lam (2000:489) further points out that "it can only be revealed through practice in a particular context and transmitted through social network". In addition, Brown & Duguid (1998:100) suggest that "Within communities, practice helps to generate knowledge and evince collective know-how." Thus, this also suggests that the tacit knowledge which is built on experience can be transmitted through the communication platform in this research, i.e. the virtual product user community.

Another characteristic of tacit knowledge is its context-dependence (/ context specific). This is related to its practical character. Sternberg (1994) suggests that tacit knowledge is mainly obtained in the work or circumstances where it is utilized. Nonaka (1991:98) also states that tacit knowledge is embedded in individual's action and practices, and is also rooted in

specific contexts, such as "a craft or a profession, a particular technology or product market, or the activities of a work group or team".

Another attribute of tacit knowledge is personal nature. Nonaka (1991) and Sternberg (1994) argue that cognitive dimensions exist in tacit knowledge. Tacit knowledge contains mental models for individuals to follow in certain circumstances. Tacit knowledge is so deeply embedded within the individual's mind that it seems completely natural (Ravetz, 1971). This also explains of the difficulty of articulating it.

According to the above, the attributes of tacit knowledge can be concluded as follows: it is unarticulated and implicit (Spender, 1994); it is difficult to be codified and transmitted; it is uncodifiable (Hu, 1995); it has a practical (/experiential) nature: it is based on practices and thus it is context independent.

2.3.3.2 The Importance of Tacit Knowledge

In the era of the knowledge economy, knowledge and the requisite ability for creating and utilizing knowledge becomes one of the most valuable resources for a business organization's sustainable competitive advantage (Nonaka, 1991; Nelson, 1991; Nonaka & Takeuchi, 1995; Spender & Grant, 1996). Brown & Duguid (1998) state that the core competency of an organization relies more on tacit knowledge of "know-how" than explicit knowledge of "know-what". Nonaka (1991), Spender (1993) and Grant (1996) also state that tacit knowledge is the key to developing sustainable competitive advantages. In addition, know-how is to a great extent generated from experience. "Know-how is to a great extent the product of experience and the tacit insights experience provides" (Brown & Duguid, 1998:95). The knowledge requisite for good performance in the working group can be usually tacit (Polanyi, 1966). Thus, the capability of incorporating product users' tacit knowledge, especially their innovative insights about product usage, new product development and marketing, can greatly promote the producer's core competency. The virtual product user community, the aggregation of a large number of product users on the Internet, certainly is a valuable source of tacit knowledge for the organization.

The interaction between these two types of knowledge, i.e. tacit knowledge and explicit knowledge, is essential for creating new knowledge (Nonaka, 1994). Tacit knowing is highly emphasized as the origin of human knowledge (Polanyi, 1966; Spender, 1996a and 1996b; Nonaka, 1994). Accordingly, Lam (2000) suggests that the social and interactive nature of

knowledge construction and learning should be paid attention to (Lam, 2000). The new knowledge creation will be discussed in the next section (2.3.4 and 2.3.5).

2.3.3.3 Four Types of Knowledge

Cook & Brown (1999) suggest four distinct forms of knowledge: explicit/tacit knowledge and individual/group knowledge. These four types of knowledge equally stand with each other, and none is superior or subordinate to any other: "This distinct character is reflected in the fact that each form of knowledge does work that others cannot" (Cook & Brown, 1999:382). However, for the explicit and tacit forms of knowledge, each can work as an aid to obtaining the other. They also argue that individual knowledge and group knowledge "each do[es] epistemic work that the other cannot" (Cook & Brown, 1999:386). The body of group knowledge is possessed by the whole group and is acquired through group action. So is individual knowledge, which is possessed by the individual and created through the individual's own action (Cook & Brown, 1999).

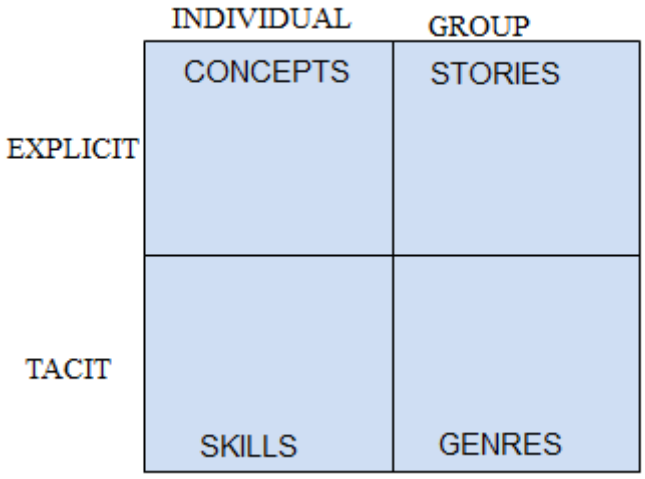


Figure 2-1: Four Forms of Knowledge (Cook & Brown, 1999: 391)

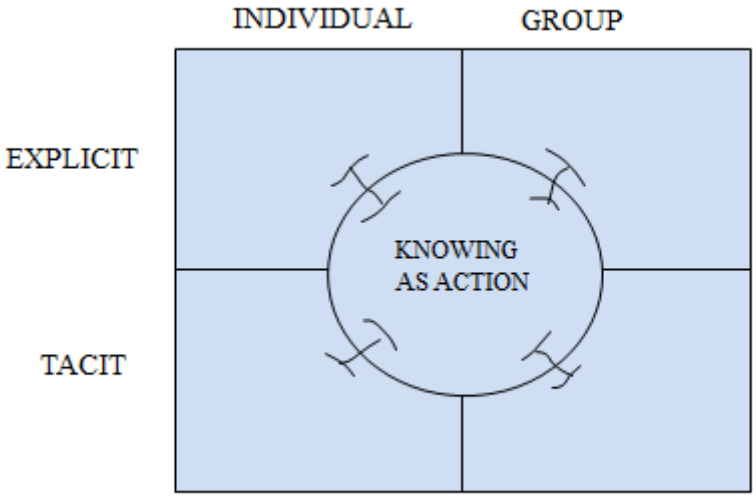


Figure 2-2: Adding Knowing to Knowledge (Cook & Brown, 1999:393)

2.3.4 Individual-level Knowledge Creation & Social-level Construction of Knowledge

Vygotsky (1978) stresses that social interaction is the way of converting explicit certain process to be internalized in the individual's thoughts. Based on this, Pea (1993:78) points out that "Knowledge is commonly socially constructed, through collaborative efforts toward shared objectives or by dialogues and challenges brought about by differences in persons' perspectives". Pena-Schaff & Nicholas (2004) point out that knowledge construction should be considered as a social and interactive process which brings in different perspectives through dialogues.

Gunawardena et al. (1997) stress that two types of knowledge creation are involved in collaborative learning activities: the individual-level and the social-level. Knowledge creation is conducted during social interaction at the level of the group. When individuals interact with the group's knowledge construction, they also create their own understandings and knowledge at the individual level. These two types of knowledge creation interact with and develop in relation to each other (Salomon, 1993). Thus, individual knowledge creation and the social construction of knowledge are interdependent on and influence each other.

This research aims at revealing the social construction of knowledge at the group level, which is embedded within online collaborative discussion transcripts in the virtual product user community, rather than the individual-level of knowledge creation which is mainly about the internalization process of thoughts.

Jonassen et al. (1993) stress that knowledge construction needs active engagement in building knowledge structures, rather than reproduction or repetition. This process necessarily requires higher-order thinking (Gunawardena et al., 1997). As discussed in the section (2.3.8.1.2 Knowledge Nature and Knowledge Transfer), this research aims to explore knowledge construction embedded within the chosen asynchronous discussion threads for solving technical problems, rather than embedded knowledge sharing, which is of a low-order thinking.

2.3.5 Social Construction of Knowledge

Social constructivists consider knowledge to be a product of human activities, and socially and culturally constructed (Prawat & Floden, 1994; Greddler, 1997; Ernest, 1999). Knowledge is constructed through social intercourse, and its advance is gradually accumulated through social interaction between people (Kanuka & Anderson, 2007). "Knowledge in some area[s] is the product of our social practices and institutions, or of the interactions and negotiations between relevant social groups" (Gasper, 1999:855). Knowledge construction is based on social experience because "the mind is instrumental and essential in interpreting events, objects, and perspectives on the real world, and that those interpretations comprise a knowledge base that is personal and individualistic" (Jonassen, 1991:29). Vygotsky (1978) emphasizes the social and cultural influences in the knowledge construction. Similarly, Yang (1997) states that meanings are actively and continuously constructed in social contexts. Based on the social constructivist perspective, Berger & Luckmann (1966) state that the reality of the social world is socially constructed.

Berger & Luckmann (1966) further suggest three key elements involved in the social construction of reality and knowledge: externalization, objectivation, and internalization. These three elements together illustrate the way in which knowledge, technologies and even social institutions are created, legitimated, maintained and transmitted through social interaction.

They argue that knowledge is initially created as a by-product of the externalization of human activities. Then a mutual but implicit understanding between people is developed when they interact with each other over time. Soon, this implicit knowledge has to undergo objectivation and become the explicit concepts and rules which language and other sign systems can refer to. Berger & Luckmann (1966:78) define the objectivation as "the process by which the externalized products of human activity attain the character of objectivity". The step of

externalization and the step of objectivation undergo a continuous dialectical process. In the last step, this knowledge is internalized by people who are not involved in its creation. Internalization refers to the process of "the objectivated social world is retrojected into consciousness in the course of socialization" (Berger & Luckmann, 1966:78-79).

Knowledge become externalized, fragmented, and formalized with order and ration, in order to transmit the objectified understanding and to legitimate the knowledge creator entity. Through this process, the informal, tacit, and fluid understanding between people in face-to-face communication becomes knowledge, which is formal, explicit, static, and culturally transmittable (Berger & Luckmann, 1966).

From the perspective of constructivism, a learning environment promotes students' interaction and dialogue and thus enables them to engage in the knowledge construction process by creating meaning (Jonassen et al., 1995). In the online learning context, students actively involve themselves in the social process of knowledge construction in terms of building on ideas proposed by discussion participants (Pena, 2003). Pea (1993) concludes that knowledge construction is the social and dialogical process of incorporating varying perspectives.

2.3.6 Organizational Knowledge Creation Models

2.3.6.1 SECI Model of Knowledge Process

Nonaka & Takeuchi (1995) developed a very renowned and prominent model of organizational knowledge creation, i.e. the SECI model in the book *The Knowledge-Creating Company*, as illustrated in Figure (3). The SECI model is one of the few existing knowledge creation models and frameworks that involve the relationships between explicit knowledge and explicit knowledge (Li et al., 2009). In addition, it is also widely used and discussed in many research areas: for instance, new product development and organizational learning (Nonaka et al., 2000b; Lee & Choi, 2003).

Nonaka & Takeuchi (1995) identify that the SECI model is mainly based on the following ideas and works: tacit and explicit knowledge (Polyani, 1966); community of practice (Brown & Druguid, 1991); shared mental models (Johnson-Laird, 1983); and declarative and procedural knowledge (Signley & Anderson, 1989). This model's goal is to "formalize a generic model of organizational knowledge creation" (Nonaka &Takeuchi, 1995: ix).

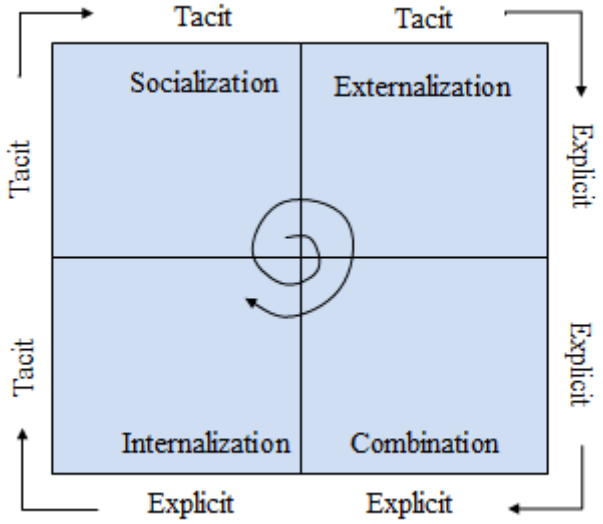


Figure 2-3: SECI Model (Nonaka & Takeuchi, 1995: 57, 62, 71)

The initial SECI model has a few variations which are developed by Nonaka and his colleagues (2000; 2002) as the following figures show. However, these new models are based on the original SECI model and have not undergone much change. Their key attributes of conversion between tacit knowledge and explicit knowledge, the four modes, and spiral knowledge creation patterns, are not changed.

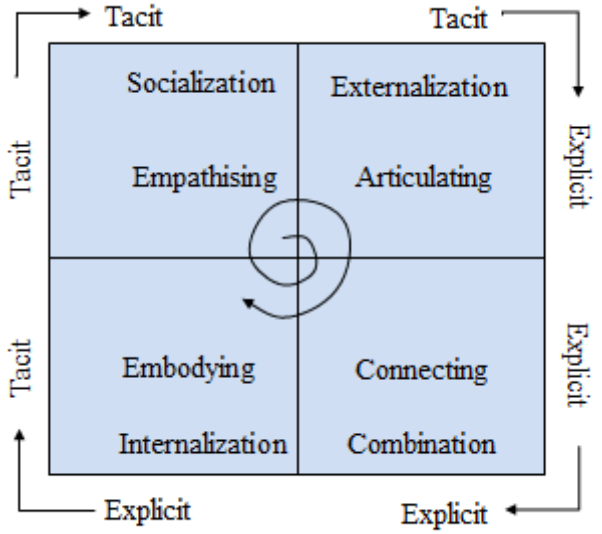


Figure 2-4: The SECI Process (Nonaka et al., 2000:12)

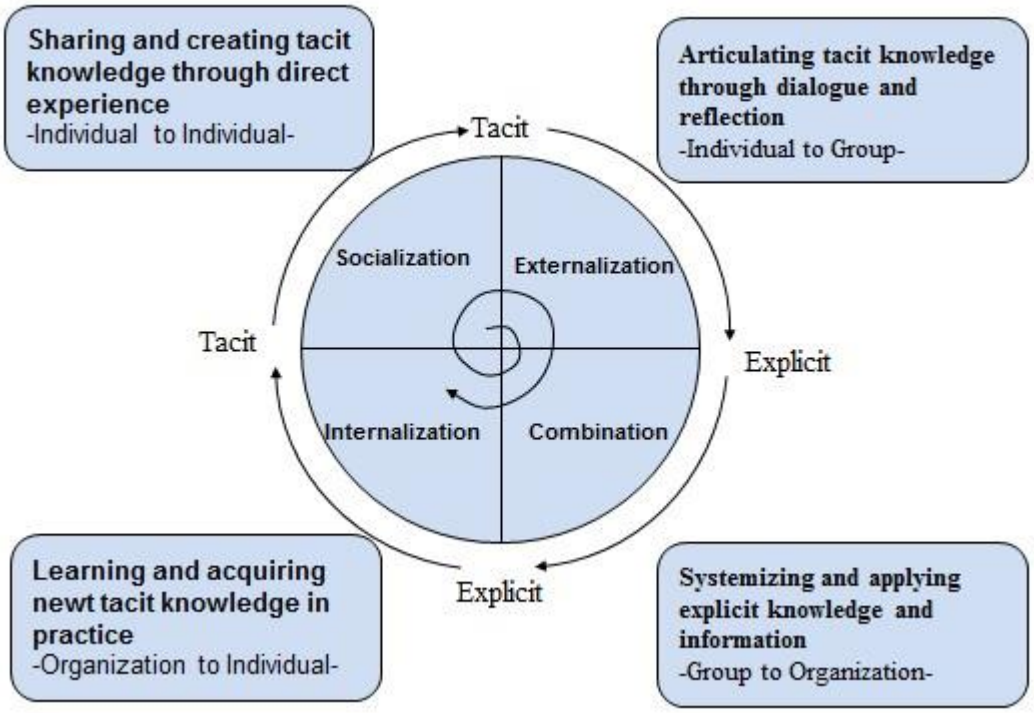


Figure 2-5: The SECI Process (Nonaka & Toyama, 2002: 996).

Knowledge is defined by Nonaka (1991) as "justified true belief" (Nonaka & Takeuchi, 1995:21). His definition of explicit knowledge has no difference to others: it is usually considered as easily articulated and expressed knowledge with clear and formal forms. Tacit knowledge is considered as more important in innovation, and is defined as "personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspective, and the value system" (Nonaka & Takeuchi, 1995: viii). Knowledge creation is defined as "self-transcending process by means of which one transcends the boundary of the old self into a new self" (Nonaka et al., 2001b:16). Later Nonaka & Toyama (2002:2) further define knowledge creation "as a dialectical process, in which various contradictions are synthesized through dynamic interactions among individuals". Organizational knowledge creation is defined by Nonaka & Takeuchi (1995: 25) as "the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems".

Nonaka & Konno (1998) propose the SECI model to illustrate organizational knowledge creation. This model indicates that the knowledge creation process contains four modes: socialization (from tacit knowledge to tacit knowledge); externalization (from tacit knowledge to explicit knowledge); combination (from explicit knowledge to explicit

knowledge); and internalization (from explicit knowledge to tacit knowledge). The starting mode, "socialization", is about converting tacit knowledge to tacit knowledge by social interaction. The second mode, "externalization", converts tacit knowledge to explicit knowledge by creating understandable and interpretable form to express or articulate tacit knowledge. The third mode "combination" is about converting explicit knowledge to explicit knowledge. This mode refers to the process of "systematizing concepts into a knowledge system" (Nonaka & Takeuchi, 1995:67). In this mode, different types of explicit knowledge are combined or synthesized and then transferred. The fourth mode, "internalization", converts explicit knowledge to tacit knowledge. In this stage, an individual absorbs explicit knowledge through learning-by-doing, documentation, or training, and explicit knowledge becomes a part of the individual's knowledge. After the last mode, the process repeats itself, but at a new level. Thus, these four modes develop in a continuous circular way and form a "spiral" of knowledge creation via dynamic interaction between explicit knowledge and tacit knowledge (Nonaka & Takeuchi, 1995). This "spiral" process is illustrated as follows:

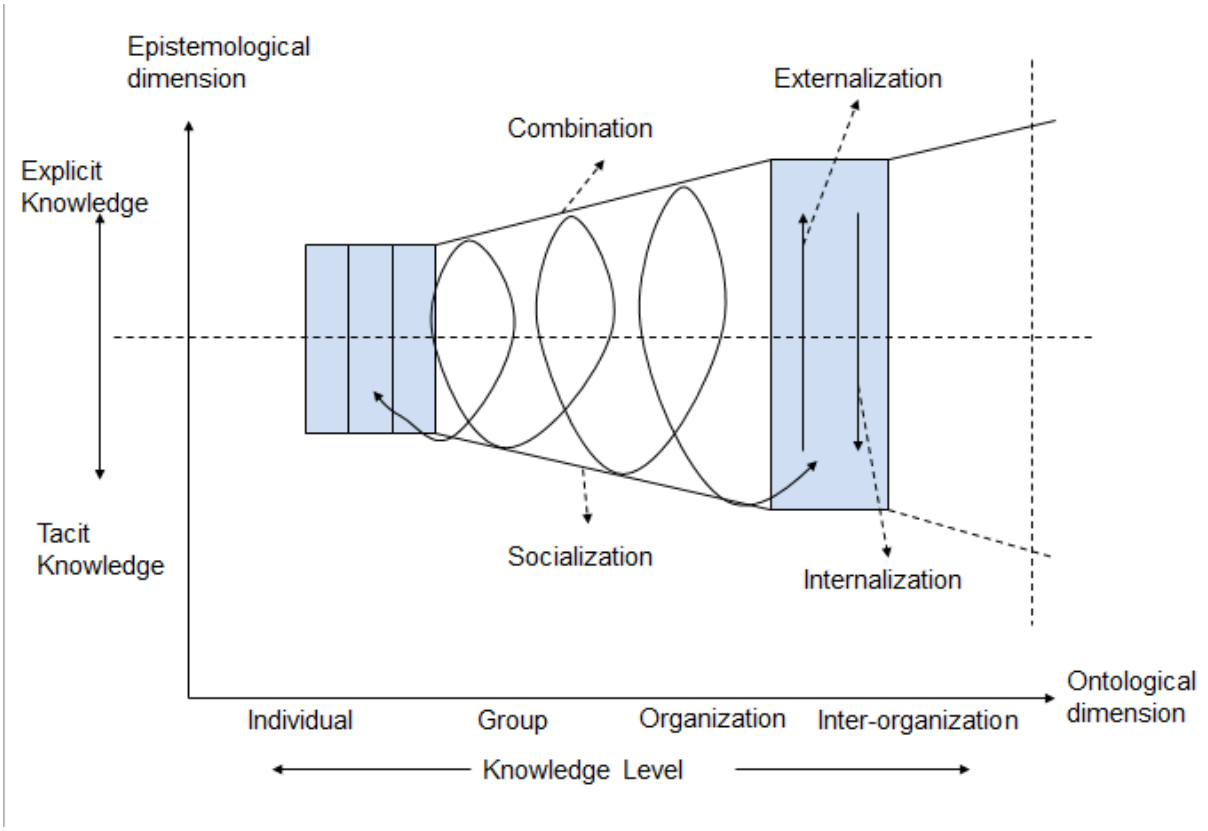


Figure 2-6: Spiral of Organizational Knowledge Creation (Nonaka & Takeuchi, 1995:73)

The organizational knowledge creation in the SECI model contains two dimensions: 1) "Epistemological" dimension, which is referred to as the "social interaction" site, where tacit and explicit knowledge interact with each other (Nonaka et al. 1994:338; Nonaka, 1994:15); and 2) the "Ontological" dimension, which refers to the levels of the entities involved in the knowledge creation process, from the individual level at one end, to the group, organizational, inter-organizational level at the other. In the process of the ontological dimension, an individual's knowledge is "amplified" and becomes "a part of the knowledge network of an organization" (Nonaka, 1994:17-18). Consequently, "a spiral emerges when the interaction between tacit and explicit knowledge is elevated dynamically from a lower ontological level to higher level" (Nonaka & Takeuchi, 1995:57). Through the spiral process of SECI model, knowledge is continuously created and utilized, and the tacit knowledge and explicit knowledge also develop from the individual level to the group level and finally to the organizational level (Nonaka & Toyama, 2002). The overall process is not linear but recursive and iterative (Engeström, 1987; Paavola et al., 2002)

These four modes are also operated by entities of different levels. The socialization mode, where tacit knowledge is shared, operates at the group level. Dynamic social interactions between group members and close collaboration are needed in this mode. The next mode, externalization, is considered as the core mode in the whole knowledge creation process (Paavola et al., 2002). In this mode, tacit knowledge, which is the innovation source, is conceptualized and explicated by the individual in order to make it useful for the group and the organization. Thus, this can be considered to be happening at the individual level. In the third mode, combination, explicit knowledge is exchanged within the group or at an organizational level. The fourth mode, internalization, is about internalizing explicit knowledge at the group or organizational level into the individual's tacit knowledge. That is to say internalization operates at the individual level. All of these four modes are summarized in the following table:

Table 2-2: Four Modes and Relevant Attributes in SECI Model

Mode	Knowledge Converting	Entities level
Socialization	from tacit knowledge to tacit knowledge	group level

Externalization	from tacit knowledge to explicit knowledge	individual level; (/individual to group level)[1]
Combination	from explicit knowledge to explicit knowledge	group or organizational level ; (/group to organization level)[2]
Internalization	from explicit knowledge to tacit knowledge	individual level (/group level to individual level)[3]

Paavola et al., (2002:27) further concludes the attributes of SECI model as the following table:

Table 2-3: Attributes of the SECI Model [adapted from the Table of Three Frameworks for Understanding Innovative Knowledge Communities (Paavola et al., 2002:27)]

SECI model's Attribute	Content
The role of individual expertise	Black box, individuals create knowledge
Main focus	Externalization of tacit knowledge (insighting)
Types of process focused on	Emphasizes bodily process, personal experience
Source of innovation	Transforming tacit knowledge to explicit knowledge
Scope of framework	Different ontological levels (individual, innovative team, organization, and inter-organizational level)
Educational application	Knowledge-creating schools

2.3.6.2 Development of SECI Model (/"Ba" and "Knowledge Assets")

The SECI model is further developed by adding another two elements, i.e. "ba" (/place) and knowledge assets, to the other elements in order to fully describe organizational knowledge creation (Nonaka et al., 2000; Nonaka et al., 2001).

Ba is defined as the "a shared context in which knowledge is shared, created and utilized" (Nonaka et al., 2000: 8). Ba indicates the context of the SECI process thus:

> "'Ba'is a place where information is given meaning through interpretation to become knowledge, and new knowledge is created out of existing knowledge through the change of the meanings and the contexts. In other words, 'ba' is a shared context in cognition and action." (Nonaka et al., 2000: 8).

[1] This is based on the figure of The SECI Process (Nonaka & Toyama, 2002: 996).
[2] This is based on the figure of The SECI Process (Nonaka & Toyama, 2002: 996).
[3] This is based on the figure of The SECI Process (Nonaka & Toyama, 2002: 996).

"Ba" is not necessarily about the physical space, rather it is about the context where individuals interact with each other. "'Ba' is an emerging relationship among individuals, and between an individual and the environment" (Nonaka et al., 2000:9). A business organization can be conceptually considered as "a dynamic configuration of 'ba'" (Nonaka et al., 2000:8). In addition, more case studies are conducted to reflect a wider range of contexts where the framework can be applied (Nonaka & Nishiguchi, 2001).

Nonaka et al. (2000) further classify ba into four types, which corresponds to the different phases of the SECI process: originating ba, dialoguing ba, systemising ba, and exercising ba. These four types of ba are defined by the interaction dimension and the media dimension. The media dimension is about which media is the interaction tool, face-to-face or online media (i.e. virtual). The interaction dimension is about whether interaction takes place at the individual level (/individually) or group level (/collectively). "Each ba offers a context for a specific step in the knowledge–creating process, though the respective relationships between each single ba and conversion modes are by no means exclusive" (Nonaka et al., 2000:16).

According to the following Figure 2-7, originating ba is defined by face-to-face and individual interactions. It is mainly about providing a context for socialization. It is the place where emotions, feelings, experiences, and mental models are shared between individuals. It also creates the basis for knowledge conversion among individuals by developing psycho-emotions of trust, love, care and commitment.

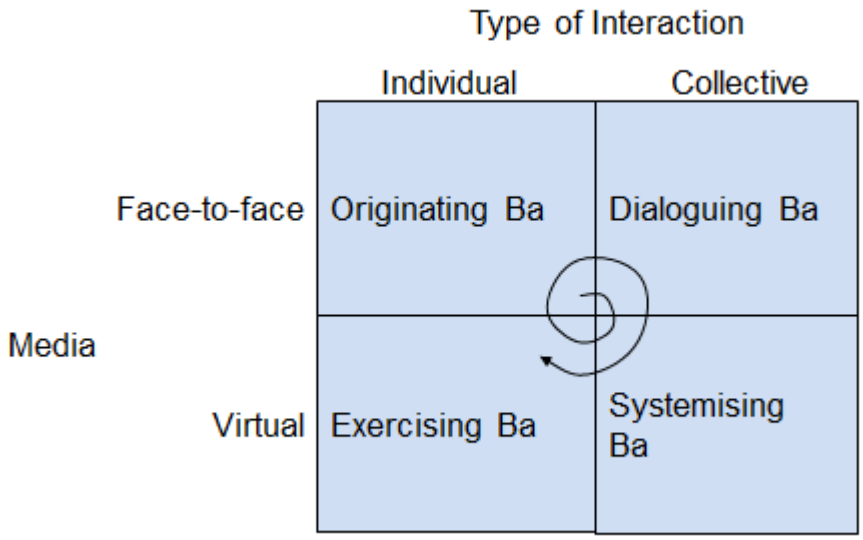


Figure 2-7: Four Types of ba (Nonaka et al., 2000:16)

Dialoguing ba is defined by face-to-face and collective interactions. Dialoguing ba is mainly about providing the context for knowledge externalization. Individuals share their mental models and have self-reflection through dialogue. In this context, individuals' tacit knowledge is shared and articulated. The constructing of dialoguing ba is more conscious and purposeful than originating ba. The common explicit terms and concepts can be generated through this process (Nonaka & Konno, 1998; Nonaka et al., 2000).

Systemising ba is defined by virtual and collective interactions. It is mainly about providing a context for the combination of explicit knowledge, which is in formalized form and is more oriented to be transmitted to a larger scale of receivers such as the group or organization. Information technology creates a virtual collaborative environment for building systemising ba.

> "Today, many organizations use such things as electronic mailing lists and news groups through which participants can exchange necessary information or answer each other's questions to collect and disseminate knowledge and information effectively and efficiently" (Nonaka et al., 2000:17).

Exercising ba is defined by virtual and individual interactions. It is about providing contexts for internalization of explicit knowledge. In the exercising ba, the explicit knowledge, which is transmitted via virtual media, is embodied by individuals. The transcendence and reflection can be synthesized by exercising ba through action. This is different from dialoguing ba, which can be achieved through thoughts.

The concept of knowledge assets is also introduced to the SECI model as the knowledge possessed by the company. It is defined as "inputs, outputs, and moderating factors of knowledge-creating processes" (Nonaka et al., 2000: 20). Nonaka et al. (2000: 15) further divide knowledge assets into four types:

- Experiential knowledge assets (i.e. tacit knowledge shared through common experiences among organizational members and other members associated with each other). Its typical examples are skills and know-how, which is acquired and accumulated by individuals in their working experience. Nonaka et al. (2000) also suggest that experiential knowledge also contains emotional knowledge (e.g. care, love and trust); physical knowledge (e.g. facial expressions and body languages); energetic knowledge (e.g. tension and enthusiasm); and rhythmic knowledge (e.g.

entrainment and improvisation). Experiential knowledge is difficult to be acquired, assessed and traded due to its tacit nature. It is also organizational specific and thus is difficult to be imitated by competitors. Therefore, it enables the enterprise to obtain a sustainable competitive advantage.

- Conceptual knowledge assets (i.e. explicit knowledge articulated by images, symbols, and language). It is articulated in tangible forms, thus it is easier to be captured than experiential knowledge.

- Routine knowledge assets (i.e. tacit knowledge which is routinised and embedded in an organization's actions and practices). Its typical examples are organizational routines, organizational culture and know-how, which are needed for conducting the daily business of companies. Its salient nature is practical.

- Systemic knowledge assets (i.e. systemized and packaged explicit knowledge). Its typical examples are manuals, explicitly articulated technologies, documents, product information, patents and so on. Its salient feature is that it can be relatively easily transferred.

These four types of knowledge assets together build the base for knowledge creation (Nonaka et al., 2000). The common nature of these knowledge assets is intangible, tacit and dynamic (Nonaka et al., 2000). Moreover, the firm's knowledge assets is dynamically created and shared in "ba" (Nonaka et al., 2000).

Zollo & Winter (2002) create a similar model, which is quite similar to Nonaka & Takeuchi (1995)'s SECI model. It contains four knowledge transformation processes, namely, variation, selection, replication, and retention. However, they use the "evolution cycle" to name the interaction between these four processes. The triggering factors for knowledge creation, namely feedback and external stimuli to the knowledge creation practitioners, are added to their model.

2.3.6.3 Unified Knowledge Creation Model

In order to provide a macro view to understand the dynamic knowledge creation in the firm and effectively manage this process, Nonaka et al. (2000) develop a new comprehensive model, namely the Model of Leading the Knowledge-Creating Process (/the Unified

Knowledge Creation Model), on the basis of incorporating the elements of SECI process, ba, and knowledge assets, knowledge vision, and organization's leadership as well.

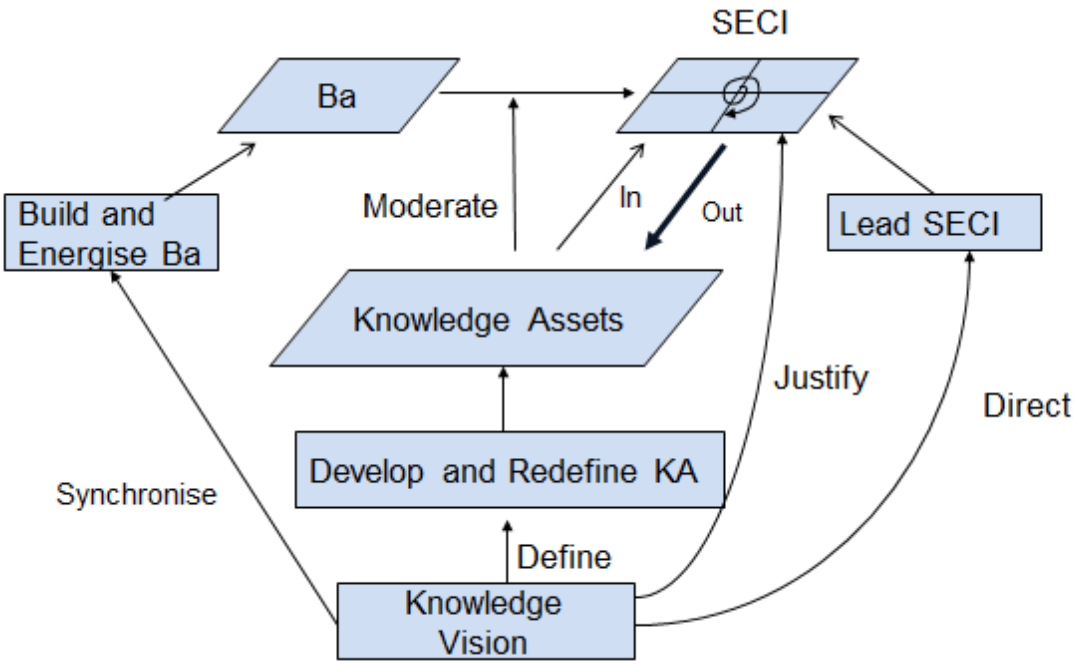


Figure 2-8: Leading the knowledge-creating process (Nonaka et al., 2000:23)

During the organizational knowledge creating process, three key elements, the SECI knowledge process, ba, and knowledge assets continuously interact with each other in an organic and dynamic way. The ba provides a place where the knowledge assets of the company are shared and mobilised. In addition, the ba is also the place where personal tacit knowledge held by individuals is augmented through the spiral SECI process (i.e. socialization, externalization, combination, and internalization).

The knowledge vision, which is articulated and disseminated to the whole company by the top management, decides "how the organization and its knowledge base evolve over the long term" (Nonaka et al., 2000:23). It defines the type of knowledge the organization should create. Moreover, it also defines the value system which assesses and determines the quality of knowledge created in the company.

According to Nonaka et al. (2000), in order to enable the continuous and dynamic knowledge creation, the three elements of knowledge process of the SECI, Ba, and knowledge assets should be closely integrated as a whole under a clear leadership from the company. Moreover, the leadership of the company plays a central role in facilitating the organizational knowledge creation process. Nonaka et al. (2000) point out that these roles include: developing and

understanding the organization's knowledge vision; understanding the company's knowledge assets; supporting and utilising ba; and managing the spiral knowledge process. In particular, the middle level manager of the company plays a key role during this process.

The organizational knowledge creating process at the company level is described by this model as "the dynamic interaction between organizational members, and between organizational members and the environment" (Nonaka et al., 2000:30). `

2.3.7 Evaluation of SECI model

The SECI model is located at the area of knowledge management and is concerned about how to organize companies to create innovate knowledge and improve innovative performance (Paavola et al., 2002).

From the macro perspective, this model is criticized due to the fact that it is based on studying Japanese management practices and cultural background and thus it cannot be transferred to other cultural contexts (Glisby & Holden, 2003).

Engeström (1999) points out that the fundamental problem of the SECI model is its excessive reliance on the idea of sharing tacit knowledge in the mode of socialization and neglecting the debates and conflicts in the knowledge creation process. Engeström (1999) suggests that the first two key phases regarding controversies and conflicts in the knowledge creation cycle should be considered, i.e., questioning and analyzing the situation. One explanation for this is that the cultural background of Nonaka's study is different (Paavola et al., 2002). The SECI model is based on the study of Japanese business organizations whose management culture is of collective cultural dimension and strongly emphasizes harmony and group thinking. On the contrary, western organizations and cultures are more oriented to taking individual differences and conflicts as a starting point (Paavola et al., 2002).

Bereiter (2002) criticizes the SECI model for its basis in mentalist "folk epistemology" (/folk psychological theory of mind). The SECI model is built on the main focus of externalization of tacit knowledge, and this makes it appears to rely on a mentalistic assumption that knowledge exits and is created in an individual's mind. Bereiter (2002) states that knowledge is systematically created and shared within a community rather than by an individual. Because of this mentalistic assumption, Nonaka & Takeuchi's (1995) SECI model lack of the knowledge considered as "conceptual artefacts" and the idea of knowledge building (Bereiter, 2002). Consequently, SECI model is not capable of capturing the critical elements of

knowledge work, i.e., "how knowledge is created, understood, and used in collaborative knowledge building" (Paavola et al., 2002: 26). McLean (2004:7) also points out that the SECI model fails to answer the question "What are mechanisms, at a detailed level, that explain how these concepts work together to create knowledge in organizations?" while admitting that the SECI model explains knowledge creation components, and, to some extent, the knowledge creation process (i.e. "how" organizational knowledge is created).

Another shortcoming of the SECI model is related to its operationalization. In order to achieve the confirmation of validity, the theoretical framework must be applied to and empirically confirmed in reality (Swanson & Chermack, 2013). In order to achieve the necessary confirmation, "…the theoretical framework must be translated, or converted, to observable, confirmable components/elements. These components/elements can be in the form of, for example, confirmable propositions, hypotheses, empirical indicators, and/or so-called knowledge claims" (Cohen, 1991, in Lynham, 2002: 232).

In the operationalization phase of theory building,

> "a primary output of the theorizing components of applied theory building is an operationalized theoretical framework-that is, a logical and sound theoretical framework that has been converted into components or elements that can be further investigated and confirmed through rigorous research and relevant application" (Swanson & Chermack, 2013: 233).

Nonaka & Takeuchi (1995) operationalize their concepts by providing case examples, broad statements of concepts, and conceptual models. Nevertheless, heavily depending on general statements, their operalization of theory work seems to be short of explicit and clearly defined testable hypotheses that can illustrate how their concepts relate to each other (McLean, 2004).

Similarly, the operationality is an obvious weakness of SECI model (McLean, 2004). Patterson (1986) defines operationality as meaning that "a theory should be capable of being reduced to procedures for testing its propositions or predictions" (Patterson, 1986: xxi).

> "A theory is operational if its concepts are richly described, it is capable of having its propositions tested by other researchers, and the stakeholders to whom it is intended to apply assent to its usefulness for their lives and contexts" (Lincoln & Lynham,2007:4).

Operationality can help ensure the precision of the concepts for evaluation, and discover the concepts which can illustrate the relations of concepts and thus organize them. The concepts of the SECI model are quite difficult to evaluate, and the changes in output of the

measurement are hard to foresee (McLean, 2004). Thus, "the extent to which the theory has been operationalized remains in question" (McLean, 2004:6). In addition, the practicality of the SECI model is also limited, due to a lack of operationalization (McLean, 2004).

Another key weakness of the SECI model is a certain lack of clarity and precision (McLean, 2004). A certain amount of ambiguity is caused by its profusion of somewhat abstract concepts. This is also related to the lack of clearly testable hypotheses. Gourlay (2006) argues that the modes of "combination" and "internationalization" in the SECI model are ambiguous concepts which conflate the processes of knowledge creation and transfer. His claim is confirmed to some extent by the empirical studies of North American companies (Martin-de-Castro, 2008). Tacit knowledge is very difficult to transfer and usually needs two different kinds of socialization. In addition, explicit knowledge transfer throughout the enterprises needs to go through knowledge combination, knowledge conversion and creation, which also supports the transfer process (Martin-de-Castro, 2008).

Mclean (2004) points out that Nonaka & Takeuchi (1995) and many researchers try to confirm the validity of the SECI model exclusively with case studies. According to his explanation, this is mainly because the operationalization of its concepts has not reached a sufficient level where other research methods can be helpful to confirm its empirical validity and verify the theory. Thus, the problem of confirming its empirical validity is also caused by the concept operationlization issue of the SECI model.

The empirical study of the knowledge creation process in knowledge-intensive firms conducted by Martin-de-Castro et al. (2008) finds that the SECI model is not so apparent in the management practices of the surveyed companies. The contextual differences of industries, cultures, and selected companies can create vital uniqueness, which makes it difficult to clearly understand the theoretical processes proposed in the SECI model (Martin-de-Castro et al., 2008). They stress that contextual factors can influence the exact knowledge creation pattern. "Each business context imposes important conditions on how the processes of knowledge creation are structured in real firms" (Martin-de-Castro, 2008: 229).

However, the SECI model is still an effective guide or starting point for exploring knowledge creation in business organizations. The tacit-explicit interaction presented in the SECI model "lie[s] in the heart of knowledge creation" (Martin-de-Castro et al., 2008:227). Moreover, special attention should be given to the context where knowledge creation happens (Martin-de-Castro et al., 2008). This is also in line with McAdam's (2004) statement that the social

constructionist approach is a very appropriate analysis approach for knowledge creation, due to its contextual and dynamic process.

2.3.8 Knowledge Transfer and Knowledge Sharing

2.3.8.1 Knowledge Transfer

Knowledge is both the resource for and impedance to innovation (Carlile, 2002). Nevertheless, knowledge transfer can promote both organizational performance and innovativeness (Van Wijk et al., 2008). Knowledge transfer between and within organizations is positively related to business performance and innovation (Lane et al., 2001).

2.3.8.1.1 The Definitions of Knowledge Transfer

Knowledge transfer conducted by an organization is initially defined by Argote et al. (2000:33) as "the process through which one unit (e.g., individual, group, department, [and] division) is affected by the experience of another". Similarly, it is also defined as "the process through which organizational actors-teams, units, or organizations-exchange, receive and are influenced by the experience and knowledge of others" by van Wijk et al. (2008:832).

Both of these two definitions include the two basic factors: 1) knowledge is transferred from the source to the recipient organization (transmission); 2) transferred knowledge has effects on the recipient organization throughout this process (influence). While including these two elements, the definition of knowledge transfer is further enriched by Nakanishi (2015: 577) as "a process in which knowledge is transferred from a source to a recipient via some channel, such that the knowledge influences the outcome of the recipient, and is integrated into its routine." This definition also includes the integration of transferred knowledge into the recipient organization (i.e. integration). In addition, it also suggests that knowledge transfer consists of several factors, such as transmission channel, transferred knowledge, knowledge source, knowledge recipient, outcome, context and routine.

Van Vijik (2008) points out that the knowledge transfer process in some studies is also labelled with alternative but relevant names, such as knowledge sharing (Tsai, 2002; Hansen, 1999), knowledge flows (Schulz, 2001; Gupta & Govindarajan, 2000), and knowledge acquisition (Lyles & Salk, 1996; Darr et al., 1995).

In this research, organizational knowledge transfer mainly refers to the process of transferring knowledge across the organizational boundary between the business organization (i.e. the

producer) and its sponsored online technical support forum (i.e. the virtual product user community).

2.3.8.1.2 Knowledge Nature and Knowledge Transfer

Many factors can have an effect on organizational knowledge transfer across the organizational boundaries, such as the organizational characteristics and network characteristics (Adler & Kwon, 2002; Inkpen & Tsang, 2005). The knowledge attribute, which is discussed in Section 2.3.2, is one of the essential influencing factors (Zander & Kogut, 1995; Birkinshaw et al., 2002). It has an important but negative influence on knowledge transfer (Van Wijk, 20008).

Knowledge has a situated and tacit nature (Suchman, 1987; Cook & Brown, 1999). This makes knowledge quite difficult to be transferred from one working situation to another. In addition, knowledge is localized, embedded, and invested in practice in new product development (Carlile, 2002). "…these same characteristics of knowledge in practice that lead to the effective specialization of knowledge become problematic when working across practices" (Carlile, 2002: 446).

Ambiguity is also one of the most critical characteristics of knowledge that influence knowledge transfer (Levin & Cross, 2004; Simonim, 1999; Szulanski et al., 2004). "Knowledge ambiguity refers to the inherent and irreducible uncertainty as to precisely what the underlying knowledge components and sources are and how they interact." (van Wijk, 2008:833). Reed & DeFilippi (1990) point out that knowledge ambiguity is created from co-occurring results of the tacit, specific, and complex nature of knowledge that is transferred. It can prevent organizational knowledge from imitation by other competitors. However, it also hinders knowledge transfers at both inter-organizational and intra-organizational level (Coff et al., 2006). Knowledge ambiguity is less harmful towards knowledge transfer at the intra-organizational level than the inter-organizational level (Van Wijk et al., 2008).

2.3.8.2 Knowledge Sharing

Knowledge sharing is a significant process in an organization, and is the basis for developing new ideas through knowledge workers' socialization and learning (Grant, 1996). Lin (2007: 2) defines knowledge sharing as "a social interaction culture, involving the exchange of employee knowledge, experiences, and skills through the whole department or organization". This definition focuses on the "social interaction" cultural aspect of knowledge sharing. The

examples provided by Lin (2007:2) are "employee willingness to communicate actively with colleagues (i.e. donate knowledge)" and "actively consult with colleagues to learn from them (i.e. collect knowledge)". Similar to the definition, these two examples also stress the interactive culture.

Lin (2007) also classifies knowledge sharing into the individual level and organizational level. At the individual level, "Knowledge sharing is talking to colleagues to help them get something done better, more quickly, or more efficiently" (Lin, 2007:2); at the organizational level, "knowledge sharing is capturing, organizing, reusing, and transferring experience-based knowledge that resides within the organization and making that knowledge available to others in the business" (Lin, 2007:2). In her definition, the latter includes knowledge acquisition, knowledge application, and knowledge transfer.

Lin's (2007) definition and classification are too broad and vague, and are not specified entirely precisely. One of its weak points is that knowledge sharing at the organizational level is not distinguished from knowledge transfer. As discussed in the above section on knowledge transfer, this includes transmission, influence, and knowledge integration. More importantly, knowledge transfer usually involves boundary spanning (Tushman & Scanlan, 1981). On the contrary, apparently, knowledge sharing mainly refers to knowledge transmission, and does not include knowledge integration and boundary spanning.

Moreover, knowledge sharing is also quite different from knowledge construction. According to Pea (1994), knowledge sharing is related to the transmission concept of communication. It is about "the transmission of knowledge between people" (van Aalst, 2009:260). In order to better understand it, Van Aalst (2009) exemplifies the concept by answering a query by offering factual information or uploading information to an intranet. The shared ideas between people are not altered by the sharing interaction in this process (Pea, 1994: Bereiter & Scardamalia, 1987). Van Alast (2009:261) points out that "in a community engaged in collaborative inquiry, knowledge-sharing practices involve the introduction of information and ideas without paying extensive attention to their interpretation, evaluation, and development".

Dole & Sinatra (1998) define cognitive engagement as the efforts involved in information processing. Thus, the knowledge sharing process does not involve any complex cognitive engagement. In this research, the selected communities had a large number of discussion threads about knowledge sharing: for instance, answering an enquiry for updating a software

link. Knowledge sharing in these discussion threads is about the transmission/exchange of already existing or already known knowledge to the question (/or enquiry) between different individuals.

The term ‘knowledge construction’ corresponds to cognitive psychology (Van Alast, 2009). In contrast to knowledge sharing, knowledge construction usually needs much higher levels of cognitive engagement and complex information processing. Van Alast (2009) indicates that knowledge construction has a range of cognitive processes, containing questioning, explaining, knowledge interpreting and evaluating, idea testing, meta-cognitive and so on. During this process, more cognitive engagement and complex knowledge processing are requested. King (1994) concludes that the outward signs of knowledge construction include speculations, justifications, explanations, inferences and so on.

2.3.9 Conclusion

This section comprehensively discusses the definitions of knowledge, knowledge attributes and classification, knowledge creation and relevant models, and the relevant concepts of knowledge transfer and knowledge sharing. They are inevitable important points from the literature for considering the knowledge construction examined in this thesis. These points discussed in this section are highly related to each other and their relationships are also discussed. Accordingly, they are also arranged in a logic way, according to their relationships.

These literatures serve to provide a broad scope (/view) for understanding the knowledge and the knowledge construction. Therefore, this section paves the way for exploring the question of how knowledge is exactly constructed (i.e. knowledge construction mechanisms), at a detailed and macro level, in virtual product user communities. The organizational knowledge creation models discussed in this section, i.e. the SECI model and the unified knowledge creation model, can shed light on knowledge construction at the organizational level, and thus provide a broad theoretical context where knowledge construction in the virtual product user communities is conducted. This is because knowledge construction within the organization sponsored virtual product user communities can be considered as part of the overall organizational knowledge creation process. However, due to its weaknesses, as discussed in the section (2.3.7 Evaluation of SECI model), the SECI model cannot provide a detailed and operational analytical framework for the process of knowledge construction embedded within the asynchronous online discussion contents published in virtual product user communities.

Hence, this creates the requirement for looking for more tailored analytical frameworks and models from the literature, in the context of Computer Supported Collaborative Learning.

2.4 Literature Review: Knowledge Construction Analytical Frameworks in Computer Supported Collaborative Learning (CSCL)

2.4.1 Introduction

In order to answer the research question "how is knowledge constructed in virtual product user communities", a comprehensive literature review was conducted to seek potentially useful content analysis frameworks or tools which can supply a lens to analyse the knowledge construction patterns and phases in the online discussions of the selected product user forums. Knowledge sharing is about exchanging already existing knowledge through interaction between different individuals. On the other hand, knowledge construction in this research mainly refers to creating new knowledge through the interaction of community members and complex cognitive and information processing when requisite knowledge is not already known. For instance, the knowledge about solving technical problems with products needs to be constructed when it cannot be acquired from experts or there is no ready answer.

However, there are no analytical frameworks or tools identified from the literature about knowledge construction in relevant types of virtual community. Therefore, the researcher had to go for online formal learning literature where there are lots of analytical frameworks for analysing collaborative knowledge construction.

Online learning, especially Computer Supported Collaborative Learning (CSCL), mainly focuses on argumentative knowledge construction. In the online learning context, students usually engage in an argumentative discourse which aims to obtain knowledge (Weinberger & Fischer, 2006). Argumentative knowledge construction is built on the assumption that "learners engage in specific discourse activities and that the frequency of these discourse activities is related to knowledge acquisition" (Weinberger & Fischer, 2006: 72). The learners build arguments when interacting with other peer students with the aim of obtaining knowledge about argumentation and knowledge about contents used for arguments (Weinberger & Fischer, 2006; Andriessen et al., 2003). Weinberger & Fischer (2006) further point out that the definition of argumentative knowledge construction should also embrace other discourse activities on process dimensions which can facilitate knowledge construction.

The following instruments and models used to analyse knowledge construction and criticality in the transcripts of asynchronous computer-mediated discussion in the context of Computer Supported Collaborative Learning are identified in the literature.

Table 2-4: Analytical frameworks or tools for studying knowledge construction and criticality in the transcripts of asynchronous computer-mediated discussion

Purpose	**Social Interaction**	**Knowledge Construction**	**Critical Thinking**	**Teaching Presence/Learning Strategy**	**Social Network**	**Overall Online Learning**
Models /Analytical Framework	Coding scheme for social presence in the community of inquiry (Rourke at al.,1999); Vertical and horizontal social interaction model (Zhu,1996)	Five Phases knowledge construction evolving model (Gunawardena, et al., 1997); Classification of task related and not-task related messages (Veerman & Veldhuis-Diermanse, 2001); Four levels of knowledge construction quality (Veldhuis-Diermanse, 2002); Knowledge construction process & evaluation instruments (Pena-Shaff & Nicholls, 2004); Four dimensional analytical approaches for argumentative knowledge construction (Weinberger & Fischer, 2005).	Thinking Analysis Protocols (Newman et al., 1996; 1997); Four categories analytical instrument of critical thinking skills (Bullen, 1997); Four Phase Practical inquiry model (Garrison et al., 2001);	Coding schemes for teaching presence in the community of inquiry (Anderson et al., 2001); Learning strategy analytical framework with five perspectives (Lockhorst et al., 2003)	Social network analysis in terms of structural and interactional exchange patterns (Fahy et al., 2000)	Three analytical approaches of online discussion in CSCL (Järvelä & Häkkinen, 2002); Four dimensions model(Henri,1992); Community of Inquiry Coding Template (Garrison et al., 2000); Burnett's (2000) typology of participant behaviours

These analytical frameworks and models among the above are based on a content analysis method, which is adopted to study knowledge construction patterns in this research too. In order to identify the most relevant and feasible coding protocols for content analysis, the researcher reviews each model and examines the communication contexts of these analytical models or frameworks, conceptual bases, theoretical backgrounds, and coding procedures in applying these models. The relationships of these models are also investigated with the aim of choosing the most suitable instruments.

The general introduction to these six analytical content analysis instruments is given in the following sections. Meanwhile, due to its important position, Henri's (1992) four dimensions model, which is the first analytical framework and constructs the basis for most analytical models, is also discussed.

2.4.2 Henri's (1992) model

Hiltz (1990) and Mason (1991) firstly propose that the quality of the collaborative learning process in asynchronous online text communication can be evaluated by analyzing its content, i.e. transcripts. In order to analyse the interaction of online postings, Henri (1992) proposes a model which is centred on five dimensions: the participative dimension; the social dimension; the interactive dimension; the meta-cognitive dimension (referring to statements about reasoning); and the cognitive dimension (referring to the statements about clarification and judgement).

The participative dimension consists of two sub-categories: 1) overall participation, which refers to the number of messages and accesses to the online discussion space; and 2) active participation regarding to learning, which is about the number of statements relevant to learning (Henri, 1992).

The interactive dimension contains two kinds: interactive statements (which are further divided into explicit and implicit interactions) and non-interactive statements. Henri (1992) points out two types of interactive messages, namely responses and commentaries. Based on the above classification, Henri (1992) suggests five categories in interactive dimension: explicit responses, implicit responses, explicit commentaries, implicit commentaries, and independent statements.

The social dimension is a common category which is included by many analytical frameworks of online discussions (Zhu, 1998; Rouke et al., 1999). Social messages in this

dimension mainly refer to "statement[s] or part[s] of a statement not related to formal content of subject matter" (Henri, 1992: 126). Social cues can include, for instance, self-introduction, expressions of personal feeling, greetings, closure, jokes, the use of symbolic icons, and praise (Hara et al., 2000).

The cognitive dimension is further divided into five categories of reasoning skills: elementary clarification; in-depth clarification; inference; judgement and strategies. The metacognitive dimension includes metacognitive knowledge (which refers to declarative knowledge about the person, learning task and strategies) and metacognitive skills, which are "procedural knowledge relating to evaluation, planning, regulation, and self-awareness" (Henri, 1992:131). Aviv et al. (2003) find that cognitive and meta-cognitive categories in Henri's model can also illustrate critical thinking stages of knowledge construction. This model requires the division of the transcript into "units of meaning", which can be a single message or a segment of it, and it then categorizes them into different categories and sub-categories, according to the meaning of the units (Aviv et al., 2003).

Henri's model not only covers the types of reasoning skills and interaction patterns embedded within the online discussion board, but also tries to describe the nature and content of online interactions which prove cognitive development and meaningful learning (Maria et al., 2004). Lally (2001:401) also comments that

> "One of the major strengths of Henri's approach to content analysis using categories is that it focuses on the social activity and the interactivity of individuals in a group at the same time as giving a picture of the cognitive and metacognitive processes of those individuals''

Henri's model (1992) is the pioneering work for analysis of online discussions from a content analysis approach and it paves the way for subsequent research. Newman et al. (1995) have successfully utilized this model in analysis of transcripts of online interactions, with the purpose of discovering high levels of critical thinking in computer learning. Hara et al. (2000) also employs the model to qualitatively analyze an online applied educational psychology course, and identifies five key variables in the five dimensions of Henri's analytical framework.

However, Henri's model is centred on an individual's critical thinking phases and it cannot be applied to studying group learning processes and outcomes (Aviv et al., 2003). Moreover, this model also has one major limitation, which is that "it gives us no impression of the social co-construction of knowledge by the group of individuals as a group, in a discussion or a

seminar" (Lally 2001:401). Another problem with Henri's (1992) model is that it is short of detailed criteria for systematic and rigorous categorization of online discussion content (Howell-Richardson & Mellar, 1996). This can result in blurred relationships among the categories and subjective classification when applying the model. Henri's (1992) model is mainly criticised due to its failure to provide "operational criteria for the classification of CSCL interactions" (Persico et al., 2009:151).

2.4.3 Garrison et al.'s (2001) Four Phases Practical Inquiry Model

Garrison et al. (2001) propose a practical inquiry model with four phases to evaluate the character and quality of critical thinking in a text-based online education setting. The four phases include the triggering event, exploration, integration, and resolution.

In the first phase of critical thinking, a triggering event emerges from an issue, dilemma, or problem which is found and recognized (Garrison et al., 2001). In the educational context, the instructor at this stage plays an important role to "add, shape, and in some cases discard triggering events that potentially serve as distract from attainment of intended educational outcomes" (Garrison, et al., 2001: 8). The teacher presence in this stage is actualized through performing of the above role. In the second phase, the participants start exploring more relevant information about the problem and moving between the individual reflective world to a public shared world, "that is, between critical reflection and discourse" (Garrison et al., 2001: 10). This stage is featured by "brain storming, questioning, and exchanging of information" (Garrison et al., 2001: 10). The third stage of integration, which is characterised by "constructing meaning form the ideas generated in the exploratory phase" (Garrison et al., 2001: 10), participants evaluate the applicability of ideas through studying the extent of the relevance and descriptive power to the problem being discussed. In the resolution phase, the proposed solutions to the problem are implemented or a hypothesis is tested by direct or indirect action. "It usually entails a vicarious test using thought experiments and consensus building with the community of inquiry" (Garrison et al., 2001: 11). See as follows:

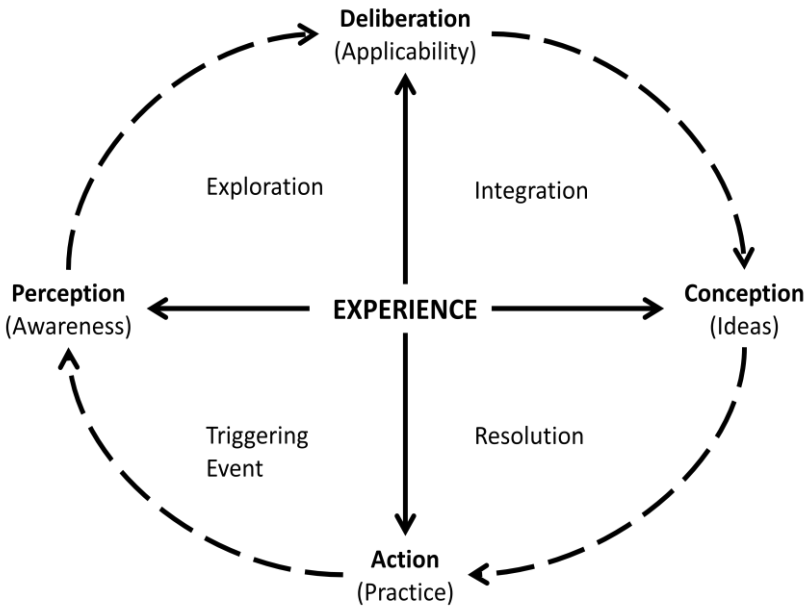


Figure 3.2: Practical Inquiry Circle (Garrison et al., 2000:99)

The four phases in the critical inquiry model are described in an idealized sequence, that is to say, the practical inquiry can be conducted in a mutable order in reality (Garrison et al., 2001). However, it is claimed that this model can still reflect the critical thinking process and measures to produce cognitive presence. Cognitive presence is referred to as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry" (Garrison et al., 2001:11). They consider cognitive presence as the reflection of a high-level of knowledge acquisition and application and the most relevant factor in critical thinking, which is usually cited as the general aim of higher education (Garrison et al., 2001; Garrison et al., 2000). Cognitive presence is believed as a "vital element in critical thinking" (Garrison et al. 2000:89). Cognitive presence is quite similar to the cognitive dimension in Henri's model and it also shares similarity with Burnett's (2000) collaborative category in some aspects (Marra et al., 2004). The four phases of triggering event, exploration, integration, and resolution give a practical approach to operationalizing cognitive presence (Garrison et al., 2001).

Garrison et al. (2000) propose a coding template for community inquiry in educational online conference context by incorporating another two core factors, in addition to cognitive presence, namely social presence and teaching presence. It is designed to describe interaction of higher quality in online leaning context.

Table 2-5: Community of Inquiry Coding Template (Garrison et al., 2000:89)

Elements	Categories	Indicators (examples only)
Cognitive Presence	Triggering Event	Sense of puzzlement
	Exploration	Information exchange
	Integration	Connecting ideas
	Resolution	Apply new ideas
Social Presence	Emotional Expression	Emotions
	Open Communication	Risk-free expression
	Group Cohesion	Encouraging Collaboration
Teaching Presence	Instructional Management	Defining and initiating discussion topics
	Building Understanding	Sharing personal meaning
	Direct Instruction	Focusing discussion

Social presence is defined as "the ability of participants in the Community of Inquiry to project their personal characteristics into the community, thereby presenting themselves to other participants as 'real people'" (Garrison et al. 2000:89). This element plays a supporting role for cognitive presence through the indirect facilitation of the collective critical thinking process. The teaching presence has two functions: designing educational experience and facilitating it. These two functions can be performed by any participants in the community of inquiry (Garrison et al., 2000). As illustrated in the following figure, these three elements combined to create educational experiences in the community of inquiry.

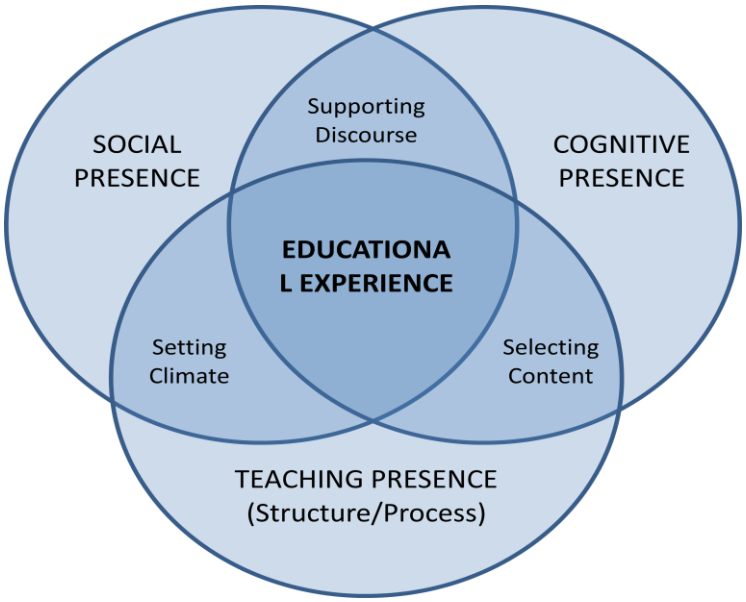


Figure 3.4: Community of Inquiry (Garrison et al., 2000:88)

2.4.4 The Interaction Analysis Model (Gunawardena et al., 1997)

In order to bypass the limitation of a lack of operational criteria in Henri's model and to simplify the data analysis process, Gunawardena et al. (1997) proposed another content analysis model, namely the Interaction Analysis Model with five stages. This model is built on the basis of an acknowledgement of Henri's framework (Marra et al., 2004).

The analytical instrument IAM (Interaction Analysis Model) created by Gunawardena et al. (1997) seeks to explore the social construction of knowledge in computer conferencing in learning contexts. IAM offers a holistic picture of the discussion flow and knowledge construction process (Marra et al., 2004). This model classifies the complete knowledge construction process in five phases: sharing and comparing of information; discovering and exploring dissonances and inconsistencies among the ideas; negotiating meaning or co-constructing knowledge; testing and modifying proposed synthesized knowledge; and phrasing of agreements and applications of newly constructed meaning. Marra et al. (2004:36) suggest that the fourth phase can be interpreted as "trying out what had been agreed on as new knowledge in a prior Phase III posting." The fifth phase includes statements of agreement and application of new knowledge, and meta-cognitive statements relating to the knowledge construction process (Gunawardena et al., 1997; Lally, 2001)

Gunawardena et al.'s (1997) analytical model is built upon an open-ended debate on the topic of building vibrant virtual conferences. Thus, the discussion content involves "brainstorming conceptual knowledge and generating definitions" and allows for a more free-flowing discussion process (Marra et al., 2004: 38). It focuses on the overall co-construction process of new knowledge in online learning environments and is most appropriate for student-centred learning context (Lally, 2001). Furthermore, this model reflects "the complete process of negotiation which must occur when there are substantial areas of inconsistency or disagreement to be resolved" (Gunnawardena et al., 1997:413).

Gunawardena et al.'s (1997) content analysis of an online discussion model (i.e., the Interaction Analysis Model) is designed to investigate knowledge building or cognitive development in online forums. Meanwhile, this model can also detect and provide evidence of knowledge building process in a collaborative online discussion context (Marra et al., 2004). Moreover, the Five Phases Interaction Analysis Model can also be used to further describe the meaning negotiation process and the knowledge construction process in the collaborative online discussion environments (Gunawardena et al., 1997). This model is

orientated to answer two research questions: "What degree of knowledge construction is achieved by the cooperative group?" and "What degree of evidence is there that the knowledge of individual participants changes?" (Aviv et al., 2003:3). Aviv et al. (2003) further conclude that the answer to the first question can be obtained by the observation of a principal cognitive phase in the discussion transcripts, while the answer to the second one can be generated through examining the individual participant's expressions about the changes (meta-cognition) or about the application of altered knowledge.

In this model, the authors propose five stages that the discussion participants usually undergo in the knowledge construction process. However, these five stages do not necessarily develop in a sequential order.

Table 2-6: Interaction Analysis model (IAM) phase definitions [Quoted from Marra et al. (2003:26), adaption based on article by Gunawardena et al. (1997: 414)]

Interaction Analysis model (IAM) phase definitions
Phase 1. Sharing and comparing of information: statement of observation or opinion; statement of alignment between participants.
Phase 2. Discovery and exploration of dissonance or inconsistency among participants: identifying areas of disagreement; asking and answering questions to clarify disagreement.
Phase 3. Negotiation of meaning or knowledge co-construction: negotiating meaning of terms and negotiation of the relative weight to be used for various arguments.
Phase 4. Testing and modification: testing the proposed new knowledge against existing cognitive schema, personal experience or other sources
Phase 5. Phrasing of agreement and applications of newly constructed meaning: summarising agreement and metacognitive statements that show new knowledge construction.

In the empirical study of two Asynchronous Learning Networks conducted by Aviv and colleagues (2003), they adopt this Five Phase Interaction Analysis Model to assess the quality of the knowledge construction process of group online learning. This content analysis model has also been used by other studies and has generated meaningful discoveries (Beaudrie, 2000: Kanuka & Anderson, 1998; Schellens & Valcke, 2003). Given the limited number of content analysis models of online discussion content (Mazur, 2004), Marra et al. (2004) state that this Five Stage Interaction Analysis Model is one of the most widely adopted ones available.

It is more difficult to code the data that belongs to each phase of the Interaction Analysis Model (IAM), but the richness of definition of each phase could generate more meaningful information to the researcher once the coding is done (Marra et al., 2004). Furthermore, the researcher can choose quotations from each stage to illustrate the nature of interaction at each

stage and the relationships between each phase. Marra et al. (2004: 37) also find that IAM is quite appropriate to studying research questions such as "…what kinds of interactions seemed [seem] to promote individuals to engage at higher phases? Or how do facilitator interactions influence online conversation content?"

2.4.5 Newman et al. (1996; 1997)'s Critical Thinking Analysis Protocols

Newman et al. (1996; 1997) identify around 40 indicators of code categories which can be used to assess a particular statement's contribution to critical thinking development, including, relevance, importance, novelty, justification and so on. Each code has a plus (+) or minus (-) attached to represent whether the coded content is useful for, or distracts from, critical thinking. Their model is based on Garrison's (1992) five-stage critical thinking model: identification; definition; exploration; evaluation; and integration.

Table 2-7: Newman, Webb, and Cochrane model codes, from Newman et al. (1996) (quoted from Marra, et al., 2004:27).

Category		**Positive indicator**		**Negative indicator**	
R ±	Relevance	R+	Relevant statements	R-	Irrelevant statements, diversions
I±	Importance	I+	Important points/issues	I-	Unimportant, trivial points/ issues
N ±	Novelty; new info, ideas, solutions	NP+	New problem-related information	NP -	Repeating what has been said
		NI+	New ideas for discussion	NI-	False or trivial leads
		NS+	New solutions to problems	NS -	Accepting first offered solution
		NQ+	Welcoming new ideas	NQ -	Squashing, putting down new ideas
		NL+	Learner brings new things in	NL -	Dragged in by tutor
O ±	Bringing outside knowledge or experience to bear on problem	OE+	Drawing on personal experience	OQ -	Squashing attempts to bring in outside knowledge
		OC+	Refer to course material	O-	Sticking to prejudice or assumptions
		OM+	Use relevant outside material		
		OK+	Using previous knowledge		
		OP+	Course related problems brought in (e.g., students identify problems from lectures and texts)		
		OQ+	Welcoming outside knowledge		
A ±	Ambiguities: clarified or confused	AC+	Clear, unambiguous statements	AC -	Confused statements
		A+	Clear up ambiguities	A-	Continue to ignore

					ambiguities
L ±	Linking ideas, interpretation	L+	Linking facts, ideas and notions	L-	Repeating information without making inferences or offering an interpretation
		L+	Generating new data from information collected	L-	Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments
J±	Justification	JP+	Providing proof or examples	JP-	Irrelevant or obscuring
		JS+	Discussing advantages and disadvantages of solutions	JS-	Offering judgments or solutions without explanations
					Offering several solutions without suggesting which is the most appropriate
P ±	Practical utility (grounding)	P+	Relate possible solutions to familiar situations	P-	Discuss in a vacuum (treated as if on Mars)
		P+	Discuss practical utility of new ideas	P-	Suggest impractical solutions
W ±	Width of understanding (complete picture)	W+	Widen discussion (problem within a larger perspective. Intervention strategies within a wider framework.)	W-	Narrow discussion. (Address bits or fragments of situation, Suggest glib, partial, interventions)

It has been suggested that the best use of Newman's (1996) protocol is for the provision of high-level descriptive data about critical thinking within the discussion content (Marra et al., 2004: 38). Additionally, it also provides "focused and segmented coding on certain potential indicators of critical thinking" (Marra et al. 2004:39).

The IAM model focuses on knowledge creation, while Newman et al.'s (1996; 1997) model stresses critical thinking, but both are designed to study online interactions qualitatively for in-depth learning on Internet forums (Marra et al., 2004). Another similarity is that neither focuses on knowledge acquisition. It is easier to conduct coding by one rater using Newman et al.'s (1996; 1997) protocol because it has clear and focused code definitions (Marra et al., 2004). However, it is difficult to meaningfully interpret its different set of ratios in its procedural applications (Marra et al., 2004).

2.4.6 Zhu's (2006) Analytical Framework for Cognitive Engagement in Discussion

Zhu's (2006) Analytical Framework for cognitive engagement is created to analyze interaction types and cognitive engagement in asynchronous online learning discussions. This framework incorporates the following coding instruments: a coding system "Note Categories

and Interaction Types" (Zhu, 1998:238); Henri's (1992) model; and Bloom (1956)'s cognitive domains of learning. It consists of five categories, namely, Question, Statement, Reflection, Mentoring, and Scaffolding. The category "Question" is further divided into two types: Type I (vertical), which is raised to seek information, and Type II (horizontal), which aims at initiating a conversation. Category "Statement" is graded into six different types, according to Bloom's (1995) learning hierarchy. It ranges from the lowest response level to the highest evaluative level. Messages of reflection are related to reflecting on learning or using strategies. Accordingly, it is categorized into two types: Type I (reflective of changes) and Type II (reflective of adopting cognitive strategies) (Zhu, 2006). The category "Mentoring" is about the messages which "connect readings and responses in an attempt to demonstrate processes or steps involved in understanding concepts and issues" (Zhu, 2006:459). Scaffolding messages are released to facilitating the student's learning and discussion by providing guidance and advice.

Table 2-8: Zhu's (2006) Analytical Framework for Cognitive Engagement in Discussion (Zhu, 2006:458)

Category	Type	Characteristics	Example
Question	Type 1	Seeking information (Vertical)	Question that has a direct and correct answer (e.g. What is an asynchronous discussion?)
	Type 2	Inquiring or starting discussion (Horizontal)	Question that has no direct and correct answer (e.g. How can we facilitate an online discussion?)
Statement	Type 1	Responding	Statement that is made in direct response to a previous message(s), offering feedback, opinion, etc.
	Type 2	Informative	Statement that provides information (anecdotal or personal) related to the topic under discussion.
	Type 3	Explanatory	Statement that presents factual information with limited personal opinions to explain related readings or messages
	Type 4	Analytical	Statement that offers analytical options about responding messages or related reading materials
	Type 5	Synthesizing	Statement that summarise or attempts to provide a summary of discussion messages and related reading materials
	Type 6	Evaluative	Statement that offers evaluative or judgmental opinions of key points in the discussion/related readings.
Reflection	Type 1	Reflective of changes	Statement that reflects on changes in personal opinions and behaviours
	Type	Reflective of	Statement that explains or reflects on one's use of

	2	using cognitive strategies	cognitive strategies/skill in accomplishing certain learning tasks
Mentoring	Type 1	Mentoring	Statement that explains or shows how the understanding of a particular concept (idea, etc.) is reached.
Scaffolding	Type 1	Scaffolding	Statement that guides students in discussing concepts and in learning content materials by offering suggestions.

2.4.7 Veerman & Veldhuis-Diermanse's (2001) Classification

Veerman & Veldhuis-Diermanse (2001) divide messages in the CSCL context into two categories: task-related and not task-related. The not task-related messages consist of four categories: planning (statements related to the procedure of group work); technical (statements about use of e-learning software), social (statements serving to enhance intimateness), and nonsense (statements that are totally irrelevant to the discussion topic). The task-related messages are further divided into three sub-categories: "new ideas (content not mentioned before), explanations (refining or elaborating already stated information), and evaluation (critical view on earlier contribution)" (De Wever et al. 2006:18). These three categories are parallel to the first three levels of knowledge construction in the analytical instrument of Gunawardena et al. (1997), namely, sharing and comparing information, dissonance and negotiating meaning (De Wever et al., 2006). However, higher levels of knowledge construction, such as the category of testing and application of new knowledge in Gunawardena's (1997) analysis instrument, are not included in this model (De Wever et al., 2006).

2.4.8 Summary Conclusion

Based on the above discussion, the researcher firstly identified that the following frameworks and tools have the potentially to provide the foundation for the development of a prior categorization matrix in the content analysis of knowledge sharing and construction process: Garrison et al.'s (2001) Four Phases Practical Inquiry Model; Community of Inquiry Coding Template (Garrison et al., 2000); the Five Phases knowledge construction evolving model (Gunawardena, et al., 1997); Newman et al.'s (1996; 1997) Critical Thinking Analysis Protocols ; Zhu's (2006) Analytical Framework for Cognitive Engagement in Discussion; and Veerman & Veldhuis-Diermanse's (2001) classification.

These analytical frameworks and tools are mainly created for exploring students' argumentative knowledge construction activities in the CSCL context. They have proved to be effective in describing and evaluating the cognitive development progress and criticality level, which featured the high-level cognitive engagement required for argumentative knowledge construction in online formal learning. However, these analytical frameworks cannot be directly applied to exploring knowledge construction embedded in discussion contents about solving technical problems in the virtual product user community due to the contextual differences between virtual product user communities and formal learning in CSCL. The attributes of virtual communities and their contexts can assert influences on knowledge construction pattern. Therefore, these identified frameworks needs to be tested first to see the extent to which their categories can be used for a new context.

2.5 Moderation in the Virtual Community of Practice

In this section, the importance of leadership of virtual CoP in achieving the organization's objectives, along with the nature and significance of the moderator's roles, are discussed. The moderator is considered to be one of the most essential influencing factors on knowledge construction in virtual communities. The literature on moderation in the virtual CoP discussed in this section can shed light on understanding its influence in the virtual product user community.

2.5.1 Leadership of VCoP

Many corporations have already implanted a virtual CoP for its staff, and the related research proves that a successful virtual CoP could bring in great benefits to those organizations with respect to increased knowledge capital, social capital, organizational learning and reduced knowledge distribution cost (Daniel et al., 2003; Lesser & Everest 2001;).

However, this also brings an absolutely new challenge to managing the virtual community of practice in order to achieve its expected goals (Ardichvili et al., 2003). Because of the high reliance on ICT, some of virtual CoP's characteristics differ from those mediated through face-to-face communication, such enrolment and geographic dispersion, and other structuring characteristics (Dubé, et al., 2006). Accordingly, this results in new complexities and ambiguities in its management. Not only does the communication technology itself have limitations, but knowledge behaviour is also quite complex and needs great efforts to be supported and managed.

In order to foster the VCoP's development on the expected track and to achieve the organization's purpose for launching it, an effective method is to implant a formal governance structure into it and appoint moderators, facilitators, and community managers from the community (Lesser & Everest, 2001; Bourhis et al., 2005; Bourhis & Dubé, 2010). Moreover, this approach entails the virtual CoP becoming tightly bounded to the organization in order to avoid inefficiency: "Without a solid leadership, the VCoP wandered without clear direction" (Bourhis & Dubé, 2010). According to the definition of Bourhis et al (2005), governance structures refer to leadership, which means "individuals can be appointed to specific roles or roles can be left to emerge through interaction."

Kim (2000) suggests that the leadership of community moderators (i.e. community leaders) is one of the key characteristics that influence the success and sustainability of virtual communities. The operational leadership of the virtual CoP is quite important to the resolution of the challenges arising from its structural characteristics, and the availability of both the leader and the supporter are crucial aspects of leadership. Bourhis et al. (2005) state that a well operated leadership that consists of different levels of leaders and supporters can effectively reduce the negative influence of structuring characteristics, like the impeditive online environment, and the lack of community experience and ICT skills. Therefore, the proper responsibilities of those community leaders include building constructive environments; enhancing trust; fostering knowledge sharing; discovering innovative insights, and so on. Certainly, the final goal is to bring more benefits to the organization.

However, the fulfilment of the duties of those leaders and moderators also requires lots of effort, support and resources from the organization as well. In order to ensure the quality of the leadership in the VCoP, the top manager of the organization should also continuously evaluate the community leadership groups' performance (Bourhis & Dubé, 2010).

2.5.2 Moderators' Roles

Some existing literature on moderation or facilitation of virtual communities focuses on dealing with the concerns of the moderators in their work and suggesting moderation strategies (Salmon, 2000; Salmon, 2002; Schenk & Schwabe, 2001).

Berge (1995) and Mason (1991) classified the roles of moderators in learning communities via face-to-face communication into four groups: 1) technical roles related to providing technical support; 2) intellectual roles related to encouraging learning through facilitation; 3)

managerial roles related to the management of interactions; 4). social roles related to building a friendly environment. When these roles are transferred from the face-to-face communication context to a virtual community, they do not undergo great changes, according to the existing literature on moderators in online communities (Gray, 2004; Collison et al, 2000). Even in the virtual environment of the CoP, the moderators are still involved in social, cultural, and organizational issues, and hence to continue to foster the development of the community through social interaction and knowledge sharing (Gray, 2004).

2.5.3 Technical Moderation Framework

Technical infrastructure provides the foundation for members to participate in virtual communities of practice. Accordingly, a well designed moderation technical system should also be implanted into the architecture of the virtual CoP. Obviously, the technical factors that promote discussion in the virtual communities can also stimulate member's online participation in virtual CoPs. The quality of IT infrastructure is identified as one of the stimulating factors which encourage participation in virtual communities (Chung et al., 2007; Restler & Woolis, 2007).

2.5.4 Summary

To conclude, the moderator and technical moderation framework are quite important in achieving the organization's objectives and deciding the success of virtual communities. The moderators play technical roles, intellectual roles, managerial roles, social roles and cultural roles in fostering community development. These four roles can assert influences on online community members' knowledge sharing and creation activities in virtual communities. The moderators are also the way of realizing the leadership in virtual communities of practice. This role creates a link between the virtual product user communities and organizations. Therefore, the moderation and moderator is considered as one of the most important community attributes, which can affect knowledge construction in the virtual product user community.

2.6 Summary and Conclusion

This thesis sets out to explore the nature of knowledge construction in virtual product user communities. It will seek to show that the virtual product user community is a specific virtual community and to define it, in the later stages. This literature review has done ground work for the comparison. Although the product user community shares some similarities with other

types of virtual communities consisting of consumers/ product users, it nevertheless has its own unique attributes with respect to its membership, establishment purpose, knowledge activities, links among members, and so on. All of these attributes are important criteria to classify virtual communities.

In order to analyse the knowledge construction process, existing frameworks were sought in the literature on the basis of clarifying the concepts of knowledge and knowledge creation. The identified knowledge construction analytical frameworks and tools have been mainly created for CSCL. The attributes of virtual communities have an effect on knowledge construction activities. Thus, the contextual differences between the virtual product user community and CSCL can influence the frameworks' workability in a new context. Part of the work of the thesis will be to examine how knowledge construction in the virtual product user community is different from that in CSCL. The realization of the virtual product user community's attributes helps to explore the contextual differences between these two types of virtual communities. Among these attributes, the moderator is one of the most important factors in deciding the success of a virtual community and influences knowledge constructions. Thus, relevant literature was reviewed to establish the concept of moderation, and to explore some of what previous authors have suggested about their roles.

Chapter 3 – Research Methodology

3.1 Introduction

This chapter introduces the philosophical foundation, research methodology, and methods of data collection and analysis adopted in the study. This study takes constructivism as its ontological foundation, and interpretivism as its epistemological basis. A case study research design is chosen in order to obtain a thorough understanding of the knowledge construction process in virtual product user communities. The main data sources in the study are observation, interview and online discussion transcripts. A qualitative content analysis method is adopted to explore knowledge construction patterns embedded in the discussion threads and thematic analysis is selected to analyse the interview transcripts.

3.2 Research Philosophy and Approach

3.2.1 Research Philosophy

Collier (1994:17) argues that "… everyone is a philosopher, though in his own way and unconsciously, since even in the slightest manifestation of any intellectual activity whatever, in 'language' there is contained a specific conception of the world". In academic research, researchers also carry their own perceptions and unexamined assumptions about the world. Research philosophy in social research is concerned with researchers' assumptions about the most common attributes of the world, including such factors as the nature of human mind, truth, reality, reason, nature of knowledge, and evidence for knowledge (Hughes, 1994). Crotty (2003: 3) names research philosophy with the parallel norm "theoretical perspective", and defines it as "the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria". It is also described as a way of observing the world and understanding it (Crotty, 2003:8).

Proctor (1998) points out that a notable philosophical issue in social research is the interrelationship between the ontological (which is concerned with the nature of reality), epistemological (which is concerned with the knowledge of the reality), and methodological (which is about the way to discover the reality) levels of investigation. Research philosophy contains two elements in relation to knowledge of the world: ontology, which is concerned with "what is" (Crotty2003:10), and epistemology, which is the way of understanding "what it means to know" (Crotty2003:10).

Research philosophy also lies behind the researcher's decisions on research methodology in terms of providing a context for the research process and positioning its logic and criteria (Crotty 2003). Moreover, Esterby- Smith et al. (1997) also state that research philosophy is important for the research methodology in three aspects: it can help refine and specify the research approach; it assists the researcher to evaluate different methodologies and methods; it helps the researcher to be creative in selecting or adapting methods.

3.2.1.1 Ontology: Constructivism

Ontology is concerned with "beliefs about what there is to know about the world" (Snape & Spencer, 2003:11). Gruber (1993:120) defines ontology as "a specification of a conceptualization". Ontological questions are about "what kinds of things are there in the world" (Snape & Spencer, 2003:11). To conclude, ontology can be considered to be related with "the nature of the social world and what can be known about it" (Snape & Spencer, 2003:22).

There are two main distinct stances in ontology, namely objectivism and constructivism. Objectivists believe that reality and the meaning of the world exist objectively, are apart from the human mind, and are independent of people (Jonassen, 1991). Thus objectivism is "one version of basic realism" (Lakoff, 1987: 158). Objectivists believe that the real reality can be known through objective scientific methods. The structure, properties and relations of entities can be identified, and represented with theoretical models and abstract symbols. Knowledge can be obtained when a person's thought processes manipulate these symbols (Vrasidas, 2000). "Knowledge consists in correctly conceptualizing and categorizing things in the world and grasping the objective connections among those things and those categories" (Lakoff, 1987:163). Learning a new knowledge process is defined by objectivists as "…change in the learner's cognitive structures" (Vrasidas, 2000: 340). However, in the virtual product user, new community knowledge is constructed through the member's interaction process, which involves the individual's personal experience and subjective interpretations. Thus, objectivism is not suitable to serve as the ontological basis for this research project.

In this research constructivism provides the ontological foundation for studying knowledge construction in virtual communities. Constructivists believe that knowledge is "a function of how the individual creates meaning from his or her experiences" (Jonassen et al., 1995:11). Jonassen (1991) states that newly created knowledge is a product of the human mind and the individual's personal experience, and results from interpretation of the context.

Most of the researchers who have explored knowledge construction in online asynchronous discussion groups mainly take the stance of constructivism (Gunawardena et al., 1997; Veerman & Veldhuis-Diermanse, 2001; Järvelä& Häkkinen 2002; Veldhuis-Diermanse, 2002; Lockhorst et al., 2003; Pena-Shaff & Nicholls, 2004; Weinberger & Fischer, 2005).

Two constructivist approaches are usually adopted in the research field of knowledge construction in online asynchronous discussion communities: social constructivism and cognitive constructivism. Social constructivism stresses the association of expertise with discourse, social norms, and particular community practices (Lave & Wenger, 1991). Social constructivists believe that knowledge is constructed, developed and rooted in people's actions, experiences, or mental structures**.** In contrast, cognitive constructivism chooses the perspective of the individual to explain knowledge as cognitive structures in the individual's mind.

Social constructivists hold the view that meaning is mediated and knowledge is jointly constructed in the collaborative process of discussing in the CSCL context (Lazonder et al., 2003). Cognitive constructivists argue that new knowledge can be created in the CSCL context because of the transformation of implicit knowledge elements to explicit knowledge through retrieval from individual memory, and successive reorganization of knowledge components in the group social interaction process (De Wever et al., 2006). Drawing upon ideas of social constructivists and cognitive constructivists, social constructivists stress the homogeneity of members' thoughts during the knowledge construction process in the knowledge community in which individuals engage in collective activity and interact with each other. In contrast, cognitive constructivists focus on the heterogeneity of individual thoughts as community individuals actively interpret social processes and contribute to the development of a collaborative knowledge creation process through externalization of their knowledge.

Constructivism, including both social constructivism and cognitive constructivism, emphasizes knowledge construction. Furthermore, social constructivism and cognitive constructivism both agree on the importance of interaction of discussion participants for knowledge construction in the online collaborative learning context (Lazonder et al., 2003:92). These two points justify the appropriateness of constructivism to serve as the potential theoretical foundation for this research, which aims to explore knowledge building and interactions in the virtual product user community.

The knowledge construction process in virtual communities occurs "through social negotiation in CMC" (Gunawardena et al., 1997:402). Social constructivism principles also state that collaborative knowledge construction results from the process of negotiation of meaning and achieving understanding through discussing and contributing knowledge in a collective way (Kanuka & Anderson, 1998). Therefore, a social constructivism approach is considered more suitable than cognitive constructivism to serve as the foundation for this research, because it aims to explore collective knowledge construction within the virtual product user community rather than the individual's knowledge behaviour.

Online interaction in the virtual community is embedded in discussion transcripts, which contain knowledge being exchanged and created. Accordingly, the discussion transcript can serve as a data source (Meyer, 2004) and has thus become the research object in many researches. For instance, some researchers have utilized online discussion transcripts to explore the process of knowledge construction (Gunawardena et al., 2001; Gunawardena, et al., 1997). In the current research project, the discussion threads embedded with interaction among virtual product user community members and knowledge construction are explored through content analysis of the selected discussion thread published in the product user forum.

3.2.1.2 Epistemology: Interpretivism

Epistemology "is concerned with philosophical claims about the way in which the world is known to us or can be made known to us" (Hughes, 1990:5). Epistemological questions aim to explore "what are to count as facts" (Hughes 1990:5). To put it briefly, epistemology refers to "the nature of knowledge and how it can be acquired" (Snape & Spencer, 2003:23). The two main epistemological stances on which most contemporary social studies are based are positivism and interpretivism (Snape & Spencer, 2003).

Positivism holds that "the world is independent of and unaffected by the researcher" (Snape & Spencer, 2003:16). Therefore, according to the positivists, this allows social studies to adopt the methods used in objective and value-free natural sciences because they believe that social behaviours are governed by "law-like regularities" (Snape & Spencer, 2003:23). In this way, positivists tend to treat the social world like the physical world, which is independent of the individual's perception as "a real, concrete, and unchanging structure" (Hudson & Ozanne, 1988: 509). This way of thinking retains the possibility of strict and accurate measurement of the social world (Morgan & Smircich, 1980).

This research project partly aims at capturing the key nuances of the knowledge construction phenomenon in the virtual product user community. The understanding of the community member's knowledge behaviour cannot be separated from the real natural context, nor can it be examined in a strict controlled laboratory experiment as in natural science research. Furthermore, the revelation of knowledge construction quality must rely on the community member's perceptions and comments rather than accurate quantified criteria. Given the above reasons, a positivist paradigm cannot serve as philosophical ground for the current research.

In contrast, interpretivism holds the opposite view, claiming that natural science methods are not appropriate for social inquiries because the social world is not controlled by law-like regularities but mediated through meaning and human action (Snape & Spencer, 2003). The social world and the researcher have mutual influences on each other. The social world can be explored and understood through both the participants' and researcher's perspectives (Snape & Spencer 2003). Interpretivist paradigms stress "understanding of the world as it is, as well as an understanding of the social world from the level of individual subjective experiences" (Nunes et al., 2006:108). Burrel & Margan (1989:28) define the interpretivist paradigm with more detail and operability in the following way: "It seeks explanation within the realm of individual consciousness and subjectivity, within the frame of reference of the participant as opposed to the observer of the action". Neuman (2000:71) defines interpretive approach as follows:

> "Interpretive approach is the systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people created and maintain their social worlds"

This research needs to gain both a thorough understanding of the social world in the virtual product user community and an interpretation of the subjective experience of individuals in the online environment. In order to present credible evidence about the knowledge construction patterns which are embedded in the discussion transcript, an in-depth understanding of the online interaction is necessary. Meanwhile, thorough interpretation and understanding of how forum members produce and maintain their social world as a virtual community in the product user forum is also needed. Individuals' subjective perceptions and consciousness related to participating in this virtual product user community also deserve attention and interpretation, for example, how individuals perceive their online behaviours, sense their status and the power of the moderator in the virtual community, and how they perceive knowledge construction conducted in the virtual environment. Hughes (1990:90)

suggests that “Knowledge of others could only be gained through an interpretative procedure grounded in the imaginative reaction of the experiences of others”. The interaction and knowledge construction embedded within the discussion transcripts are “the objectifications of the human mind” (Hughes, 1990: 90), which have distinct difference from material things. “Accordingly, understanding such phenomena required that lived experiences of others be grasped through the apprehension of their inner meaning; the meaning that led to their production” (Hughes, 1990: 90). Therefore, interpretivism is the best approach to achieve these goals.

Furthermore, interpretivists are more focused on exploring the relationships and interaction between social entities. Neuman (2000:71) states that “interpretive social science is concerned with how people interact and get along with each other”. Additionally, the nature of this research is to explore research participants’ knowledge sharing and construction through social interaction in the virtual product user community. This requires the researcher to interpret their knowledge behaviours, related social norms and values through their perspective. Clarke & Dawson (1999) suggest that researchers should minimize their distance from the research objects if an in-depth understanding of the actors’ viewpoints is needed. Nunes et al. (2006:109) also state that “Interpretivist research tries to understand all the nuances of the phenomena at issue, in order to obtain clarification and insight of the situation.” Given this research’s nature and requirements, interpretivsm is considered as the most suitable epistemological stance.

3.2.2 Research Approach

There are two approaches to generating new knowledge, namely the deductive approach and the inductive approach. The inductive approach is mainly used to identify patterns and build theory through observation, while a deductive approach is used to produce propositions and hypotheses by logical reasoning. Snape & Spencer (2003:23) state that “Induction looks for patterns and associations derived from observations of the world; deduction generates propositions and hypotheses theoretically through a logically derived process”. Moreover, Hyde (2000:83) points out that inductive reasoning is used to build theory and deductive reasoning is suitable to test a theory:

> “Inductive reasoning is a theory building process, starting with observations of specific instances, and seeking to establish generalisations about the phenomenon under investigation.

> Deductive reasoning is a theory testing process which commences with an established theory or generalisation, and seeks to see if the theory applies to specific instances." (Hyde, 2000: 83).

This research primarily adopts a deductive approach. A deductive approach, as suggested by Creswell (1994), is more appropriate for the research topic on which there is rich literature to define theoretical frameworks. In contrast, if the research topic is new and there is little literature, it is more suitable to adopt an inductive approach (Creswell, 1994). The researcher performed an extensive search of literature around the subject area at the beginning of this research project. The literature areas that the researcher considers highly relevant to this research topic are, namely, the attributes and functions of different types of virtual community, knowledge process and knowledge behaviour in various online communities (especially CSCL community), leadership and moderation of virtual communities. The prior theories identified in the literature review help focus on the research question. Additionally, the existing analysis instruments in the CSCL context provide a lens to create a more tailored coding framework for knowledge construction process in the virtual product user community when conducting content analysis of discussion threads. Moreover, these theories, drawn from the existing literature, will be extended, and the existing theoretical constructs proposed by previous studies in the relevant context (i.e. CSCL context) will also be verified by empirical data.

However, this approach is not purely deductive in nature. For instance, in the literature there is no discussion of the theoretical implications of the virtual product user community member's knowledge construction and relevant moderation. Thus, the researcher needs to build relevant new concepts, theories, and hypotheses from the data to fill the gap identified in the literature review.

3.3 Research Methodology & Research Design

3.3.1 Research Methodology

This research mainly adopts a qualitative research methodology to study knowledge construction in the virtual product user community. However, the selected discussion threads are also analysed in a quantitative way to complement the qualitative approach and thereby give a much richer picture. In the first step of thread analysis, the researcher collected quantitative data about discussion participation at both the individual level, group level and temporal level. Nevertheless, these quantitative data about numbers of posts contributed by the product user forum participants are quite difficult to utilize for identifying interaction

quality (Mever, 2004) and, more specifically, the knowledge construction process and levels. Hence, in order to explore the knowledge construction patterns and process in the selected thread transcripts from the product user peer support forums, qualitative content analysis is adopted. Content analysis is justified as an effective tool to "reveal information that is not situated at the surface of the transcripts" (De Wever et al., 2006:7).

3.3.2 Research Design: Case Study Design

3.3.2.1 Case Study

This study adopts a case study design to achieve the general aim of theory testing and extension. The case study is defined by Robson (2002:52) as an "investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence". Gorman & Clayton (2005:47) define it in a more concrete way as

> "an in-depth investigation of a discrete entity (which may be a single setting, subject, collection or event) on the assumption that it is possible to derive knowledge of the wider phenomenon from intensive investigation of a specific instance or case".

Yin (1994) proposes that case study is typically used to explore questions like "how" or "why". It is quite suitable for studying phenomena in a real-life context, especially when the researcher has little or no control over behavioural events (Yin, 1994). Accordingly, this characteristic especially suits the interpretivisim paradigm adopted in this research, which also stresses the natural settings of the research object. Its procedural characteristics include a variety of interests, multiple sources of evidence, and propositions drawn from existing theories to guide data collection and analysis (Yin, 1994).

There are three main types of case studies: explanatory case study, exploratory case study and descriptive case study (Yin, 1994). This research is both explanatory and exploratory in nature. The main research question of this research is "how is knowledge created in a virtual product user community?" Based on the insights gained on the above question, this research also aims to explore leadership strategies that can be adopted by moderators and managing teams in the pursuit of using knowledge sharing, creation, and transfer to fulfil the needs of individual product users as well as to achieve organizational objectives.

Furthermore, case study research can employ either single or multiple case studies, based on the number of cases selected by the researcher (Yin, 1994). This research chooses multiple-case study design based on purposive sampling strategy. As stated by Patton (1990: 169),

> "the logic and power of purposeful sampling lies in selecting information –rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling".

Accordingly, a typical peer user support forum sponsored by Dell is chosen as the case for initial analysis of knowledge construction in the first research stage. It is identified as a representative virtual product user community which can provide rich and in-depth data to meet the needs of this research. In addition, in the last data analysis stage, a variety of virtual communities and networks with different but comparable key attributes are selected as the cases to explore contextual influences on knowledge construction.

3.4 Data Collection

Interviews with community participants, postings in two IT product user forums, and observation data are the main data sources in this research. Knowledge sharing patterns and the knowledge construction process are embedded within the postings released onto the forums. The other main data source is the interviews, which will be conducted in the next research stage. Interview data will reveal the perceptions and feelings of the community participants' towards the knowledge sharing and construction activities, and moderation activities, which cannot be reflected from their released published threads. The findings from the above two types of data will then be combined and synthesised in order to answer the research question.

3.4.1 Data Sources

This research explores knowledge construction patterns within a virtual product user community. Therefore, it requires qualitative data related to people's knowledge behaviours. Mason (2002: 52) classifies qualitative data sources into the following six groups:

> "People (as individuals, groups or collectives)
> Organizations, institutions and entities
> Texts (published and unpublished sources including virtual ones)
> Settings and environments (material, visual/sensory and virtual)
> Objects, artefacts, media products (material, visual/sensory and virtual)
> Events and happenings (material, visual/sensory and virtual)"

In this study the researcher mainly collected qualitative data from two types of data sources in, namely texts in the form of postings released onto these forums under investigation and documents published by the forums and their sponsors (for example, the FAQ page of the

forums and organizational policies which can provide background information of these forums and their operating mechanisms); forum participants from whom the interview data is collected.

The interview is one of the most frequently used data collection methods in social science and allows the researcher to directly interact with research participants through language to collect qualitative data on the research question (Matthews & Ross, 2010). The researcher initially planned to interview three groups of community participants, namely, ordinary forum users, forum moderators, and forum management team members on Dell Support Forum. However, the moderators, the forum managers, and some active forum users with the title "RockStars" were constrained to be interviewed due to the non-disclosure contracts. Therefore, the rest forum members were chosen to be interviewed. The questions in the interview mainly concentrate on their experience of knowledge sharing and creation, opinions towards moderation and management activities, and perceptions about community culture.

In addition to archives, questionnaires and interviews, observation is another type of data collection method for case studies (Eisenhardt, 1989). In this research, the observations will be made of community members' publishing activities in the selected forums and the moderator's moderation activities. Observation also plays an extremely important role in selecting discussion threads in order to derive the richest picture of knowledge construction patterns.

3.4.2 Data Collection Methods

3.4.2.1 Semi-structured Interview

According to the degree of structure and standardisation, interviews can be classified into three groups: structured interviews, semi-structured interviews and unstructured interviews (Matthews & Ross, 2010). In this research, the semi-structured interview method is selected because it provides both flexibility and structure for the interview process. Moreover, it meets the researcher's need to investigate certain research sub-questions, by allowing questions to be asked in different order or by different methods according to the interview situation.

Semi-structured interviews are commonly used to collect qualitative data. They are especially suitable when the researcher plans to collect qualitative data about "…people's experiences, behaviour and understandings and how and why they experience and understand the social

world in this way" (Matthews & Ross, 2010:221). The current research aims to collect qualitative data about virtual product user community members' experience of knowledge building, and their understandings about the virtual community and their online knowledge activities. The semi-structured interview has the following characteristics (Matthews & Ross, 2010:221):

> "Follow a common set of topics or questions for each interview";
> "May introduce the topics or questions in different ways or orders [orders] as appropriate for each interview";
> "Allow the participant to answer the questions or discuss the topic in their own way using their own words".

The Semi-structured interview can be used in exploratory research, explanatory research, and evaluation research (Matthews & Ross, 2010). The main aim of the current research is to investigate questions about "How is knowledge constructed in a virtual product user community?" Thus, the semi-structured interview is an appropriate data collection method to study this "how" question, which focuses on the exploration of knowledge behaviour in the virtual product user community as well as the evaluation of existing theories and models emerging from relevant contexts (e.g. CSCL, virtual community of practice). For instance, the theoretical conclusions of the moderator's functions in CSCL can be evaluated through the findings from interviews both with the forum users and the moderators themselves.

The use of the semi-structured interview also has the following advantages: the informal, adaptable and flexible format of the semi-structured interview can guide the community member interviewees toward revealing more about their own experience of knowledge exchanges, new knowledge building and forum management activities, and their personal perceptions towards community running issues, in their own way; using the main interview questions as a guide, the semi-structured interview can ensure that the same area will be covered in each interview of the same kind of interviewee; in-depth data about the research question can be collected within a manifest framework which is embedded in the interview guide. Hence, the nature of the research question and the advantages of semi-structured interview in producing appropriate data justify the researcher's adoption of semi-structured interview in this research.

The interviews were conducted through computer-mediated communications, and mainly by e-mail, but alternatively on Skype (only one interviewee was asked follow-up interview questions via Skype). The choice of the particular communication tool for interview (i.e.

either by e-mail or on Skype) was based on the convenience of the interviewees. Interviews by communication software were also recorded.

3.4.2.2 Sampling of Interviewees

In terms of selecting the interviewees, a "purposive sampling" method was employed. In this approach "people are chosen with purpose to enable the researcher to explore the research question or develop theory" (Matthews & Ross, 2010:225). Marshall (1996) points out that purposive sampling also allows the research subjects in the sample to suggest other potentially useful candidates for study (i.e. snowball sampling). Accordingly, the use of purposive sampling in this research reduced the potential difficulty of accessing sufficient interviewees though the interviewee's personal network. However, this sampling strategy also has limitations; in particular, there is the question of whether the sample is representative of the whole population. However, the interviewing purpose aims at producing rich data which can help answer the research questions rather than giving accurate description of the whole population. Thus, selecting representative interviewees is not the focus. In addition, this limitation can be offset to some extent by selecting a combination of varying participants.

The research participants who were selected for interview were to be chosen to have different experience of participating in the product user forum that is relevant to the interviewing questions. That is to say, people who are involved with knowledge sharing and creation, moderation and management activities would be potential interview candidates. In general, three types of research participants were originally targeted as interviewees.

1. Registered members of the selected product user forum (i.e. virtual product user community members).

2. Moderators and facilitators allocated to the selected forum.

3. Managing group members of the forum, with responsibility for managing the virtual product community and whose duty it is to ensure that the forum is maintained in a way that enables it to achieve the organization's objectives.

The three types of interviewees were planned to be selected according to their characteristics and experience of participating in these forums. Their perceptions and comments about their participation are directly linked to the research question and sub-questions, thus allowing the researcher to conduct an in-depth study of the research topic.

However, in practice it proved impossible to interview the managing team members and moderators, due to access limitations and non-disclosure contracts between them and the organization, In addition, some active forum members (/knowledge contributors) who had accepted the title of "RockStar" were also constrained by non-disclosure contracts. Thus, only the novices, medium active members, and active members without the "RockStar" title were in practice interviewed. These interviewees, because of the diverse knowledge levels and experiences of participating in the forum, did provide a wide range of views, comments and opinions relevant to the study's research questions. Thus, a fairly comprehensive understanding about community member groups' perspectives towards knowledge construction and relevant issues was achieved through this purposive sampling strategy.

3.4.2.3 Sampling Strategy of Selecting Threads

The initial research stage entailed analysis of theoretically rich threads in order to explore the research question and develop new theories about the collaborative knowledge construction process in the selected virtual product user communities. This involved selecting a theoretically important discussion thread which contained rich elements of knowledge construction. For example, a thread is around the topic of solving the noisy fan problem on a laptop and attracts a dozen community members to participate in discussion. Three posts in this thread are marked with the label "  ". During this collaborative discussion to find a solution, a complete knowledge construction process emerges.

In the following research stages, the same judgement sampling strategy, which is introduced in detail (section 3.5.6.1.1), is adopted in selecting discussion threads from the Dell Support Forum, the Dell IdeaStorm Community, and other virtual communities and networks. The discussion threads with rich data and theoretical interests were chosen to serve different research questions in each stage, for instance, to elaborate the newly developed content analysis framework, and to explore the influence of contextual attributes on knowledge construction.

3.4.2.4 Other Potential Data Collection Methods

The ethnographic approach places great emphasis on "first-hand experience" of the setting of the object of research (Atkinson et al., 2001).

> "It emphasizes the use of cultural settings as data sources (sometimes seen as natural settings), and argues that the best-although not the only-way of generating knowledge of these is for a researcher to get right inside them" (Mason, 2002:55).

The product user forums and websites selected for study in this research project belong to commercial organizations, and it is quite difficult to negotiate access to their organizational work settings to experience the daily routines of the moderators and managing group. Additionally, the time limits of this research project cannot meet the long term requirement of ethnographic study. Therefore, the ethnographic approach is not suitable for this research project.

Gaining access to the workplace is difficult, and participant observation activities are relatively time consuming. Furthermore, when using participant observation method it is impossible to simultaneously record all of the participants' knowledge transferring activities and social interactions. Therefore, it was not considered an appropriate approach for this research.

3.5 Content Analysis of Posting Transcripts

Content analysis can not only be used in quantitative or qualitative research studies, but also can be used in an inductive or deductive way. This research adopts qualitative content analysis method to study the knowledge construction embedded within the discussion threads. Additionally, a deductive approach is used during the coding process.

3.5.1 Consideration of Alternative Data Analysis Methods of Posting Transcripts

3.5.1.1 Conversation Analysis

Conversation analysis is rooted in the ethnographic perspective, with the purpose of exploring people's "method" for "producing orderly social interaction" (Silverman, 2001:167). It is an empiricist approach, which depends on "close and minute scrutiny of sequences of dialogue according to certain conversations" (Mason, 2002:57). Conversation analysis, which is usually considered as a subset of discourse analysis, can be used to determine how online conversations contribute to the learning development process of the discussion participants (Marra et al., 2004). Van Dijk (1997) also suggests that conversation analysis techniques can be used to examine online discussion content. However, Mazur (2004) discovers that a "paucity" exists in conversation analysis methods for online conversations.

Where conversations among online discussion participants are the main focus, some researchers explore online interaction from the approach of discourse analysis (e.g. Yagelski & Grabill, 1998). However, the current research mainly concentrates on analysis and categorization of discussion texts in order to reveal knowledge sharing and creation patterns rather than exploration of the communication process or specific speech acts per se, as is the case in discourse analysis. Hence, the analysis of online discussion transcript data in this research primarily relies on content analysis methodology.

3.5.1.2 Thematic Analysis

Thematic analysis concentrates on finding the most identifiable themes and patterns of behaviour from texts (Arson, 1994). The purpose of analysing the transcripts of the postings in these forums was to reveal the knowledge construction process, which is not immediately apparent as it is usually hidden beyond the lines of the transcripts and needs more interpretation effort. The themes in each post are usually around the topic of technical solution (e.g. state the technical problem, and suggest a solution) and they are quite difficult to link with implicit knowledge construction patterns. Hence, thematic analysis was not considered an appropriate data analysis method for exploring hidden patterns related to complex knowledge behaviour and, in particular, the complicated knowledge construction process.

3.5.2 Definition of Content Analysis

Berelson (1952:18) offers an initial definition of content analysis as "a research technique for the objective, systematic, and quantitative description of the manifest content of communication". Based on the above definition, Krippendorff (1980:21) adds another perspective towards the definition of content analysis: it is "a technique for making replicable and valid inferences from data to their context". This definition stresses interpretation of meaning of the content through content analysis rather than simply summarizing surface features of the content. Thus, this data analysis method goes beyond pure summarizing of manifest content to deal with interpretation of latent content (Graneheim &Lundman, 2003). The hidden patterns of knowledge construction patterns embedded in discussion transcripts can be explored through the content analysis method. Ultimately, a content analysis method is adopted to "provide knowledge and understanding of the phenomenon under study" (Downe-Wamboldt, 1992:314).

According to its different usages, this method can be divided into two approaches: quantitative content analysis and qualitative content analysis (Hsieh & Shannon, 2005). In a survey of 10 commonly referenced studies of online discussions, Rourke et al. (2000) find that in analysing transcripts of asynchronous text-based online discussions quantitative content analysis is mainly used for descriptive and experimental research designs. Given the "how" and "why" nature of the research question, quantitative content analysis is not an appropriate method for this explorative research. Therefore, qualitative content analysis method is selected to analyse discussion thread transcripts in this research.

3.5.3 Qualitative Content Analysis

Hsieh & Shannon (2005:1278) define qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns". Accordingly, qualitative content analysis is mainly used to explore characteristics of the textual language used for communication purposes, especially in terms of its content (verbal meaning) or contextual meaning (Lindkvist, 1981; McTavish & Pirro, 1990; Tesch, 1990).

Hsieh & Shannon (2005) adopt a data coding approach to classify qualitative content analysis into three types based on their different purposes and data coding approaches: conventional content analysis (inductive content approach), directed content analysis(/deductive content analysis) and summative content analysis. The initial coding scheme is the key difference among these three approaches to qualitative content analysis.

3.5.3.1 Conventional Content Analysis /Inductive Content Analysis

Conventional content analysis is an approach used to describe the phenomenon that is under investigation and it is applicable to research areas which lack existing theory or literature (Hsieh & Shannon, 2005). This approach is also known as inductive content analysis on the basis of its categorization process (Kondracki & Mayring, 2000; Lauri & Kyngäs, 2005). The categories and their names emerge directly and inductively from the data rather than from preconceived categories (Kondracki & Wellman, 2002). The organization of qualitative data in inductive content analysis is divided into three phases: open coding, creating categories and abstraction (Elo & Kyngäs; 2008). Kondracki & Mayring (2000) define this process as inductive category development. Wellman (2002) suggests that it requires researchers to

immerse themselves in the data in order to obtain new insights. Therefore, this approach can enable the data to speak for themselves.

If theories and knowledge about the phenomenon being studied are lacking or the existing knowledge is fragmented, the inductive approach of content analysis is preferred (Lauri & Kyngäs, 2005; Elo & Kyngäs; 2008; Hsieh & Shannon, 2005). However, although few researchers have investigated knowledge behaviour in virtual product user communities, dozens of models and frameworks exist for analysis of knowledge construction and cognitive development in the context of CSCL. Hence, conventional content analysis is not considered the appropriate method for this research project.

3.5.3.2 Summative Content Analysis

Another approach to qualitative content analysis is summative content analysis, which emphasizes finding underlying meanings of words or content (Babbie, 1992; Catanzaro, 1988; Morse & Field, 1995). It "starts with identifying and quantifying certain words or content in text with the purpose of understanding the contextual use of words or content" (Hsieh & Shannon, 2005).This approach can generate interpretation of the text through measuring the usage of specific words or phrases (Hsieh & Shannon, 2005). However, statistical measurement of the words used in the postings in product users' forums would not reflect the knowledge construction process, as this lies beyond the lines of the online discussion content. Therefore, summative content analysis approach is considered inappropriate for analysis of online interaction and knowledge construction patterns in virtual product user communities.

3.5.3.3 Directed Content Analysis/Deductive Content Analysis

Directed content analysis is also referred to as the deductive approach to content analysis (Potter & Levine-Donnerstein, 1999; Mayring, 2000; Hsieh & Shannon, 2005). Hsieh & Shannon (2005) point out that directed content analysis is the most appropriate data analysis method when existing theory or prior research can supply a lens to study the phenomenon, even though the existing literature is not complete and the research question still needs further exploration. The directed content analysis is aimed to "validate or extend conceptually a theoretical framework or theory" (Hsieh & Shannon, 2005:1281).

Existing theory can assist the researcher to determine the focus of the research questions. Furthermore, it can provide preconceived ideas of "the variables of interest or about the

relationships among variables" (Hsieh & Shannon, 2005). Therefore, existing theoretical frameworks or literature can help create the initial coding scheme and categories or relations between codes (Hsieh & Shannon, 2005). Given the role of existing theory, it can be described as a deductive use of theory (Potter & Levine-Donnerstein, 1999), or alternatively referred to as deductive category application (Mayring, 2000). Consequently, direct content analysis is distinguished from the conventional approach by its more structured process (Hickey & Kipping, 1996).

Deductive content analysis aims to evaluate prior theories, models, categories and concepts (Marshall & Rossman, 1995). It is recommended as applicable when the aim of the study is to test existing theory in a different context or to compare categories at different time periods, or when the analysis structure of the study is built on previous knowledge (Kyngäs & Vanhanen, 1999; Elo & Kyngäs, 2008; Catanzaro, 1988).

As discussed in the section 2.3 (Literature Review: Knowledge construction Analytical Frameworks in Computer Supported Collaborative Learning), many research and content analysis theoretical models already exist in relation to the study of knowledge construction, critical thinking, and cognitive development in asynchronous online discussion in the CSCL context. Given this, the deductive content analysis approach is therefore selected to explore knowledge building in a new context, namely the virtual product user community. In this research, the most appropriate analytical frameworks are selected from existing literature in relation to analysis of the knowledge construction, critical thinking and cognitive development embedded in online discussions in the CSCL context. Then these coding frameworks are investigated using the data drawn from the selected threads in the online product user forum. Moreover, as the categories and concepts in these models and analytical frameworks are tested, new categories can emerge from the data. In the next research step, the analytical framework can be elaborated by more theoretically rich and interesting threads which are selected for analysis.

3.5.4 General Process of Deductive Content Analysis

In deductive content analysis, the researcher first identifies crucial concepts or variables as the initial coding categories, with the guidance of the existing theory (Potter & Levine-Donnerstein, 1999). In the next step, the researcher supplies an operational definition for each category according to the theory (Hsieh & Shannon, 2005).

In terms of the subsequent coding process, Hsieh & Shannon (2005) highlight two different coding strategies for adoption in directed content analysis according to the differing nature of the research questions. The first strategy involves identifying and categorizing all factors related to a specific phenomenon. In the beginning, the researcher reads the transcripts and highlights the text according to representation of the various coding categories, based on first impressions. Then the researcher codes the highlighted text in line with the preconceived codes from the existing literature. If a particular section of text cannot be classified into any of the predetermined categories a new code will be created (Hsieh & Shannon, 2005).

Another approach to coding is to use the predetermined coding schemes drawn from the literature as the starting point rather than an initial reading through of the text. Data which cannot be coded according to the initial coding scheme are later dealt with through identification of their relationship with the predetermined coding categories (i.e. a new code category or a subcategory of an existing code) (Hsieh & Shannon, 2005).

The choice between these two strategies depends on the nature of the collected qualitative data and the researcher's aim. If the researcher is seeking to gain the richest possible picture of the phenomenon, the decision may be to highlight the text before starting coding, in order to enhance the trustworthiness of the research. Alternatively, if the researcher is confident that the predetermined coding scheme does not bring theoretic bias to the coding process, the decision may be to start coding immediately. Then the researcher can develop relevant sub-categories (Hsieh & Shannon, 2005).

In this research, the researcher first explored the literature for analytical frameworks and models of knowledge construction, critical thinking, and cognitive development. Although all of the existing analytical instruments were designed for the context of CSCL, it is still believed that some of these frameworks could to some extent supply a lens for the analysis of knowledge construction in the context of the virtual product user community. The identification of the most relevant and feasible instruments is mainly discussed in the literature review chapter (2.3) and the following coding section (section 3.5.6.2.2). The analytical frameworks are then selected and the coding categories are listed and defined. In terms of the coding strategy, the decision was made to read the transcripts through first and then to highlight the texts according to the pre-decided categories. In the following steps, the highlighted text was coded and sections of text that could not be classified into the initial categories were used to create new codes.

The categories included in this analytical framework were derived from the literature (i.e. content analysis frameworks in CSCL, see new section 2.4. Literature Review: Knowledge Construction Analytical Frameworks in CSCL). These prior categories were evaluated with the data, including the contextual attributes of the virtual product user community and the selected thread. The contextual differences between the virtual product user community and the CSCL can decide the evaluation of these prior analytical frameworks, thus their contextual attributes were compared, and the similarities and differences were explored. This paves the way of next step: evaluating these frameworks and identifying the categories which can describe the selected discussion transcript data. Some categories in these prior frameworks have a general nature, and can reflect the knowledge construction behaviours in the virtual product user community. These categories were taken out and could be applied to the new context. In some cases, some categories in the prior identified framework were slight modified in order to make them more tailored to describing data.

3.5.5 Advantages and Disadvantages of Deductive Content Analysis

The advantages and disadvantages of deductive content analysis are summarized by Hsieh & Shannon (2005) as follows.

Advantages of deductive content analysis:

a. The findings generated from directed content analysis can provide evidence to support or question a theory. Such evidence can take the form of codes with exemplars or descriptive evidence.

b. Existing theory can guide the discussion of findings. Additionally, this direct approach can support and extend existing theories.

c. The researcher is unlikely to conduct research from a naturalistic perspective.

Disadvantages of deductive content analysis:

a. The research is limited by the theoretical influence or bias present in existing theory. This increases the possibility of finding supportive evidence for adopted existing theories rather than non-supportive evidence.

b. Participants in the research are likely to be influenced by the researcher when being questioned. “They may get cues to answer in a certain way or agree with questions to please

researchers" (Hsieh & Shannon, 2005). As the data source in the current research is transcripts of postings in virtual product user forums, this problem can be avoided.

c. The researcher is likely to ignore contextual factors of the phenomenon by overemphasizing existing theories. In order to offset this disadvantage, in the current research, contextual similarities and differences between CSCL and virtual product user communities are thoroughly examined before starting the data coding process.

These limitations can have a negative influence on the objectivity of the research. Hsieh & Shannon (2005) suggest that such negative effects can be offset by incorporating an audit trail and audit process into the coding process. Meanwhile, the virtual product user community's contextual can become familiar though studying the forum's policy, introduction and FAQ page, and by long-term observation of posting activities.

3.5.6 Deductive Content Analysis Stages for Analysing Posting Transcript Data

Data analysis of the transcripts selected from these two virtual communities was conducted through three phases: preparation, organizing and reporting (Elo & Kynga, 2007).

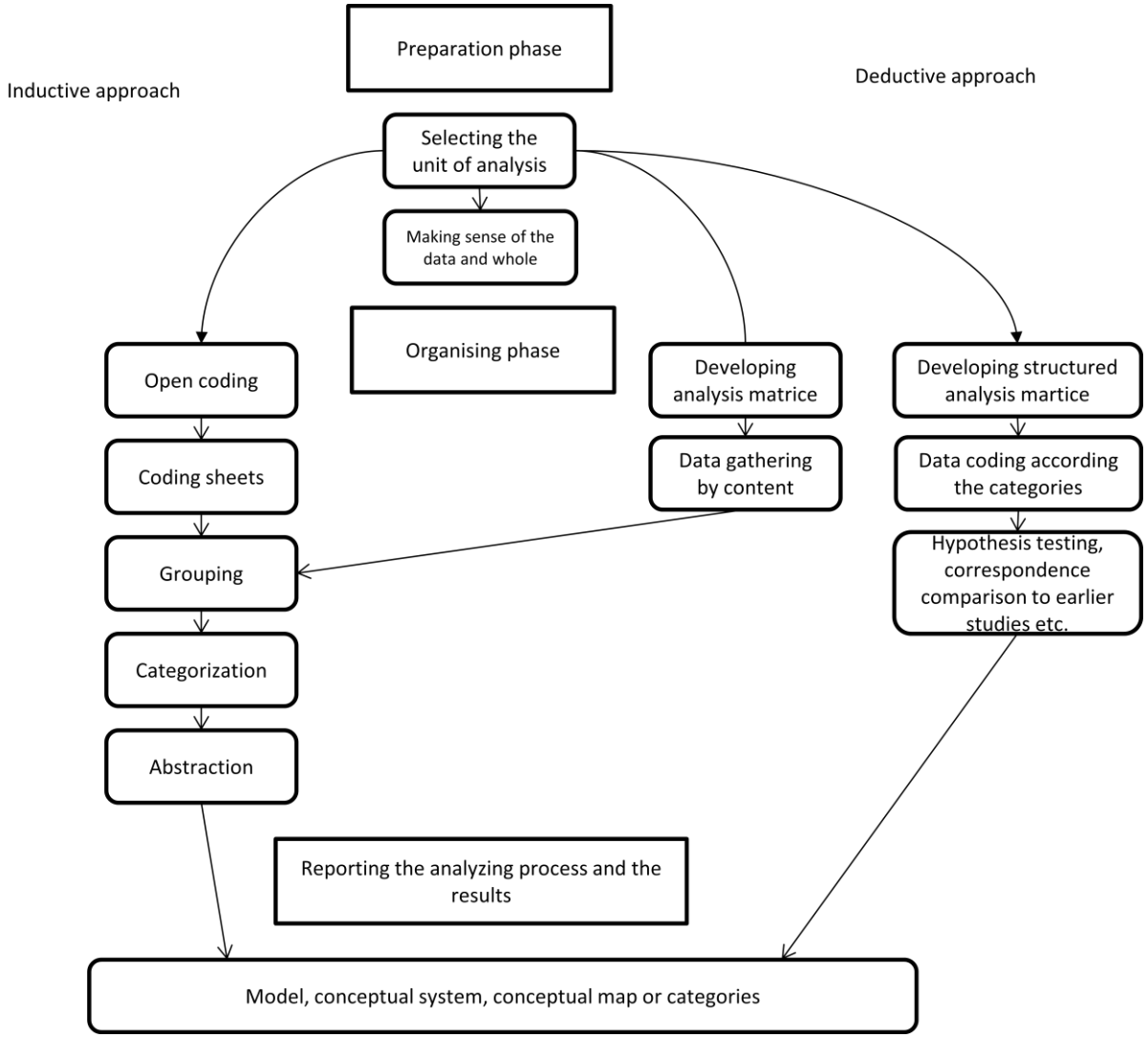


Figure 4.1: Preparation, organizing and resulting phases in the content process (adapted from Elo &Kynga, 2007:110)

[Note: "Developing analysis matrice" should be "Developing analysis matrix"]

3.5.6.1 First Phase: Preparation stage

3.5.6.1.1 Before Selection of the Unit of Analysis

Two additional factors need to be considered before selection of the unit of analysis: what to analyse and how extensive the analysis should be, and the decision on sampling strategies (Cavanagh, 1997). The first factor requires the researcher to decide what content to analyse: manifest content which represents surface meanings, or latent content which refers to hidden meanings. These two kinds of content require different degrees of interpretation effort. Elo & Kungas (2008) argue that this issue must be considered when beginning the analysis. Sampling strategy is another factor that requires consideration.

After consideration of various sampling strategies for selecting the thread transcripts in this study, judgement sampling is considered as the most appropriate method.

Gao (1996) suggests that probability sampling or judgement sampling may be necessary when the text data is too large to be analysed. However, probability sampling, although commonly used in quantitative studies, is inappropriate in qualitative research for both theoretical and practical reasons (Marshall, 1996). The main reason is that probability sampling "is not the most effective way of developing an understanding of complex issues relating to human behaviour" (Marshall, 1996:523). In addition, convenience sampling, although it involves least cost to the researcher and is one of the most frequently used approaches in qualitative studies, is not sufficiently rigorous to guarantee intellectual credibility and can produce data of poor quality (Marshall, 1996). Thus, convenience sampling can be excluded from consideration as a sampling strategy. In grounded theory studies (Coyne, 1997), which focus on the constant comparison of collected data, theoretical sampling is the principal strategy used. Hence, purposeful sampling is identified as the most appropriate sampling strategy in this research on the basis of exclusion of other strategies.

Purposive sampling, also known as judgement sampling, is the most frequently used sampling technique (Marshall, 1996). It enables the researcher to select the most productive sampling units in terms of answering the research questions (Marshall, 1996). In particular, it has the following advantage:

> "this can involve developing a framework of the variables that might influence an individual's contribution and will be based on the researcher's practical knowledge of the research area, the available literature and evidence from the study itself " (Marshall, 1996: 523).

This characteristic of judgement sampling makes it especially appropriate for directed content analysis of online discussions in this research project, which strongly relies on the existing theoretical models and framework for coding variables. Additionally, the extensive literature review conducted by the researcher before reaching the data analysis stage has created a basis for constructing a framework of variables.

Furthermore, there is the additional advantage that a broad range of subjects can be studied (Marshall, 1996). These subjects include "outliers (deviant sample), subjects who have specific experiences (critical case sample) or subjects with special expertise (key informant sample)" (Marshall, 1996:523). In this way, judgement sampling enables the researcher to handle a wide range of data that not only falls into categories in the existing analytical models

of knowledge construction, but also includes deviant data which can be incorporated to create new categories.

In this research, following a judgement sampling strategy, the threads which were considered to contain the richest data about key elements in the knowledge construction process in the virtual product user community were selected after extensive reading of the threads published in the forum. Thus, the selection of these most theoretically productive threads were able to help achieve the aim of generating significant knowledge about knowledge building in this specific type of online community, namely the virtual product user community. Coyne (1997: 629) points out that there is "much confusion and overlapping of variations of sampling" in qualitative research. In the literature, judgement sampling is considered synonymously and used interchangeably with other terms, including purposeful sampling and selective sampling (Marshall, 1996; Coyne, 1997). Therefore, although judgement sampling, purposeful sampling and selective sampling, as stated above, are commonly viewed synonymously, in order to maintain consistency, the term "judgement sampling" is adopted throughout this thesis.

3.5.6.1.2 Latent content and manifest content

In content analysis, data is usually classified into two types: manifest content and latent content. The researcher has decided to analyse both the manifest and latent content of the online discussions in the selected threads. Manifest content is referred to as "content that resides on the surface of communication and is therefore easily observable" (Rourke et al., 2001: 14). It is the obvious and superficial content that can be easily found in the communication. Thus, it brings little burden for the coder to interpret the embedded meaning (Hagelin, 1999). In this research, the manifest content that is explored includes the main theme expressed in the post (e.g. asking a question or answering a question), response relationship and response frequency, number of posts within a single thread, number of posts published by each individual forum user, the number of posts released by classified forum user groups, number of posts released in different periods, and so on.

In contrast, latent content is related to the hidden meanings and patterns between the lines, which can be revealed through deep interpretation by the coder. Although some researchers debate whether the hidden meaning in documents can be analysed or not (Elo & Kyngas, 2008), Robson (1993) points out that researchers should be directed by the research aim and research questions of the study when making decisions on what content to analyse. In this

study, it is crucial to investigate latent content of the knowledge construction patterns and process given that the research question is "how is knowledge shared and constructed in the virtual product user community". Latent content, in terms of the forums under investigation, mainly refers to the interaction patterns, knowledge sharing patterns, group cognitive process, knowledge construction process and the contextual influences. To offer a more detailed view, it can be further broken down into the following categories: individual attitudes, values, beliefs, prejudices, bias, debates, doubt, confirmation, argument, justification, consensus and so on, within the online discussion.

There is no denying that latent content is unavoidably embedded within the subjective and interpretative nature of this study (Rourke et al., 2001). However, content analysis experts have suggested the following strategies for minimizing subjectivity:

1) Newman, Webb, and Cochrane (1995: 69) state that:

> "Rather than classify every statement in a transcript as, e.g. critical assessment or uncritical acceptance, we mark and count the obvious examples, and ignore the intermediate shades of grey. This eases the task of the assessors, since there is less need for subtle, subjective, borderline judgements...Of course, one statement might show more than one indicator, ... Or indicators can even overlap" .

This approach to measuring latent content can promote both objectivity and reliability while also easing the coder's workload. In this research, the salient ideas embedded within each post were coded, whereas those that were more vague, with subtler meaning, were usually ignored. Furthermore, in some cases, one post contained two categories.

2) Holsti (1969) proposes delaying analysis of latent content until the interpretative stage. "During that period, the investigator is free to use all of his powers of imagination and intuition to draw meaningful conclusions from the data" (Holsti, 1969: 12-13). In this research, the researcher firstly familiarised himself with the contextual information of the forum and discussion contents in the thread, then analysed the manifest content (namely distribution of posts by individuals and classified forum user groups and post distribution in different periods) when building an initial analysis framework in the first stage. The analysis of latent content (to identify knowledge construction patterns) was conducted at a later stage, after obtaining much sufficient knowledge about the research subjects.

3) A more popular approach is to "define the latent variables and then deduce manifest indicators of these variables" (Rourke et al., 2001:16). This has been widely adopted by

researchers when analysing computer mediated communication transcripts (Bullen, 1998; Garrison et al., 2000b; Gunawardena et al., 1997; Henri, 1991; Marttunen, 1997; McDonald, 1998; Newman et al., 1995; Zhu, 1996), as it helps to ensure objectivity and reliability during coding of the latent content. This categorization of the variables can represent a descriptive level of content, and therefore it can be considered as the expression of the manifest content of the text (Graneheim & Lundman, 2004). In the first findings chapter, the main categories of the knowledge construction process which represent latent knowledge building patterns are defined. Each main category is divided into sub-categories which are derived from and highly reflective of the posts' content, and then the manifest indicator of each sub-category is illustrated. This enables the abstract content of knowledge construction to be presented in a much more understandable and credible way.

3.5.6.1.3 Selecting the unit of analysis

The unit of analysis is usually chosen in the preparation phase of a research study (McCain, 1998; Cavanagh, 1997; Guthrie et al., 2004). The choice of unit of analysis is dependent on the research question, and it can be a letter, a single word, a theme, message portions of pages, sentence, paragraph, even the number of discussion participants or discussion length (Polit & Beck, 2004; Robson, 1993; Fahy et al., 2000; Hillman, 1999; Hara et al., 2000; Ahern et al., 1992; Garrison et al., 2000b).

The selection of the unit of analysis has critical impact on the coding process and coding quality. "The unit of analysis determines how the overall discussion is to be broken down into manageable items for subsequent coding according to the analysis categories" (De Wever et al., 2006:24). Furthermore, the unit of analysis can influence the accuracy of the coding process and the representation of data in terms of the content of the original discourse (Hearnshaw, 2000). De Wever et al. (2006) also state that the selection of the unit of analysis affects the understanding of collaborative knowledge construction.

> "The unit of analysis determines the granularity in looking at the transcripts in the online discussion. To get a complete and meaningful picture of the collaborative process, this granularity needs to be set appropriately" (De Wever et al., 2006:24).

In the existing literature on online discussion groups and communities, the following units have been selected for content analysis: sentence unit (Fahy et al., 2001; PenaShaff & Nicholls,2004;), paragraph unit(Hara et al., 2000), unit of complete message (Anderson et al., 2001; Bullen, 1997; Garrison et al., 2001; Gunawardena et al., 1997; Zhu, 1996; Veerman &

Veldhuis-Diermanse, 2001), thematic unit/units of meaning (Henri, 1992;Lockhorst et al., 2003; Newman et al., 1995; Rourke et al., 1999), micro- and macro-segments (Weiberger & Fischer, 2005), and the complete discussion as the unit of analysis (Järvelä, & Häkkinen, 2002).

However, none of these units of analysis are perfect as they each have their own advantages and weaknesses (Strijbos et al., 2005). Most of the prior researchers in this field have attempted to ensure reliability and containing exclusive and exhaustive, meaningful units when selecting the unit of analysis, but the relationship between these two criteria is negatively correlated (Rouke et al., 2001; De Wever et al, 2006).

For this research, following Rourke et al. (2001), small fixed units of analysis such as single words and individual sentences would have had the advantage of being easily and objectively identified. However, they do not necessarily cover the construct (i.e. meaningful unit) under investigation and they would have yielded a large number of cases. Neither is the paragraph unit applicable, although it can considerably reduce the number of cases. Some posts may not be correctly divisible into paragraphs by writers, and one construct (meaning unit) can span across several paragraphs (Rourke et al., 2001). Therefore, none of these three options, namely single word, sentence and paragraph, is the best choice as the unit of analysis in this research.

Thematic unit is depicted by Budd et al. (1967:34) as "…a single thought unit or idea unit that conveys a single item of information extracted from a segment of content". Henri (1991) proposes a similar concept, namely the "unit of meaning". Henri (1991:34) argues that "it is absolutely useless to wonder if it is the word, the proposition, the sentence or the paragraph which is the proper unit of meaning, for the unit of meaning is lodged in meaning". Nevertheless, the thematic unit has inherent volatility that may result in subjective ratings and low reliability when coding a complex latent construct (Rourke, et al. 2001:18). Due to the lack of literature on knowledge construction in the virtual product user community, it is quite difficult to identify all of the thematic units relating to knowledge building. Thus, the thematic unit was not considered appropriate for adoption in this research.

The complete message (i.e. a single post) has more advantages as a unit of analysis, and this method is adopted by most studies (De Wever et al., 2006; Rourke et al., 2001). Its most obvious advantage is that it can ensure objectivity to the most extent when identifying the unit of analysis. Rourke et al. (2001:18) summarize these advantages as follows: first, it can

be objectively identified. This enables multiple raters to agree on the number of cases in a consistent way; second, it yields an acceptable number of cases; third, it encompasses the constructs in an exhaustive and exclusive way; fourth, its parameters are decided by the message author.

Krippendorf (1980:64) points out that the process of unitization (i.e. decision on the unit of analysis) "involves considerable compromise" in order to maintain balance between reliability, meaningfulness, efficiency, and productivity. In addition to the advantages deriving from selecting the complete message as the unit of analysis, the knowledge construction development process and patterns can only be reflected through the complete discussion within one thread. Hence, complete messages were considered the most appropriate units of analysis in this research.

3.5.6.2 Second Phase: Organizing Phase

3.5.6.2.1 Making sense of the data and the whole

The guidelines and introduction webpage of the forums were read through several times, and notes about their features and operational mechanisms were also noted in order to enable the researcher to familiarise himself with the context of the online discussions in these forums and to gain a sense of the whole. Then the thread samples, namely selected complete discussion messages, were selected according to the researcher's theoretical interests in the knowledge creation process. These threads were read several times until the researcher fully understood them.

3.5.6.2.2 Categorization of Coding

Once the preparation work is completed, the next stage is to "develop a categorization matrix and to code the data according to the categories" (Elo & Kynga 2007:111). Creating categories is the core process of qualitative content analysis (Graneheim & Lundman, 2004).

A category is described by Weber (1990:37) as "a group of words with similar meaning or connotations". Patten (1987) states that categories should be internally homogeneous and externally heterogeneous. Furthermore, researchers should also ensure that categories are exhaustive and mutually exclusive (Krippendorff, 1980). Categories are created as a means to describe the phenomenon, to enhance our understanding and to produce knowledge (Cavanagh, 1997). Dey (1993:96-97) points out that " categories must have two aspects, an internal aspect–they must be meaningful in relation to the data–and an external aspect – they

must be meaningful in relation to the other categories". A category can be split into sub-categories, and sub-categories with similar events and attributes can be grouped together as a category (Roberson, 1993; Kyngäs & Vanhanen, 1999). In this research, the categories of the knowledge construction analytical framework are divided into two levels: main and sub-categories.

When creating the categorization matrix, the researcher identifies the initial coding categories based on key concepts or variables in the existing literature and theories (Potter & Levine-Donnerstein, 1999). The matrix can also be derived from prior research in terms of theories, literature reviews, models, and mind maps (Sandelowski, 1995; Polit & Beck, 2004; Hsieh &Shannon, 2005). Kyngäs & Vanhanen (1999) state that either a structured or unconstrained matrix can be adopted, according to the research aim.

The names for these categories can be derived from three main sources: terms emerging from data; actual terms adopted by the research participants; terms from existing theory and literature (Strauss & Corbin, 1998). In this deductive content analysis of the knowledge building process, the perceived categories were guided by existing theories and literature, specifically those content analysis theoretical models and frameworks about knowledge sharing and construction identified in CSCL. These existing analytical instruments, which were considered to shed light on developing categories for knowledge building in the virtual product user community, were comprehensively discussed in the literature review chapter.

After the creation of the categorization matrix, the researcher needs to supply an operational definition for each category within the selected theory or models (Hsieh & Shannon, 2005). Then all of the data are reviewed and coded in accordance with or for exemplification of the selected categories (Polit & Beck, 2004). Any new data that do not fall into any of these categories are treated as new codes.

3.6 Thematic Analysis of the Interview Transcripts

3.6.1 Introduction

The content analysis of the verbal data is completely suitable for the case study approach and builds the basis for interpretation in context (Schrire, 2006). It allows the researcher to focus on the interpreting the meaning of the data rather than the mere description (Chi, 1997; Merriam, 2001). Therefore, the content analysis is compatible with the case study approach which this research adopted. In addition, it also allows researcher to interpret and investigate

the knowledge construction within the selected threads of virtual product user community, which is different from the CSCL context. Its coding way enables the researcher to interpret the knowledge construction embedded within discussion contents in the chosen virtual community, rather than focus on the pure description of verbal meaning (e.g. discussion contents related to symptoms of problems with detailed technical information).

Given many existing content analysis frameworks for analysing asynchronous online discussions in the CSCL context were identified and discussed in the section (2.4 Literature Review: Knowledge Construction Analytical Frameworks in Computer Supported Collaborative Learning (CSCL), a deductive approach is quite appropriate tool to investigate the knowledge construction in the online discussions of virtual product user community. This has been discussed with details in the section (3.5.3.3Directed Content Analysis/Deductive Content Analysis) on the basis of comparing the contextual difference between the virtual product user community and the formal online learning community. Given the content analysis approach, the selected discussion threads are analysed using content analysis methods. The data, being individual messages, naturally fits a content analysis approach.

The thematic analysis of the interview is a complementary data analysis method in this research. It is in line with the nature of semi-structured interview data. This research adopted a semi-structured interview method as the second data source. Each interview question is targeted at one specific issue (related to the research question), and the themes generated from thematic analysis can well correspond with that. Moreover, the contents and patterns of the interview data are quite different from these in the technical problem solution discussion threads. The interviewees' answers usually provided general descriptions about their experiences and comments rather than detailed discussion contents in the threads. Therefore, this makes the content analysis not suitable for coding the semi-structured interview data.

The thematic analysis chosen in this research is also in line with the purpose of the semi-structured interview data. The categories included in the newly created content analysis framework needs to be verified by the narrative data from interviewee (i.e. the community member). Some patterns and factors hidden from the online discussion contents need to be revealed through interview data. A deductive approach of thematic analysis of interview data is more oriented to generate relevant themes to evaluate the categories derived from content analysis of asynchronous discussion. In addition, some themes which cannot be revealed from the online discussion contents in the thread, for instances, community culture and

community members' attitudes towards the moderation, can be created to further investigate these influencing issues and explore the relationship between the included categories in the content analysis framework. Therefore, the thematic analysis of interview data and content analysis of asynchronous online discussion contents can complement with each and enable the researcher to explore the research to the most extent.

3.6.2 Thematic Analysis

Thematic analysis is one of the most frequently used qualitative analysis methods. Daly, Kellehear & Gliksman (1997) state that thematic analysis is a method of searching for important themes to describe a phenomenon. A theme is referred to as "a pattern in the information that at minimum describes and organises the possible observations and at maximum interprets aspects of the phenomenon" (Boyatzis, 1998:161). Themes are referred to as meaning units derived from patterns such as "conversation topics, vocabulary, recurring activities, meanings, feelings, or folk sayings and proverbs" (Taylor & Bogdan, 1984:131). The thematic analysis process requires identification of themes by "careful reading and re-reading of the data" (Rice & Ezzy, 1999:258). Leininger (1985:60) provides a much more detailed approach to identifying themes, entailing "bringing together components or fragments of ideas or experiences, which often are meaningless when viewed alone".

3.6.3 General Thematic Analysis Process

According to Aronson (1994), thematic analysis can be divided into the following steps:

- The first step is data collection. After the interview conversation has been transcribed, patterns of experiences, feelings, and comments can be listed. Names for these identified patterns can be generated from direct quotes or paraphrased common ideas (Aronson, 1994).
- The second step is to find all data related to the already grouped patterns and categorize the data according to the corresponding pattern. Consequently, the identified patterns can be explicated.
- The third step is to integrate and classify relevant patterns into sub-themes. When data belonging to sub-themes have been collected, a comprehensive picture of the information is built up and patterns emerge.

- The last step is to construct a valid argument for selecting the themes by referring back to the literature. When the literature has been linked coherently to the themes, the theme statement will be formed to create a story line.

Howitt & Cramer (2007) state that the researcher can alter and modify the analysis at every phase as ideas develop. Therefore, the researcher can adjust the coding in the earlier stages according to the overall view of the data. Howitt & Cramer (2007) stress that the coding should be as close to the data as possible while avoiding redundant codings. Moreover, the researcher can also present numerical indications of incidence and frequency of every theme in the data (Howitt & Cramer, 2007); for instance, to what extent the participants repeat the same data belonging to a particular theme.

Boyatzis (1998:1) points out that the coding process "involves recognizing (seeing) an important moment and encoding it (seeing it as something) before the interpretation process". A "good code" is the one of descriptive richness of the phenomenon (Boyatzis, 1998:1). During the encoding process, the data is organized in order to identify and produce themes.

3.6.4 Deductive Thematic Analysis

Thematic analysis mainly follows the conventions of template analysis, in which the analyst generates a list of codes (template) to stand for the themes identified from the interview transcripts (text data) (King, 2004).

Deductive thematic analysis is adopted in this research project. This is because many relevant theoretical concepts, constructs and ideas were expected to be generated from a comparatively thorough and comprehensive literature review and findings from thread analysis. Moreover, a deductive thematic analysis approach can facilitate the interpretation and classification of identifiable themes and knowledge behaviour patterns embedded within the interview transcripts.

The concrete stages followed in this research were as follows:

Stage One: The researcher reads through the interview transcript corpus a number of times in order to become familiar with the data corpus.

Stage Two: The researcher identifies data sets through initial interpretation of the data and then copies the data sets into a document which is divided into two margins (left margin and right margin). The original data sets are arranged into the right margin, while the notes about

the initial thoughts of the data are put into the left margin. These notes will concern concepts and phrases that are judged as theoretically interesting, relevant or important.

Stage Three: The researcher transforms the notes into initial themes. Definitions of these themes are also given in this stage. During this process any notes which are considered to be irrelevant or unimportant are deleted, whilst notes which can lead to meaningful themes are kept for the remaining stages. In order to ensure the validity of theme generation, the researcher invites a second rater to comment on the generated themes. Alternatively, the second rater can generate another list of themes from the same sets of data; then the two raters can discuss the validity of the different themes until agreement is reached.

Stage Four: The researcher re-reads the data and then refines all of these discovered themes into more specific clusters. Each cluster of themes can be based on the concepts and constructs identified from the literature or those newly discovered from the data analysis of postings.

Stage Five: The researcher analyses the logic relationship between these theme clusters and then further categorizes them into different types.

Stage Six: According to the guideline proposed by Braun & Clarke (2006), original text extracted from the raw data is attached to each theme within varying categories. This can provide evidence to support the validity and appropriateness of the theme generation and classification process. The final analysis of the extracted text is referred back to the literature review, findings from the post analysis and research question.

3.7 Research Reliability & Reflexivity

3.7.1 Inter-rater Reliability of Content Analysis of Postings

Rourke and colleagues (2001:7) state that

> "the reliability of a coding scheme can be viewed as a continuum, beginning with coder stability (one coder agreeing with herself over time), to interrater reliability (two or more coders agreeing with each other), and ultimately to replicability (the ability of multiple and distinct groups of researchers to apply a coding scheme reliably)"

Inter-rater reliability is the critical factor to ensure objectivity in content studies (Rourke et al., 2001; De Wever, et al., 2006). It is considered as "the primary test of objectivity in content

studies" and defined as "the extent to which different coders, each coding the same content, come to the same coding decisions" (Rourke et al. 2001:6).

There are several indexes to reflect inter-rater reliability of content analysis studies, including percent agreement, Cohen's kappa, Holsti's method, Scott's pi, Spearman's rho, Krippendorff's alpha, Pearson's correlation coefficient, Kupper-Hafner index, Lin's concordance correlation coefficient, and so on (De Wever et al., 2006; Krippendorff, 1980; Kupper & Hafner, 1989; Neuendorf, 2002; Lombard et al., 2002; Rourke et al., 2001). However, "there is no general consensus on what index should be used" (De Wever et al., 2006:10).

The most commonly used index of inter-rater reliability is percent agreement statistics, which is also by far the simplest (De Wever et al., 2006:10; Rourke et al., 2001). Percent agreement is the ratio between the number of codes which the raters agree upon and the overall number of codes (De Wever at al., 2006). Thus, it can "reflect the number of agreements per total number of coding decisions" (Rourke et al., 2001:11). The formula for calculating percent agreement is provided by Holsti's (1969) coefficient of reliability as follows:

> "C. R. = 2m / n1 + n2
> Where: m = the number of coding decisions upon which the two coders agree
> n1 = number of coding decisions made by rater 1
> n2 = number of coding decisions made by rater 2" (Rourke et al., 2001:11)

However, percent agreement has a major disadvantage in that it cannot account for chance agreement among raters (Lombard et al., 2002; Neuendorf, 2002; Capozzoli, et al., 1999). Therefore, De Wever and colleagues (2006) suggest that one of three commonly used indexes which account for change agreement can be used to complement percent agreement: Scott's pi, Cohen's kappa or Krippendorff's alpha. Krippendorf's alpha is favoured by De Wever and colleagues (2006) for several reasons: 1. Scott's pi and Cohen's kappa only take nominal levels of the data into account. In contrast, Krippendorff's alpha considers the magnitude of the misses during calculating, thus it is flexible for the measurement of variables in varying terms, such as nominal, ordinal, interval, and ratio (Krippendorf, 1980; Lombard et al., 2002; Neuendorf , 2002; De Wever et al., 2006); 2. Moreover, it is applicable to multiple coders, whereas the other two indexes are only suitable for coding by two raters (De Wever et al., 2006). According to Lombard and colleagues, the main disadvantage of Krippendorf's alpha is its complexity and the difficulty of calculating it manually, especially for interval and ratio

level variables (Lombard et al., 2002). However, De Wever et al. (2006) suggest that this problem can be solved through software, for instance, the free software R.P.

As for the exact level of inter-rater reliability, there are no established standards so far (De Wever et al., 2006; Rourke et al., 2001). For percent agreement figures, there is no consensus on the exact standard, although some researchers suggest that a value of 0.70 may be acceptable (Neuendorf, 2002; Rourke et al., 2001). Rourke et al. (2001) state that the researcher should decide on the acceptable range. Riffe et al. (1998:131) note that "research that is breaking new ground with concepts that are rich in analytical value may go ahead with reliability levels somewhat below that range". Similarly, there is no consensus for chance correcting measures, and no widely accepted standard to indicate the level of inter-rater reliability. For Cohen's kappa, it has been suggested that values of more than 0.75 represent excellent agreement beyond chance; values below 0.40, low agreement beyond chance; values between 0.40 and 0.75 represent fair to good agreement beyond chance (Capozzoli et al., 1999; Krippendorf, 1980; Neuendorf, 2002).

In this research, another rater with the required computer knowledge and language level was invited to undertake second coding of a thread which was selected from all the posting data analysed in this research. Thus, the inter-rater reliability of content analysis can be evaluated at less cost to the second coder.

The second rater in this research was an English lecturer of Chinese ethnic origin who familiarised himself with the analytical framework and its categories before the coding. His coding of a discussion thread from the Dell IdeaStorm Community produced the result that 11 posts with single codes and 16 with double codes out of a total 74 posts differed. In addition, half of these double codes were similar to those of the researcher. The percent agreement calculated according to Holsti's (1969) formula is 0.73, which is within the acceptable range of inter-rater reliability.

3.7.2 Research Reflexivity

Research is a reflexive process and requires "scrutiny, reflection and interrogation of the data, the researcher, and the participants, and the context that they inhabit" (Guillemin & Gillam, 2004:274). Therefore, the researcher should apply continuous reflexivity throughout the research process to ensure rigorous research quality.

Research reflexivity can enhance research quality and validity while recognizing the research limitations of the newly constructed knowledge (Guillemin & Gillam, 2004). Guillemin & Gillam (2004) conclude that research reflexivity is a process of critical reflection on newly generated knowledge throughout the research and on the way in which that knowledge is produced. In addition, McGraw et al. (2000) state that research ethics should also be considered as part of the reflexivity process. Therefore, the researchers should continuously reflect on their way of constructing knowledge in the research process, and various factors that can influence knowledge construction in the planning, conducting and writing up stages.

When dealing with the data, the researcher were reflective towards the facts and limited the influence of those factors which could affect neutrality and interpretation of the data, such as cultural beliefs, thoughts, mental images and prior theories. The contextual differences between the virtual product user community and CSCL were also thorough discussed in the Discussion Chapter (10.2). The researcher tested the relevant theories thoroughly by applying them to analysis of the online discussion content in order to exclude potential introduction of bias by prior theories. Reflective awareness was maintained throughout the research process. The limitations of the research were identified, acknowledged and reported (mainly in section 11.5), including those relating to the research process, research time limits, theoretical context, representativeness of sampling strategies , and data analysis. A research diary is suggested for recording reflections on different aspects of the research process and the researcher's role within building research knowledge (Blaxter et al., 2001). The researcher took research notes throughout the research. They mainly consisted of four kinds of content: observational notes, which concerned description of research events such as interviews, observations; methodological notes, which contained reflection on methodological issues and the researcher's actions in conducting interviews, observations and so on; theoretical notes, which were concerned with deriving meaning from data, and explanation of the data; analytic memos, in which the researcher brought various inferences together to identity patterns in the data or link the analysis to the literature.

3.7.3 Data Triangulation

Triangulation is a method to enhance the research validity of qualitative research through "increasing confidence in research data, creating innovative ways of understanding a phenomenon, revealing unique findings, challenging or integrating theories, and providing a clearer understanding of the problem" (Thurmond, 2001: 254). Data triangulation entails

cross verification of two or more data sources to enhance the validity of the research. If two or more forms of data confirm a finding its credibility is enhanced. Banik (1993) concludes that the strength of data triangulation lies in the nature and quantity of data collected for interpretation. In this research, two types of data are collected: online discussion contents (i.e. postings) in the virtual product user community and interview data from community members. The findings about knowledge construction from the content analysis of published posts in the forum can be strengthened and enriched by cross verification with the interview data. If divergences emerge between the findings of these two types of data, these can help to highlight weaknesses in the research, identify new patterns, and improve research quality.

Furthermore, interview data are obtained from different types of virtual product user community members in the Dell Support Forum, namely the active forum users, medium active forum users, and novices. Thus, the researcher can gain a more comprehensive understanding of knowledge sharing and construction patterns in the virtual product user community through gathering the different perspectives of different groups of participants.

3.8 Research Ethics

Research ethics in Internet research are mainly concerned with the way of enabling the researchers to conduct their research and fulfil their research goals while avoiding harm and distress to their human subjects. The widely accepted Golden Rule (Allen, 1996; Herring, 1996; Thomas, 1996a, 1996b) sets three principles to guide online research practice: 1) research subjects should never be deceived; 2) research subjects should never be wittingly put in a dangerous position; 3) public and private good should be maximized while harm is minimized (Thomas 1996b:53).

Online research guidelines have proven quite a controversial issue. Research ethics for Internet researchers are usually classified into a deontological position or a consequentialist position (Capurro & Pingel, 2002; Thomas 1996a). The deontological position insists on strict "rule following" and is usually based on formal ethical codes and guidelines (Nozick, 1978; Thomas, 1996a:109). For example, the Association of Internet Researchers (AoIR) created professional ethical codes to outline the responsibilities of Internet researchers (Berry, 2004). In contrast, a consequentialist position is based on the idea that the consequence of a research act determines the ethical behaviour (Thomas, 1996a:109). Therefore, the consequentialist argues that it is potentially acceptable to intentionally lie to obtain access to

deviant research settings as long as the research can make a contribution to the public good (Thomas, 1996a:109).

However, in the context of the Free/Libre and Open Source Software (FLOSS) movements, Capurro & Pingel (2002) propose a different approach towards research ethics, namely Open-Source Ethics. This approach stresses non-alienating care during the research process and the use of the Free/Libre and Open Source (FLOSS) approach in dealing with ethical issues. In addition, flexibility is an extraordinarily important factor in all ethical frameworks applied to online studies (Bruckman, 2001; Herring, 1996; Ess, 2007). Flexibility is also the most obvious strong point of open-source ethics, which allows swift adaptation of the ethical framework according to research needs (Berry, 2004).

In cases where the author of the text that is subject to analysis is not identified, the risks can be minimized through concealing the link between the generated data and the text writer (Koocher &Keith-Spiegel, 1998). King (1996) suggests that removing any information that can be linked to the identity of the author, even the place or publishing time of posting, is necessary in order to minimize the potential harm caused by reporting of results from analysed postings. The information which should be removed is listed as follows (King, 1996: 127):

> "1. Remove all headers and signatures.
> 2. Remove all references within the citation to any person's name or pseudo-name.
> 3. Remove all references to the name and to the type (e-mail, BBS, etc.) of the group.
> 4. Do not make any specific reference to the location of or exact type of forum studied.
> 5. Store the original data in a safe manner and make it available to other qualified researchers who may wish to validate the findings."

In the thesis, however, it was decided that due to the need to introduce the case and for research transparency, the names of the virtual communities and online groups were not removed; and the locations and community type investigated were also clarified.

Many researchers have discussed the problem of gaining permission from online groups (Bakardjieva & Feenberg, 2001; Bassett & O' Riordan, 2002; Bruckman, 2001; Walther, 2002; White, 2002). They raise several different questions, including: should the researcher get permission from the community as a whole or should only the individuals whose text is analysed give permission? If standard copyright regulations and fair rights principles can be applied to the content in the online community, is obtaining permission no longer necessary?

In order to avoid the above debates, Bakardijeva & Feenberg (2001:235) suggest an alternative way, namely "non-alienation" as the guiding ethical rule to "serve as a guide for finding one's bearings on the broader question of privacy in cyberspace". Alienation is defined as "the appropriation of the products of somebody's action for purposes never intended or foreseen by the actor herself, drawing these products into a system of relations over which the producer has no knowledge or control" (Bakardjieva & Feenberg, 2001:236). Non-alienation refers to avoidance of using content of online discussion out of its original communication context without obtaining the express agreement of concerned parties (Bakardjieva & Feenberg, 2001). The virtual communities and online groups chosen for analysis were open to the public and no access credentials were needed. In addition, the published data was mainly about technical problems rather than sensitive topics.

Bakardjieva & Feenberg (2001:235) state that open-mindedness and methodological flexibility is required to ensure real inclusiveness of the participants in research. Considering the fact that many users of the forum may not log in frequently, informed consent from authors of postings targeted for analysis can be relatively difficult to obtain. The researcher has chosen to contact the moderators of the forums in order to explain the research project. Meanwhile, a post containing brief introductory information and ethical instructions will also be released onto the forums. In addition, the post will provide a link to a webpage built to supply detailed information about the research project and ethical consent. In order to secure the confidence of the contributors to the forum, they will be informed by an e-mail through the mailing system of the forum of the researcher's intention to analyse their postings. Privacy and confidentiality will be ensured when analysing and presenting the data collected. Any information potentially identifying the participants will be deleted or replaced by pseudonyms in the thesis.

This research followed the University of Sheffield's ethical research policy and obtained approval from the University Research Ethics Committee for conducting interviews with Dell Support Forum members. The interviews were conducted observing the principles of voluntary and informed consent. A post containing introduction information about the project and research ethical approval was released to the forum. The introduction of ethical information was provided in the interview request mails and interview questions mails sent to the interviewees. An e-mail containing similar information was also sent to a forum manager, who agreed that the researcher to use the discussion contents on the forum, and informed that the moderators and "RockStars" were not allowed to be interviewed due to non-disclosure

contracts. All contents included in the information sheet also could be seen on the research project website. The guidelines for participant safety and anonymity were complied with throughout the research.

3.9 Conclusion

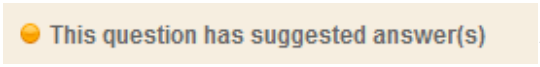
This chapter has given a thorough account of how the decisions made in conducting the research. Specifically, it discussed the philosophical basis, introduced the research methodology and research design, justified data collection and analysis methods in detail, and explained issues regarding research reliability and ethics.

The following chapter will introduce the initial findings from analysis of a theoretically interesting discussion thread on the Dell Support Forum in the first research stage of the study. It will present an initial content analysis framework for exploring knowledge construction activities and its creation process. It will also introduce a knowledge building model created at this stage and a knowledge construction strategy discovered from forum users' discussions regarding problem-solving.

Chapter 4 – Content Analysis of Online Discussions in a Virtual Product User Community

4.1 Introduction

This chapter reports the first stage of the research, which was an attempt to gain a rounded view of knowledge construction activities in a virtual product user community. The work reported in the chapter was significant in suggesting the direction of the research and paved the way for the rest of the research. The researcher conducted a comprehensive analysis of a theoretically interesting long thread from multiple perspectives, including the participation perspective, interaction perspective, and knowledge construction perspective, in order to establish initial findings and help clarify the research scope. One of the most important objectives of this section was also to create an initial content analysis framework which could be used for exploring knowledge construction in the virtual product user community after being improved and elaborated on the later research stages. Thus, this section is mainly related to the first two research questions: it intends to begin to answer the question "What is the virtual product user community and what are its attributes?" and the question that "How is knowledge constructed?"

In this section, one theoretically significant discussion about a noisy fan problem on a laptop which is marked with "  " in the Dell User Support Forum was chosen and analysed. This thread was selected due to its encapsulation of significant elements in the knowledge construction process that were of interest to this research after reading dozens of threads released onto this forum. The researcher explored three perspectives of the selected thread through different approaches in order to obtain a more rounded view of knowledge sharing and creation in a peer product user support online community, specifically the participation perspective, interaction perspective, and knowledge construction perspective. These three analysis approaches are based on an adaption of Henri's (1990) model, which contains five dimensions of analysed interaction in online learning contexts, namely the participative dimension, the social dimension, the interactive dimension, the meta-cognitive dimension and the cognitive dimension. Given the research question and contextual differences between CSCL and the virtual product user community, the social dimension is not explored, and the meta-cognitive dimension and cognitive dimension is incorporated into the knowledge constructive perspective in this research.

Furthermore, a content analysis framework for analysing knowledge construction in virtual product user communities was developed, based on a critical analysis of existing content analysis instruments and testing on this thread as empirical data.

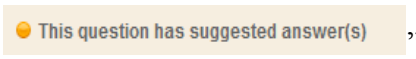
In the first section of the chapter, a general description of the selected thread is given. Then the forum users' participation in the discussion is explored through measuring individual users' post distribution, classified user group's post distribution, and the temporal distribution of posting. The analysis of a user's participation mainly aims to identify "who is a more active knowledge contributor" and whether "there is any correlation between knowledge expertise and posting activeness". It is very important to know the active knowledge contributors and their attributes before answering the main research question. In the third section, the interaction dimension is explored by studying the relationship between interaction type and question type. In the last section, the embedded knowledge construction dimension, namely the collaborative construction of new knowledge to solve technical problems by the users themselves in this peer support forum, is studied through content analysis. In the fifth section, the newly developed content analysis tool is utilized to analyse different user groups' knowledge contribution patterns.

4.2 Introduction of the Product User Forum in the Website of Dell

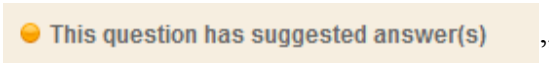
4.2.1 Dell Support Forums and Sub-forum of Laptop

Dell Support Forum (English) is sponsored by Dell Company, and exists on its official website. It is inside the community according to its website structure. Dell Support Forum is an important component of its customer community. It is the platform for the Dell product users to solve their technical problems through collaborative efforts. It consists of several sections of different kinds of products and services.

One sub-forum, whose threads focus on laptop/notebook computers and mobile workstations in Dell support forums, is selected in the initial research stage. The laptop and notebook are personal electronic products that have more technical questions and problems in their usage compared to other types of home electronic appliances. For expensive enterprise-level electronic equipment, the producer usually gives faster feedback on a technical problem, and provides more tailored solutions, offered by professional technicians. In contrast, due to different computer configurations and complicated software environments, it is very difficult for the producer to give quick and effective response and solutions to personal computer

users. Hence, in addition to seeking technical support from producer's customer support, more collective efforts to share knowledge among the users and build knowledge by themselves are also required to solve technical problems within their laptops. Given these issues, the researcher selected the laptop sub-forum to explore the product user forum. These laptop users who meet technical problems or have questions about their laptop usually publish a post containing relevant questions in this sub-forum. Other peer users, most of whom have the same type of problem, join the discussion in this thread. If a solution is found and proved effective during the discussion of this technical problem, then a label "  " will be put at the top of the thread. The post which contains a workable answer is also marked with the label "  ".

4.3 General Description of Discussion Transcript Data

One thread marked with the label "  " in the laptop sub-section of Dell support forums was selected (http://en.community.dell.com/support-forums/laptop/f/3518/t/19371524.aspx?PageIndex=1) after extensive reading of the threads. It is a thread with a triggering question and answers. The discussion participants in this thread successfully achieved resolution of the proposed problem after a long period of collective effort (i.e. nearly four month by 15 July, 2011). This thread was triggered by one post which described a noisy fan problem in one type of Dell laptop and asked for help to find a solution. 24 forum members contributed 93 posts in total from 26 March 2011 to 15 July 2011, among which 3 replies were marked with the label "  " by the community members. These three effective answers, accepted by the forum users, emerged through a long process of collaborative solution finding in which many other ideas were also proposed, discussed and tested. The forum moderator did not participate in the discussion or provide answers in this thread. Thus, this supports the researcher in the belief that embedded collaborative knowledge building in this thread successfully reaches the stage of solving the technical problem. Rich data about knowledge sharing and creation patterns, especially about complex knowledge building processes can be explored in this selected thread. In this research stage, the researcher plans to explore knowledge construction in the discussion thread without a moderator's intervention. Then discussion threads containing knowledge building process with the involvement of the moderator will be analysed in the next chapter.

4.4 Post Distribution of Forum Members (/Participation Dimension)

In order to obtain a more comprehensive understanding of the discussion process, the researcher describes participation from multiple perspectives in this section, including an individual participation perspective, a classified user group participation perspective, and the temporal perspective. That is to say, not only each forum user's posts but also active and non-active user groups' post proportions were calculated. Additionally, the number of posts sent in different periods (the temporal posts distribution) is also studied.

4.4.1 Individual Forum Member's Post Distribution

The post number released by each individual is displayed in the following figures.

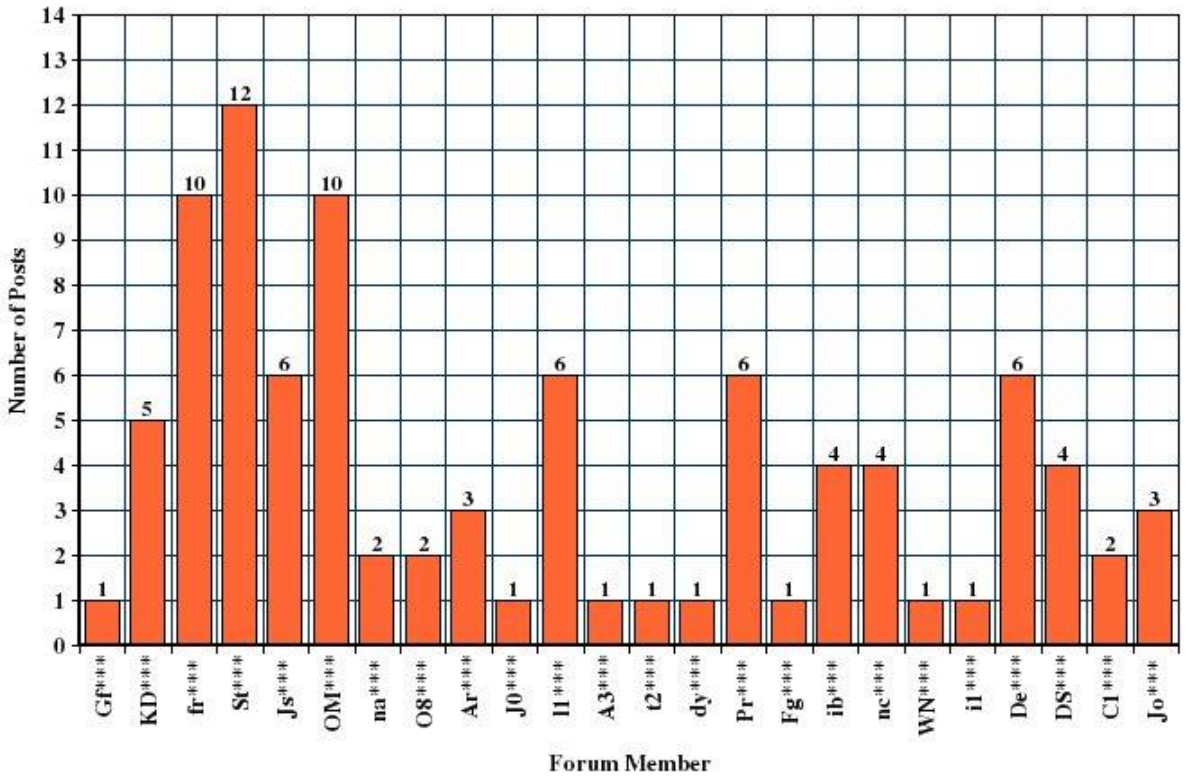


Figure 4-1: Posts Distribution by Individual Forum Member

Table 4-1: Individual User's Posts Number and Relevant Users' Number

Individual User's Posts Number	1	2	3	4	5	6	10	12
Number of user's posting at this level	8	3	2	3	1	4	2	1

(Note: The first row is the number of posts a single forum user released, while the second row is the number of users who released the same quantity of posts)

It is noticeable that 8 forum users only contributed one post each. Furthermore, five out of these eight users asked questions about detailed information of the suggested idea in their posts. One user described the technical problem that he or she faced, and the other two users stated that they would test or had already tested the suggestions. Thus it appears that people who posted little tended only to ask questions or describe the problem rather than try to propose feasible ideas for solving the problem.

There were three forum users who contributed just two posts, namely na***, 08***, and c1***. Among their total six posts, one was about proposing a suggestion; two expressed the idea of waiting for formal solutions from the company; one was about asking questions; one contained the statement of waiting for other users' feedback on the suggested idea's effectiveness; and the last one was about testing the suggested idea. In these three user's posts, we can see that only one resolution idea was proposed.

Only two forum users (namely Ar*** and Jo***) published three posts respectively. Among Ar***'s three posts, one post suggested a resolution method, one clarified the idea and one was about testing the idea. It was found that the forum user Ar*** not only proposed one solution but also clarified and tested it. The forum user JO*** released his posts in the later discussion stage (post 85, 90, 93 in this thread). One of his posts stated his wish to arouse the company's attention; one said that a generally accepted idea did not work on his laptop due to a different configuration; one restated the technical problem he faced.

12 ideas to solve the problem were proposed by seven forum members who released 5 or more than 5 posts while the remaining 4 ideas were published by four members who released less than 5 posts. Additionally, three accepted answers were released by two active forum users with 5 and more than 5 posts respectively (KD*** with 5posts, and St*** with 12 posts).

Table 4-2: Distribution of Ideas and Idea Contributors

Idea Contributor	**Members with 5 or more than 5 posts**	**Members with less than 5 posts**
Number of people	7 (63.6%)	4 (36.4%)
Number of Resolution Ideas	12 (75%)	4 (25%)

Given the above fact, the researcher found that the active forum members (who are more active in both of these threads, and across the forum, according to the number of posts they published in their profile information) were more inclined to occupy a central position (e.g. proposing a solution idea) in the knowledge construction process than those less active members who are in a peripheral position (e.g. asking questions about the proposed idea). In order to assess this conclusion, the researcher would adopt a content analysis instrument which is developed in the latter section of this chapter to analyze those active and less active users' knowledge construction behaviours. The result is presented in the following section.

4.4.2 Classification of Forum User Group's Post Distribution

The discussion space, consisting of 93 posts in this thread, was not just dominated by a few post writers. However, the active forum members in this thread contributed a large proportion of posts, especially all of the three posts marked with "suggested answers". Eight out of twenty four post writers contributed five or more than five posts each. These 8 active posters released 61 posts in total, which were about 66% of the total posts compared with 35% which were released by other 16 participants. In contrast, there were 11 less active posters who just released one or two posts, and their posts were only 14 in total, which was just 15% of the total posts. 5 medium active posters, with three or four posts, contributed 18 posts, which was 19% of the total posts.

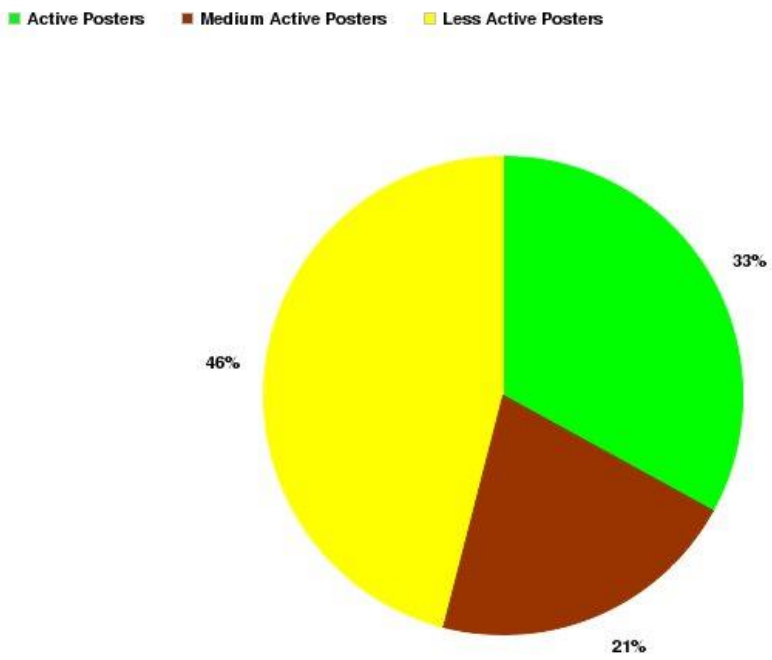


Figure 4-2: Discussion Participants Distribution

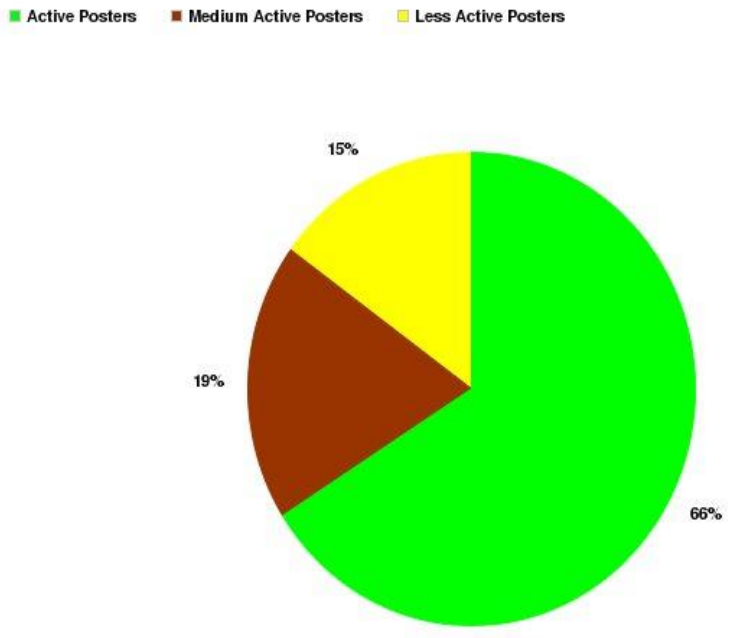


Figure 4-3: Posts Distribution

Table 4-3: Participants Distribution & Posts Distribution

	Active Posters	Medium Active Posters	Less Active Posters
Participants Distribution	33% (8 people)	21% (5 people)	46% (11 people)
Posts Distribution	66% (61 posts)	19% (18 posts)	15% (14 posts)

(Note: Here active posters are considered to be those forum users who published five or more than five posts; medium active posters published three or four posts; and non-active posters sent below three posts in this thread.)

Moreover, nearly all of the posts containing practical solutions, including those posts labelled with "suggested answer" and the suggestions which proved effective but were not labelled, were contributed by the more active forum members. Two active users in this thread contributed all of the three posts which were identified as the "suggested answer" by the discussion participants (i.e., forum user KD***'s fifth post, and St***'s ninth and tenth post)[4]. Additionally, another user l1***'s suggestion was also heatedly discussed and tested, and some users proved that it also worked on their laptops, although this post was not given the label "suggested answer". This shows that the active members in this thread who were more involved into the knowledge construction were more inclined to give workable answers, compared to the non-active members in this thread. Meanwhile, the active posters in this thread seemed to have more knowledge and expertise on the laptop problem, as revealed in the content of their posts. For instance, forum member De*** claimed to be an expert with years of technician experience:

> "…Trust me, as someone who has been in technology for years, a lot of hardware issue are often fixed in firmware revisions since replacing the hardware is cost prohibitive".

Following the above discussion, the researcher proposes that the forum user's formal status in the forum, decided by their expertise, can be connected to their activeness, which is reflected by the number of posts they release. Therefore, it is practical for the user support forum to give their members hierarchical titles in order to show their expertise and to encourage their knowledge contribution, based on the number of posts they release. This will help the forum

[4] KD*** published 3924 posts throughout the whole discussion forum, while St*** published 15 posts in total and l1*** 9 posts. They are also more active across the forum than those people who are less active in this thread. This information can be obtained from the forum member's profile information.

users to identify peers with more expertise, while motivating more people to participate in discussion and contribute their knowledge.

4.4.3 Temporal Distribution of Posts

The discussion of this topic in this thread lasted for nearly four months, thus the researcher divides it into eight periods of equal length, each of which contains 15 days.

Table 4-4: Temporal Distribution of Posts

Time	Number of posts
26/03-09/04	4 (26 Mar 2011 7:12 PM-8 Apr 2011 2:43 AM)
10/04-24/04	30 (12 Apr 2011 6:04 AM-22 Apr 2011 1:47 PM)
25/04-02/05	7 (25 Apr 2011 9:57 AM-2 May 2011 9:23 PM)
03/05-17/05	9(3 May 2011 8:45 AM-10 May 2011 2:12 PM)
18/05-01/06	0
02/06-16/06	4(10 Jun 2011 2:54 PM- 12 Jun 2011 1:58 PM)
17/06-30/06	11(18 Jun 2011 11:34 PM-27 Jun 2011 2:31 PM)
01/07-15/07	29 (2 Jul 2011 1:41 AM-15 Jul 2011 3:29 PM)

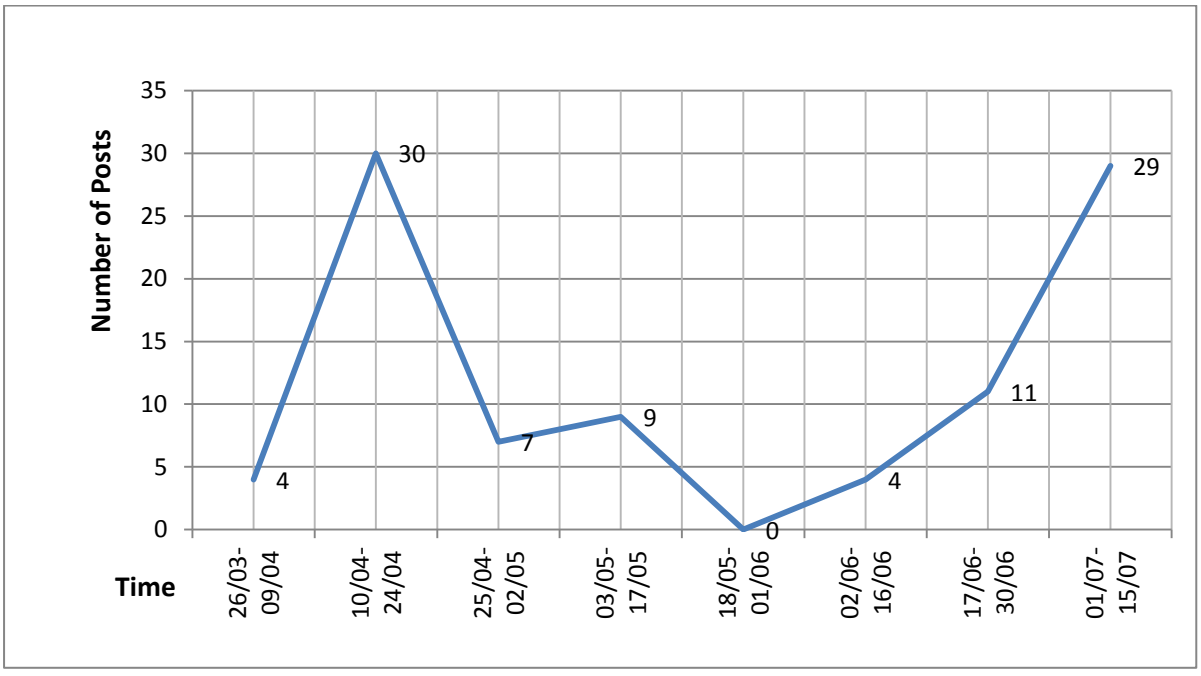


Figure 4-4: Temporal Distribution of Posts

The first period of this discussion is the process of reaching a consensus of this general fan problem in one laptop. Six people participated in the discussion in this period and there were ten replies to the triggering question, which described the problem, until a general consensus was reached. In this discussion trigger period, most replies focused on repeating the same technical problem they had met, in both direct and indirect ways, and gradually achieved the consensus that this was a common problem. Five out of these eleven posts (about 45%) released by 4 people (about 67% of the total participants in the first stage) stated this problem very directly:

The third post confirmed the technical problem: "I have the same problem" (by fr***).

The fifth post also confirmed the problem: "I'm having the same problem with the fan of my L502X…" (Js***)

The seventh post confirmed the problem: "I have the same issue …" (OM***)

The eleventh post finally concluded that the problem was common on this type of laptop: "OK, since it appears to be a common issue…" (Js***).

Meanwhile, several posts also stressed the problem they met in an indirect way, for instance, "…It anoyes [annoys] me that thers [there is] no better fix then this try and error method" (the fourth post released by St***). Although the remaining 5 posts were talking about finding the solution, this also indirectly stressed the technical problem. The direct and indirect repetition of the technical problem aroused other users' attention to solving it and pushed the discussion on to the second stage. In the later research stage, it was found that repeating the technical problem can also provide necessary knowledge about those technical problems.

In the second discussion phase (which can be considered to start from the 12th post and continue to the 74th post, which is the one before the post with the first accepted answer), the forum users concentrated on proposing different ideas and evaluating them. However, the most acceptable answers ("suggested answer") did not emerge at this stage. In the last phase, three replies marked as "suggested answer" finally emerged, after being tested by several members (i.e.75th reply, 82th reply, and 87th reply).

It is quite noticeable that there was a blank period without any posts for nearly one month since the post released by dy*** (on 10 May 2011 2:12 pm) until the one posted by Pr***

(on10 June 2011 2:54 pm). The prior twelve posts (39th post to 50th post) before this blank period had focused on the suggestion proposed by l1***. The discussion participants of these twelve posts asked focused questions about this suggestion, got clarification from the solution finder, justified the suggestion, tried proposed idea, and proved its effectiveness. Although these posts were not exactly released in the above cumulative and progressive order, it can still be considered to be a complete knowledge construction process. The 51st post released after the blank period restated the same fan problem of the new laptop and expressed the motive to return it, which activated heated discussion about solving this problem permanently.

The discussion about solving the noisy fan problem in this thread involved a comprehensive knowledge construction process over a long period. A consensus on this common technical problem was reached at the beginning through several forum users repeating the problem by a few forum users. This helped to arouse people's attention and interest in solving this problem. Furthermore, the discussion was restarted after the discussion blank period, due to a post which repeated the same problem again. Thus, we can conclude that the posts which contained information repeating the problem (/or asking for help) played an important role in terms of triggering the discussion event and pushing forward the knowledge construction process to a deeper level. However, more data need to be analysed in order to discover whether there are other temporal patterns regarding knowledge construction.

4.5 Interaction Type & Question Type (/Interaction Dimension)

According to the theoretical framework proposed by Zhu (1996), social interaction can be divided into two types based on different knowledge contributing patterns, namely vertical interaction and horizontal interaction. Vertical interaction is conducted when "group members will concentrate on looking for the more capable member's desired answers rather than contribute to and construct knowledge" (Zhu 1996:824). In contrast, horizontal interaction emerges when "members' desires to express their ideas tend to be strong, because no authoritative correct answers are expected to come immediately" (Zhu 1996:824-825). Therefore, a variety of ideas can be expressed and exchanged in order to find an acceptable answer in horizontal interaction, and this directly makes a contribution to the knowledge construction process (Zhu, 1996).

In the thread selected for analysis, the discussion participants made various suggestions about the laptop fan problem when they did not get any authoritative solution or technical support from the customer support department of the company. Furthermore, the peer support forum

on which the question was released defined itself as a peer assistance community. That is to say, these forum members needed to find the answers by themselves, through a collaborative method, rather than obtain the formal solution from a company technician. There were also no ready answers from the capable product users with more expertise or knowledge. Therefore, the group members' desire to solve the problem through collaborative efforts was very strong. They exchanged lots of information, contributed many ideas, and tested these ideas until they identified effective solutions. Thus, the interaction pattern of this thread, consisting of 93 posts, involves horizontal interaction rather than vertical interaction.

As for the types of questions in the online interaction context, Graesser & Person (1994) suggest that they can be divided into information-seeking questions and discussing questions. Information which can assist users to find a solution is usually missing in information seeking questions, while discussing questions usually contain some kind of information for inquiry or triggering a dialogue (Zhu, 1996). There are underlying assumptions within information seeking questions (Van der Meiji, 1987; Graesser &Person, 1994): the questioner knows little about the information which is asked for in the question (Van der Meiji, 1987); the questioner believes in the existence of an answer (Van der Meiji, 1987); the questioner is looking for the answer (Van der Meiji, 1987); and the questioner thinks the answer will not be triggered without this question (Van der Meiji, 1987). There is a parallel to vertical interaction. Assumptions embedded in discussing questions are: the questioner can explain the problem a bit, but he/she thinks it is probably not appropriate nor complete; the questioner knows that the ready answers and existing answers are not available; the questioner seeks suggestions from peers or experts; and the questioner aims to trigger a dialogue among peers rather than to ask for answers (Zhu, 1996).

> "My new XPS 15 L502X fan comes on for a second then turns off for a second, then repeats. it does this process half a dozen times... then stops for 10 secs then repeats. I get this issue when just doing light stuff like word/internet/etc... Is this by design or a fault? My temps ussualy lie between 55-60C when this is happening... Is there a setting i can adjust? Also is 55-60C too hot for an i7 2720qm thats doing literally nothing?" (Posted by Gf***on 26 Mar 2011)

The above triggering question in this thread can be identified as a discussing question rather than information seeking question, according to Zhu's (1996) distinctions. The questioner provided some kind of explanation to his question in his post, for instance, "Is this by design or a fault?" and "Also is 55-60C too hot for an i7 2720qm thats [that's] doing literally nothing?" However, he was not confident with his ideas and this made him seek suggestions

from other users in Dell's peer-to-peer support forum. According to the definition of this peer support forum, the solutions for any proposed technical questions are usually collaboratively identified by forum users. Therefore, the questioner usually knows that there is no ready answer when he releases his question onto this forum and he needs to wait for others' answers. Moreover, this question also resulted in a broad discussion about the noisy fan problem of one type laptop in this thread, comprising 93 posts. This discussing question triggered a thorough discussion about solving this fan problem through different approaches. In addition, several other issues were also covered in the discussion, such as evaluation of the product quality, responsibilities of the Dell support centre, and the reporting of their collective opinions to Dell. This is also worth attention in future research work.

The question type has a direct influence on interaction pattern of online discussion participants. According to Zhu (1996), an information seeking question is more oriented to producing vertical interaction, while discussing questions is more inclined to generate horizontal interaction, although both of these two types of interaction are "conductive to knowledge construction" (Zhu, 1996: 838). Furthermore, there are two relevant types of knowledge construction process in the online interaction environment: construction of knowledge by a group affected, stimulated and facilitated by discussion and interaction among peers; and simple assimilation of information provided by others, probably with some editing or adaption, but with vital interpersonal interaction being absent in this process (Zhu, 1996). Those active group members with great motivation to participate are more likely to build knowledge through the first process. In contrast, the less active members are more likely to engage in the latter process (Zhu, 1996).

The discussing question about the noisy fan problem in this thread triggered horizontal interaction which led to a collaborative knowledge construction process rather than the simple assimilation of information. Because of the peer assistance nature of this forum and the complexity of the technical problems in the starting question, the discussion in this thread took the form of horizontal interaction. That is to say, the forum members needed to express various ideas, justify and test these ideas, and collaboratively construct relevant knowledge to solve this technical problem. This collaborative knowledge construction process which proceeded to solve the noisy fan problem was stimulated, influenced and facilitated by interactions among peers, especially those active forums members who passively participated in the interaction and greatly contributed their knowledge to the final solution.

This thread confirms Zhu's (1996) claim that horizontal interaction is usually associated with greater levels of participation of group members to construct new knowledge. In addition, discussing questions are more inclined to trigger a collaborative knowledge construction process which is promoted and facilitated by interaction among peer users. The discussion of the noisy fan problem which took the form of horizontal interaction was triggered by a discussing question in this thread, and the forum users actively participated in knowledge construction to solve the problem.

4.6 Content Analysis of the Thread (/Knowledge Construction Dimension)

4.6.1 The knowledge Construction Process

Having looked at its participation patterns and interaction type, the main analysis of the thread is a deductive (/directed) content analysis approach. In the beginning, the following analytical frameworks and models which include coding schemes for knowledge construction, critical thinking and cognitive development in the CSCL context, were identified from existing literature, specifically Henri's (1992) four dimensions model, Gunawardena et al. (1997), Garrison et al.'s (2000) model, Veerman & Veldhuis-Diermanse (2001), Bullen (1997), Fahy et al. (2000), Garrision et al.'s (2001) analytical tool for cognitive presence, Järvelä & Häkkinen (2002), Veldhuis-Diermanse (2002), Pena-Shaff and Nicholls (2004), and Weinberge & Fischer (2005).

In the next step, these frameworks' contextual basis, namely the CSCL context, was analyzed and compared with the product user peer support online forum's context. Additionally, their theoretical backgrounds, advantages and disadvantages, and the relationship among these models were also examined with the aim of choosing the most suitable instrument. Then these frameworks were tested against the data (i.e. the chosen thread) by applying them. However, these content analysis instruments' contexts and their purposes varied a lot from that in this case, and none of these content analysis instruments in CSCL alone could identify the embedded knowledge construction patterns within this discussion transcript. When these frameworks were applied to the data, some of elements (i.e. categories) were not reflected in the content of this thread, and some transcript data could not be described by the categories included in these frameworks. This made it necessary to develop a much more detailed model which could appropriately describe the knowledge construction process in the discussion thread of a product user peer support forum. Rourke & Anderson (2003) suggest that researchers should adopt already developed schemes rather than develop new coding schemes.

Therefore some of the frameworks' elements which emerged in both CSCL context and virtual product user community can be adopted in this new content analysis model.

4.6.2 Analysis and Assessment of Prior Relevant Analytical Instruments

Since nearly all of the existing content analysis instruments are designed for CSCL in formal learning context, the differences between the online collaborative learning and open peer user support forum were analysed. Then the prior relevant analytical instruments were explored in order to find the most relevant categories for this data transcript.

4.6.2.1 Contextual Differences between Virtual Product User Peer Support Forum and CSCL

In addition to the research aims and these analytical frameworks' own characteristics, the attributes of the CSCL context and virtual product user community also decided the evaluation of these content analysis instruments. Both the CSCL and the virtual product user community share the following characteristics: knowledge sharing and creation oriented online behaviour; and similar technical infrastructures and communication platforms. However, it has to be admitted that there are great differences between the virtual product user community context and CSCL regarding their goals and aims, memberships, off-line influences, facilitating strategies, and network attributes. The most important difference is that the CSCL community is more closed, more mandatory, more structured and focused on formal educational aims.

The virtual product peer support forum differs from online discussions in the learning context in this aspect: in the online learning context, students have to actively participate in the online discussion, which is usually mandatory and graded, whilst, product users' participation in online discussions is mainly based on their willingness rather than being required to share their knowledge.

The focus of online learning also differs from that of an online peer support product forum. The analytical instrument created for online learning context is focused on high level learning activities. For example, Zhu's (2006) analytical instrument for cognitive development in online learning discussion activities ranges students' statements into 6 different types according to Bloom (1956)'s learning hierarchy. In contrast, the terms of the forum state that the designing purpose of the user support forum is to help the forum users find solutions in an

efficient way. It appears to the researcher that the main purpose of people's participation in the open Internet user support forum is to find solutions to problems in the most efficient and simplest way. Moreover, technical designing functions (for example, a search engine within the forum, ranking of posts, and marking of threads) also serve to meet the users' needs. This means that more complex cognitive factors are absent from product peer user support forums. Critical thinking is one of the most important learning goals in the formal learning CSCL. It involves multiple cognitive and meta-cognitive skills (De Wever et al., 2006:16). In the Delphi Study conducted by the Facione (1990) critical thinking is referred as a complicated process involving self-regulatory judgement with specific purposes, which results in evidential, contextual, conceptual, methodological, and criterion logical consideration of reason (Facione, 1990). However, the critical thinking factors are not so evident in the virtual product user community.

The moderator (or facilitator/instructor) presence is sometimes absent in a public peer support product forum. Even though they are installed in these public forums, they cannot play a role like instructors, who give a lot of support, facilitation and mentoring in the online learning context, due to large quantities of postings on public forums. In contrast, the teacher in the online learning context usually plays a role of moderator/facilitator/guide for students' collaborative learning (Olivares, 2005). Meanwhile, "online discussions with interaction among students and the instructor facilitate information sharing, knowledge construction, and achieving other learning goals" (Zhu, 2006:475).

4.6.2.2 Evaluations of Content Analysis Frameworks in CSCL

The researcher evaluated the selected content analysis models and analytical frameworks based on the contextual differences between the CSCL and virtual product user community, the relationship between these models, and the exact content of the collected data. Furthermore, the researcher tried to apply these models to code the selected thread. However, these models failed to describe the content of the early published discussion posts because some contents were not reflected by the codes. Additionally, some categories in these models did not fit the data. In future work, the research will illustrate the exact percentage of the posts that can be described by these categories in the selected models.

In review of these models, some categories of the models only have meaning within the model and its relevant context (i.e. the CSCL context) where the model develops. However, other parts of the model have a general nature, and reflect other knowledge behaviours in

different contexts. Thus, these categories with parallel meanings in different contexts can be taken out and applied to a new context.

4.6.3 Categorization

4.6.3.1 Sub- level Categories (/Sub-categories)

Following the method proposed by Hsieh & Shannon (2005), the researcher read through the transcript several times until reaching a level of familiarity with it, in order to obtain a deep understanding of its content, after the potentially feasible analytical instruments were identified. Then texts of each message which seemed to stand for one category of codes on the first impression were highlighted. In the next step, these highlighted messages were coded with pre-selected codes belonging to the above analytical frameworks designed for the knowledge construction process. A point worth noting is that the researcher only coded the salient ideas embedded within each message during the coding process. The least conspicuous idea was usually ignored during the coding process. For example, in the post "*I can confirm Frank's method work on XPS - L502X i7Qm. It anoyes [annoys] me that thers [there is] no better fix then this try and error method*" (released by St*** on 8 Apr 2011) the most obvious content that was relevant to knowledge construction was the confirmation of the effectiveness of one idea. The content in the latter sentence was not distinct in relation to the knowledge construction process. Thus this post was given only one code: "testing or evaluating the idea". In some cases, one post can fall into two categories. In the last phase, the remaining messages which did not fall into any prior categories were treated as a new code.

The pre-perceived categories derived from the existing content analysis instruments were further refined according to the content of messages in the selected thread transcript and the semantic relationship among these categories identified.

The codes, derived from existing analysis frameworks, which are considered to describe the transcript data, are as follows. Some terms are borrowed without any change, and some are slightly adapted to make it applicable in this context and more tailored to describing the content of the thread. Some codes parallel to others in terms of having similar semantic meanings are not adopted.

- Category “bringing outside knowledge or experience to bear on problem” included in Newman’s (1996) protocol. It is adapt as “bring outside knowledge” in order to make it more appropriate for the discussion content in a virtual product user community. This category usually takes the form of sending a webpage link.

- Category “justification”, included in Newman’s (1996) protocol. It is changed to “evaluating suggested idea” (usually by reasoning or existing facts) to make the category more specific for the research context.

- Category “clarifying ambiguity”, which is remedied based on the category “ambiguities: clarified or confused” contained in Newman’s (1996) protocol.

- Category “explanations”. It is about “refining or elaborating already stated information” (Wever, et al., 2006:18) which is adopted from the analytical framework of Veerman & Veldhuis-Diermanse (2001). However, this category is parallel to the category “clarify ambiguity”, thus these two categories were merged together.

- Category “new ideas”. It refers to “content not mentioned before” (Wever, et al., 2006:18), which is adopted from the analytical instrument of Veerman & Veldhuis-Diermanse (2001). In order to make it more understandable and specific, the name of this category is changed to “proposing a new idea”.

- Category “evaluations” is adopted from the analytical instrument of Veerman & Veldhuis-Diermanse (2001). It is altered to “testing the idea”, which means testing the suggestions by applying them. In addition, a new category “claiming to test the suggested idea”, which is also adjusted according this category, is derived from the data during the coding process because some posters just stated that they would test each others’ ideas later.
- Category “practical utility” (Newman et al., 1995) was abandoned later because it is parallel to the meaning of the code “evaluation”, which is more suitable to describing the content related to applying ideas to test their workability.

- Category “triggering event” (asking a question to start the discussion), which is adopted from the Garrison et al.’s (2000) framework. In order to be more concise, this category is adapted to “triggering question”.

The following categories were formed after the refinement: “triggering question” (asking a question to start the discussion), “clarifying ambiguity” (answering the focused question), “bringing outside knowledge”, “repeating/refining or elaborating already stated idea/solution”, “proposing a new idea or solution”, “evaluating suggested idea”, “claiming to test the suggested idea”, and “testing the idea”.

The content in some messages that did not fall into the categories of existing content analysis instruments forms the following categories: “repeating same problem”, “asking focused question”, “statement of waiting for authentic solutions from the company”, “statement of giving up finding solution” (i.e. statement of returning the laptop), “repeating/refining or elaborating already stated idea/solution”, and “statement of waiting for other member’s solutions or feedbacks”.

The researcher had assumed that there could be a category “asking irrelevant questions”. However, this category was not derived from the data. This illustrates that this thread was highly focused on the topic and the responses were also concentrated on collaboratively finding feasible solutions to the proposed technical problem.

According to the above codification result, we can conclude that the transcript data of this complete thread can be coded into the following categories of sub-level:

- Triggering Question
- Statement of giving up finding solution (e.g. statement of returning the laptop)
- Repeating same problem
- Statement of waiting for authentic solutions from the company
- Statement of waiting for other member’s solutions or feedbacks
- Bringing outside knowledge (usually by sending a webpage link)
- Asking focused question
- Clarifying ambiguity
- Repeating/refining or elaborating already stated idea/solution
- Proposing a new idea
- Evaluating suggested ideas (by reasoning or existing facts)

- Accepted answers for the question (identified by the label "This question has suggested answers(s)")
- Claiming to test the suggested idea
- Testing the idea (usually by applying the idea)

4.6.3.2 Main- level Categories (/Main Categories)

In order to illustrate a complete picture of the knowledge construction process through a more micro perspective, the main-level categories are further derived from the above sub-categories which directly describe the text data.

4.6.3.2.1 Main Category of Knowledge Construction Episodes

Three content analysis instruments elaborating knowledge construction process in CSCL are identified in the existing literature: Interaction Analysis Model (Gunawardena et al., 1997), Veerman & Veldhuis-Diermanse's (2001) model, and the model of Garrison et al. (2001). They are considered to be capable of shedding light on developing the main category of knowledge construction episodes to some extent.

Table 4-5: Exiting Models about Knowledge Construction Process in CSCL

Model of Garrison et al. (2001) : four phases of practical inquiry process	Interaction Analysis Model (Gunawardena et al., 1997): five-phase knowledge construction	Model of Veerman & Veldhuis-Diermanse (2001): three-categories of task-related messages
1. Initiation phase (which can be considered as triggering event) 2. Exploration phase (characterized by brain-storming, questioning, and information exchange). 3. Integration phase (characterized by constructing meaning from ideas created in the second phase) 4. Resolution phase (characterized by resolving the problem posed by triggering event)	Phase 1: Sharing and comparing information Phase 2: Discovery and exploration of dissonance or inconsistency among participants Phase 3: Testing and modification Phase 4: Phrasing of agreement and application of newly constructed meaning	Category 1: New idea (content not mentioned before) Category 2: Explanations (refining or elaborating already stated information) Category 3: Evaluation (critical view on earlier contribution)

According to the above sub-categories, none of these three content analysis instruments alone are capable of including these sub-categories and therefore describing the collaborative knowledge construction process embedded in this thread from a micro view. In the formal online learning context, "meaning construction" is the basis for students understanding of academic concepts and negotiation of meaning, thus to share and construct knowledge. In the virtual product user community, users usually use simple technical words and no abstract and comprehensive concepts are involved. The element of "meaning construction" in the formal online learning discussion environment (i.e. CSCL context) is not involved in this peer product user discussion thread. Thus, the category "integration phase" (characterized by constructing meaning from ideas created in the second phase) in the model of Garrison et al. (2001) decides that this instrument cannot be applied to describe the transcript data. There are great variations between the content of the technical solution discussion in the peer product user forum and that of student online academic discussions, and the categories in "phases 2" and "phase 4" of the Interaction Analysis Model (Gunawardena et al., 1997) are not reflected in the data. Thus it is not suitable for this discussion transcript either. As for Veerman & Veldhuis-Diermanse's model (2001), the newly suggested idea is not proposed at the very beginning in this thread. Additionally, several other elements in this selected thread are also not contained in this model, for example, clarifying the focused question and repeating the already stated ideas. Therefore, this model cannot be used to describe the discussion in this selected thread either. In a word, any of these three content analysis instruments alone are not capable of coding this transcript data.

In this peer user support forum, the first message is usually related to seeking suggestions about the technical problem they have met, in the form of questioning. In some cases, a few posts in one thread focus on describing the same problem and asking similar questions. Thus, the "phase I: sharing and comparing of information" in the Interaction Analysis Model (Gunawardena et al., 1997) and "the category: New idea" in Veerman & Veldhuis-Diermanse's (2001) model could not be applied in describing the first post. However, the "Initiation Phase", which refers to the discussion triggering event in the Garrison et al.'s (2001) model, is quite appropriate for describing the first post which triggers the following collaborative problem solution discussion. Thus, the initiation phase in Garrison et al.'s (2001) model is borrowed as the first stage of the knowledge construction process in this peer user support forum. Due to the non-linear and recurring knowledge construction process in this thread, the researcher chose to use "episode" rather than "phase" to describe this process.

Accordingly, it is further defined as the "Initiation Episode" and features the triggering question(s).

The sub-category "Proposing new ideas or solution" is one of the most frequent categories according to the content analysis chart of the selected thread. It is also the focus of the whole discussion thread and the key content of new knowledge. Through examination of the prior analytical frameworks, the category "New Idea" in Veerman & Veldhuis-Diermanse's (2001) model is quite suitable to be used as the main category to describe this episode of knowledge construction process in this thread.

Both the category "Exploration Phase" in Garrison et al.'s (2001) model and the category "Explanations" in Veerman & Veldhuis-Diermanse's (2001) model are reflected in the following subcategories drawn from content analysis of this thread: bringing outside knowledge(/link), asking focused question, clarifying ambiguity, and repeating/refining or elaborating an already stated idea. However, these two categories are interwoven in the knowledge construction process embedded in this thread. For example, "asking focused question" and "clarifying ambiguity" could be considered as "exploration phase" in the form of "questioning and information exchanging". Meanwhile, they can also be treated as "Explanations" in the form of "repeating or refining or elaborating already stated information". Thus, the researcher incorporated these two prior categories as one, namely "exploration and explanation episode". Additionally, the single main category "exploration and explanation episode" is more capable of illustrating these complicated sections involving clarifying focused questions and repeating the already stated ideas process in a much more simple and clear way.

The category "Phase III Testing and modification" in the Interaction Analysis Model (Gunawardena et al., 1997) and "Category 3: Evaluation" in Veerman & Veldhuis-Diermanse's (2001) model are parallel to each other (Schellens & Valcke, 2005). They are reflected by the following identified subcategories: "evaluating suggested idea" (by reasoning or existing facts), "claiming to test the suggested idea", and "testing the idea" (by applying the suggested solution). Due to the parallel nature of these two prior categories, the category "Phase III Testing and modification" and "Category 3: Evaluation" are incorporated as one category "Evaluating and Testing Episode."

The category of "Resolution phase" in Garrison et al.'s (2001) model can be borrowed to describe posts labeled with "suggested answer". However, these posts which are considered

as accepted answers to resolve the technical problem usually emerge at the end of the discussion. It is understandable that the correct solution needs to be built on a comprehensive discussion of the problem, evaluating and testing suggested potential ideas. According to the above discussion, the relationships between the main categories and subcategories, which form the knowledge building process, can be represented as follows:

Table 4-6: Knowledge Construction Episodes

Main category	Subcategory		
	Subcategory	Definition of Subcategory	Example
Initiation Episode	Triggering Question	It refers to the first post (or first few posts) which asks question about the technical problem and triggers the following discussion on its solutions.	"My new XPS 15 L502X fan comes on for a second then turns off for a second, then repeats. it [It]does this process half a dozen times... then stops for 10 secs then repeats. I get this issue when just doing light stuff like word/internet/etc... Is this by design or a fault? My temps ussualy [usually] lie between 55-60C when this is happening...Is there a setting i can adjust? Also is 55-60C too hot for an i7 2720qm thats doing literally nothing?"(Posted by Gf*** on 26 Mar 2011 7:12 PM)
New Idea Proposing Episode	Proposing a new idea	It refers to the problem solution idea which is not mentioned before.	"I have the same problem. It started happening after I updated the bios to A04. So beware that. Of course if you already have the problem - you might as well try it. I found that if I put the computer on power-saver mode and then make it sleep (close the lid) and then open it again - it works ok. The problem exists as soon as I turn on the high-performance mode or any mode that uses active cooling. It won't go back again until the machine is put to sleep. Just changing the mode doesn't work. I really hope they fix this. It's annoying and it puts wear and tear on my computer." (Posted by Ff*** replied on 7 Apr 2011 9:25 PM)
	Bringing outside knowledge	It mainly refers to releasing a webpage link directed to other information source or bringing outside knowledge in order to enhance the possibility of solving the problem.	"A discussion about this annoyance has taken place here: http://forum.notebookreview.com/dell-xps-studio-xps/561563-l502x-fan-starts-up-every-several-mins-any-xps-fan-control-apps.html Please pay attention to the latest message. Could it be an NVIDIA issue instead of a fan issue? Has anyone tried to update ALL of the latest drivers, not only the BIOS?" **(**Posted **by** Js**** replied on 15 Apr 2011 4:56 PM)

Exploration & Explanation Episode	Asking focused question	It refers to asking specific question about the suggested solution, or requiring more detailed information about the problem (especially about the suggested solution ideas).	"…Can we go back to A01? My 502x laptop arrived last week so I've always had BIOS A04." (Posted by Js*** replied on 15 Apr 2011 6:44 PM)
	Clarifying ambiguity	It refers to providing relevant information to answer the focused question.	"Well, the pre-loaded Dell software I uninstalled was done before I even started working on the fan issue. I really don't recall but I can tell you the only Dell apps left are: Dell Support Center Dell Stage Dell Webcam ...And that's it!Pretty sure the fan was "misbehaving" after those apps were removed. I can definitely tell you that once I updated the nVidia drivers to 267.21 the problem went away. And the fans are still behaving "normally". Any more questions, please ask!" (posted by Ar*** replied on 18 Apr 2011 2:35 PM)
	Repeating/ refining or elaborating already stated idea	It refers to repeating, refining or adding more detailed information to the already stated idea.	"Theres [There's] a workaround to the fan issue on page 5 of this thread." (Posted by St***replied on 15 Jul 2011 1:54 PM)
	Evaluating suggested idea (by reasoning or existing facts)	It refers to justifying the idea by reasoning or linking the idea to existing facts.	"Thanks, but...I have the latest Dell drivers for NVIDIA and the latest Dell Bios (A04). My fan problem still exists. In fact, I didn't have a problem until I upgraded my bios from A01 to A04."(Posted by fr**** replied on 15 Apr 2011 6:37 PM)
	Claiming to test the suggested	It refers to statements about planning to test the	"Ok. I: definitely going to try this tonight. I'm sorry I: didn't understand your first post totally. I also didn't realize that NVIDIA had released reference drivers at long

Evaluating and Testing Episode	idea	suggested idea.	last. I thought all they had was the beta. Thank you for this. I'll report back."(Posted by fr**** replied on 5 May 2011 1:05 AM)
	Testing the idea (by applying the suggested idea)	It refers to testing the suggested idea through applying it.	"Works fine for me in all modes. I play Crysis 2 for an hour and the fans are blasting extremely hot air at full force but the machine keeps chugging along."(Posted by l1*** replied on 4 May 2011 4:26 PM)
Resolution Episode	Accepted answers to the question	It refers to the formally accepted suggestion which is labelled with "Suggested Answer".	"So ok. I finally got it right. Basically i followed lamer01 guide. AS in this post -> http://en.community.dell.com/support-forums/laptop/f/3518/p/19371524/19866336.aspx#19866336 The driver he talk about is found here -> http://en.community.dell.com/support-forums/laptop/f/3518/p/19371524/19866848.aspx#19866848 and is the one i have installed Optimus for those that are noobish as myself is the program for nvidia config. Called NVIDIA Kontrollpanel hen i fixed the power settings as Pyxter suggest in this post -> http://en.community.dell.com/support-forums/laptop/f/3518/p/19371524/19898747.aspx#19898747 These step i had taken before, what is new is: remove all gadget that has something to do with cpu monitoring, graphics card monitor or to do with fan speed control and such. ***Note.*** I did not have any of those gadget displaying on my screen, but they where installed.After uninstalling gadgets for cpu meter, gpu temp , cpu monitor, i chose the "power saver" power plan. Rebooted Resulting in my fan is slowly and almost noiseless pushing out some no to hot air. ***No buzzing on and off.*** If i start a program the fan activates to jobs a bit harder falling to calm after one minute or so." (Posted by St*** replied on 5 Jul 2011 5:42 PM) (PS: This posts is labelled with the icon Suggested Answer)

[Note: In this case, the sub-category "repeating/refining or elaborating already stated idea" can be distinguished from the sub-category "clarifying ambiguity" although they all serve a similar purpose. It is mainly about repeating/refining the idea rather than answering others' questions. However, it is allowed to be incorporated into one sub-category "clarifying ambiguity" in other studies.]

- The initiation Episode. This episode is characterized by discussion triggering question(s). In this thread, the initiation episode only refers to the first post in which the question about the fan problem is proposed. (If the first few posts are all about asking similar questions, these posts can also be considered as an initiation episode).

- New Idea Proposing Episode: It is characterized by proposing an idea about a technical problem solution not mentioned before.

- Exploration & Explanation Episode: It is characterized by repeating, refining or elaborating already stated ideas or by questioning and answering, and information exchanging)

- Evaluating and Testing Episode: It is characterized by evaluating suggested idea by reasoning and through knowledge of already existing facts (i.e. linking ideas to facts), or by testing through applying the suggested idea.

- Resolution Episode. This episode is characterized by resolving problem posed by triggering question (i.e. finding appropriate solutions). This phase usually emerges in the latter part or at the end of discussion.

These five episodes are considered to directly contribute to knowledge building for problem-solving and they form an overall progressive knowledge construction process in one-way direction when in the ideal situation. Accordingly, they are considered to belong to a higher level of "knowledge construction episodes".

4.6.3.2.2 Main Category of "Non-constructive Episode"

It can be concluded that all the messages formed the whole discussion of this technical problem and expressed the poster's personal opinions and comments about the topic. However, the extent of their contribution to the construction of requisite knowledge varied between the posters. Some messages did not actively contribute to knowledge creation, and sometimes even can hinder the collective knowledge building by lowering other participant's motivation for and confidence about solving technical problem by their negative remarks. Therefore, these messages that did not actively contribute to new knowledge building were considered to be a "Non-constructive Episode", which consists of two sub-categories, namely

"Statement of giving up finding solution" (e.g. statement of returning the laptop) and "Statement of waiting for authentic solutions". These two sub-categories were part of the discussion content and could express the post writer's personal opinions and standpoint about the solution. However, they did not add new ideas or test proposed ideas, and so did not push forward the knowledge building process towards the goal of solving the technical problem. In some cases, they can even hinder this process due to its negative influence onto the participants' motivation.

As for the sub-category "repeating same problem", it cannot directly contribute requisite knowledge to the solution finding process, but stressing this technical problem probably can arouse other participants' desire and attention to solving this problem. Meanwhile, the subcategory "Statement of waiting for other member's solutions or feedbacks" has a similar effect of encouraging the forum users to solve the technical problem. Accordingly, these two sub-categories do not fall into the main category of "Non-constructive episode".

The "Non-constructive episode" which does not make a contribution to building required knowledge sometimes cannot be avoided, due to the different knowledge levels and motivations of the participants. The "non-constructive episode" is comparatively more prone to occur in these open Internet forums than in online learning context. It is understandable that students are less willing to express such speech which can disturb other student's morale in online learning context because of the existence of teachers in the online learning space and the assessment element of online discussion. Additionally, according to the coding result, the "Non-constructive episode" can also occur between any episodes of the knowledge construction process in the product user virtual community.

4.6.3.2.3 Main Category of "Others"

The remaining two sub-categories, "Repeating same problem" and "Statement of waiting for other member's solutions or feedbacks", are considered to belong to the main category "Others" due to their deviant nature from other subcategories and their atypical emergence.

Although "Statement of waiting for other member's solutions or feedbacks" does not directly bring in new knowledge or verify stated knowledge (i.e. participate in the requisite knowledge content building), it can promote people's motivation and encourage participants to find feasible solutions. As for the subcategory "Repeat same problem", its influence towards the knowledge construction process is very difficult to be empirically evaluated so far because of the lack of interview data.

In other similar studies, the researcher proposes that the main category "Others" can also include codes that do not belong to the category of "knowledge construction episodes" or "non-constructive episode".

Table 4-7: Non-constructive Episodes and "Others"

Main Category	Sub-category	Definition	Example
Non-constructive Episode	Statement of giving up finding solution	Comments on quitting finding the solution or returning the products	"I just returned it...spoke to dell..I felt like i was working on a vaccuum cleaner...Fan goes on and off continuously...pretty annoying in the meetings" (Posted by DS*** on 14 Jul 2011 9:19 AM)
	Statement of waiting for authentic solutions	Statements of waiting for the company to release the formal solution to solve the problem permanently or reporting the problem to the company for assistance	"I cannot update the NVIDIA drivers since I could not find a driver package for Win 7 on the NVIDIA site. I saw a Beta driver but I did not want to install it.I've had this issue since I got the laptop (received it on Monday).I suggest raising a case with Dell to investigate." (Posted by OM*** on 15 Apr 2011 5:23 PM)
Others	Repeating same problem	Content of describing same technical problem the users have	"I'm having the same problem with the fan of my L502X. It's frustrating... It's a brand new computer. Called customer service, upgraded to the latest bios (A04), but still the same issue: the fan goes on and off any time it chooses." (Posted by Js*** replied on 12 Apr 2011 6:04 AM)
	Statement of waiting for other member's solutions or feedback	Statement of waiting for other product users to find the solution or the feedback about the effectiveness of the proposed idea.	"If anyone has tried to downgrade the BIOS from A04 to A01, please report if there's any noticeable improvement with the fan issue." (Posted by Js**** on 16 Apr 2011 9:54 AM)

(Note: In other cases, the main category "Others" can refer to any codes that do not fall into the main category of "Knowledge Construction Episodes" or "Non-constructive Episode".)

4.6.4 Application of Newly Created Content Analysis Framework

In this section, the researcher adopted the newly created instrument to explore the participation patterns of different user groups of varying activeness. In order to identify those patterns hidden in the statistical data, the researcher analyzed the posts' distribution from different levels of categorization. Firstly, the researcher calculated the posts released by classified user groups in each sub-category. Then the posts were further calculated from a higher level, namely the main category level.

Table 4-8: Classified User Groups' Posts Distribution in Sub-Category Classifications

Classified User Group	Triggering Question	Statement of giving up finding solution	Repeating problem	Statement of waiting for authentic solution	Statement of waiting for other member's solutions or feedback about the suggested idea	Asking focused question	Clarifying ambiguity or repeating/ refining or elaborating already stated idea	Bringing outside knowledge (/link)	Proposing new ideas or solution	evaluating suggested ideas	claiming to test the suggested idea	testing the idea
Active User Group		1	3	8	1	8	12	2	12	11	1	13
Medium Active User Group		3	1	5		1	2		3	2		3
Less Active User Group	1		2	4		6	1		1		1	2

Table 4-9: Classified User Groups' Posts Distribution in Main Category Classifications

Classified User Group	Initiation Episode	New Idea Proposing Episode	Exploration & Explanation Episode	Evaluating and Testing Episode	Resolution Episode	Non-constructive Episode	Others	Total
Active User Group		10	22	25	2	9	4	72
Medium Active User Group		3	3	5		8	1	20
Less Active User Group	1	1	7	3		4	2	18
Total	1	14	32	33	2	21	7	110

According to the content analysis model created by this research, Initiation Episode refers to the sub-category "triggering question" while "New Idea Proposing Episode" is relevant to the subcategory "Proposing new ideas or solution". However, two posts of the sub-category "Proposing new ideas or solutions" were marked as " ✔ Suggested Answer " and they were categorized into the "Resolution Episode". That is to say, 12 posts of the sub-category of "Proposing new ideas or solution" were classified into two main categories in this calculation: 10 into the main category of "New Idea Proposing Episode" and 2 into the main category "Resolution Episode". The main category of "Exploration & Explanation Episode" includes the following sub-categories: "Bringing outside knowledge (/link)", "Asking focused question", and "Clarifying ambiguity or repeating/ refining or elaborating already stated idea". The main category of "Evaluating and Testing Episode" contains the sub-category of "evaluating of suggested ideas", "claiming to test the suggested idea" and "testing the idea". "Resolution Episode" refers to the accepted ideas, namely the 2 posts tagged as " ✔ Suggested Answer ". "Non-constructive Episode" contains the subcategories of "Statement of giving up finding solution" and "Statement of waiting for authentic solution".

The main category of "others" refers to the sub-categories of "Repeating problem" and "Statement of waiting for other member's solutions or feedback about the suggested idea".

Table 4-10: Classified User Groups' Posts Distribution in higher Classification of Categories

Classified User Group	**Knowledge Construction Episodes**	**Non-constructive Episode**	**Others**	**Total**
Active User Group	59	9	4	72
Medium Active User Group	11	8	1	20
Less Active User Group	12	4	2	18
Total	82	21	7	110

Table 4-11: Proportion of Each Group in Individual Category of the Higher Classification of Total Posts

Classified User Group	**Knowledge Construction Episodes**	**Non-constructive Episode**	**Others**
Active User Group	72%	43%	57%
Medium Active User Group	13%	38%	14%
Less Active User Group	15%	19%	29%
Total	100%	100%	100%

Table 4-12: Proportion of Each Category of High-Level Classification in Individual Group's Total Posts

Classified User Group	**Knowledge Construction Episodes**	**Non-constructive Episode**	**Others**	**Total**
Active User Group	82%	12.5%	5.5%	100%
Medium Active User Group	55%	40%	5%	100%
LessActiveUser Group	67%	22%	11%	100%

The above figures reveals that those active forum users contributed most of the knowledge construction related posts (namely 72% of the total posts that fell into "Knowledge Construction Episode"). Furthermore, 82% of the activive user group's posts were of the category "Knowledge Construction Episode", compared to 12.5% posts of "Non-constructive Episode" and only 5.5% of "others". Accordingly, this reveals that these active users' participation in discussions were more concentrated on knowledge construction process than other medium-active forum users and less-active forum users.

Although it seems that 67% of the less active user group's posts were also about knowledge building, their 7 posts were about asking focused question (including the triggering question). These 7 posts were 58% of the posts falling into the main category "Knowledge Construction Episodes", and 39% of the less active user group's total posts. In contrast, only 8 posts released by active user group members belonged to the sub-category of "Asking focused question". These 8 posts only accounted for 14% of total posts falling into the higher classification of "Knowledge Construction Episodes" and 11% of the active users' total posts. Therefore, we can say that the less active members' participation into knowledge building mainly took the form of asking focused question, which is part of "Exploration & Explanation Stage". In contrast, they were less involved in later level of knowledge building of "Evaluating and Testing Stage". Additionally, their activities in another important stage "New Idea Proposing" were also not vigorous, either.

To conclude, the above analysis confirms the hypothesis proposed in section 2.1., namely that active forum members' posting activities were more focused on knowledge building process than those of less active members. As a result, they occupy a more centred position in the knowledge building process than those less active participants.

4.6.5 Conclusion of Knowledge Construction Process

4.6.5.1 Knowledge Construction Process in the Selected Thread

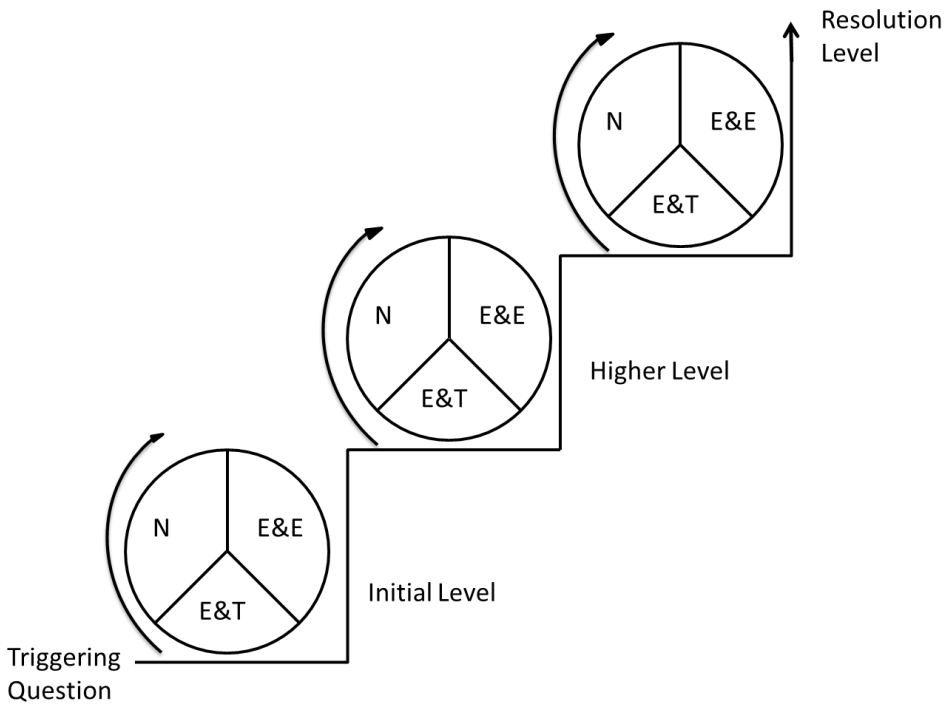
As shown above, this selected discussion thread transcript contained a complicated knowledge construction process. A recurring process including "New Idea Proposing Episode", "Exploration & Explanation Episode", and "Evaluating and Testing Episode" was quite evident according to the data coding result. Whenever a new idea was proposed, it would be followed by "Exploration & Explanation Episode" or "Evaluating and Testing Episode" or both of these two episodes. As this process repeated itself, the suggested ideas

became more and more reliable and effective for solving the problem. The solutions they collaboratively found started from temporary solutions and moved to permanent solutions as the recurring process proceeded. This also can be known from that the resolution stage emerges as the discussion develops. That is to say, the posts containing accepted answers are posted in the latter discussion stage. Thus, this process was not simply a loop. In fact, it was an ascending spiral pattern because the new proposed idea was based upon the former idea, and also proved more reliable than the former idea. This ascending spiral pattern did not stop until the accepted correct answers were identified; in other words, until the "Resolution Episode" in this thread was reached.

According to the coding outcome of this selected thread, the main categories of "Non-constructive Episode" or "Others" or both could be interwoven between the knowledge construction episodes, namely "New Idea Proposing Episode", "Exploration & Explanation Episode", "Evaluating and Testing Episode", and "Resolution Episode".

4.6.5.2 Knowledge Building Process Model

According to the above coding result, one prototypical knowledge construction process involving building comparatively complicated knowledge in the open product user peer support online community can follow the cumulative and progressive order of these identified knowledge construction episodes in a cyclical way. Meanwhile, the "Non-constructive Episode" can be absent from the whole discussion process in this theoretically ideal situation. Therefore, this more efficient knowledge building process can be categorized into the following five phases in this prototypical model: Initiation Phase, featuring by the triggering question; New Idea Proposing Phase; Exploration & Explanation Phase; Evaluating and Testing Phase; and Resolution Phase. It is understandable that a new idea proposed to solve the triggering question still needs exploration and explanation in order to achieve clarification and common understanding between the questioner and the knowledge experts. Then the clarified idea can be justified by reasoning or through existing facts, or by testing through applying the idea. If the idea is proved workable after justification and testing, the knowledge building will achieve the resolution phase. If not, the knowledge construction procedure "loop" will recycle from the "New Idea Proposing Phase" to the "Evaluating and Testing Phase" until a solution is found. Accordingly, it can be presented in the following model



(PS: N= New Idea Proposing Episode; E&E= Exploration & Explanation Episode; E&T= Evaluating & Testing Episode)

Figure 4-5: Model of the Knowledge Building Process within the Virtual Product User Community

This model illustrating the progressive process of knowledge construction in the open user peer support forum can be considered as a prototype of the knowledge building process in the real world. Like all models, this is just a simple abstraction of the reality which it tries to reproduce. The reality of knowledge building process is more complex, due to more involving factors, such as non-constructive episodes, and other moderation cues. However, this model is a useful abstraction which identifies the most important factors of knowledge construction and their general relationship to one another. This model contains the most essential elements related to the knowledge construction process. Thus, it can be transformed into other variations of knowledge construction in similar research cases. Therefore, it can offer a lens for the practitioners to foster the collaborative knowledge construction in a more open Internet environment, especially in virtual product user communities.

4.6.5.3 Other Possible Knowledge Construction Processes in the Virtual Product User Community

There can be varying types of knowledge construction processes in which these knowledge construction episodes can be combined freely like bricks in the peer support community. The combination of these "bricks" depends on the nature of the question, the members' expertise levels and participation motivation, and other influential factors.

It is not necessary for all of these episodes to emerge in the knowledge building process. In some cases the resolution phase can be immediately achieved after the triggering question is asked in the initiation phase if the peer user can provide a ready answer. Therefore, there are only two episodes involved in this case, namely, the initiation phase and the resolution phase.

The knowledge construction process can also be performed in other comparatively complicated approaches. The discussion process can jump freely among the following episodes: "New Idea Proposing Episode", "Exploration & Explanation Episode", "Evaluating and Testing Episode", and "Resolution Episode". Meanwhile, any of these three episodes can be repeated many times in the process. Thus, there can be a large number of combinations of these three episodes between the Initiation Episode and Resolution Episode, in reality. For instance, the knowledge construction process could proceed in this way: Initiation Episode- New Idea Proposing Episode- Exploration & Explanation Episode- New Idea Proposing Episode- Evaluating and Testing Episode- Evaluating and Testing Episode-Resolution Phase.

4.7 "Trial-and-Error" Strategy

According to the coding result that a new proposed idea was usually proposed before evaluating or testing of the earlier idea, the discussion participants used a general approach to solve the problem, namely a "trial-and-error" strategy to collaboratively identify feasible solutions. It is considered to be simple and efficient due to the fact that these ideas are immediately applicable to the laptop at hand. When one suggestion was proposed, it would be tested by applying the idea or evaluated by linking the idea with existing facts. Then a new solution would be suggested if the former one was confirmed to be impractical or unsuccessful. This process would be conducted in a continuous way until the practicable solution was found by those forum users in the thread. Furthermore, it emerged in a hierarchical process as well. At the beginning, the initially proposed idea was a temporary solution, such as covering the lid of the computer in order to reduce the noise of its fan.

Gradually, more reliable and permanent solutions were proposed through this simple "trial-and-error" approach.

However, in the formal learning context, the strategy of learning via problem solving is based on the building and transformation of mental models, which "entail changes in organization and structure of knowledge and primarily occur in the context of problem solving" (Alavi, 1994:161). When mental models are examined, extended, and improved until they become effective and reliable to solve that problem, the learning is considered to be advanced in the problem solving situation (Alavi, 1994). Meanwhile, collaborative learning is achieved through individuals' exercising, verifying, solidifying and improving their models when interactions and information exchange occurred in the problem-solving process (Alavi, 1994). According to Alavi's empirical study, learning strategies in the CSCL context should also include three characteristics of effective learning, namely: "1. Active learning and construction of knowledge; 2. Cooperation and teamwork in learning; and 3. Learning via problem solving." (1994: 161).

4.8 Summary and Conclusion

This section mainly focuses on the exploration of the knowledge construction process embedded in a discussion thread which was chosen from one product user peer support forum (i.e. the Dell User Support Forum). A number of content analysis models which are designed to explore knowledge construction, cognitive development, and critical thinking in the formal learning context (i.e. CSCL) were tested against the data.

However, some of the key elements in the CSCL context are missing in the virtual product user community context. The higher level of cognitive development and critical thinking, which are the main learning goals in CSCL, are not obviously reflected in the discussion thread of this peer user support forum. There are also some common elements of low level learning, which are shared by both the CSCL and the virtual product user community. According to Bloom's learning taxonomy (1956), low level cognitive domains, including knowledge (which is related to recalling data or information), comprehension and application, are reflected in most of the content in this discussion thread. One unique characteristic of the virtual product user community is that the forum members can immediately apply the proposed idea to test whether it works when the idea is clarified. The forum users are more inclined to adopt a "trial and error" strategy to find the workable solutions rather than involve themselves in higher-level mental processes, such as synthesizing, interpreting, logical

inquiry and reasoning, and more importantly, critical thinking in argumentative knowledge construction. Therefore, high-level cognitive activity and critical thinking activities, which are the main features of the formal learning context, are not typical in the collaborative technical solution finding process in the virtual product user community.

In order to adapt the framework for the virtual product user community context, the researcher designed a much more detailed content analysis framework to describe the knowledge construction process featuring low-level cognitive activities and ready application of the proposed ideas in the selected thread. This framework includes the knowledge construction episodes (including Initiation Episode, New Idea Proposing Episode, Exploration & Explanation Episode, Evaluating & Testing Episode, and Resolution Episode), Non-constructive Episodes, and "others". Additionally, the researcher also proposed a prototypical model to illustrate the knowledge construction process in the virtual product user community. This prototypical model contains the key knowledge construction elements abstracted from the data in the virtual product user community. It can be varied into other forms in different cases.

To conclude, the data analysis results illustrate one way in which knowledge is collaboratively constructed to solve technical problems through peer support in virtual product user communities. Unlike the knowledge construction process in the CSCL context, its patterns are involved with low-level criticality and the virtual product user community mainly adopts the "trial-and-error" strategy.

Thus in this stage of the research, the researcher created an initial content analysis framework, developed a knowledge construction model, and identified a model of a knowledge construction strategy. However, the analysis framework still needs to be elaborated and improved by more threads analysis in the following research stages. The relationship between these main categories also needs to be clarified. The knowledge construction model will be applied to more threads to test its validity and generalisability in the next phase of the research.

Chapter 5 – Analysis of More Threads in the User Support Forum

5.1 Introduction

The main objective of this chapter is to elaborate the analytical framework created in the previous stage of the research. Thus, it is mainly related to the second research question addressed in this thesis: "How knowledge is constructed in a virtual product user community?" In order to achieve this objective 10 threads were selected from the Dell User Support Forum, including 3 threads with the moderator's participation. They were analyzed with the newly created analysis framework. The researcher identified new sub-categories related to knowledge transference from the virtual product user community to the business organization when analyzing the threads with the involvement of formal moderators. Accordingly, the transference patterns of different types of knowledge, including technical problems, and solutions proposed by community members and engineers within the organization, are also explored.

In addition, the knowledge construction model developed in the first stage was evaluated and confirmed to be effective in describing the knowledge construction process in solving technical problems. Accordingly, the knowledge construction strategy of "trial and error" was also confirmed in these discussion threads selected from the User Support Forum.

5.2 Complete Knowledge Flow Direction

In two of these three selected threads, where the forum moderator participated, the forum users could solve the technical problems they encountered through peer support. Therefore, they had to provide knowledge about the technical problems and other relevant information, which could help technicians in the organization to analyse the causes of the technical problems, to the moderator in their postings. Then moderators transmitted these questions and relevant information about the problem to the engineers who were in charge of solving these technical problems for the customers in the company's laboratory. Besides transmitting knowledge about the problem to the engineers, these moderators also took responsibility for releasing solutions obtained from engineers to the online user community in the discussion thread. In this knowledge flow process, two types of knowledge are transmitted, namely knowledge about problems and knowledge about solutions identified by the engineers. Accordingly, the whole knowledge flow process, starting with a forum user's provision of a

technical problem and related information, and ending with the forum user's receiving of knowledge about solutions, is illustrated as follows:

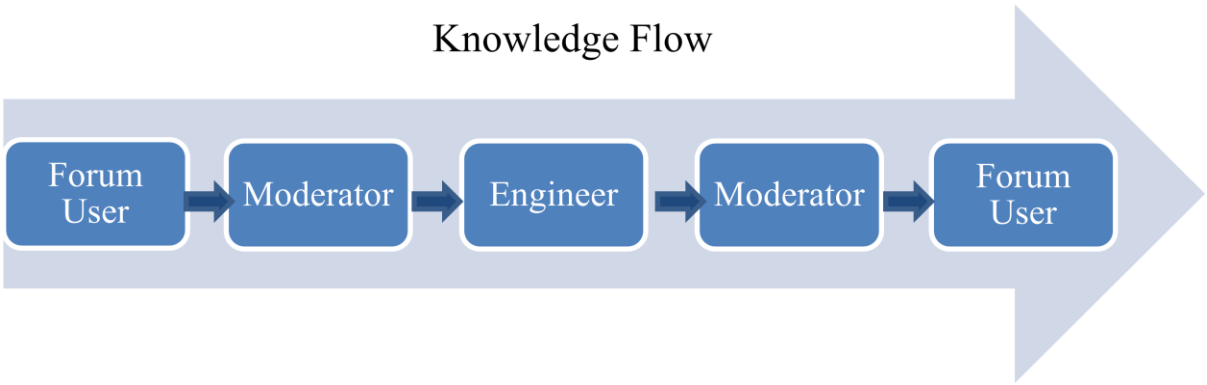


Figure 5-1: Knowledge Flow Process about Technical Problem and Engineer's Solution Ideas

Usually, the forum user will test these solution ideas by applying them and then provide the feedback by releasing the test results in the discussion threads. If the solution idea is not workable, the moderator will continue to transmit the feedback of the solution to the engineers in order to find a more reliable and permanent method. Then the knowledge flow process continues from the engineer to the moderator, and finally to the forum user. This process keeps on recurring until a workable solution is found by the forum users or the engineers.

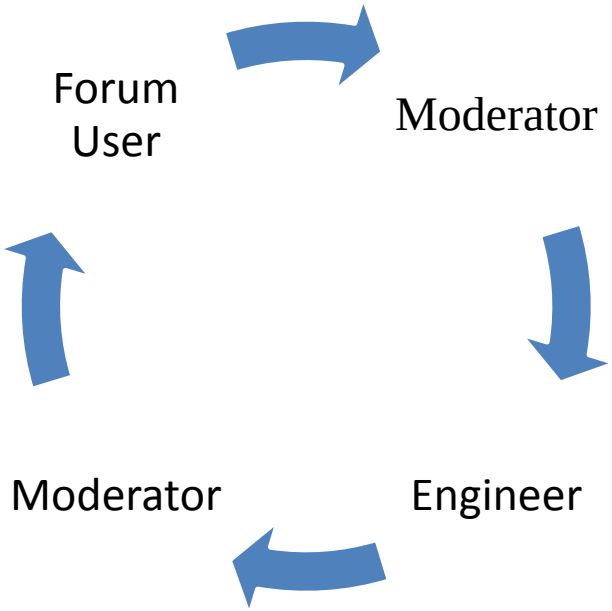


Figure 5-2: Knowledge Flow Process of Technical Problem and Engineer's Solution Ideas

This knowledge flow process begins with the forum user's provision of much more detailed knowledge about the technical problem on the basis of the requirements of the moderator. The engineers working in the company's lab explore the causes of the problem and find the solutions according to the knowledge collected by the moderator. Then the solution ideas are transmitted from the engineer to the moderator. Finally the moderator distributes the solution ideas to the forum users.

5.3 Knowledge Transfer between Forum Users and Moderators

5.3.1 Two Types of Knowledge Transfer across the Boundary

There are two types of knowledge transferred across the boundary between the virtual product user community and organization (/organization's knowledge network/ bank). One type of knowledge is about technical problems of laptop products in the form of users' descriptions of the problem, and the detailed technical information about the problem which can help engineers to explore its causes, such as the exact patterns of the problem, and the hardware and software environment of their laptops (e.g. software configuration). This kind of knowledge is firstly collected by the moderator and then transferred from the product user community to the engineers working in the lab located in the organization through the bridging role of the moderator.

The other type is knowledge about solution ideas which can be found by both the engineers within the business organization and the forum users in the product user community. In

contrast to the knowledge flow direction of the first one, the types of knowledge about engineer's solutions flow across the organizational knowledge boundary to the virtual product user community through the moderators, who receive solution ideas from engineers and distribute them to forum users.

Two key important trunks of the whole knowledge flow process, namely the accurate knowledge delivery and acquirement between forum users and moderators, along with "smooth" interactions, strongly influence the success of knowledge transfer, and help achieve solution of the problem for the virtual product user community members.

Knowledge transfer regarding specific problems between forum users and moderators are all conducted within a single discussion thread, and on the more micro level of the virtual product user community.

Two existing categories created in early research findings can be used to code the relevant content about knowledge transfer and reveal the way knowledge is transferred between the moderator and forum users: "ask focused question" and "clarify the ambiguity". In order to make them in accordance with these two types of knowledge, these two categories are further classified into four groups, based on the knowledge type transmitted between the forum users and moderators: ask focused question/information about the problem; clarify the ambiguity about the problem; ask focused question/information about the solution; and clarify the ambiguity of the solution.

Table 5-1: Two Types of Knowledge and Respective Sub-category

Knowledge Type	Knowledge Flow Direction	Sub-category	Example
Knowledge about the problem	From forum users to moderators	Asking focused question (about the problem)	Example 1
		Clarifying the ambiguity (about the problem)	Example 2
Knowledge about the solution	From moderators to forum users	Asking focused question (about the idea)	Example 7
		Clarifying the ambiguity (about the idea)	Example 9

5.3.2 Knowledge Transfer from Forum Users to Moderator

The first type of knowledge, namely the detailed information/knowledge about the product's technical problem, is transmitted from forum users to the moderator. When the knowledge around the technical problem is transferred from the community members to the moderator two sub-classified categories developed in the early research stage are reflected: "ask focused question/information about the problem" and "clarify the ambiguity about the problem". They are also the patterns indicating how knowledge transfer is performed.

Set Example 1

Category I: "Asking focused question (about the problem)"

Example 1:

> "…I know that engineering and Renesas is taking this very seriously, but has yet to been able to duplicate the problem in the labs. I would like to find out what software is different in your homes, than what is being tested with at the labs. So I would like to find out if there is a common denominator, a programme, utility or even a Windows update that has been installed on your systems that is interfering with the new driver." (post 22 in thread 2; Posted by moderator Dell-TB*** replied on 5 Apr 2012 6:15 PM).

Although some users had already described the technical problem and their laptop's software environment in this selected thread, the forum moderator still called for provision of more information about software and programs installed on the users' laptops in order to duplicate the problem and find out the common cause of failure of the new touchpad driver.

Category II: "Clarifying the ambiguity (about the problem)"

Example 2:

> "Thanks for reply Terry, My specs on laptop are i5 with 128gig running Win8 maybe that will help. Sincerely German S." (Post 10 in thread 2; Posted by GS*** replied on 27 Mar 2012 4:28 PM).

> "Good find, Steve. We had two XPS13's. One trackpad was fine, the other was defective. The one that didn't work had AVG installed on it." (Post 35 in thread 2; Posted by jB*** replied on 25 Apr 2012 8:47 PM).

These two posts contain the knowledge about the specific computer environments that the moderator asked for. The former was posted before the moderator's post calling for provision

of more such knowledge, and the latter was made after it. They both helped to clarify the ambiguity of the technical problem, especially about what software installed on the laptop conflicted with the touchpad driver. This detailed knowledge about a problem can help engineers working in the lab explore causes, and thus find solutions.

Set Example 2

Category I: "Asking focused question (about the problem)"

Example 3:

> "Engineering [Engineer] is asking what GPUs shipped with your systems, and want to know if there is a specific video card that is having the problems. They are also asking for service tags of the effected systems. Please shoot me a private message with the GPU model and the service tag of your system and I will pass this along to engineering. I appreciate all of your patience in this and hopefully we can figure out why the most current video and audio card drivers won't install on your notebooks. Thanks. TB". (Post 28 in thread 1; Posted by moderator Dell-TB*** replied on 16 Dec 2011 3:20 PM).

Category II: "Clarifying the ambiguity (about the problem)"

Example 4:

> "Thanks for all the effort you are going to with this ongoing problem Terry, we do appreciate it. From Australia, I tried the browser download method to get the new drivers files this morning with IE9, Chrome and Firefox and nothing worked. I eventually got them downloaded using the download manager with IE9 and everything installed sucessfully [successful]
> I find it strange that previously, there were no files listed as being specific to my service tag except the Dell Diagnostics however the new drivers are now listed as being files for my service tag.
> Quickset 11.0.22, A04
> CardReader 1.00.64.1, A01
> RealTek LAN 7.048.0823.2001, A02
> NVidia GT555M 8.17.12.6959, A09
> The driver detect utility on geforce.com still detects my card but fails to detect any drivers installed and the latest whql drivers still fail to detect a compatible device. Device Manager displays my Nvidia card as "NVIDIA GeForce GT555M with hardware ID PCI\VEN_10DE&DEV_124D&SUBSYS_05711028&REV_A1.
> There is also a new TouchPad driver in the "All files for XPS 17 MLK" section which i downloaded (again i had to use download manager) and installed successfully.

Synaptics Touchpad 15.3.22.0, A01

I havent tried rolling back to an earlier BIOS version yet but if Bill-B over on notebook review forums still thinks this is a suggested step im willing to consider it.

XPS17 l702x: i7-2760QM 2.4GHz | 8GB 1333MHz DDR3 SDRAM | NVIDIA® GT 555M (GF116) 3GB | Crucial M4 128GB | Seagate 750GB 7200RPM | 6230 WIFI+Bluetooth | WLED (1600x900) gloss screen with Multi Touch | Backlit Keyboard | Blu Ray Burner" (Post 30 in thread 1;Posted by Or*** replied on 16 Dec 2011 5:42 PM) .

In these examples, the knowledge about the problems is transmitted through the interaction between the moderator and the forum users. The moderator collects the knowledge about the technical problem and asks questions to encourage the provision of more knowledge. The forum users describe their laptops' problems in a detailed way and provide other relevant information to the moderator to clarify the problem. Through this process, the knowledge about the problem is clarified and transferred from the forum users to the moderator, who is located in both the virtual product user community and the business organization knowledge network.

5.3.3 Knowledge Transfer from Moderator to Forum Users

The other type of knowledge transferred from the moderator to the forum users is about the solution ideas proposed by the engineers in the lab. The moderators are the people who directly communicate with the product users in the forum. Thus, they are in charge of transmitting the knowledge of the engineers' solutions to the forum users. This knowledge transference usually takes the form of two categories of knowledge behaviour: ask focused question (about the solution), and clarify the ambiguity (about the solution). After the moderator had released the engineers' solutions to the discussion thread, the forum users still asked questions about more detailed information. Then the moderator answered their questions to clarify the ambiguity of the solution.

Category: "Claiming to bring knowledge from the organization to the community"

Example 5:

"I have asked engineering about the drivers and am waiting an answer. I apologize for the inconvenience here, and I hope to have more for all of you shortly. TB" (Post 20 in thread 1; Posted by DELL-T B***replied on 15 Dec 2011 4:40 PM).

Example 6:

"I spoke with Bill B today and I have more from his article in Notebook Review. Looks like he managed to obtain a test L702X with A03 installed. He flashed it to A!4, then reinstalled the video drivers from support.dell.com with no problems. Here is a link to the thread…" (Post 21 in thread 1;Posted by moderator DELL-T B***replied on 15 Dec 2011 4:40 PM)

Category: "Asking focused question (about the idea)"

Moderator Dell Terry B stated that he had contacted with the expert Bill B in the organization and got the solution from him in post 21, and then he released the solution in this post as follows.

Example 7:

"I spoke with Bill B today and I have more from his article in Notebook Review. Looks like he managed to obtain a test L702X with A03 installed. He flashed it to A!4, then reinstalled the video drivers from support.dell.com with no problems. Here is a link to the thread. *forum.notebookreview.com/.../632309-dell-xps-17-l702x-do-not-flash-bios-a14-please-read.html* Right now if you already have your system up and running, then as far as I am concerned, if it isn't broken don't fix it. For the rest of you with a simular problem, try down flashing to A12 and then try the drivers on support.dell.com. A14 was up for a little earlier today but will likely be taken down. Engineering will likely take a look at the bios rev and release it at a later date once they are sure that it is working correctly. TB" (Posted by moderator DELL-T B*** replied on 15 Dec 2011 4:40 PM).

In the post 43, moderator Dell-Terry B further added more information about the solution, i.e. the locations of the correct drivers that the user should install.

" I just wanted to post the locations of the correct drivers to install if your XPS L702X shipped with the A14 BIOS.

Nvidia GPU driver www.dell.com/.../DriverFileFormats

Realtek Ethernet driver www.dell.com/.../DriverFileFormats

Nvidia 3D driver www.dell.com/.../DriverFileFormats..." (Posted by moderator DELL-T B*** replied on 22 Dec 2011 1:33 PM)

Then another forum user jbreen95 asked his question in the post 47 as follows:

Example 8:

"I am not a big computer literate individual but I did just recently purchase an XPS L702X system that seems to have an issue with compatibility. I recently purchased Quickbooks for Windows 7 and while it initially installed and I was able to use the program, I can no longer open it. It tells me that it is already open and running, which it is not. When I look at the

properties, it tells me that it is running in Windows XP Service Pack 2. I also have this issue with my printer when I downloaded the drivers for Windows 7 off of HP's website. My Quickbooks program was just purchased and is for Windows 7. Does this kind of issue have anything to do with what you are referring to?" (Post 47 in thread 1; Posted by dr*** replied on 1 Jan 2012 9:10 PM)

Category II: "Clarifying the ambiguity (about the idea)"

In the following post, the moderator answered above question regarding to the solution.

Example 9:

"dbahnmiller It sounds like you may have a different issue. Quickbooks looks to have been corrupted on your system. You may need to run a repair reinstall and see if it helps. Seb.F.Have you tried the links to the drivers that I posted previously and if so did they help? What version of the BIOS do you have on your notebook as well? TB" (Post 49 in thread 1; Posted by moderator DELL-T B*** replied on 3 Jan 2012 4:34 PM)

In fact, some forum users' focused questions about the solution can also be answered by their peer users, besides the moderator. The knowledge about the solution is clarified in this way after the moderator has released the solution.

Asking focused questions and clarifying the ambiguities is also a common method used among peer users when answering community members' focused questions about the solution.

In addition, the knowledge transfer between the moderator and engineers working in the lab within the organizational boundary can be further explored and elaborated by the interview data of the moderator and other management team members.

5.4 Knowledge Transfer within the Business Organization (Between the Moderator and the Engineer)

Category: "Claiming to bring knowledge from the community to the internal organization "

Example 10:

"…I have mentioned to engineering what Steveclow has found, and I am sure that they will be testing with AVG shortly to verify this." (Post 38 in thread2; Posted by DELL-T B*** replied on 27 Apr 2012 11:16 AM)

The transference of two types of knowledge, namely knowledge about the problem and knowledge about the engineer's solution, across the boundaries between the virtual product user community and the organizational knowledge bank, with exact forms, is illustrated in the following figure:

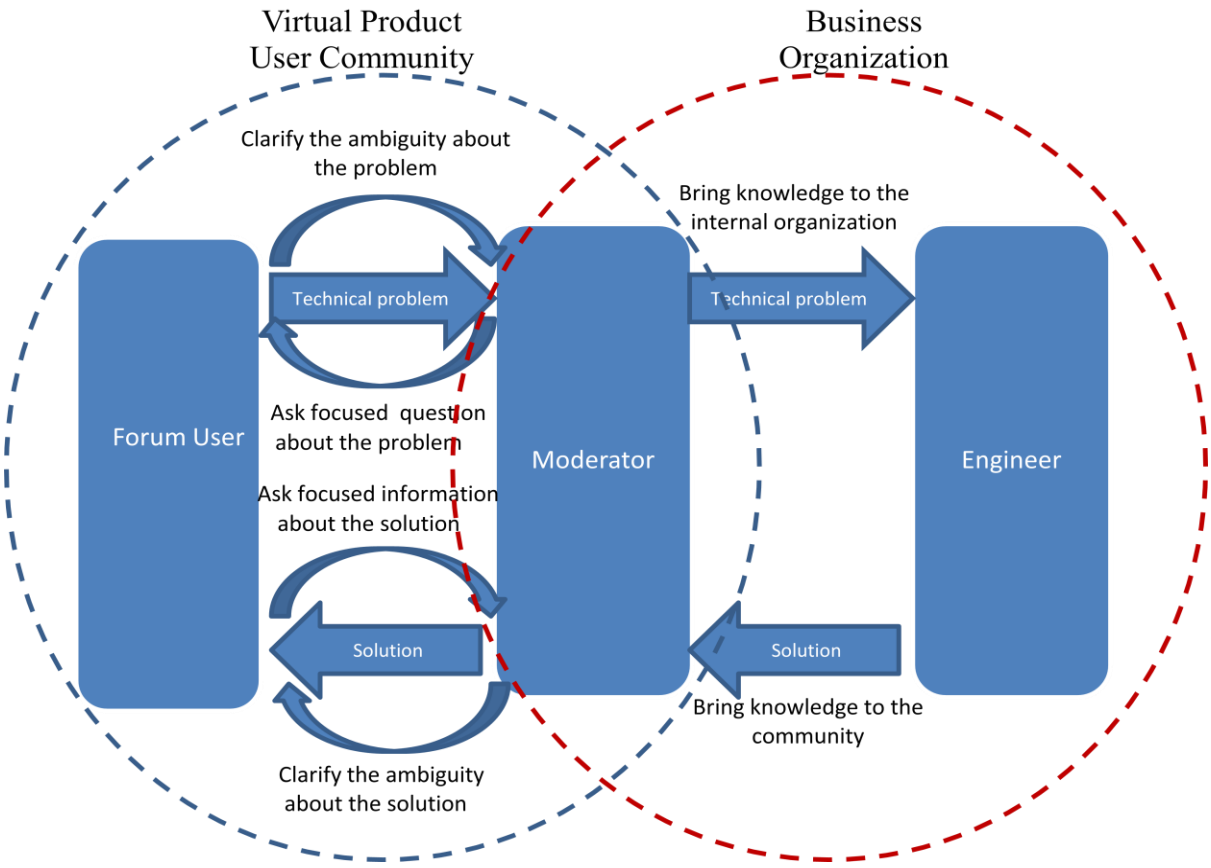


Figure 5-3: Knowledge Transfer about Technical Problem and Engineers' Solution Ideas between Virtual Community and Business Organization

The moderators belong to both the virtual user community and the business organization network. They are the boundary spanners who connect these two knowledge network together like bridges. In this knowledge flow process, the moderator transmits two types of knowledge, namely knowledge about the problem and knowledge about the solution, across the boundary between the virtual product user community and business organizations.

5.5 The knowledge about the solutions found by community members

In another thread, a different type of knowledge was identified: solutions found by the forum users.

5.5.1 Overall knowledge flow process of the knowledge about the solution generated by forum users

In some cases, the resolution ideas can also be proposed by the forum user. The moderator collects this knowledge on solutions and transmits it to the engineer working in the lab. In another thread, one solution idea proposed by the forum user was verified and proved workable. The moderator then sent it to the technician for further testing. The knowledge flow reflected from the discussion posts in that thread is illustrated as follows:

When the engineers received the solution idea generated by the moderator, they usually test the idea to verify it in the lab. If the engineer further refines the solution idea, the improved knowledge which is built up, based on the forum user's original ideas, will be transmitted to the moderator, through whom the solution is distributed to the user community. Accordingly, the complete knowledge flow is illustrated as follows:

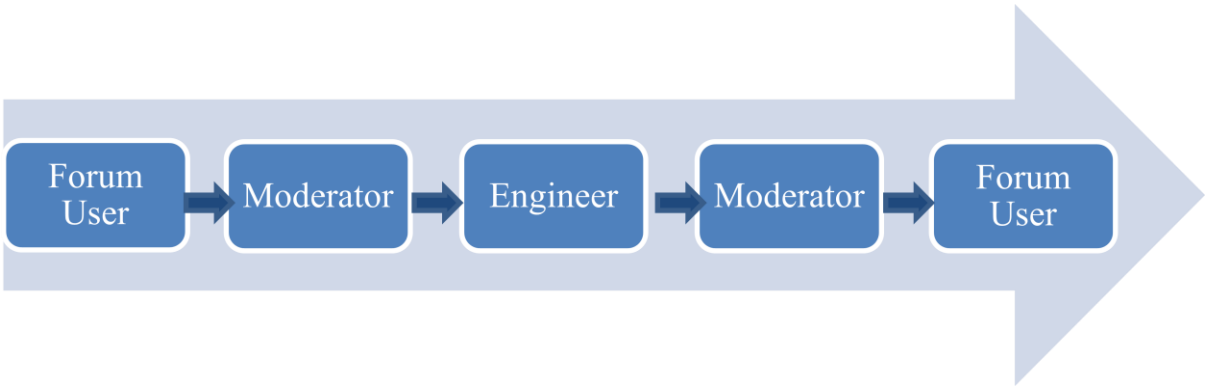


Figure 5-4: Knowledge Flow of Solutions Proposed by Forum User

5.5.2 Knowledge Transfer between Forum Users and Moderators

In thread 2, the forum users interacted with each other with the purpose of finding solutions through collective efforts for the track pad problem. One user (Sw***) proposed a solution idea, then another user (Rt***) tested it. Other forum users also participated in discussion about this idea in terms of asking focused question, clarifying ambiguity, and so on. When the moderator noticed the emergence of the solution within the community, he collected the idea and asked more focused questions about the solution in order to obtain a thorough understanding about the idea. After the forum users clarified the ambiguity regarding the solution, the moderator claimed to report the user's suggested solution to the engineers to test this idea. The overall knowledge transfer within and across the virtual product user community and organization is presented as follows:

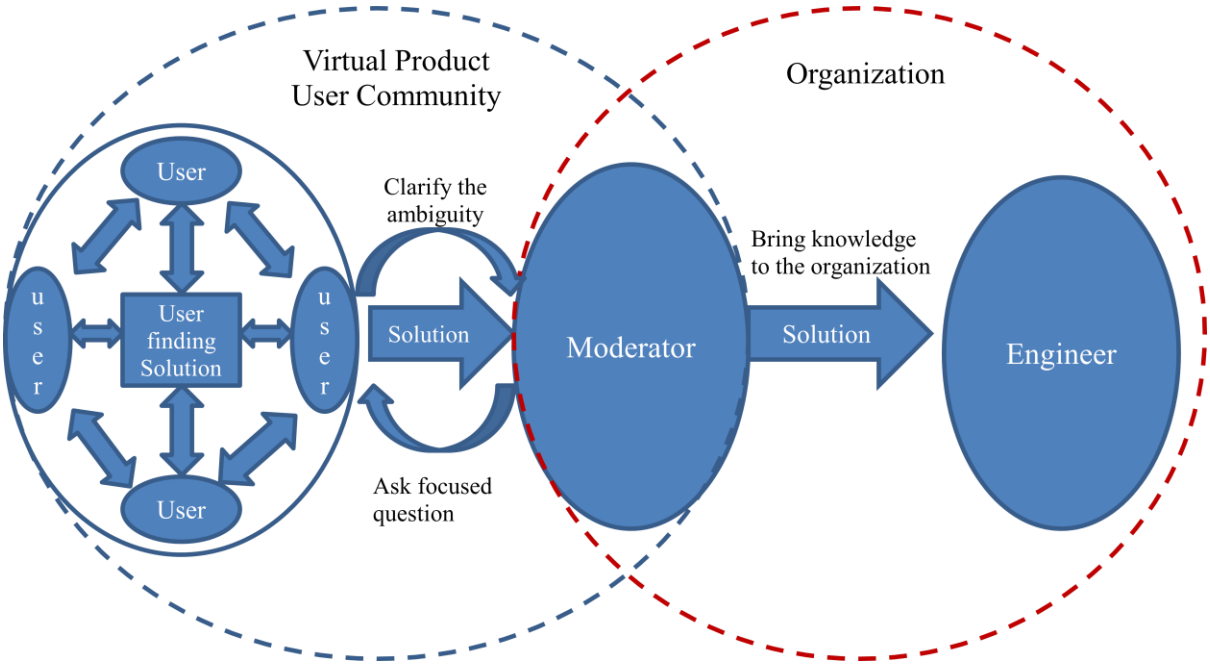


Figure 5-5: Knowledge Transfer about Solutions Proposed by the Forum User between Virtual Community and Business Organization (I)

When coding the discussion thread in the content analysis method, two categories included in the newly developed analytical tool are identified to reflect the knowledge exchange (and interaction): "asking focused question (about the solution)" and "clarify the ambiguity (about the solution)". One new category which is not included in this framework and is related to the moderator's knowledge transfer role is also found, namely the sub-category of "claiming to bring knowledge from the community to the organizational knowledge network".

Category I: "Asking focused question (about the idea)"

The content concerning questions in the following post released by a moderator DELL-T B*** belong to this category.

Example 11:

> "…I appreciate SteveClow for bringing for posting that removing AVG seems to restore the full functionally of the Trackpad. I thank you Rlprecourt for verifying that removing AVG has corrected the problem for you as well.
> I have mentioned to engineering what Steveclow has found, and I am sure that they will be testing with AVG shortly to verify this. So while we are waiting on engineering, what version of AVG do you have installed on your notebooks? Have any of you AVG users played around with AVG to see if you really need to uninstall the entire program, or can it be configured and

still allow the full functionality of the Trackpad? Personally I appreciate any information that you can provide.Thanks TB." (Posted by moderator DELL-T B*** replied on 27 Apr 2012 11:16 AM)

Category II: "Clarifying ambiguity (about the idea)"

The following post released by the user rt*** as the reply to the question in the above post:

Example 12:

"In reply to Terry B, I use the full paid version of AVG Anti-Virus 2012.
I uninstalled the McAfee the minute I got the computer, as I hate it. So much so that I even removed it from an earlier XPS laptop that came with a 3-year paid subscription in lieu of AVG.
I currently have this same version of AVG installed on the following machines with no problems at all:
Dell XPS m1310
Dell XPS 15
Acer Aspire Revo R3700
Acer Aspire 5251-1805
I do find it interesting that the earlier trackpad driver worked fine with AVG installed, while the later version does not. Seems more like the driver broke it rather than AVG, since AVG did not change while the driver did. Just a thought...." (Replied by Posted by rt*** replied on 27 Apr 2012 12:43 PM)

In these two posts, the moderator confirmed the emergence of the accepted answer found by the forum users, and then further asked more focused and specific questions about the solution at the end of his post.

Example 13:

"what [What] version of AVG do you have installed on your notebooks? Have any of you AVG users played around with AVG to see if you really need to uninstall the entire program, or can it be configured and still allow the full functionality of the Trackpad [Track Pad]?"

In the reply post, the user answered the questions one by one. Therefore, the knowledge about the solution is clarified from the perspective of the moderator. This paves the way for the accurate and complete transfer of knowledge to the engineers in the organization knowledge network.

Category III: "Claiming to bring knowledge from the community to the internal organization"

This category can be reflected from the following content in the above example post, published by the moderator.

Example 14:

> **"…**I have mentioned to engineering what Steveclow has found, and I am sure that they will be testing with AVG shortly to verify this." (Posted by moderator DELL-T B*** replied on 27 Apr 2012 11:16 AM).

Category IV: "Claiming to bring knowledge from the organization to the community"

From the following content in the moderator's post, we can draw the conclusion that the engineer would give feedback about the user's solution idea to the moderator after testing.

Example 15:

> "I have mentioned to engineering what Steveclow has found, and I am sure that they will be testing with AVG shortly to verify this. So while we are waiting on engineering, what version of AVG do you have installed on your notebooks? " (Posted by moderator DB***)

Certainly, the feedback would also be finally transmitted to the forum user community in this thread by the moderator. In this process, another category identified in the thread analysis can be also perceived to be reflected: "Claiming to bring knowledge from the organization to the community". Accordingly, the whole knowledge transfer process can be presented as follows.

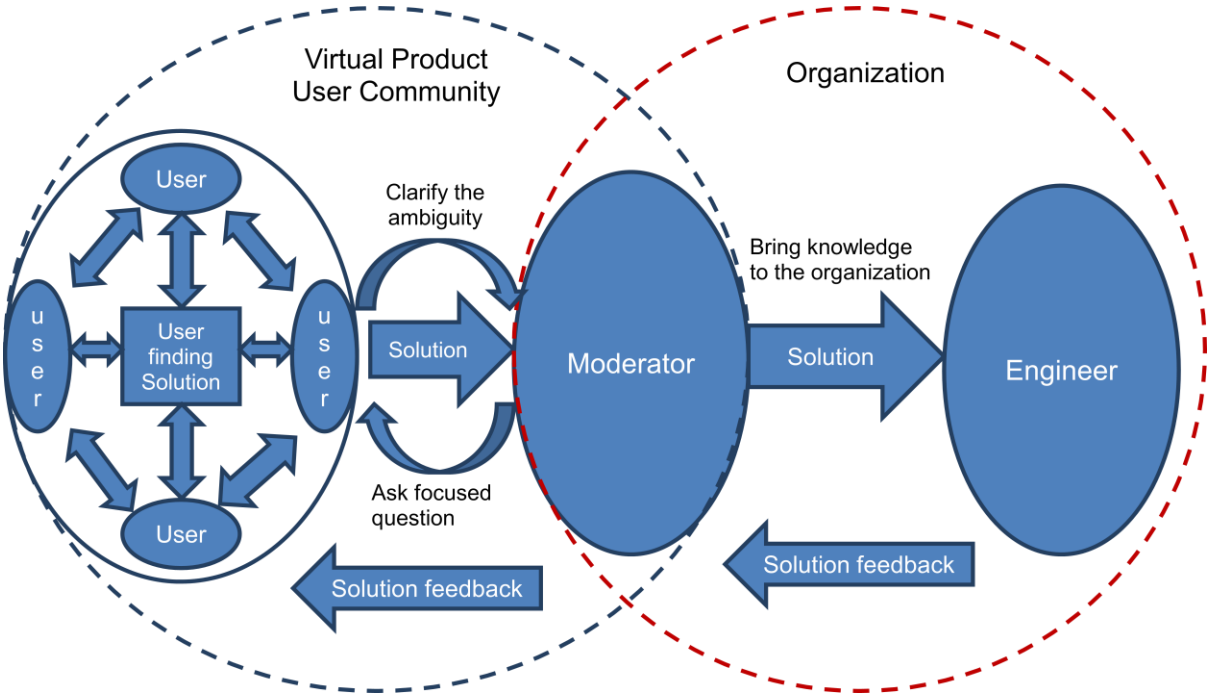


Figure 5-6: Knowledge Transfer about Solutions Proposed by the Forum User between Virtual Community and Business Organization (II)

5.6 Knowledge Construction Process

Based on the above data analysis findings, it can be safely concluded that the knowledge construction episodes proposed in the early research stage are still reflected in the threads with the participation of the moderator, namely the "New Idea Proposing Episode", "Exploration & Explanation Episode", and "Justifying and Testing Episode".

These knowledge construction episodes are essential in the knowledge building process conducted in the macro knowledge network comprised of the virtual user community and organizational knowledge network, and bridged by the moderator. Whenever a new idea is proposed, it will be explored and explained, in order to achieve clarification, and then it will be tested by either the forum users in the product user community or the engineers in the organizational knowledge network. Meanwhile, they also play important roles in successful transfer across boundaries and transition between the actors (e.g. between the forum users and moderator). Both the "Exploration & Explanation Episode" and "Justifying and Testing Episode" decide the reliability and quality of the knowledge about the solution, which is transferred between the community and the organization. In addition, the "trial-and error" strategy is adopted by both the engineer and the forum user to identify the best solutions.

5.7 Summary and Conclusion

In this chapter, the content analysis framework was applied to analyze more discussion threads selected from the Dell User Support Forum, including threads like the first thread analyzed in the first stage and also threads where a moderator participated.

The content analysis of the discussion threads without a moderator's participation did not generate any differences from that in the first thread analyzed in the first stage. However, when analyzing the three discussion threads with the involvement of the moderator, the following issues were discovered: there are two types of knowledge transferred within these discussion threads, i.e. knowledge about technical problems and knowledge about solution ideas. Because of the different types of knowledge identified at this stage, the sub-categories of "Asking Focused Question" and "Clarify the ambiguity" included in the original analytical framework were elaborated into "Asking focused question (about the idea /about the problem)" and "Clarifying ambiguity (about the idea/about the problem)", in order to better illustrate the knowledge transference. New sub-categories were identified relating to knowledge transfer conducted by the moderator, namely "Claiming to bring knowledge from the community to the internal organization" and "Claiming to bring knowledge from the organization to the community". The moderator's knowledge transfer role, which can be seen in the above two sub-categories, was also revealed. The overall picture of the knowledge transfer process across the virtual product user community and organization was developed.

To conclude, new knowledge construction episodes were identified at this stage of the analysis. The knowledge construction model developed in the first stage can still effectively describe the knowledge construction process. However, as the new categories relating to the moderator's role emerge, the prior analytical framework, which includes the main categories of "Knowledge Construction episodes", "Non-constructive episodes" and "others", needs to be adjusted in the next stage. In addition, the relationship between these three main categories needs to be clarified by more thread analysis and interview data analysis in the following research stages. These further stages in the research are very important to understand how knowledge is exactly constructed within the discussion process, with potential implications for the analysis framework.

Chapter 6 – Idea Storm Community Thread Analysis

6.1 Introduction

In order to embrace more sub-categories for this analytical framework and identify more rich interesting patterns, the researcher selected more discussion threads from the Idea Storm Community on the Dell website. There are two types of discussion threads, namely technical solution oriented discussion threads and idea oriented discussion threads, according to the researcher's observation. Bayus (2013) also makes the same classification of the discussion contents in the IdeaStorm Community. In this research stage, both the technical solution oriented discussion threads and the idea oriented discussion threads were analyzed using the analytical framework created in the last two stages. To conclude, this section of work is mainly related to the second research question: "How is knowledge constructed in a product user community?"

6.2 Introduction to the IdeaStorm Community

6.2.1 IdeaStorm Community

The IdeaStorm (http://www.ideastorm.com) is an English language forum of Dell official website and was established in February 2007 for the purpose of communicating directly with the customers of Dell (IdeaStorm Community of Dell, 2011) and sharing ideas among community members. It was launched to enable customers to share varying ideas about potential new products and services, and between the Dell Company and its product users. "IdeaStorm is not intended as a way for visitor to get answers from Dell on any issue; it is intended as a means to exchange ideas and propose solutions" (IdeaStorm Community of Dell, 2011). It is estimated that over 18,413 ideas have been submitted by IdeaStorm Community members and 522 ideas had been implemented by the Dell Company by 7th January 2013 (IdeaStorm Community of Dell, 2012).

The Ideastorm Community takes the form of open discussion site. The community management team's commitment is to collect users' "input and ideas to improve our products, services, and the way we do business" (IdeaStorm Community, 2012). Accordingly, its main discussions are considered to be related to three types of knowledge: product improvement, service improvement and business mode improvement. All of the ideas are categorized into three groups in the Community's website: 1) Dell Ideas, which include the sub-groups of Advertising and Marketing, Dell community, Retail and so on; 2) Product Ideas, which

include the sub-groups of Accessories, Broadband and Mobility, Desktops and Laptops, Mobile Devices, New Product Ideas and so on; and 3) Topic Ideas, which include the sub-groups of Education, Environment, Gaming, Healthcare and Life Science, Small Business, Storm Session Topics and so on (IdeaStorm Community of Dell, 2012). All of the ideas are evaluated and receive feedback from the company in terms of being given different label statuses. Each proposed idea will go through a life cycle of eight statuses and will be marked with a label at each status, including: "New", "Acknowledged", "Under review", "Already offered", "Partially implemented", and "Implemented".

Moreover, a new function, "Storm Sessions", was also implanted on this site in December 2009, where a particular topic is posted by moderators and the customers are encouraged to submit their suggestions and ideas. In order to make discussions in "Storm Sessions" more specific, relevant and time bound, these sessions only last for a short period (IdeaStorm Community of Dell, 2011). In addition, Dell provided a new function of idea "Extensions" in IdeaStorm Community. It allows idea posters to promote other's comments on their idea and to incorporate these comments as part of the idea. Therefore, these ideas can evolve over time through the community member's collaborative discussions (IdeaStorm Community of Dell, 2012).

6.2.2 Moderation and Moderators

Since its introduction in 2011, the IdeaStorm community has not been heavily and actively moderated by the site managers. Community members flag up inappropriate content and notify community managers for the removal of deviant content that is against community regulations.

> "To foster a real-time and free flow discussion, comments will not be actively moderated by Dell. The site will be moderated by the community, and users can and should flag any materials that don't fit the site guidelines" (IdeaStorm Community of Dell, 2011).

According to the above introduction, the company appears to choose a community moderation (/collective moderation) which is actively conducted by the community members themselves.

Although the comments published on the site are not moderated prior to posting, the company appoints community managers and moderators retroactively remove posts that are

reported to be against the guidelines and other policies of the community. A profanities filter (/filtering software) has been installed in this community, and any ideas or comments containing unacceptable profanity cannot be posted unless these words are removed (IdeaStorm of Dell, 2011).

Collective moderation is also conducted through promoting and demoting the rank of ideas by the community members. When one idea is promoted each time, its score will increase by 10 points. On the other hand, it loses 10 points when demoted each time. The higher the score an idea gets, the higher the position it obtains on the "Popular Page". Another point worth noticing is that an older idea' position reduces as time goes by. "The combination of these forces decides how the ideas are ranked in the 'Popular Ideas' sections" (IdeaStorm Community of Dell, 2011).

Moderators implemented by Dell, who have a Dell logo next to their user name on the site, also participate in the community in terms of offering updates and feedback to the community members' ideas and comments in official roles. Sometimes, these employees also join in the discussion or require more knowledge on an idea generated by a community member.

6.3 Thread Analysis

6.3.1 Classification of Dell IdeaStorm Community Threads

The IdeaStorm community forum officially classifies all threads into three categories: Dell Ideas, Product Ideas, and Topic Ideas (IdeaStorm Community of Dell, 2011). According to the attributes of these discussion topics, some are more oriented to the pure idea which cannot be immediately applied by community members and or company functioning teams. Other discussion issues are more related to finding solutions to technical problems, and the solution ideas generated in the discussion can be immediately tested and applied. Bayus (2013) also makes a similar classification of discussions threads in the Dell Ideastorm. Accordingly, the threads of IdeaStorm are grouped into two types by the researcher:

1) Idea-oriented discussion threads

Examples: a thread entitled "*Allow your partners to post responses on IdeaStorm*" and the thread "*IPS Display for upcoming xps and alienware should be included*".

Ideas proposed in these two threads are quite difficult to apply and test within a short period by community members. The idea in the first thread needs cooperation from company partners, and it is time consuming to negotiate with the many partners and make arrangements. The second idea is suggested for new product development, which is also quite a long process. Thus, they can only be evaluated by reasoning or linking with existing facts.

2) Technical solution-oriented discussion threads

Example: thread **"**Dell's Website must work with Firefox running on Linux".

In this discussion thread, ideas proposed to solve technical problems can be tested immediately by adjusting users' flash plug-in in Firefox browser or switching to another suitable open source browser. The proposed ideas can also be applied by Dell teams through improving the Dell website to a standard format.

6.3.2 Selection of threads for analysis

A purposeful sampling strategy is adopted in selecting threads from the Dell Ideastorm Community. Firstly, the researcher familiarized himself with the community's purpose, features, regulations, and publishing content and so on. Then the researcher read through the community website and selected the threads of theoretical richness. The capturing of theoretical richness embedded in the threads was based on earlier research findings and existing literature. These threads, with rich theories, can serve for the research purpose of extending and elaborating findings about knowledge construction and transfer in the Dell Ideastorm Community, which is a new but similar context as the Dell user support forum.

Furthermore, as there are two types of threads in Ideastorm Community, namely idea oriented discussion threads and technical solution oriented discussion threads, it is necessary to analyze threads of each type in order to see whether knowledge construction patterns are different from each. This can ensure the exploration of the most relevant theories to the most extend. Accordingly, the research selected theoretically rich threads from each type for analysis.

6.4 Analysis of Technical Solution Oriented Discussion Thread of Ideastorm Community

In the thread with the title **"**Dell's website must work with Firefox running on Linux"(The idea was published on July 16, 2007, and the last comment to this idea was released on Jan 30, 2009. http://www.ideastorm.com/idea2ReadIdea?Id=0877000000009fLAAQ [Accessed on January 10, 2013]), the main discussion centred on finding technical solutions to allow an Internet browser based on open source code to view Dell's web pages. 33 IdeaStorm community members, including the idea poster, had published 74 posts in total (by Jan 30, 2009) when the labels of " **Status Update** Pl ***'s comment, this issue has been resolved" and "Status: Implemented" were given.

The sub-categories included in the developed analytical framework created in the early stages are identified: "Triggering question", "Propose a new idea", "Asking focused question", "Clarifying ambiguity", "Bringing outside knowledge", "Evaluating suggested ideas (by reasoning or existing facts)", "Testing the idea (usually by applying the idea)", "Statement of giving up finding solution", "Statement of waiting for authentic solutions", and "Repeating same/similar problem"

Meanwhile, there are also new sub-categories identified in this thread: Moderator's "Claiming to bring knowledge from the community to the internal organization", "Comment about promoting/demoting the discussion idea", "Moderator's labelling status to the discussion thread", "Disputing on/ talking about unnecessary issue", "Judging the existence of the problem", "Mediating the arguing/ stopping talking about unnecessary topic", and "Invalid posts".

6.4.1 Knowledge Construction Episodes

The starting post of this thread released a technical problem about the website code format:

> "It's discouraging to have a Tier 1 vendor (Dell) selling Linux products and yet not really tailoring to Linux. Don't get me wrong Dell, I am not trying to take away all the good you have done. Offering Linux is a step in the right direction and I would like to see more steps taken in a monthly or quarterly basis. But, it seems that the basis for your current Linux promotion is for the Open Source enthusiast like me. I use Linux at home and at work as my main operating system. I use Firefox as my browser and I'm trying to order a Dell Inspiron 1420N. However, it

> seems that the embedded flash script that shows the different colors choices for the Inspiron is not working under Linux. It also shows that I can't see the different images thereafter. It works with Windows running Firefox as my vmware machine verified. But that is not the type of user that will most likely purchase a Linux laptop.
>
> My request is simple. Can someone fix and verify that this page works well with Linux browser technology? So, that users can enjoy purchasing your Linux products and demonstrate that Dell really cares about their customer's operating system preference.
>
> Dell I wish you the best in this venture as your success in this territory will help the Linux Desktop become a reality to the open source community." (Posted by qn*** on July 16, 2007)

From the company's perspective, the problem mentioned in this post can be considered as an idea to improve Dell's service and product. Dell can change their website to standard format in order to be compatible with open source browsers. From the community members' stance, this post can also be considered as releasing a technical problem for them to solve. They can find other suitable open source browsers or change settings of their open source browser through peer support. In other words, the discussion participants in this thread have two choices regarding this problem: find solutions by themselves or wait for official solutions from the company. This technical problem, described by the first poster, soon triggered a heated discussion about finding a solution among the community members. Finally, owing to their collaborative efforts and the adoption of a "trial and error" strategy, these community members successfully found a solution, that of "upgrading to Intrepid Ibex" at the end of the discussion. This solution was workable after testing by other members and also gained the company's official reorganization. It appears to be a permanent solution and no side effect has been discovered in the discussion thread so far. The possibility that there are other feasible solutions for this technical problem cannot be ruled out. However, the identified solution is the most practical one among all of the proposed ideas.

According to the coding result of this thread, the knowledge construction episodes embedding workable solution finding process through community member's collective efforts are evident. They consist of the five essential knowledge construction episodes: "Initiation Episode" (containing the subcategory "Triggering question"), "New Idea Proposing Episode" (containing the subcategory of "Proposing a new idea"), "Exploration & Explanation Episode" (containing subcategories of "Asking focused question", "Clarifying ambiguity", and "Bringing outside knowledge"), "Evaluating & Testing Episode" (containing subcategories of **"**Evaluating suggested ideas (by reasoning or existing facts)" and "Testing the idea (usually by applying the idea)". "Resolution Episode" (This category refers to the

post whose idea is proved workable and can be indicated by the thread upgrade label of resolution.)

The number of posts falling into each sub-category and the relation between the knowledge construction episodes and their subcategories are presented as follows:

Table 6-1: Knowledge Construction Episodes

Main Category	Sub-category			
	Subcategory	Definition	Number of posts	Example
Initiation Episode	Triggering question	It refers to the first post (or first few posts) which ask questions about the technical problem and trigger the following discussion on its solutions.	1	"…I use Linux at home and at work as my main operating system. I use Firefox as my browser and I'm trying to order a Dell Inspiron 1420N. However, it seems that the embedded flash script that shows the different colors choices for the Inspiron is not working under Linux. It also shows that I can't see the different images thereafter. It works with Windows running Firefox as my vmware machine verified. But that is not the type of user that will most likely purchase a Linux laptop. My request is simple. Can someone fix and verify that this page works well with Linux browser technology? So, that users can enjoy purchasing your Linux products and demonstrate that Dell really cares about their customer's operating system preference." (Posted by qn*** on July 16, 2007)
New Idea Proposing Episode	Proposing a new idea	It refers to the idea of solving the problem not mentioned before.	16	Example 1: "Probably because Firefox likely cannot run ASP.NET (Dell has Windows Server 2003 servers, and their web pages have an extension of .aspx). Try Internet Explorer with WINE or other emulator. (Posted By: wie*** on Jul 16, 2007) Example 2: "Actually Dell should concentrate on W3C standard. All dell sites should be 100% W3C compliant. http://validator.w3.org/" (Posted by yw***on Aug 9, 2007) Example 3: "Arent all websites selling goods or services meant to comply with some kind of readability / useability standards ? Shoudlnt there a be a text only version that you can use but still make / choices purchases with ?" (Posted by cw***on Aug 8, 2007) Example 4: "For me, Dell works with Linux and Firefox. But anyway: JavaScript, Cookies and Flash are evil an should be avoided! Normally I disable all of them by default and I am only willing to enable Cookies when I place an order (even though anything would be possible without!). So please use pure XHTML/CSS, nothing else." (Posted by mw*** on Sep 16, 2007)
	Asking focused question	It refers to ask specific question about the suggested solution, or	2	Example 1: "This idea is quite unstable like a "jelly"...;) My substantiation: Not all the customers are much aware about the Linux or Firewall How will the customers who have IE & other .....etc.etc... access Dell's website then? will it not result in

Exploration & Explanation Episode		require more detailed information about the problem (especially about the suggested solution ideas).		"bugs"? @ Dell_Admin2 & Tim: I require your valid explanation plz.....;)" (Posted by pm*** on Sep 16, 2007) Example 2: "qgonjon, thanks again for reporting this issue and my apologies for it taking some time to get back to you. We're researching the issue and I wanted to get some clarifying information to help focus our fix: 1. Just to make sure I understand the issue correctly, what specific URL are you seeing this issue on? By your description, I think that you're talking about the flash sitelet on http://www.dell.com/content/products/category.aspx/inspnnb?c=us&cs=19&l=en&s=dhs, which starts with the color selector and is followed by many images. There is also the actual color selector in our configurator (http://configure.us.dell.com/dellstore/config.aspx?c=us&cs=19&kc=6V440&l=en&oc=DNCWJL1&s=dhs&sm=2), but I didn't think this was it since it doesn't have flash. 2. Which of the linux OSes and firefox browser versions are you using? I want to pass this information onto the teams that determine application and content compatibility for dell.com. I'll also make sure that we test for all of our normally-compatible browser versions on Linux. Thanks again for your help. Tim" (Posted By: tt***on Aug 6, 2007)
	Clarifying ambiguity (by answering the focused question)	It refers to providing relevant information to answer the focused question.	2	"Hi Tim, you said, "Just to make sure I understand the issue correctly, what specific URL are you seeing this issue on? " answer: The color selector in the configurator of all your Linux based notebooks and desktops below: http://configure.us.dell.com/dellstore/config.aspx? c=us&cs=19&kc=6V440&l=en&oc=DNCWJL1&s=dhs&sm=2 http://configure.us.dell.com/dellstore/config.aspx? c=us&cs=19&kc=6V440&l=en&oc=DDCWDAL&s=dhs http://configure.us.dell.com/dellstore/config.aspx? c=us&cs=19&kc=6V440&l=en&oc=DXCWNC1&s=dhs The entire configurator process from start to finish has this problem when selecting one of the Linux based machines. you said, "but I didn't think this was it since it doesn't have flash." answer: Yes it does have flash embedded as explained by td-linux's post below: "It seems that the images are displayed with Javascript, which should be perfectly fine. However, on Linux, when right-clicking the area it seems to be Flash. My

				hypothesis is that for some reason one of the Flash applets on the page is oversized and covering up the image. Normally, this wouldn't be a problem, because the web browser should z-sort everything so that the Flash is covered. However, the Flash Player for Linux (even the most recent version 9) uses an older API which prevents this from working. The Flash developers are working on this bug right now, as one can see in their blog." you said, "Which of the linux OSes and firefox browser versions are you using?" answer: Ubuntu Linux 7.04, firefox version 2.0.0.6 with flash player 9 plugin for linux. I hope this answers your questions please don't hesitate to post more questions if needed. Thank you Dell for your speedy response to my issue." (Posted by qn*** on Aug 8, 2007)
	Bringing outside knowledge	It mainly refers to releasing a webpage link directed to another information source or bringing outside knowledge in order to enhance the possibility of solving the problem.	1	"As requested here is 100% w3c compliant idea - http://www.ideastorm.com/article/show/73005/" (Posted by ye***on Aug 12, 2007)
Evaluating & Testing Episode	Evaluating suggested ideas (by reasoning or existing facts)	It refers to evaluating the idea by reasoning or linking the idea with existing facts.	11	Example 1: "i think yesmathew has won this thread :)" (Posted by he***on Aug 9, 2007). Example 2: "I agree with .Net technology one cannot make W3C compliant web site unless its a simple site. See how bad is .Net technology. After paying so much money on M$ technology they are unable to make their web site W3C compliant." (Posted by yesmathew on Aug 16, 2007)
	Testing the idea (usually by applying the idea)	It refers to testing the suggested idea by applying it.	7	Example 1: "Now the dell community web site working on Mozilla Firefox 2.0.0.11 on Windows XP. I am very happy!!" (Posted by h1***on Feb 1, 2008) Example 2: "Layout gets messed up here when I resize the text. Text resizing is why I use FireFox. BTW: I block Flash now. I like the FlashBlocker add-on for FireFox. Websites should use standards, thus supporting any broswer. While Flash is ubiquitous, it's still an application-x/* mimetype." (Posted by rd***on Apr 4, 2008)

Resolution Episode	Accepted answer (/s) for the question	It refers to the suggested idea which is tested to be workable, and thus the status of the thread can be labelled with "Implemented"	1	"gjc: the problem is a parameter called "wmode" in the flash-applet. adobe knows about the problem and has known about it for a number of years. they still haven't fixed it." (Posted by he***on Aug 20, 2008)[5]

[Note: In this case, due to having the same purpose, the sub-category "repeating/refining or elaborating already stated idea" in the content analytical framework developed in earlier research stage can be incorporated into the sub-category "clarifying ambiguity", which is about both the suggested idea and the detailed information about the problem.]

[5] This post is considered as the accepted answer because the later post writer gic upgraded the browser based on he***'s idea. "i just upgraded to Intrepid Ibex yesterday and the problem has gone away! i can see the menus! thanks for the explaination though howlingmadhowi". (posted by gc*** on Nov 1, 2008). This idea was further tested by another users jl*** and was proved to be workable: "This issue has been resolved. Working in Firefox." (Posted by jl***on Jan 30, 2009). The idea contributor he*** also stated that "gjc: intrepid (8.10) uses flash 10. adobe has now finally fixed the problem." (Posted by he***on Nov 1, 2008).Accordingly, the labels of "DELL**Status Update** *Per jl****'s comment, this issue has been resolved" and "Status: Implemented" was given to this thread.

6.4.2 Main Category of "Non-constructive Episode"

The main category of "Non-constructive Episode" refers to the discussion content which cannot directly and actively push forward new knowledge building and can even hinder this process, to some extent. It includes three sub-categories in this thread: "Statement of giving up finding solution", "Statement of waiting for authentic solutions", and a newly identified sub-category "Debating on/talking about unnecessary issue". This new sub-category refers to the discussion of other topics which have no direct relationship with the solution being discussed and cannot directly construct new knowledge.

The number of posts falling into each sub-category, the relationship between main category and sub-categories, and respective examples, are presented as follows:

Table 6-2: "Non-constructive Episode"

Main Category	Sub-category			
	Subcategory	Definition	Number of posts	Example
Non-constructive Episode	Statement of giving up finding solution	Comments of quitting finding the solution	6	"If you decide to buy an OS that has limited compatibility, you must live with the consequences. I don't understand why everyone's always bashing Windows. It's a good operating system and is compatible with almost everything worth mentioning. Instead of complaining about compatibility problems, just buy a Windows PC next time." (posted by mr*** on Jul 30, 2007)
	Statement of waiting for authentic solutions	Statements of waiting for the company to release the official solution to solve the problem permanently or reporting the problem to the company for assistance	16	Example 1: "Since Dell is actually selling Ubuntu now, I'd think this would get reviewed and IMPLEMENTED quicker.. it's not like those users are going to become repeat customers by ordering on their friend's old Windows system." (Posted by zk***on Feb 1, 2008) Example 2: "I hope dell will fix there site that is compatible to linux. thanks dell" (posted by cl*** on Aug 3, 2007)
	Debating /talking about unnecessary issues	The discussion of another topic which has no direct relationship with the solution being discussed and cannot directly construct new knowledge	13	"windows data formats force people to use windows products. by exchanging information in a proprietary data format, we force the third world to also use windows products and send large amounts of money back to a foreign country. the gnu/linux philosophy on the other hand requires that all data formats are open. they can be freely implemented by anyone who wants to. i am not bitter because windows has been successful. i am bitter because it is expected of me to contribute to the continued imperialistic abuse of the third world and for me to give up my freedom to understand my own possessions. if you want to give up your possessions and strengthen the servitude of the developing countries, you must come to terms with that yourself with your own morality. but do not force me to do the same thing. open data formats are a necessity for a moral society. that is the big picture here. what sort of society do we want to live in? we in the first world are rich. we can afford to pay microsoft to become its slaves. the citizens of other countries should not be forced to do so. so no, you have not understood what this is about. maybe you will

				understand it when you send someone a document and they reply that they cannot open it because they have the choice between feeding their family or buying the software needed. or when a third world country is 100% dependent on microsoft for their technical infrastructure. that is the evil that the gnu/linux philosophy is fighting. i do not ask that you fight with us, but i would recommend to you that you learn about how the imperialistic and colonial domination and exploitation of the third world works and has always worked. microsoft is just one more nail in their coffin." (Posted by he***, Jul 31, 2007)

[Note: some posts can fall into two different sub-categories]

Although the sub-category of "Debating on/talking about irrelevant issue" cannot directly construct new knowledge to solve the problem, it indirectly exerts influence on building relationships among community members, fostering the development of the task group and the sense of community identity, and creating community culture. Tuckman (1965) states that the "storming" stage is a crucial step in developing small groups. During this stage, different and even conflicting ideas fight for consideration and the team members decide issues, like which problems are really worth their effort. Then they can enter the next stage of "Norming", in which the collective group goal and mutual plan are decided, and all the group members take the responsibility of realizing this goal. In this thread, the discussion participants argued about the operating system war of Linux vs Microsoft, and the related choice of solving the problem or not. When another poster released a post to require the discussion to focus on the topic, the knowledge building process around the problem solving started again. In other words, the group formed in this thread entered the stage of "Norming" again. Therefore, this sub-category did not directly contribute to the knowledge construction of solving the problem, but it was still an important element, related to the "Storming" stage of the group forming.

Newcomb (1961) states that people with the same attitude or experience are more oriented to build relationships. During the argument about the operating system war, these discussion participants expressed their attitude towards the open source movement, and supported each other to rebut another member's opinion about using the Windows system. Meanwhile, they also pointed out the meaning of their collaborative efforts of

solving this open source browser problem. In this way, they were able to communicate their community identity and community culture to each other. Consequently, the community identity and a relevant community culture can be formed and fostered.

6.4.3 Main Category of "Problem Description Episode"

A new main level category "Problem Description Episode" also emerged in this thread. It is derived from the main category of "Others", which refers to any codes that do not fall into the main categories of "Knowledge Construction Episodes" or "Non-constructive Episodes", included in the initial analytical framework developed at early research stage. This newly identified category verifies the initial analytical framework and proves the suitability of its classification of the categories. The categories of "Knowledge Construction Episode" and "Non-constructive Episode" and "Others" included in the early content analytical framework are mutually exclusive. Meanwhile, "Knowledge Construction Episode" and "Non-constructive Episode" are the two key categories that cannot be further divided. In addition, it also elaborates the framework by adding an important category about the problem discussion embedded in the discussion, which is also an essential element of resolution finding discussion. The category of "Problem Description Episode" can help community members and or moderators to obtain a better understanding of the problem, and thus pave the way to finding a solution. In addition, the repetition of the technical problem by many community members can arouse the attention of the community moderator and encourage other members to generate solution ideas.

This main category of "Problem Description Episodes" in this thread includes two sub-categories: "Repeating same/similar problem" and a new sub-category "Judging the existence of the problem" in this thread. The sub-category "Judging the existence of the problem" here refers to statements and or comments about the fact of the problem's existence.

Table 6-3: Problem Description Episodes

Main Category	**Sub-category**			
	Subcategory	**Definition**	**Number of posts**	**Example**
Problem Description Episode	Repeating same/similar problem	Content of describing same/similar	11	Example1: "Dell, I have the same problem as qgonjon. I run Firefox with Adobe Flash plugin on Ubuntu, Thank

		technical problem the users have		you for fixing." (Posted by yx***on Apr 9, 2008) Example 2: "the drop down menus on the front page go under the main flash rectangle so that i cannot use them :(. i am running Firefox on Ubuntu on a Dell laptop." (Posted by gc***on Aug 20, 2008)
	Judging the existence of the problem	Statement about the fact of the problem's existence.	1	"What are you saying? It works! I just ordered a Dell system while using Firefox running on Linux Mint Cassandra (Ubuntu Feisty). Everything works great on my end!" (Posted by fh*** on Aug 16, 2007)

"Repeating same/ similar problem" help the IdeaStorm community members acquire a better understanding of the problem from different perspectives. Understanding and analyzing the problem are essential processes to pave the way to finding solutions. Meanwhile, many product users' statements about the same problems can also arouse the company's attention to the problem and push the company to release an official solution.

"Judging the existence of the problem" is a new sub-category identified from the discussion thread. In this thread, only one member "fabsh" published a post stating that the problem being discussed in this thread did not exist on his Firefox browser.

> "What are you saying? It works! I just ordered a Dell system while using Firefox running on Linux Mint Cassandra (Ubuntu Feisty). Everything works great on my end!" (fh*** published on Aug 16, 2007).

However, there was no response to his post from other participants. This was probably because of his denial of the problem, which had already been officially admitted by the Dell team and whose solutions were still being worked on by the rest of the discussion participants. The category "repeating same /or elaborating the problem" is the direct proof of the problem's existence. Other categories can also be considered as indirect evidence. The

category of “judging the existence of the problem” is not very common in the technical problem-oriented discussion threads. Usually product users just describe the problems they meet in a new thread rather than deny or doubt the problem in other’s discussion threads. Nevertheless, “judging the existence of the problem” does not hinder the collective solution finding process. Even if a doubt about the problem exists, it still helps the group to know the problem better, from an indirect perspective.

6.4.4 Main Category of “Moderation Episode”

A new category related to moderation activities was identified in this thread, namely “Moderation Episode”. This episode is characterized by moderation activities conducted by both the formal moderator implemented by the company and the community members participating in the discussion, including response to community members’ discussion; facilitation of the discussion; users’ mediation of auguring and debating on irrelevant issues; users’ comments about the promotion and demotion of threads; and labeling the status to the thread and transferring knowledge conducted by the moderator.

“Moderation Episode” embedded in this thread includes four sub-categories: “Comments about promoting/demoting the discussion idea”, “Mediating the arguing/stopping talking about unnecessary topic”, “Moderator's labelling status to the discussion thread”, and Moderator's “Claiming to bring knowledge from the community to the internal organization”.

The main category and sub-categories are presented as follows:

Table 6-4: Moderation Episodes

Main Category	**Sub-category**			
	Subcategory	Definition	Number of posts	Example
Moderation Episode	Comments about promoting/demoting the discussion idea	Direct statements about promotion and demotion of the idea.	2	1. "yesmathew, Thanks for the link. I just promoted your idea. Let's hope that Dell takes this seriously." (published by qn*** on Aug 13, 2007) 2. "How can people demote this idea?? Is it because he said Linux and not GNU/Linux???" (Posted by lw***on Apr 8, 2008)
	Mediating the arguing /stopping talking about unnecessary topic	Comments related to mediating argument and focusing on discussion topic	1	"Hi maverick4ever, Please don't start an OS war under my idea. I respect your opinion of Microsoft and I hope you can give me the same respect. As my goal here is to help Dell fine tune their Linux business by suggesting an idea or two that will help them sell more Linux machines to Linux users/newbies. As such, I hope that we can stay focus in our comments regarding my idea and not go off on tangents. There are other forums that focus on Windows vs Linux wars and there have been no winners to my understanding. It is a waste of time converting anyone here to a different OS.." (Posted by qn*** on Aug 1, 2007)
	Moderator's labelling status to the discussion thread	Statement of labelling the status to the thread	1	"Changed status to **UNDER REVIEW**." (posted by Posted by d2*** on Jul 26, 2007)
	Claiming to bring knowledge from the community to the internal organization	Moderator's statement of bring the clarified knowledge about the technical problem to the engineers in the business organization	1	"qgonjon, thanks again for reporting this issue and my apologies for it taking some time to get back to you. We're researching the issue and I wanted to get some clarifying information to help focus our fix: 1. Just to make sure I understand the issue correctly, what specific URL are you seeing this issue on? By your description, I think that you're talking about the flash sitelet on ..., which starts with the color selector and is followed by many images. There is also the actual color selector in our configurator . (http://configure.us.dell.com/dellstore/config.aspx?c=us&cs=19&kc=6V440&l=en&oc=DNCWJL1&s=dhs&sm=2), but I didn't think this was it since it doesn't have flash. 2. Which of the linux OSes and firefox browser versions are you using? I want to pass this information onto the teams that determine application and content compatibility for dell.com. I'll also make sure that we test for allof our normally-compatible browser versions on Linux. Thanks again for your help. Tim" (Posted by tt*** on Aug 6, 2007)

[Note: some posts can fall into two different sub-categories]

Both the formal moderators and community members participated in the "Moderation Episode". The formal moderator's role is mainly focused on the community asset manager and the knowledge network spanner. Maintaining the community environment and knowledge construction process is achieved through collective moderation by the community members.

The sub-categories involved by the moderator mainly concentrate on managing the community asset and processing knowledge (including transferring knowledge). In this thread, the formal moderator was responsible of categorizing the user generated content by giving status labels and transferring knowledge to the internal organization. These knowledge behaviours are reflected in two sub-categories related to the moderator, namely, "Moderator's labelling status to the discussion thread" and "Moderator's claiming to bring knowledge to the internal organization". These two sub-categories are related to the community managing team's responsibility for "community asset management" (Williams & Cotheral, 2000), more specifically, for processing the user generated content.

Moderators associated with the company not only categorize the threads through giving status labels, but also transfer knowledge across the boundary between the organization and the Ideastorm community. In this thread, the moderator asked specific questions about the detailed information of the problem and claimed to send this clarified knowledge to the organization.

> "We're researching the issue and I wanted to get some clarifying information to help focus our fix: 1. Just to make sure I understand the issue correctly, what specific URL are you seeing this issue on? 2. Which of the linux OSes and firefox browser versions are you using? I want to pass this information onto the teams that determine application and content compatibility for dell.com." (Posted by tt*** on Aug 6, 2007).

According to the moderator's statement, he would also disseminate knowledge of solution idea obtained from the engineers within the organization to the community members. Thus, the moderators' knowledge transfer through the boundary spanning is also an important role defined by the establishment objective of the Ideastorm community. Meanwhile, the moderator's knowledge transfer behaviour is also a kind of knowledge processing, in other words, "Community asset management".

The posts belonging to the sub-categories of "Comments about promoting/demoting the discussion idea" and "Mediating the arguing/stopping talking about unnecessary topic" were

all published by the community members rather than the formal moderator. Posts containing comments about promoting or demoting the discussion idea can arouse the attention of discussion participants and increase the ranking of the thread. Thus, the discussion motive and participation can be promoted. "Mediating the arguing/stopping talking about irrelevant topic" can help the discussion stay on topic. Meanwhile, it can also maintain a friendly community environment by stopping individuals arguing on irreverent topics which are usually mixed with the inharmonious factors, such as, quarrelling in the discussion. In a word, these two subcategories have great relevance to the moderator's roles suggested by Gray (2004): promoting the discussion and fostering the social aspects of the community. In addition, maintaining knowledge construction is also an important function of these two sub-categories. Thus, the moderation conducted by the community members concentrates on two dimensions: the knowledge construction process dimension and the social dimension. Furthermore, it can be concluded that the moderator's role in relation to social aspects (i.e. social roles regarding building a friendly online discussion environment) and the moderator's role of knowledge construction process co-ordinator (i.e. promoting the discussion and maintaining knowledge construction) can be played by community members in this context.

The subcategories, knowledge behaviors, functions, roles, dimensions with regard to the moderation conducted by both moderators and community members can be concluded as follows:

Table 6-5: Conclusion of "Moderation Episode" conducted by moderators and community members

People	Sub-category	Knowledge Behavior	Function	Role	Dimension
Moderator	"Moderator's labeling status to the discussion thread"	categorizing the user generated content	managing the community asset; processing knowledge & transferring knowledge	community asst manager (including the knowledge Spanner)	Knowledge management dimension
	"Claiming to bring knowledge from the community to the internal organization"	transferring knowledge			
Community	"Comments about promoting/demoting the discussion idea"	indirectly promoting the discussion idea	promoting the discussion	facilitator	Knowledge construction process dimension

Member	"Mediating the arguing/stopping talking about unnecessary topic"	helping the discussion stay on topic	maintaining knowledge construction/ building a friendly online environment	mediator	& social dimension

6.4.5 Main Category of "Others"

The main category of "Others" in this thread mainly refers to the posts which have a deviant nature from the above categories. It mainly contains the sub-category of "Invalid posts" in this thread. There are just two posts belonging to "sub-category": one (post 24) is about deletion of the double post: "*double post – deleted.*" (published by he*** on Jul 31, 2007); the other (post 60) is about a community member publishing the wrong status of the problem on his laptop, which was later replaced with correct information in another post (post 63) by the same poster.

Post 60:

"works [work] fine for me. firefox 2 in fedora 8" (published by jc*** on Jan 25, 2008).

Post 63:

"changing my status.... when i'm configuring machines, i get no big pictures on the left side. only the small ones on the bottom" (published by jc*** on Feb 2, 2008).

Table 6-6: Main Category of "Others"

Main Category	**Sub-category**			
	Subcategory	**Definition**	**Number of posts**	**Example**
Others	Invalid posts	Post lacking validity	2	"*double post – deleted.*" (published by howlingmadhowie on Jul 31, 2007)

6.4.6 Summary

6.4.6.1 Overall Discussion Process

From the understanding of the whole discussion thread that has been built up in this chapter, it is apparent that a "Knowledge Construction Episode" proceeds in a logical pattern. Usually, after an idea is proposed, it will be evaluated and (/or) tested. During this process, some questions about the suggested ideas or details of the problem can be asked and answered. Some external knowledge will sometimes be introduced in order to elaborate the suggested idea. Thus, the knowledge of the idea (or technical problem) is further explored and explained. In some cases, a newly proposed idea may be just ignored by other members, mainly due to its infeasibility. "Non-Constructive Episode" and "Problem Description Episode" can occur between any episodes of knowledge construction in the discussion thread. A "Moderation Episode" can also emerge during the discussion to maintain a friendly online social space, to keep the knowledge construction process moving forward, and to manage the community member generated content.

6.4.6.2 Moderation and Community Principle

In this discussion thread, there were only two posts published by the moderator, whose role focused on labeling the thread and transmitting knowledge about the problem to the internal knowledge network. The moderator did not heavily involve himself in the discussion except when they asked one focused question about the problem and claimed to bring the problem information to the organization. Community members themselves voluntarily took responsibility for fostering the social aspects of the community discussion (i.e. maintaining the group discussion process and friendly online environment) through "Mediating the arguing /stopping talking about unnecessary topic" and promoting participation through "Comments about promoting/demoting the discussion topic". Such interventions promote a free flow of discussion, thus greatly encouraging the community members' participation in the knowledge construction process and generation of solution ideas. This is also in line with the definition of IdeastStorm Community's function "as a means to exchange ideas and propose solutions" (IdeaStorm Community of Dell, 2011) and its core principle that "*...comments will not be actively moderated by Dell. The site will be moderated by the community...*" (IdeaStorm Community of Dell, 2011).

6.4.6.3 Corresponding Relationship

Users' comments about promoting (/demoting) a thread and mediating the arguing (/stopping talking about irrelevant topic) were usually published after specific types of events (e.g. the demotion of the thread by some members) or specific type of episode (i.e. "Debating on/talking about irrelevant issue").

Therefore, there is a corresponding relationship between some of the "Moderation Episodes" and particular "Non-constructive episodes". More specifically, the distraction caused by "Disputing on/ talking about unnecessary issues" can be overcome by community members' collective moderation in terms of "Mediating the arguing/stopping talking about unnecessary topic". In this thread, 7 (post 11, 12, 13, 14, 15, 17 and 18) continuous posts centring on the operating system war of "Windows vs. Linux" were published, as well as the open source movement, the poverty of developing countries, the globalization and Microsoft's imperialism, and so on. The discussion of these irrelevant topics was stopped by a community member's post (i.e. post 19) which required the discussion to focus on the problem being discussed:

> "Hi maverick4ever, Please don't start an OS war under my idea. I respect your opinion of Microsoft and I hope you can give me the same respect. As my goal here is to help Dell fine tune their Linux business by suggesting an idea or two that will help them sell more Linux machines to Linux users/newbies. As such, I hope that we can stay focus in our comments regarding my idea and not go off on tangents. There are other forums that focus on Windows vs Linux wars and there have been no winners to my understanding. It is a waste of time converting anyone here to a different OS. I hope that others here feel the same and ignore any OS war comments from this moment on." (Posted by qn*** on Aug 1, 2007)

After this post, the following posts immediately returned to the discussion trajectory of solving the problem. In this example, the following discussion started to mainly focus on "Knowledge Construction Episode" again. For instance, in the following 20 posts (from post 20 to post 39), 5 posts fell into the sub-category of "Proposing a new idea", 6 into the subcategory of "Evaluating suggested ideas (by reasoning or existing facts)", 2 into "clarifying the ambiguity", and 1 into "bringing outside knowledge". This is an example of how the collective moderation of community members can effectively ensure a smooth knowledge construction process in a thread.

Sometimes, it is not necessary to stop continuous "Debating on/talking about irrelevant issue" by releasing the post of "Mediating the arguing/stopping talking about unnecessary topic". Usually the debating or arguing can automatically stop when the following posters just ignore irrelevant arguing and publish their posts concentrating on "Knowledge Construction Episode" and "Problem Description Episode". Thus, ignoring irrelevant argument allows the discussion to move on.

6.4.6.4 Knowledge Flow Process

There are two types of knowledge being transferred from the Ideastorm Community to the business organization in this thread: detailed information about technical problems with a Linux laptop; and the solution ideas identified by community members. The knowledge transference process mainly occurred between community members and the moderator.

In this thread, the knowledge about the problem were the exact patterns of the problem (i.e. specific URL and display of the website) and the software environment (i.e. Linux OSes and Firefox browser versions) which were specifically asked for by the moderator (post 24 published by tt*** on Aug 6, 2007). In response to these queries the community members clarified the technical information of the laptop's software environment related to the problem in the next post (post 25 published by qn*** on Aug 8, 2007). Two sub-categories created in the content analytical framework of knowledge construction can be used to illustrate how this type of knowledge was transferred from the community member to the moderator: "ask focused question/information (about the problem)" and "clarifying the ambiguity (about the problem)". The specific knowledge (about the technical problem) transfer process between the Ideastorm Community and the business organization is as follows:

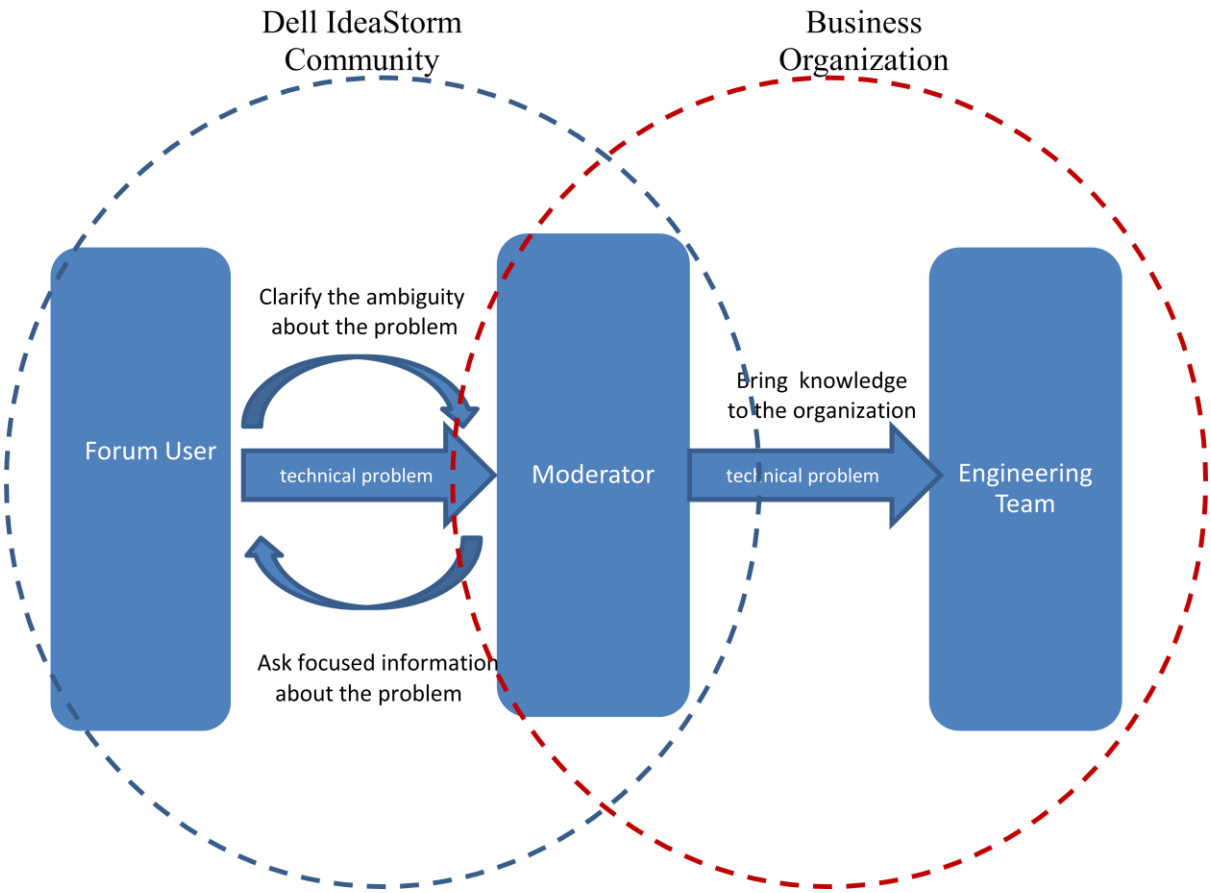


Figure 6-1: Knowledge Transfer Process of Technical Problem

As for knowledge about the solution ideas, this is generated by the community members and transmitted to the engineers by the moderator for testing. This could be inferred from thread status “Implemented” which requires the final testing by internal engineers of working team according to the relevant policy of Ideastorm community.

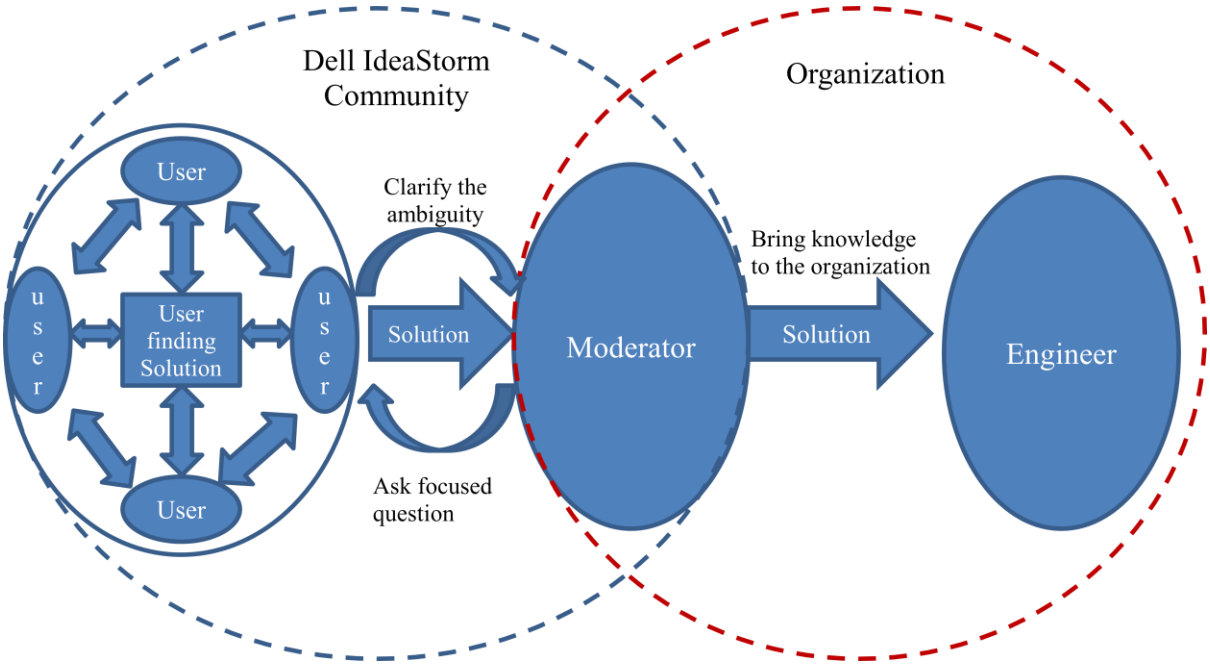


Figure 6-2: Knowledge Transfer Process of Solution Ideas

Therefore, the overall knowledge flow process (including knowledge about the technical problem and knowledge about its solution) is illustrated as follows:

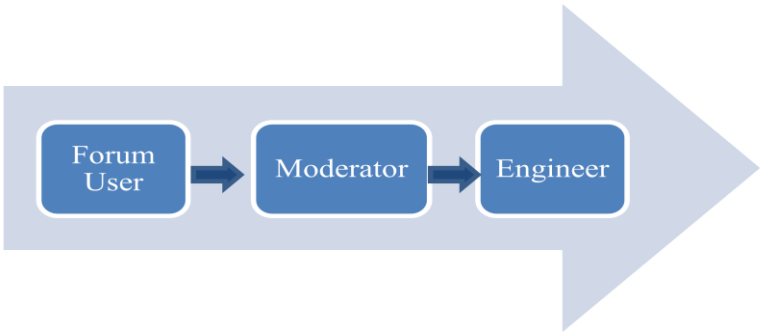


Figure 6-3: Overall Knowledge Flow Process

6.4.6.5 The knowledge construction process

According to the thread analysis results, knowledge about solutions is usually constructed through the following episodes: Initiation Episode (Triggering the question), New Idea Proposing Episode, Exploring & Explaining Episode, and Evaluating & Testing Episode. These episodes are essential and necessary for achieving the "Resolution Episode".

In this discussion thread, the questions about both the technical problems and the new solutions idea were proposed by community members. Thus, these two episodes just emerged within the Ideastorm Community. The Episodes of "Exploring & Explaining" and "Evaluating & Testing" were conducted within both the Ideastorm Community and the

organization. When the moderator asked specific questions about the technical problem and got clarification from a community member, the episodes of knowledge exploration and explanation were conducted in both the community and business organizations, due to the spanning role of the moderator. According to the introduction of the Ideastorm community, not only did the community members evaluate and test the suggested idea, the engineers also tested the reported solution obtained from the moderator in the last step before the final label was given to the thread. Then the implemented idea could potentially be transformed into a new service or be applied to new products.

According to the data analysis, it is quite typical that the "New Idea Proposing Episode" is followed by "Exploration & Explanation Episode" and "Evaluating & Testing" or one of these. It is understandable that a new idea should be explored and explained to make it more practical and more acceptable before facing evaluating and testing. Thus, in order to better present this single cumulative and progressive knowledge building process (one-way direction), a prototype of theoretical knowledge construction process (excluding "Non-constructive Episode" and other episodes) occurred in the selected thread of the Ideastorm community and the organization was developed as illustrated in figure 6-4:

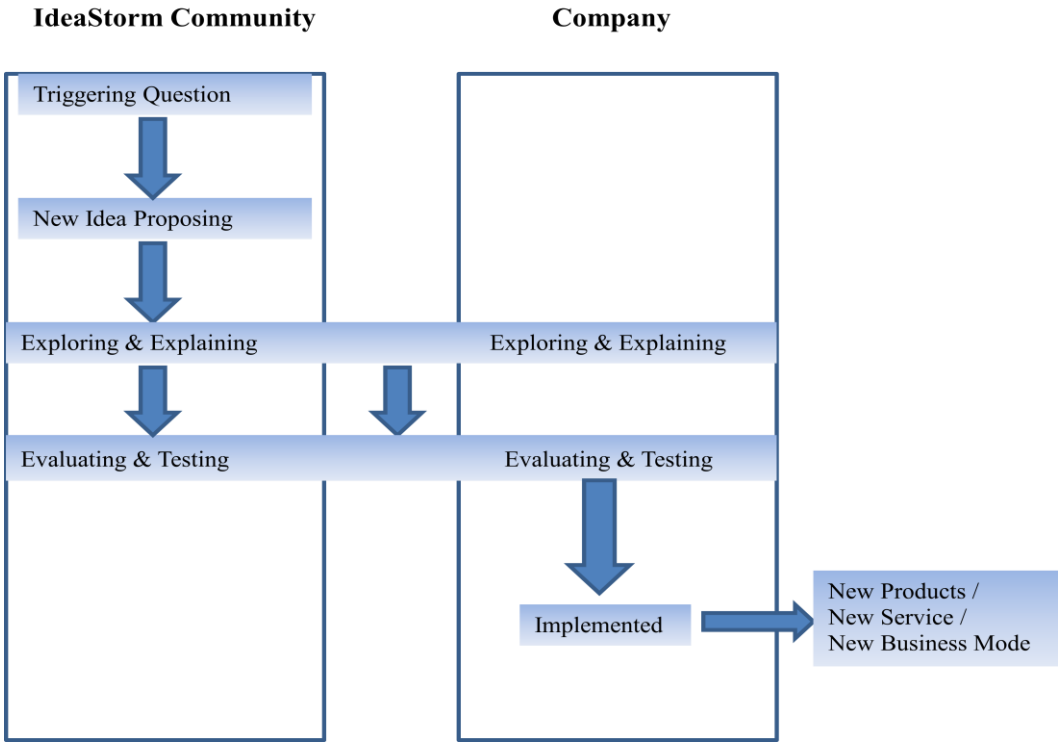
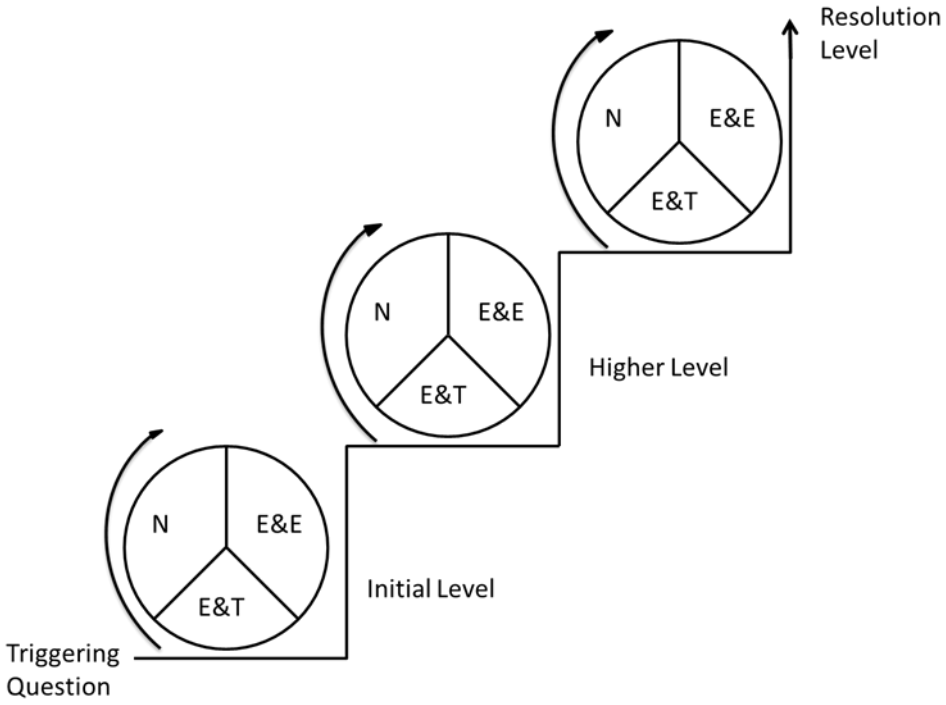


Figure 6-4: Knowledge Construction Process in Technical Solution Oriented Discussions in IdeaStorm Community

In the reality of this community, the knowledge construction episodes may proceed without a distinctly cumulative and progressive order towards one way direction and usually are mixed with "Non-constructive Episodes", "Problem Description Episodes" and other types of discussion contents. These episodes can emerge in varying patterns due to the open and free-style nature of the discussion. Moreover, the knowledge construction process within the community usually proceeds in an iterative way. A newly proposed idea usually undergoes the process of "Exploring & Explaining Episode" and "Evaluating & Testing Episode". When one proposed solution is believed to be impractical, another new idea will be suggested and then explored and tested. The process repeats itself until a workable idea is identified. Thus, this prototypical model is a theoretical and simplified illustration to reproduce the complicated underlying pattern within the knowledge construction process in reality. This prototype is built based on the abstraction of the key knowledge construction elements and the typical order of the process. Therefore, it can help us to understand the complicated knowledge construction process in a direct and simple way.

This knowledge construction process repeats itself until the resolution idea is identified. Each newly proposed idea is usually based on previous ones and thus it is usually much closer to the core solution. In the whole discussion process, the latter proposed ideas are usually more oriented towards the real causes of the problem than earlier ones. Due to this hierarchical level of the ideas proposed in different stage, the knowledge construction process also emerges in an ascending spiral pattern, as follows:



(PS: N= New Idea Proposing Episode; E&E= Exploration & Explanation Episode; E&T= Evaluating & Testing Episode)

Figure 6-5: Model of Knowledge Construction in Technical Solution Oriented Discussions in IdeaStorm Community

[Note: it is reproduced from figure 4-5]

6.4.6.6 Knowledge Construction Strategy: "Trial-and- Error"

In order to find a feasible solution idea, the "Trial-and-Error" strategy is adopted by the community members in this technical problem oriented discussion thread. This strategy enables them to gradually reach the core solution of the problem. Whenever a new solution idea is proposed, it is evaluated and or tested. Then another idea would be proposed and then be evaluated and/or tested, if the first proposal failed to solve the problem.

For instance, at the beginning, a wrong idea which just targeted the superficial problem was proposed: "…*A workaround for Dell would be to simply shrink the large Flash applet.*" (posted by tx*** on Jul 24, 2007). This was not the real cause of the incompatibility of the browser on Linux. Then another member proposed the temporary solution of using a text only version: "…*Shoudlnt there a be a text only version that you can use but still make / choices purchases with*?" (Posted by cw*** on Aug 8, 2007). In the later discussion, the community members suggested that the format of the website should be completely of W3C standard to solve incompatibility problems, for instance, "*Actually Dell should concentrate*

on W3C standard. All dell sites should be 100% W3C compliant." (Posted by yw*** on Aug 9, 2007). However, this solution idea all depended on the Dell company's willingness to change the format of its website. It was evaluated as not workable over a short period. They subsequently found that Adobe flash-plug in Firefox also caused the display problem. This process just repeated itself until a feasible solution was identified and accepted: "*gjc: intrepid (8.10) uses flash 10. adobe has now finally fixed the problem*" (Posted by he*** on Nov 1, 2008). This also proves that the proposed ideas also follow a hierarchical order during the adoption of "Trial-and Error" strategy to successfully identify permanent and reliable solutions.

Table 6-7 Proportion of Main Category

Main Categories	Knowledge construction Episodes	Non-construction Episodes	Problem Description Episodes	Moderation Episodes	Total
Number of posts	41	35	12	5	93
Percentage	44%	38%	13%	5%	100%

[Note: 19 (Posts of 12, 13, 14, 15, 16, 18, 19, 20, 25, 32, 33, 45, 46, 47, 48, 49, 50, 59 and 60) posts fall into two categories in this thread. Thus, the total number of posts belonging to all categories are 93.]

The perscentage of knowledge construction episodes in the selected technical problem oriented discussion thread of the Ideastorm community is much less than that in the user support forum. Non-construction episodes make up a large portion in this thread. This indicates that the user generated content in Ideastorm community has a much more open nature and its discussion is also more diverse and less structured. This is also related to the establishenment purpose and management strategy of IdeaStorm Community. The Non-constructive episode cannot directly generate new knowledge , but its subcategory of "Debating on/arguing about irrelevent issue" helps the community members to promote the member's relationships and to build a collective sense, as a community. During the debating and arguing process, the community culture is also reflected in their debating process. Thus, the community culture is also fostered. Finally, this episode facilitates the development of the community and promotes relationships between community members.

Although the moderation episodes make up a small percentage of the discussion thread, they can effectively limit the scope and length of "Non-constructive episode" and ensure the smoothness of knowledge construction. Therefore, light-touch but sufficient moderation creates a dynamic and free online space for finding solutions. In addition, the social

perspective of moderation is conducted through collective moderation by the community members themselves. This further ensures the collective moderation feature of the community and stimulates participation. In a word, all of these features help achieve the establishment purpose of promoting idea generation in the IdeaStorm Community.

6.5 Analysis of Idea Oriented Discussion Threads

The selected threads in the IdeaStorm Community usually start with a proposed idea relevant to products and business modes, rather than with technical problems in the Support forum.

6.5.1 Knowledge Construction Patterns and Process

In the first thread of the topic "Allow your partners to post responses on IdeaStorm", there were 13 comments following the posted idea. All of these posts just fell into 4 categories of content analysis frameworks developed in the early research stage: proposing a new idea, repeating/refining/elaborating already stated idea, evaluating suggested idea by reasoning or existing facts. A new category which was not included in the earlier analytical framework was also identified, namely "debating on/talking about unnecessary issues".

Table 6-8: Number of Posts Falling into Sub-categories

Sub-category	proposing a new idea	repeating/ refining/elaborating already stated idea	evaluating suggested idea (by reasoning or existing facts)	debating on /talking about unnecessary issue
Number of posts	1	3	5	5

[Note: 5 posts are about discussing a previous topic which is posted by the idea poster *jervis961* and is not relevant with the topic in this thread, namely "*I found your idea on the XPS 15x and Stigtrix's on the 15zx but didn't find it yet. I'll keep looking.*" (posted by the moderator Dell CJ***).

The second thread started with the idea of improving one upcoming type of laptop's hardware configuration, namely "IPS Display for upcoming xps and alienware should included". 16 posts were published in this thread, including the starting idea proposition post and 15 following comments. Five categories of post consist of the discussion thread: "proposing a new idea", "asking focused question", "repeating/ refining/elaborating already stated idea", "evaluating suggested idea by reasoning or existing facts", and the moderator's "Claiming to bring knowledge from the community to the internal organization".

Table 6-9: Number of Posts Falling into Sub-categories

Category	proposing a new idea	asking focused question	repeating/ refining/elaborating already stated idea	evaluating suggested idea (by reasoning or existing facts)	claiming to bring knowledge from the community to the internal organization
Number of posts	1	1	6	10	2

(Note: There are 4 posts falling into two sub-categories).

It can be observed that two categories "claiming to test the suggested idea" and "testing idea by applying the suggested idea" are absent in these two threads. It is also in line with the main attribute of the idea oriented discussion threads, namely the proposed ideas can only be evaluated by reasoning or by linking with existing facts rather than by being tested.

However, three knowledge episodes are found to be the key factors for constructing new knowledge:

1. New Idea Proposing Episode: this includes the sub-category "proposing a new idea".

2. Explaining & Exploring Episode: this includes the sub-category "asking focused question" and "repeating/refining/elaborating already stated idea".

3. Evaluating Episode: this includes the sub-category "evaluating suggested idea by reasoning or existing facts".

These three episodes are also considered to be the essential and requisite knowledge construction factors to construct new knowledge in the user support forum. After a new idea is proposed, the idea poster and other community members will refine and elaborate the suggested idea to make it more detailed, reasonable, reliable and practical. Moreover, justification of the idea is also a key part of developing new knowledge. Usually the whole discussion is centred on the ideas contained by the starting post through the threads. Other posts which elaborate or refine the idea are just extensions of the main idea. This is also in accordance with the design purpose of the idea "Extensions" in the IdeaStorm Community forum.

The knowledge construction pattern in the idea oriented threads in the Ideastorm Community differs from the knowledge construction model in the product user support forum of Dell in terms of the knowledge construction process, idea level, and knowledge construction strategy. In the idea-oriented threads, the whole discussion was just around one idea and the rest were just extensions of that core idea. Thus, it mainly takes the form of a progressive and cumulative knowledge construction process. On the contrary, in the user support forum, there are usually several proposed solution ideas which are quite different from each other, and the latter ones are usually more reliable than the former through iterative knowledge construction episodes. There is also a hierarchical level of ideas according to their reliability and practicality in the user support forum. In addition, users in the support forum adopt a "trial and error" strategy to find the most reliable solution. In contrast, this strategy is not applicable in the idea-oriented discussion threads in the Ideastorm Community, due to the nature of the discussion topic and the characteristics of the idea.

6.5.2 Overall Knowledge Flow Process

As the above analysis shows, the idea proposed in the IdeaStorm community's forum with the label of "Under Review" or other types of label usually undergoes three knowledge construction episodes within the discussion thread: "Idea proposing Episode", "Explaining & Exploring Episode", and "Evaluating & Testing episode". This knowledge construction process embedded in the discussion thread is participated in by community members within the Ideastorm community boundary. According to the introduction of the idea labels and how the idea is labelled, the Ideastorm team and specific business teams in the organization also participate in the knowledge explanation and exploration, and the justification and testing process as supporting power/corresponding group to the Ideastorm Community.

According to the introduction, there are 8 types of thread status labels in IdeaStorm Community as follows:

- "New: Every idea starts with this status upon submission.
- Acknowledged: Every idea is read by the IdeaStorm team within 48 hours to ensure that each submission is truly an idea and it passes the Terms of Use.
- Under review: The idea is being reviewed by the appropriate business team for further investigation.

- Already Offered: The idea is already part of a product or service that is already offered by Dell. Ideas that receive this status will also receive a conclusion by the IdeaStorm team with a reference to where the customer can see where the idea is already offered.
- Partially implemented: Some ideas are implemented in stages. Items given the status partially implemented are still available for future consideration.
- Implemented: Dell has taken action and the idea has been put into production.
- Not planned: There are times where an idea, although interesting, is not in line with the business plans and will not be implemented.
- Archived: All ideas that have not received the status of Under Review, Partially Implemented or Implemented after six months will be given this status. These ideas will no longer be viewable on the site, however are still viewable by the Dell teams." (IdeaStorm of Dell, 2011[6])

It can be inferred that the ideas generated by the IdeaStorm community will be evaluated by both the IdeaStorm Community teams and the appropriate business team. Every idea will be given the status label "New" once it is submitted. As the status labels illustrate, these ideas are then processed differently after they are officially evaluated to be "truly an idea" and in accord with the Terms of Use. Some ideas can be implemented and transformed into new products, new services and business modes, and some ideas cannot. The remaining ideas are held for further investigation or are just archived.

Some practical ideas which are in line with the business plan can be adopted and implemented (or partially implemented). These ideas will be labelled with "Implemented" or "Partially implemented". The ideas that are evaluated to have already been put into production will be given the label "Already offered". Some ideas which are unable to be implemented due to the limitation of business plan, although interesting, will be marked with the status label "Not planned". Some ideas that the IdeaStorm team cannot evaluate are sent to the appropriate business teams in the organization for further investigation and labelled with the status "Under review". The remaining ideas that have no status since the submission will be given the status label "Archived" and can only be viewed by Dell teams.

Therefore, the overall knowledge flow process of the ideas can be presented as follows:

[6] http://www.ideastorm.com/idea2AboutIdeaStorm?v=1357766818021)

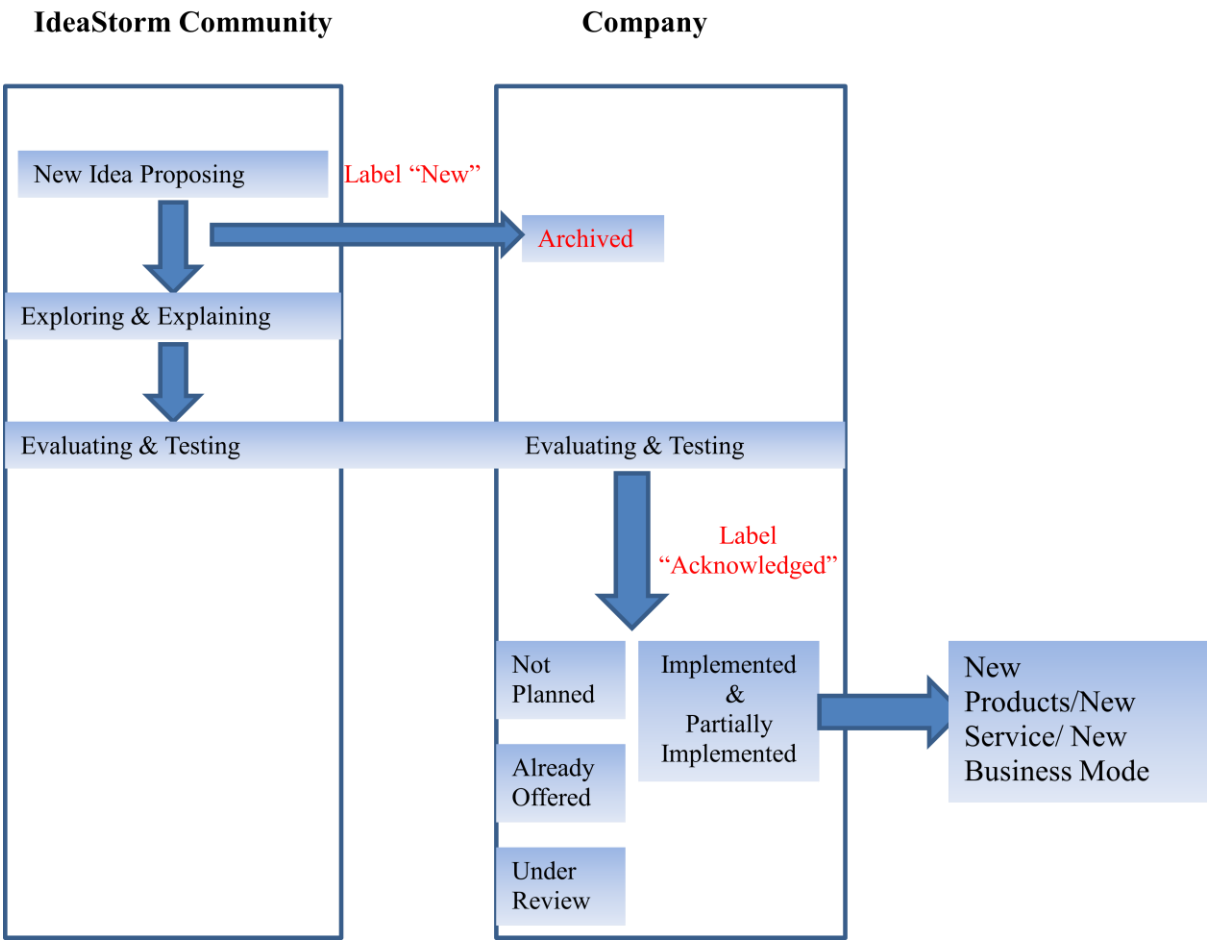


Figure 6-6: Knowledge Construction Process in Idea Oriented Discussions in IdeaStorm Community (Type I)

[Note: The Dell teams, including both the IdeaStorm Team and business teams, don't participate in the knowledge exploration and explanation episodes here. It is possible that a newly proposed idea is explored first and then evaluated. However, knowledge evaluation and testing should be the last phase before considering implementation or not. In order to present the knowledge flow process in a simple and clear way, a simplified method is adopted and the recurring process between "exploring & explaining" and "evaluating & testing" is ignored.]

[Note 2: the left column represents the Dell IdeaStorm members, and the right Dell IdeaStorm teams and other Dell Business, if they also participate in some cases]

When a new idea is proposed (i.e. at the New Idea Proposing episode), a status label "New" will be given to the initial post containing the idea. Then this idea is further explored in terms of becoming more detailed, reliable, and practical through the collective efforts of the discussion participants. The idea is usually evaluated (and/or tested) by the discussion participants. Meanwhile, Dell Ideastorm team also reads the post and gives an initial evaluation of the idea to ensure its value as truly an idea and its compliance with the user terms within 48 hours of each submission.

At this status, the thread is marked with the label "Acknowledged". After the latter and also the final justification (and/or testing) by the Dell Ideastorm team (/other Dell business teams), these idea are given different labels according to practicality and in accordance with the business plan, such as "Already Offered" (for ideas that have been taken action); "Not Planned" (for interesting but impractical ideas); "Implemented" and "Partially Implemented" are (for ideas that have been adopted and put into production); and "Under Review" (for ideas that are delivered to appropriate Dell business teams for further investigation).

If the Dell IdeaStorm Teams also participate in knowledge exploration, the whole knowledge flow process can be adapted as described in the following figure:

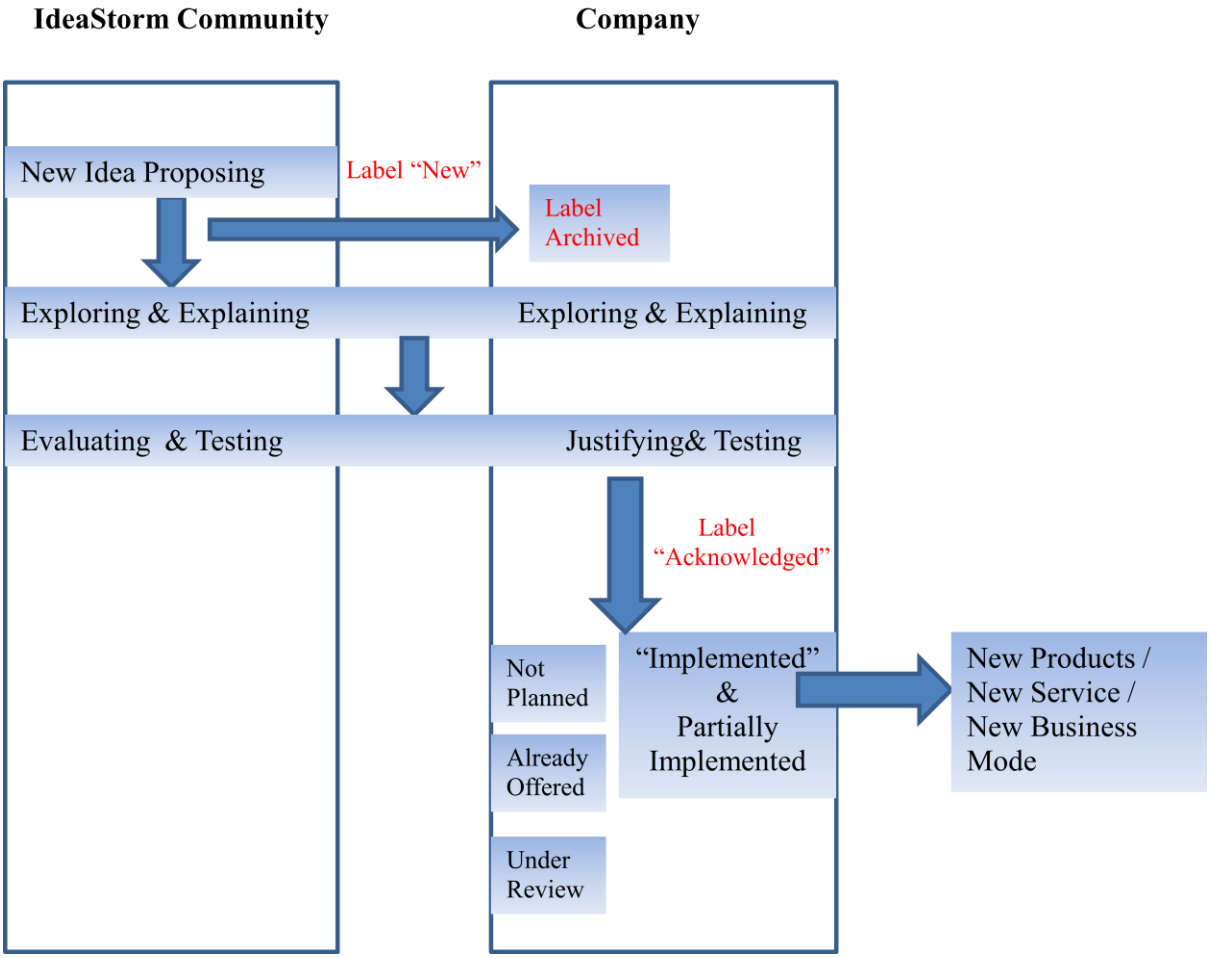


Figure 6-7: Knowledge Construction Process in Idea Oriented Discussions in IdeaStorm Community (Type II)

(Note: the left column represents the Dell IdeaStorm members, and the right Dell IdeaStorm teams and other Dell Business teams, if they also participate in some cases)

In order to better illustrate the knowledge flow process, an individual model for different ideas can be conceptualised, as follows:

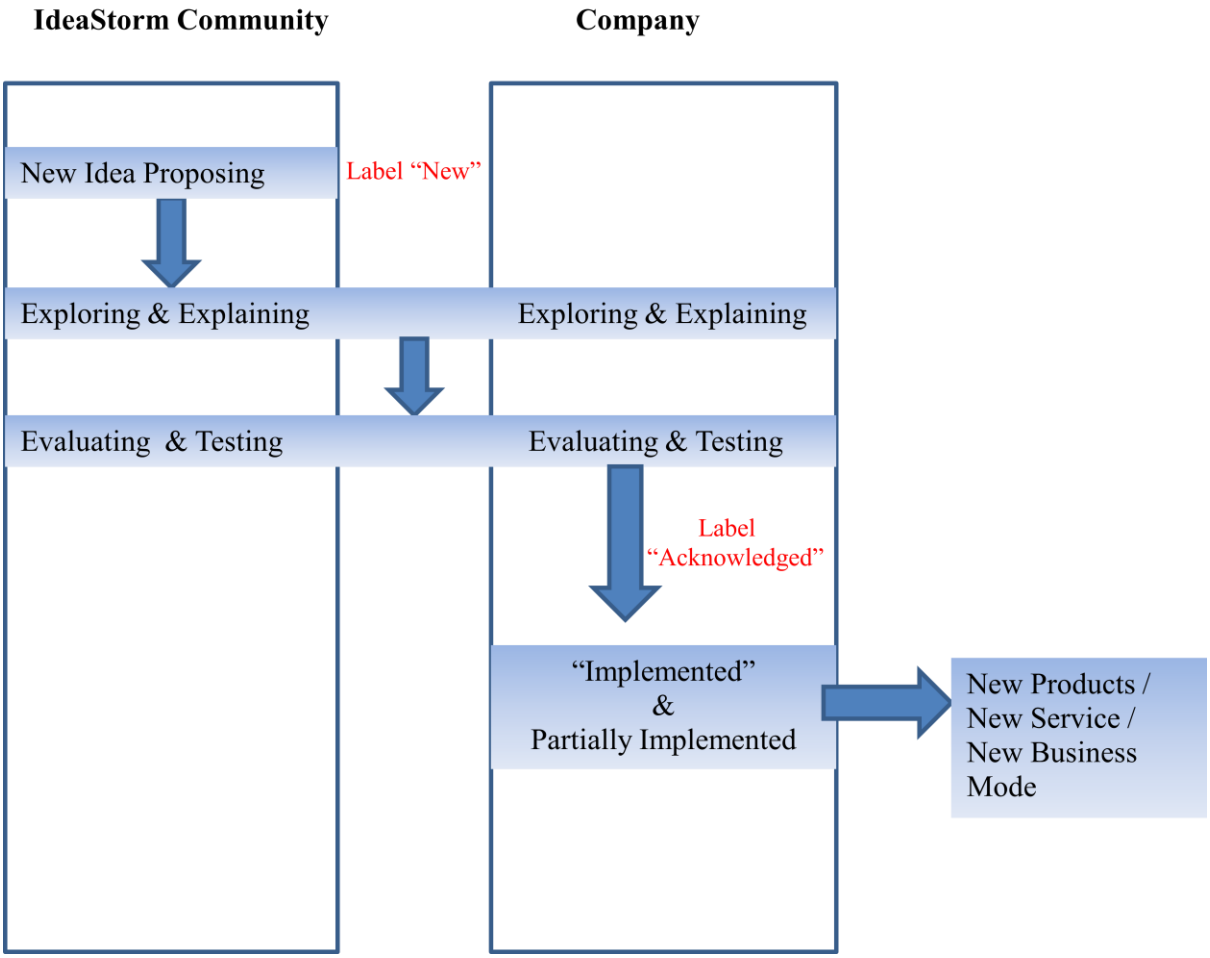


Figure 6-8: Knowledge Flow Process of Ideas with the Labels "Implemented" and "Partially Implemented"

(Note: the left column represents the Dell IdeaStorm members, and the right Dell IdeaStorm teams and other Dell business teams, if they also participate in some cases)

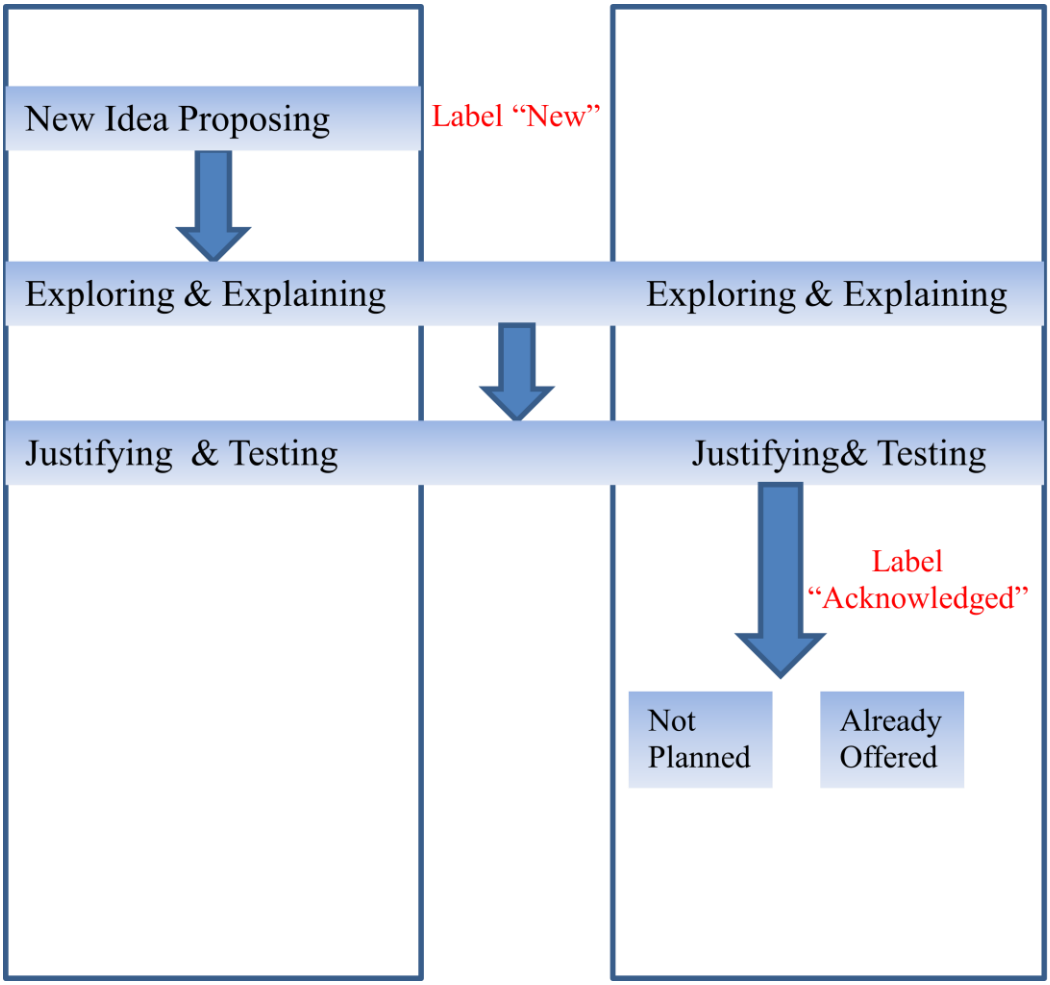


Figure 6-9: Knowledge Flow Process of Ideas with labels "Not Planned" and "Already Offered"

(Note: the left column represents the Dell IdeaStorm members, and the right Dell IdeaStorm teams and other Dell business teams if they also participate in some occasions)

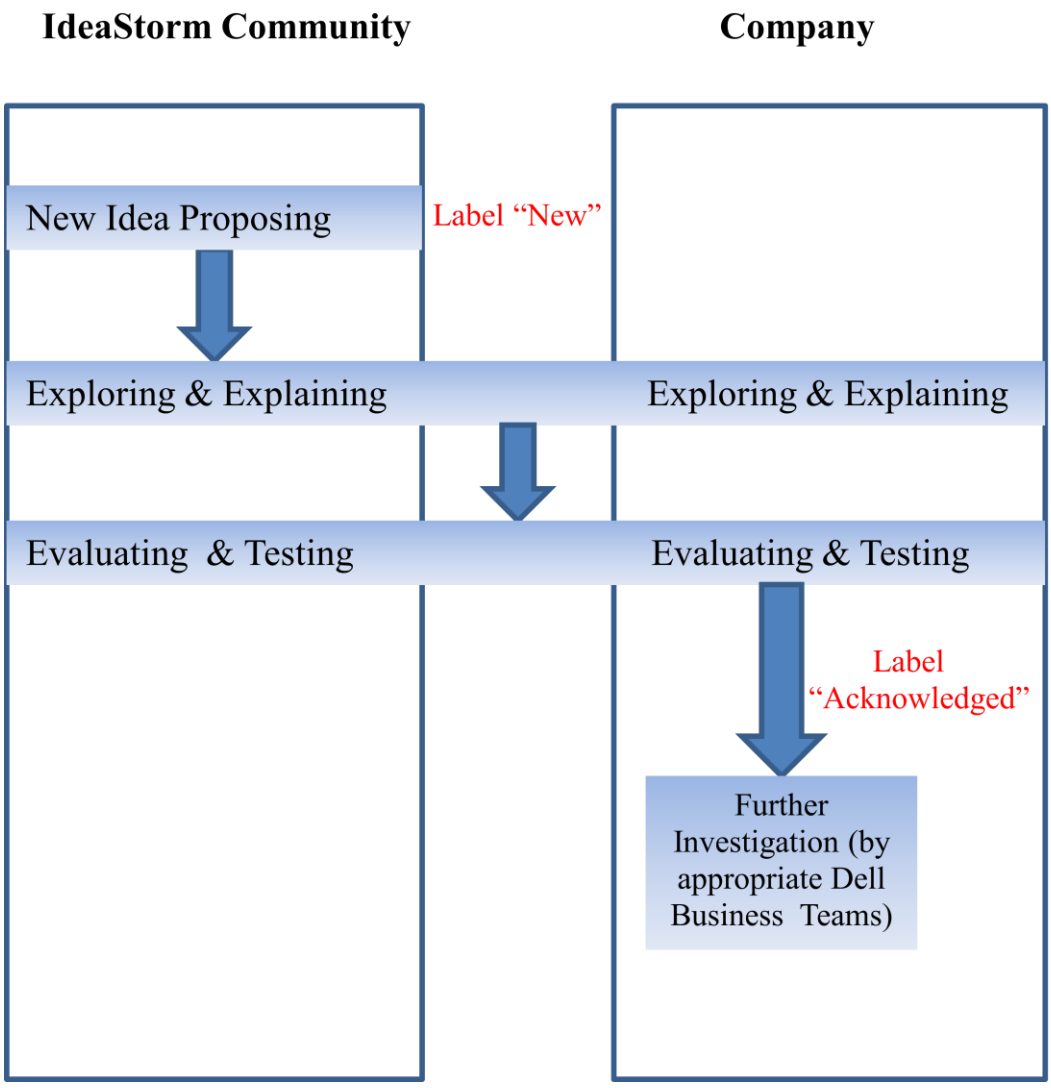


Figure 6-10: Knowledge Flow Process of Ideas with label "Under Review"

(Note: the left column represents the Dell IdeaStorm members, and the right Dell IdeaStorm teams and other Dell Business, if they also participate in some cases)

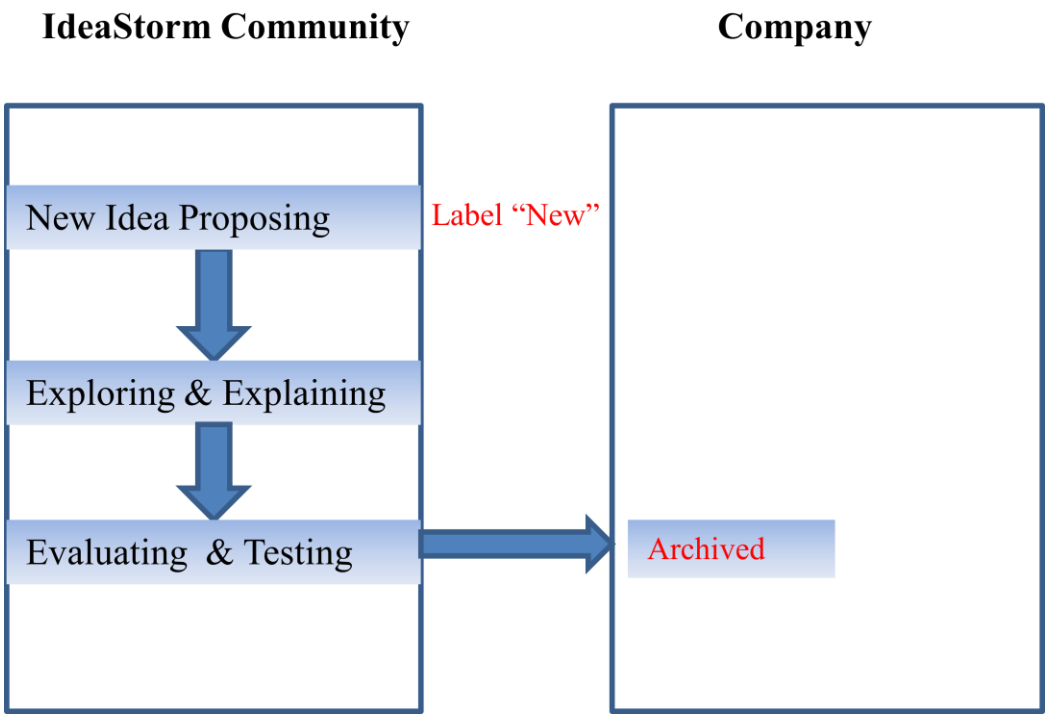


Figure 6-11: Knowledge Flow Process of Ideas with label "Archived"

(Note: This figure is developed based on the introduction of different labels on the Website. Therefore, this is just a possible knowledge flow pattern. There is no reason that other patterns cannot exist.)

6.6 Summary and conclusion

At this stage, the content analysis framework was finally completed and the main relationships between its categories clarified. The knowledge construction model and the knowledge building strategy for solving technical problems were also confirmed.

The coding results reveal that there was no new knowledge construction episode identified in the threads analysis. However, the following new sub-categories were derived from the data: "Comments about promoting/demoting the discussion idea", "Disputing on/ talking about unnecessary issue", "Mediating the arguing/ stopping talking about unnecessary topic", and "Moderator's labelling status to the discussion thread", "Judging the existence of the problem", and "Invalid posts". The researcher classified all these identified sub-categories into new main category groups according to their connections and relationships at this stage: "Knowledge Construction Episode", "Problem Description Episodes", "Non-constructive Episodes", "Moderation Episode", and "others". The final content analysis framework was completed at this stage. Moreover, the inter-relationship among the three main categories was

also clarified. The knowledge building model, which consists of the key "Knowledge Construction Episodes" was still reflected in these threads analyses. The knowledge building strategy of "trial and error" was used in the discussion threads about technical problems. Another finding in this research stage is about the knowledge transfer across the boundary in IdeaStorm community.

The categories included in the newly developed analytical framework and their relationships still need to be verified and clarified by the interview data obtained from discussion participants in the virtual product user community. In addition, some issues which cannot be explored through content analysis of discussion threads need to be revealed through thematic analysis of interview data in the next research stage. For instance, the exact way of proposing a solution idea, feelings and comments towards the moderator and the community culture all need to be considered further.

Chapter 7 – Interviews with Dell Forum Users

7.1 Introduction

In the research stage reported in this chapter, the main purpose was to evaluate the categories included in the content analysis framework which was developed in the prior stages. The relationship amongst these categories also needs to be further clarified through interviewee data. In addition, some research issues which cannot be discovered from the discussion contents can also be explored by the narrative of interviewees. The exact solution identification method embedded within the knowledge construction process, and the nature of community members' knowledge can be revealed by the interview data. The community members' perceptions of the moderator and the community culture can be explored through the interview data. In order to achieve the above goals, 20 interview transcripts of active, medium active and less active Dell User Support Forum members were analyzed. In this section, the main objective is to continue to explore the research question "How is knowledge constructed?" In addition, some attributes of the virtual product user community will be revealed through thematic interviews with community members. Therefore, the research question "What is a virtual product user community and what are its attributes?" can also be partially answered.

7.2 The composition of the Forum Members/Interviewees

7.2.1 Introduction

This section discusses the composition of members of Dell Support Forum, including the forum users of different levels of expertise and activeness, and company staff with different powers and responsibilities in this forum.

7.2.2 Community Members Composition

According to the interview data, the researcher's observations and the introductory texts of the Dell support forum, this product user community consists of these types of members:

- Active users of high knowledge level, who regularly participate in the discussion and mainly answer others' questions, most having the title "Rockstar" (http://en.community.dell.com/p/dcf-rockstars.aspx);

- Users of medium knowledge level, who are regular users of the forum, ask questions and sometimes give answers to other users;
- Less active users, who are mainly newbies, and usually have low level knowledge and occasionally log into the forum to seek answers;
- Lurkers, who register in the forum to read others' postings and do not participate in discussions;
- Company staff with company labels attached to their user names, including the formal moderator with the label "liaisons" and moderating power, and other company staff without moderation responsibilities.

One interviewee commented:

> "Like in every other community, forums has [have] a virtual hierarchy of sorts. There are "low level" users who only come by when they need a questions [question] answered. There are more general type users who tend to hang around, assist on some topics and also ask questions about stuff they are interested in. Above gerenal [general] folks stand the community *starts* ["Rockstar"], who try to put up F.A.Q.s and guides and help people as much as possible, thoug [though] this help is mostly generalized …There are staff members (which I'm unsure if they are actual moderators) who try to pass the information to respective divisions of support department."-Dr***

The above interviewee points out a virtual hierarchical level of users, according to their participation activeness, expertise levels and power. This interviewee used "low level" to refer to users who participated in the discussion to a minimum level and only occasionally asked questions. The most common users both asked questions and assisted others to find solutions. This interviewee also noticed active users with the label "Rockstar", who voluntarily helped other users to find solutions to technical problems. The company staffs are also included in the community and one of their functions is mentioned, although this interviewee could not further classify their different roles and powers in the forum.

> "Again, I can't say how they are now, although I don't expect much has changed, but when I was an active participant, the users could be divided into two broad groups – (1) users who were desperate to find solutions to their computer problems and (2) users who were very knowledgeable about computers and could eventually provide help."-Sn***

Certainly, different interviewee had different sets of categories of community members. The above interviewee noticed two basic types of users in this forum during his active period: 1). users who asked for knowledge to solve their computer problems; 2) users who could provide help with their knowledge.

7.2.2.1 Active Users

The attributes of the active users are described in a much more detailed way in the following quotations.

> "Most of the people who answered questions were regulars who had become experts in various areas"-Dr***
>
> "Most forums, including the Dell forum, for the most part, are populated by a "regular crowd" that knows the answers to most common questions."-Bi***

Active users are considered as forum users who regularly participate in discussions, have expertise in various areas and actively provide answers to others' problems. These three attributes are necessary to define an active forum user.

The forum members with the badge of "Rockstar" consist of a major portion of the active user group. They are independent individuals with high-level expertise in computers and voluntarily contribute their knowledge to solve technical issues and ideation in the community. According to the introduction of this Dell Community Rockstar, these active users are also considered to be representatives of customer groups to communicate with Dell.

> "The Dell Community Rockstar program recognizes independent experts and enthusiasts for their community contributions in solving technical issues, ideation and helping customers learn about and get the most from Dell products and services. These key people play a critical role by sharing their knowledge and enthusiasm for Dell with the community, as well as representing the voice of the customer back inside Dell." (Dell Forum, 2013).

One interviewee who used to be an experienced forum regular provided his own understanding and comments about "RockStars".

> "RockStars. a small number of the RockStars have limited Forum [forum] management duties. Like all RockStars they are not Dell employees and are unpaid. Being given moderation duties is one of the rewards I was talking about before. It is clever because Dell has severely reduced the Moderator staff but they make up for that by getting free services from the RockStars…The decision on which RockStars are given moderation duties is made by the management of the Forum..."-Jo***

A small number of the "RockStars" group were empowered with limited forum management duties, although they were not paid for this. This decision was made by the forum management team. More importantly, participating in forum moderation is considered to be a reward from this interviewee's perspective. This can be related to sharing power with the forum administers and managers.

There are also some active users who do not accept formal "Rockstar" titles from the company. One active forum user who once refused the invitation to be a "RockStar" talked about his volunteer facilitation work.

> "… I would say that I am now performing the facilitator function on that particular board, through organizing and disseminating the information in various ways, by correcting any misinformation that gets posted, by directing posters to relevant information, etc. "-Jo***

This interviewee states that his work as a volunteer facilitator on one board in terms of involved managing the content published on the forum. This includes organizing and disseminating the knowledge and correcting the wrong information.

It has been observed that a small group of these active users publish a large number of posts and obtain high-level knowledge and expertise from the core of the community. These core members include active users with the formal title of "RockStars" who are formally recognized as contributors by the company; and volunteer ones without titles.

7.2.2.2 Medium Active Users

The medium active users usually had some experience of solving problems, seeking help from other peer users and answering other's questions. Unlike active forum users, they did not frequently participate in the forum and had much narrower knowledge.

> "Some people who asked questions were more sophisticated and were stumped by something unusual. Sometimes, it was some unique feature of dell's hardware or software that they were not familiar with. Some of these people stuck on in the forums after their question had been answered because they had always wanted to help others in such a social setting…"-Bi***

The above quotation shows the existence of medium active users in this forum, who also ask questions. Although they have more knowledge than newbies, they still need other users to provide answers to the unique features of the products that they are unfamiliar with. After

they have received the answers, they still participate in the forum, in order to repay help from others.

The following interviewee is also a medium active user, who looked for some knowledge he needed to begin with and then started to help others regarding specific issues that he knew. Unlike active forum users, this interviewee did not publish lots of posts, due to his relative lack of knowledge.

> "At first I only logged on once to register and "scout" through the forum content for material relevant to me. After finding a thread (GPU Upgrading) where people were actively participating and updating on what seemed like an hourly basis, I would also log on every other hour to see what people were sharing/contributing. I then transitioned to being a contributor myself, and wrote component reviews, and findings, and would log on to reply whenever I got a response/question from another forumer [forum user]. ..If it's something that's very specific to a particular problem they're having, I am very inclined to help those who are less-knowledgeable than me. ..I was only heavily involved in 4-5 threads in the forum…"-Vy***

According to his description, at beginning, this interviewee visited the forum to find knowledge relevant to his computer, i.e. threads about GPU upgrading. Then he started to participate in the discussion and contributed his knowledge by writing component reviews, findings and replying to other forum users' questions. However, he could only answer questions to particular problems. His limited knowledge constrained his knowledge contribution capability. Nevertheless, his description illustrates the process of transiting to the core of the community.

7.2.2.3 Less Active Users

There were a much larger number of newbies, who had little knowledge about computers, but occasionally released posts to ask questions about problems they met.

> "The people who asked questions were mostly non-technical. Many of them were new to computers. Most questions that were asked could be answered trivially with a little online research, but most of the questioners were too unsophisticated to even do sensible google searches. Most of them never used the forums unless they had a problem, and when the problem was solved, they were gone (at least until the next time their computer gave them an error message)."-Bi***

The above statement provides a general description of their features. Many lacked sufficient knowledge about computers, causing difficulties for them in their using online searches to find solutions to their computer problems. They occasionally used the forum, unless they had some questions to ask, and also seldom participated in the discussion. Another interviewee thought most of the less active users tended to be new users of the products.

> **"**Most of the people I've met on the forum we're actually new users/buyers looking for more information on their products.**"**-Vy***

The following interviewee described the less active forum users from a community member's perspective:

> "Then there are the "noobs" who would constantly ask questions for every minor thing which could be solved just with a simple Google search. This group would usually consist of the younger forum users, still new to the scene/community."-Vy***

This interviewee expressed his dismissive view towards less active users with regards to their constantly asking questions about minor issues. However, he still considered them to be community members. This hints that some of these users have the potential to become core community members.

7.2.2.4 Lurkers

There were also a large number of lurkers who never participated in the discussions on the forum but just registered to read posts and had no intention of contributing.

> "Then of course, we cannot forget the lurkers, who are the users who just register to read what others are saying or have said. They have mo [no] intention of contributing, and are just there to leech of others. There is no denying that everyone is a leech in various other forums when it comes to looking for solutions to a problem. But you can't avoid the fact that this archetype of forum users exists."-Vy***

As stated above, the lurkers were also one type of the community member in this forum, although they did not contribute any knowledge. This interviewee pointed out the existence of lurkers in every forum and that everyone sometimes acts as a "leech" to exploit others. This interviewee accepted the lurkers but still showed some irritation with forum members who did not really make any knowledge contribution. However, lurkers also had the potential to participate in discussions and make some contributions.

7.2.2.5 Company Employees

Company employees also joined in the support forum. However, these employees had different titles, power, and duties within it. Among them, only a few are moderators, who have a "Liaison" badge and relevant moderating responsibilities. The rest are company employees with the "Dell" label in their user name, who are considered to be "Dell representatives" and "Social Media Specialists" by the interviewees, participating in the discussion and sometimes trying to give an answer. However, they did not have the power to moderate and manage the forum.

It has been observed that a small number of company staff with the "Dell" label also had the title "Forum Liaison". They are moderators in each sub-forum with managing and moderating privileges. Their titles are marked in their posts and mentioned in their forum profiles: for instances, 

, 

, 

, and 

. This is also confirmed by one interviewee with long experience of this forum.

> "… back when I was a Dell V.I.P about 18 months ago., we were told that due to cutbacks the number of Forum moderators/liaisons had been reduced from 20 to a mere 4 people. The 4 were
>
> DELL-Terry B -- on his profile page it says "Terry B Liaison"
>
> DELL-Robert P -- on his profile page it says "Job Title Forum Liaison"
>
> DELL-Chris M -- on his profile page it says "Forum Liaison"
>
> …These moderators are based in the USA. Most everybody else are not moderators/liaisons. I guess they are based in India or that vicinity as many of them have Indian-like names, such as DELL-Rajath N, DELL-Sujatha K, Dell-Rajesh R, DELL-Prateek K, etc.
>
> …in every instance where I have used the word **Moderator or Liaison** i [I]was referring to formal Dell company employees who have at least as partial duty the management of this Forum. Note: they used to be called Moderators but Dell changed the name to Liaison."-Jo***

The above examples provided by the interviewee illustrate the existence of moderators with the title of "Liaison". According to this interviewee, who had quite extended experience in this forum, there were just 4 liaisons left in the forum when he was a Dell V.I.P and most of the other company employees were from an offshore service centre. The liaisons used to be

called moderators and were still in charge of managing the forum. The clarification about the moderator by this interviewee strongly emphasized the importance of their moderation power and forum management duties. This is also the way to distinguish moderators from ordinary company staff in this forum.

These four liaisons were in charge of moderating the forum. Other company staff in the forum who once referred themselves as the "social media specialists" according to this experienced forum user, also participated in answering questions. However, this cannot be directly confirmed without access to the management teams and relevant documents. These moderators' roles can only be explored through their participation in forum discussions, when their off-forum activities cannot be observed.

There were only a small number of moderators with the label of "Liaisons" managing the forum. In contrast, a large group of company staffs with Dell titles in the forum also joined in the forum.

> **"Social Media Specialists**. I use that term for Dell employees who have a partial duty to give rote answers in the Forum and to sell products through the Forum, but unlike the Moderators/Liaisons they have no management role in the Forum."-Jo***

These staff members just participated in discussion and sometimes provided solutions but did not have any duties of moderating the forum. According to this experienced forum user, the latter type of company staff participating in the forum used to have the title of "social media specialists".

> "I call them social media specialists" because when they first appeared on the forum that is how they referred to themselves. These people apparently have been required to answer questions on the forum, using scripted generic answers, as an excuse to sell services that require a fee such as software support or extended warranties."-Jo***

These company employees participating in the forum discussions were more connected with marketing purposes, although they were also required to answer forum users' questions from general scripts. This interviewee also hints that these types of answers which are based on general scripts were not very useful because most of the questions were specific.

Accordingly, there is a clear distinction between the moderators labelled as "Liaison" and ordinary company staff in terms of identity, power, and duties. Restler & Woolis (2007) state

that “the moderator is the individual from within the community who has legitimate authority to push and prod the community to set its priorities and conduct its work.” Thus, the “Liaison” can be considered as the moderator in this virtual product user community. However, due to having no access to the formal introduction of their work division, the above classification can only be made based on the knowledge and experience of these forum regulars, along with thread analysis findings.

7.2.3 Conclusion

This virtual product user community on the Dell Support Forum (English) consists of both varying forum users and company staff. The forum users can be classified into: 1) active users, who have high-level knowledge and usually give suggestions to peer users; 2) medium active forum users who publish a smaller number of posts, ask questions and answer other’s questions; 3) less active forum users, who are newbies and mainly ask questions; 4) Lurkers, who register in the forum and just read other’s posts and do not publish any contents. The active users, including “RockStars” and volunteer experts, are the core members who provide answers for other users. Some “RockStars” are also involved in limited moderation work. Company staffs are also appointed to join in this forum. A few of them bearing the title of “Liaisons” have the power of moderating the forum. The remaining company staffs do not have any forum managing power and they have more of a marketing role through providing answers to forum users, based on general scripts.

7.3 Reasons for Using the Forum (/Participating in the Community)

In this section, the reasons for using Dell Support Forum are discussed. This helps us to understand users’ perceptions of the forum, and thus to know the difference between it and other online knowledge resources. There are multiple reasons for these community members to use the Dell forum, including its specific and unique knowledge, the experiential nature of the knowledge, the number of dedicated and knowledgeable users on it, its unique search function, and so on. These aspects make this forum an ideal knowledge resource for complicated questions and specific technical problems

7.3.1 Specific Knowledge about the Dell Products

Most of the interviewees go to the Dell user forum for specific knowledge about the Dell products rather than general knowledge about computers. It was observed during the threads selection process that nearly all discussion threads were about Dell products.

> "The forum is an essential source of information for issues that are specific to Dell computers. But it was not and still is not the best place for information on computers is general. My approach has always been to check the forum first if I suspect a problem that is specific to Dell and to just use Google searches for most other stuff."-Vo***

The Dell Support Forum contains more specific knowledge on Dell products. This is considered to be one of its values on the Internet. It is limited in providing general computer information and knowledge. This feature also influences the user's knowledge searching strategy. For other general knowledge about computers, the interviewees mainly conduct searches on Google.

7.3.2 Experiential Knowledge

Another unique feature of this forum is users' experiential knowledge which is developed on their actual participation in the discussions. This makes the knowledge generated on this forum quite unique. These answers and solutions cannot be found from other online knowledge resources, due to their experiential nature.

> "It is a source of information based on the actual experience of users, who can verify or rebut the claims of manufacturers and other online IT experts. In many cases, they also have information that is not available elsewhere. For example, the E520 forum that I use has information re compatible components that goes way beyond what Dell specify."- Nn***

The users' practical knowledge, which is built on their actual experience, can verify or rebut the claims of manufacturers and other online IT experts. In addition, their knowledge is quite specific and unique, and cannot be found elsewhere.

In addition, the solution provider responds to other's question according to his or her own research and experience.

> "I try to respond with the fullest information that I have, based on my own research and experience, and in a timely manner."-Nn***

7.3.3 Suitable for Complex Problems

In addition, this forum is also considered as the most appropriate discussion space for solving complex hardware and software problems in Dell products.

> "The forums are for solving those most complex problems. Simple problems can be solved by friends or Dell customer support. But those complex problems (requiring in depth software and/or hardware knowledge) are beyond what customer (tech) support can deal with. The forums are for those problems. The experts there use their own personal knowledge combined with knowledge gathered from the problems solved on the forums to provide help."-Pr***

The community members here have more knowledge about specific technical problems than the technical support staff, and they are helpful too. This personal knowledge is based on accumulated personal experience and gathering indirect knowledge from the forum. Thus, it is suitable to solve complex problems which cannot be solved by general knowledge.

7.3.4 Access to Amateur Expertise

One of the Dell forum's valuable features is its dedicated and helpful forum regulars with high-level expertise.

> "It used to be quite valuable because it was comprised of dedicated amateurs whose combined knowledge often outstripped that of their Dell counterparts. My article "Choppy/Skipping Audio FAQ" contains dozens of examples of solutions provided by Dell owners that Dell itself could not or would not resolve. The owners have access to the expertise of the regulars at any time during their ownership of their Dell and the forum can be a particularly valuable resourse [resource] after their warranty has expired."-Jo***

These amateurs, whose knowledge was considered to be better than their Dell counterparts, were considered to be valuable. In some cases, they solved problems which Dell technicians could not deal with. Therefore, convenient access to forum regulars attracts Dell customers.

> "I think that the strength of a forum depends on a few very faithful, dedicated and competent users that are very generous of their time and willingness of helping others. In this matter, I think Dell is well represented."-ru***

The core community members, i.e. forum regulars with dedication and competence, are also considered to be the strength of the Dell Support Forum.

7.3.5 More Productive

Meanwhile they also consider the forum is more productive as it provides more reliable answers to their questions than customer support staff.

> "In many cases, people came to the forums as a last resort after wasting time and energy with technical support folks, and were surprised when the solutions we suggested were so simple, quick and effective."-Bi***

The above interviewee points out that the answers provided by the active forum users were simple, quick and effective. This cannot be obtained through the technical support staff.

7.3.6 Platform for Product Users with Same Technical Problems

Another reason the forum attracts participants was because it acted as a communication platform for people using the same products to share knowledge.

> "B/c it provides a platform for different users around the globe to discuss a particular problem/experience that they have with their device and eventually find solutions/tips/tricks which might help them get the most out of their device."-Yr***

One interviewee considered that the forum provided a communication platform for product users encountering the same technical problem to help them solve their problems through collaborative efforts.

> "You can communicate with people who are in the same boat as you are, meaning you can find corelation [correlation] between certain issues and find a general concensus [consensus] solution, which will suit a user base for a given hardware model."-Dr***

7.3.7 Unique Search Feature

The search feature of tags in this forum attracts users to seek information about Dell products.

> "If I've understood the question I can tell you that this forum has an important feature that other forum doesn't have, the possibility to specify the search tags. It's important because if you perform a simply search you see the result based on the words that are in the title of the topic, or in the text, but they're a little bit general, but writing some specific words related to your topic in search tags when you start a new topic you will help people that in future will search for topics with your specific questions. And this helped me a lot."-k2***

Specific search tags are given when conducting searches in the forum. This function is not provided in other forums. It can help users quickly identify the information they need.

7.3.8 Conclusion

This forum mainly contains specific knowledge about Dell products, which cannot be found from other Internet sources. The specific knowledge on this forum has a strong experiential nature. This is mainly because most of the knowledge is built on the actual experience of the forum users. In addition, it is more suitable for solving complex hardware and software problems, which are quite specific, due to varying software and hardware environments in each user's computer. One of the unique features of this forum is the number of dedicated active forum users with high levels of expertise. Thus, access to these amateur users to solve technical problems also attracts forum users. The unique search function increases its usability. The answers obtained from this forum are more reliable than other online sources. In addition, the forum is considered to be one of the quickest methods to receive reliable answers. It is also a platform for product users with similar technical problems to solve their problems through collaborative efforts.

7.4 Participation Activeness & Participation Patterns

In this section, the experiential nature of the community member's nature has been revealed. Knowledge sharing and new knowledge construction have also been explored. Sharing knowledge about ready answers usually takes the form of searching the forum for existing answers and providing answers when other users don't know the answer. Parts of knowledge building episodes are identified in the interview. The knowledge construction is found to be related to experiential knowledge and clarification of contextual knowledge about the problem. The knowledge building process and knowledge building strategy of "trial-and-error" are also illustrated in this section.

7.4.1 Experiential Knowledge of the Active Community Members

Knowledge obtained by these active community members has an experiential feature. In other words, the forum users' knowledge is built upon the experience of problem solving process. Then their experiential knowledge can be shared with others who have the same problems. Moreover, the knowledge can be built on both direct and indirect experiences.

> "The experts there use their own personal knowledge combined with knowledge gathered from the problems solved on the forums to provide help. For example, a user might ask, "What is the highest processor my Dimension 3000 can take?" The official Dell specs generally only indicate what was tested at the time the machine was sold. However, the chipset and

> motherboard may support new processors and people can chime in with what they have learned."-P***

The community members with expertise provide help to solve others' problems, based on their own personal knowledge from participating in solving problems and knowledge gathered from other posts. There is no direct relationship between the interviewees' job and using the forum. Their personal knowledge is usually non-work related and mainly from direct experience of participating in discussions on the forum. Other parts of knowledge can be learned from posts published on this forum which record other users' experiences of solving various problems. In the given example, the answer to the question about the best processor for one type of computer could not be provided by the Dell technicians due to a lack of experience. However, the forum users could give a correct answer because of their experience regarding it, either in a direct way or indirect way.

7.4.2 Direct Experience

Direct experience of participating in solving problems can be one source of an active community member's knowledge.

> "I try to respond with the fullest information that I have, based on my own research and experience, and in a timely manner."-Nn***

The above quotation clearly illustrates that this person's knowledge used for responding to others' problems is based on his own experience of researching previous problems and participating in solving problems.

> "Most of us who helped other users were knowledgeable enough about the computers because of our own experience…"-Vo***

This quotation illustrates one interviewee's claim that personal experience of these active forum users is indeed the basis of solving problems. Long-term experience of participating in other users' solving problems also can equip individuals with sufficient knowledge to offer help.

> "…But anyone who has used one of these infernal machines for more than an hour or two has had some sort of difficulty! If I see a post about a problem that I have faced and conquered, I feel as though I should help that user. (I understand how he/she is feeling. [)]"-Jf***

The above quotation also states that the forum user with relevant experience of solving the same or similar problems is oriented to sharing this knowledge with others. The experience of

encountering the same technical problem enables the interviewee to obtain requisite knowledge about the problem and they feel obliged to share this knowledge.

> "If I find something about a topic that interests me and or I have any personal experience regarding some or if I have something constructive to add or propose then I would actively try to participate and would like to help everyone to the best of my knowledge."-Yr***

This interviewee mentioned that, having personal experience regarding others' posts was one of the reasons for helping others. This also reflects the fact that direct experiential knowledge is the basis of offering help on this forum.

7.4.3 Indirect Experience

The active community members' knowledge can also be built on indirect experience of solving technical problems, that is to say, on other community member' experience.

> "On a more general level, for years I have read every post on what is now called the Laptop Audio board. Most of my raw knowledge of audio in Dell laptops comes from reading those posts. A lot of my understanding of the same [problem] comes directly from Dell owners who post, and a lot of it comes from analyzing, filtering and connecting the raw data in various ways."-Jo***

Most of this interviewee's knowledge about audio in Dell laptops was from reading other posts on the Laptop Audio board, in other words, from learning about others' experiences of solving problems in discussion threads. In addition, when offering help to solve problems, a lot of his understanding of technical problems was directly from reading other posts, which contained relevant experience of solving the same problem, or of integrating the original knowledge from other posts through "analyzing, filtering and connecting". This interviewee's knowledge was from the indirect experience of solving problems.

> "Most of us who helped other users … could very effectively use search engines to find answers. I kept my own database of links and solutions so that I could easily copy and paste information in forum posts." -Vo***

These active users are also good at using the forum's search engine to find answers for other users' question, according to this interviewee. Moreover, he even goes to a higher level of maintaining an elaborate database storing links and solutions. This illustrates that active users are experts not only in knowing knowledge but also in utilizing others' experiences, as recorded on this forum.

7.4.4 New Solution based on Experience

The new knowledge proposed for solving complicated problems is also built on the product users' experience of experimenting with different solution ideas on their computers. Lots of solutions which cannot be provided by the Dell Company are found through users' experiences of trying various ideas until they achieve a valuable finding.

> "…A large number of solutions that are unknown to Dell come about by people experimenting with their computers. People do this all the time and occasionally they stumble upon something of value, and when they do they often disseminate it by posting on the forum." –Jo***

Experiential knowledge can help other forum users with the same problems. Some specific problems are more likely to be solved by those active users who have relevant experience of the same problems. When one forum user has relevant knowledge obtained from his own experience, he will be more willing to help others with the same technical problems.

> "But anyone who has used one of these infernal machines for more than an hour or two has had some sort of difficulty! If I see a post about a problem that I have faced and conquered, I feel as though I should help that user. (I understand how he/she is feeling."-Jf***

Most of the problems were solved by the active community members with expertise and experience. Their expertise was mainly from their experience. This was also found in relation to the threads analysis: most of the ideas were proposed by active posters.

> "The regulars answered the questions that were put forth, of course, but beyond that all shared knowledge -- regulars and non-regulars -- and interacted with each other in a grand gestalt that advanced the overall understanding of Dell computers."-Jo***

7.4.5 Knowledge Sharing for Ready Answers

7.4.5.1 Search the Forum for Existing Answers

The forum is not just an online discussion place for technical problems with Dell products. In addition, it is also a knowledge base with a search function for forum users to identity solutions to the same or similar problems which have already been discussed and solved. That is to say, the search engine within the forum can help forum users to find existing knowledge for similar technical problems.

> "First one would (should) search the appropriate forum section for a similar issue. If answer is not there or is not clear to the user he/she would start a new post with an attention getting subject line and state the problem as clearly as is possible. Sit back and wait for help."-Jf***

This quotation illustrates that the first choice for forum users seeking solutions to their problems is to use the search function on the forum to look for similar problems which have already been solved. When there is no ready or clear knowledge about its solution, they start a new thread, which includes a clear description of the problem, in order to seek a solution and construct new knowledge regarding the question.

> "The easiest way is to first search the forum, as a large proportion of the problems have already been addressed"-Vo***

The above interviewee also states that the easiest way to solve a problem is using the forum's search function. This is because lots of the problems have already been discussed and solved in this forum and it saves time and efforts to search for the ready answers.

The following are good examples of individuals using the search function on this forum.

> **"**I am a firm believer of not wasting forum space/time with previously asked questions. If I have a problem/question to ask, I will use the search function to check if it's already been asked. Only after having done that do I start a new thread with my problem."-Vy***

This interviewee also stated that using the search function of the forum to search for already answers was their first choice, rather than starting a new thread. He had a clear awareness of saving forum space and other members' time. This also reflects his sense of responsibility to the community, as a member.

7.4.5.2 Provide the Answer When Someone Knows Relevant Knowledge

Knowledge can be shared among peer users in the threads if someone already has an answer. If the peer user already knows the answer, he can immediately provide his answer to the questions of peer users in the discussion thread.

> **"**Many problems are solved just by knowing the answer."-Pr***

In many cases, the problems described in the threads can be easily solved when some forum user already knows the relevant answer. The forum users with relevant knowledge just need to provide the answer to the questioner in the thread. Therefore, no complicated knowledge construction process is involved in this situation. The questions which had already been solved by other users were more oriented to getting answers from peer users who once met similar problems. In other words, experiential knowledge can be easily shared by peer users who have had experience of solving the similar problems.

> "But anyone who has used one of these infernal machines for more than an hour or two has had some sort of difficulty! If I see a post about a problem that I have faced and conquered, I feel as though I should help that user. (I understand how he/she is feeling.)"-Jf***

This quotation states that the forum member has a natural sense of offering his experiential knowledge to other peer users who were facing the same problem as he was. This sense is mainly based on the sympathetic feeling and knowing that seeking for help is a common need.

7.4.6 New Knowledge Construction

New knowledge needs to be built to solve problems through collaborative efforts when there is no ready knowledge that can be searched on the forum or provided by forum users with relevant ready knowledge. The following knowledge construction episodes which emerged during this process are identified from the interview data, including "bringing outside knowledge", "asking focused question", "clarifying ambiguity", and "testing the idea".

7.4.6.1 Bringing Outside Knowledge

An external webpage link which is directed to other knowledge resources can be released to a discussion thread to help solve the problem. Knowledge found outside the forum can be brought to improve the chances of finding solutions.

> "By ourselves, most of us are quite capable of finding solutions to problems. But what really helps is when my peers introduce new websites/links/forums/youtube [Youtube] videos that we're unknown to us before, that assist us to solve our problem."-Vy***

External knowledge resources can also assist in solving a problem. As stated in the above quotation, in some cases, the interviewee's peers introduce external knowledge from outside the forum, which they are unfamiliar with, for instance, Youtube videos. It can assist them to solve their problems in an efficient way.

> "Occasionally I will include links to websites or quotes from other documents to illustrate a point." -Nn***

The above interviewee also occasionally posted website links to external knowledge or direct quotes from external knowledge sources to clarify an ambiguity.

> "Usually, I did not use the forum for answers to my questions. But if I went to a forum with a question and nobody on the forum had encountered a problem like mine, I would focus my

> effort on finding the answer elsewhere on the internet rather than continue pushing forward in the forum. Most forums, including the Dell forum, for the most part, are populated by a "regular crowd" that knows the answers to most common questions. If they are stumped, there is usually not much point in continuing the discussion. This is true if you are a sophisticated and advanced computer user with years of experience, and who knows how to use the internet, search tools, etc. effectively."-Bi***

For these active users with high-level of expertise, when their occasional questions released onto the forum could not be solved by other members and the discussions of the problem was stuck, would usually seek knowledge from other Internet sources rather than continually pushing forward the discussion in their threads. He believed that using other Internet sources was more effective than waiting for answers in the forum when regular members with high level knowledge and long experience were stumped.

7.4.6.2 Testing the Idea

The proposed solution idea is usually tested by applying it on the computer to check its workability. This is one of the essential knowledge construction episodes for solving technical problems.

> "After all the resources have been "compiled" and looked through, usually we depend on the more experienced forumers [forum users] to test/experiment themselves until a solution is found."-Vy***

The above statement manifests the existence of a sub-category of "testing the idea" in the collaborative knowledge solution finding process. According to this interviewee, the idea needs to be continuously tested by experienced forum users until a solution is found. It happens before "all of the resources have been 'compiled' and looked through". In other words, testing the idea mainly takes place after "proposing a solution idea" and "knowledge explanation & exploration episodes" To be more specific, the category of "proposing a solution idea" helps to bring all of the ideas together, i.e. "compile the resources". "Knowledge explanation and exploration episodes" help to "look through" these ideas. The categories of "bringing outside knowledge", "asking focused questions" and "clarifying ambiguity" help to shed light on finding a solution, and to acquire more contextual knowledge about the problem.

7.4.6.3 Asking Focused Question and Clarifying Ambiguity

The episodes of "asking focused question" and "clarifying ambiguity" are quite important in the knowledge construction process, i.e. the solution finding discussion process.

> "One user asks a question. The next user wanting to help will usually ask more details in order to better understand the question. Than [then] a third intervention, maybe by the same user will provide an answer. So there will be one user asking a question, than [then] one or two users will try answering the question."-ru***

The above quotation describes the process of asking questions and providing answers. When one user asks a question about the solution to the technical problem, the next forum user who wants to help will ask more detailed and specific questions about the problem in order to better understand it, and thus to diagnose its cause. According to the threads analysis, in most cases, these questions are about contextual information about the problem, rather than directly about the problem itself. After more contextual knowledge about technical problem is acquired, either the same poster who wants to help or a third user with the answer will propose a solution idea. This interviewee's statement emphasized the knowledge episode of "asking focused question" about a technical problem, which helped understanding of the problem during the solution identification process. The episode of "clarifying the ambiguity", which corresponds to "asking focused question", is also a necessary episode before the discussion achieves resolution.

> "Most discussions ended with the original poster reporting that the problem had gone away, either because of following the solution suggested on the forum or due to some other unknown reason. Some discussions were abandoned by the original poster when asked for more information."-Bi***

Most of the discussion can reach the last knowledge construction step, namely "Resolution Episode", after following suggested solutions from the forum users or for other unknown reason. Original posters usually report the solution of their problem as response to others' suggestions at the end of threads. In some cases, providing specific knowledge about the problem to clarify the ambiguity can decide the success of a solution. Some problems cannot be solved and the discussion is stopped because the original posters do not provide more detailed contextual knowledge about their problem. This also indirectly reflects that

contextual knowledge is very important for other members with expertise to diagnose the causes and offer suggestions.

7.4.6.4 Clarify the Ambiguity about the Problem

Clarifying the problem is highly emphasized by active users who usually help others solve their problems. One active user was asked "If there is no existing answer on the forum, what is the commonest process for the forum users to find a resolution?" by the researcher. His answer was:

> "Start a new post with as much information as possible. (I.E. system make up. Software running [ )] & a description of the current problem."-Jf***

The interviewee emphasized two key pieces of information needed for clarifying the ambiguity of the problem and for solving the problem, when starting a new thread:

1). contextual knowledge about the problem, such as his examples of system make up and software running in the computer. The above contextual information is not directly related to the problem, but it helps the active users to diagnose what factors cause problem.

2). Accurate information about the problem. Users significantly rely on the thread starter's description of the problem. This helps the users with relevant knowledge to know what the problem is.

It is important to give correct descriptions to enable the solution advisor to know what the problem is, and thus to provide a suitable solution.

> "Hardest when you don't know how to describe your problem -when you don't know the roots of it...and when you get an answer which doesn't solve it....It happens often to get an answer which doesn't fit in your case."-an***

The above interviewee, who was a medium active user in the forum, also stressed the difficulty and importance of describing the problem. It decides the success of the given answers. It is very common that a failed description causes suggested answer not to fit the case.

Giving sufficient contextual knowledge about the problem by the questioner is an important part in clarifying ambiguity. It helps peer knowledge experts to diagnose the problem and to prose a solution idea.

> "If there is no existing answer on the forum, what is the commonest process for the forum users to find a resolution? I suspect they are stuck. There are some real experts and if they can't help, it probably requires an expert at the computer (some problems are too complex too [to] solve through Q and A and some users are unable to provide the data needed to diagnose/solve the problem)."-Pr***

This active user pointed out that there are two reasons which cause the discussion become stuck: the active users do not know the answer and an expert is needed; the thread starter cannot provide the needed contextual information to diagnose and solve the problem. Thus, it can be seen that lack of contextual information, can result in a failure to solve the problem.

> "If answer is not there or is not clear to the user he/she would start a new post with an attention getting subject line and state the problem as clearly as is possible. Sit back and wait for help."-Jf***

> "I would first ask for more information about the problem, if necessary, then make some suggestions on how to solve the problem or where to look for a solution."-Vo***

From the perspectives of the questioner and the advisor, the above two active users respectively stressed the importance of providing clear and sufficient knowledge to clarify the ambiguity of the problem. The former interviewee thought the thread starter should classify the subject of his question, and more importantly, describe the problem as clearly as possible before getting an answer. The latter stated that he should have asked for more contextual information about the problem before giving suggestions.

> "The most complicated way is to not provide enough information up front so that there has to be several messages back and forth before someone trying to help can even begin to work on a solution to the problem."-Vo***

The above interviewees thought the most difficult aspect to solving a problem involved the questioner not clarifying his problem with enough contextual information. In this case, "asking the question (about the problem)" and "clarifying the ambiguity (about the problem)" between the questioner and advisor were conducted in a continuous way before the expert began working on the solution. This process is also identified in many selected other threads analysed. These two sub-categories usually happen before the sub-category of "proposing an idea", when there is no clear or sufficient knowledge about the problem.

Failure to provide a correct description of the problem and the relevant contextual information can bring in impractical answers from other users or cause the discussion to halt. Therefore, it is quite important to provide correct description of the problem and sufficient

contextual knowledge about the problem for other users to diagnose the cause and propose suggestions.

The forum user who is willing to help with high level knowledge also considers that it is essential to obtain more detailed knowledge about the problem before suggesting any solution. The function of clear and sufficient knowledge is to help diagnose the cause, which paves the way for proposing a solution.

> "1. Asking for more information and details
> 2. Suggesting a solution
> 3. Speculating on a cause and suggesting a course of action to confirm the cause, which if confirmed, would enable me to propose a solution"-Bi***

When the above interviewee was asked about the way he responded to others' questions, he pointed out that asking for more information about the problem was the first step before he devised a solution. This is an essential step for him to be able to speculate on the cause and propose a solution idea. Thus, the sub-categories "asking focused questions (about the problem)" and "clarifying the ambiguity (about the problem)" are strongly related to diagnosing the cause of the problem.

7.4.6.5 Contextual Knowledge about Problems & Finding Solutions

As stated above, the knowledge about problems can be divided into two types: 1. Knowledge about symptom of the problem, such as a very noisy laptop fan problem; 2. Contextual knowledge about the problem, such as the laptop model, hardware model and installed software. The first type is about "what is the problem". It tells other users what is wrong with his or her computer. The second type is about "What is the context of the occurrence of problem", which helps to diagnose the cause. It helps the forum users with expertise to understand what has caused the problem, in other words, to diagnose its causes. Therefore, the contextual knowledge about the problem is also the basis for proposing a solution.

The following quotation illustrates the importance of obtaining contextual knowledge about technical problems for forum users with expertise to understand the question and to diagnose the causes of the problem.

> "The discussion usually starts off the user stating the problem, but not offering enough information on the specifics, such [as] model of computer, operating system, model of specific devices, etc. So the first person to attempt to answer the question, usually has to ask for more

> information. Someone then usually suggest some things to try and hopes that the initial poster will report back on the results of the suggestions."-Vo***

In the above quotation, the interviewee emphasizes the importance of obtaining sufficient contextual knowledge about the problem, i.e. "enough information on the specifics, such [as] model of computer, operating system, model of specific devices, etc." This information is not about the symptom of the problem but about the computer environment where the problem occurred. Based on the thread analysis, in general, the contextual knowledge should include hardware information and software information. If the first poster starting with a technical problem does not provide sufficient contextual knowledge, other users have to ask for it before suggesting a solution. Meanwhile, this interviewee also states that feedback is also expected after testing has been carried out, for further action, like confirming the diagnosis and solution.

Another interviewee also stresses the importance of contextual knowledge about technical problem regarding better understand the problem.

> "One user asks a question. The next user wanting to help will usually ask more details in order to better understand the question. Than a third intervention, maybe by the same user will provide an answer." –ru***

This interviewee points out the requisite nature of contextual knowledge about the problem. Acquiring more contextual knowledge about the problem by asking the forum user focused questions helps to better understand the question. It is essential to understand the problem before diagnosing the causes and providing an answer.

Contextual knowledge is the vital part of knowledge about technical problems needed for finding solutions. Knowledge about symptoms helps the advisor to understand what the problem is, while contextual knowledge helps identify causes and solutions. Diagnosing the cause and proposing solutions are also based on the advisor's experiential knowledge, obtained directly or indirectly. The solution is usually quite specific, depending on different contextual situations of the problem. Therefore, detailed contextual information about a problem is required for proposing solution ideas, which are mainly based on experts' experiential knowledge.

Clarifying ambiguity about the technical problems is mainly about providing detailed contextual information, which can help the advisor to identity what type of experiential knowledge is needed to solve this specific problem. This is because experiential knowledge is built based on the advisor's or other person's previous problem solving efforts. Finding a

solution to a particular technical problem is usually quite specific due to different types of models of computer, hardware models, and software environments and so on.

> "If a person posts a question but omits necessary details, someone will usually ask for more information. This is an area where experience helps. One learns to pay attention to every detail of the post, including the subject heading, the main text, and the tag field. It is also useful to go to the poster's "profile" page where there are links to all of their postings on the Forum. Many times I can learn missing context or specific information, such as model number or operating system, from reading their other posts."-Jo***

The above quotation explains why specific and detailed contextual knowledge about problems is important in solving a problem. It is related to the "area where experience helps". That is to say, the contextual knowledge about technical problems helps forum users with expertise to understand what kind of knowledge is needed and how to use their experiential knowledge to solve the problem. Thus, forum users who are willing to help pay attention to: 1) direct contextual information about the problem, such as the tag field, and 2) indirect information about the problem found in the questioner's other posts on the forum.

Those thread starters with technical problems usually fail to provide sufficient and detailed contextual knowledge about technical problems, which is essential for diagnosing the problem and proposing solutions. This can be caused by not knowing what details are needed. Another reason can be overly generalized descriptions of the problems, due to the assumption of the general nature of the problem. Sometimes this is because these users are under-informed about their products.

> "They "usually" provide sufficient details but very frequently do not. One reason for that is not knowing which details to include. For example, the question might concern a lack of sound from the laptop speakers, and the poster will fail to mention whether or not there is still sound through headphones, because the poster does not know that that datum is important in order to diagnose the cause of the problem.
>
> Another reason is that people tend to over-generalize. They tend to think that whatever problem they are having is a common problem with all similar laptops and so they think that the details of their specific laptop are not important.
>
> Similarly, they think that whatever software they are using is a well known product and so they do not provide details about it. I frequently have to go to a software product's web site to learn what it does, its requirements, its features, etc., in order to help resolve a question concerning audio.

> Sometimes they are under-informed. For example a poster might think that he/she owns a set of usb [USB] (digital) headphones and will state that in the initial post, then I find out later through research that the headphones are actually analog but have a usb [USB] plug only to access power from the usb [USB] port."-Jo***

The given example about a sound problem in the laptop speaker in the above quotation illustrates well the importance of sufficient contextual knowledge about technical problems in diagnosing a cause. The questioner just released the information about the problem: there was no sound in his laptop's speaker. However, he failed to clarify specific context knowledge about the problem: whether there was sound in the headphones. Similarly, important contextual knowledge about the problem is also missing in the second example. Although the poster had USB headphones, he did not specify other contextual knowledge:

> "the headphones are actually analog but have a usb [USB] plug only to access power from the usb [USB] port."

Without this specific contextual knowledge, other peer users could not diagnose the cause of the problem and propose a workable solution.

When the forum users cannot find required existing answers to their problems from the forum, they will start a new thread and try to explain the problem in a detailed and accurate way in order to let others with more expertise and experience figure out its cause.

> "The hardest part sure would be to read everything you possible could in regards to your problem and only in case you are still unable to troubleshoot and fix the issue you are facing yoursel [yourself], then come and explain the problem IN DETAIL and state the steps you've done so far to fix the issue…"-Dr***

In this quotation, the interviewee emphasizes the importance of providing detailed contextual information about problems in block letters. However, clarifying ambiguity about the problem is still considered to be the hardest part of finding a solution for this interviewee.

One interviewee who used to be an active forum user with high knowledge level described a common way of providing a solution for the questioner who cannot find a ready answer in the forum. The importance of contextual knowledge is highly stressed in his statement, as follows:

> "Think logically about the problem, combine the symptoms of the problem with knowledge of how computers (and in particular, Dell computers) work, and arrive at a probable cause for the problem. Once the cause is identified, confirm by asking the user more questions or asking

them to do something that would confirm the diagnosis. Then suggest a solution or tell the user that that was how computers worked, and there was nothing they could do to change that (they were not encountering an error condition).”-Bi***

During his solution finding process, contextual knowledge about the problem was strongly emphasized. Firstly, when identifying a likely cause of the problem, information about the symptoms of the technical problem described by the inquirer was combined with contextual knowledge likely to be related to that type of problem, such as the interviewee’s statement of “knowledge of how computers (and in particular, Dell computers) work”; secondly, more detailed contextual knowledge about the problem, which can help confirm the diagnosis of the cause, is asked. Asking focused questions to get more detailed information about the problem and receiving clarification from the initial poster helped the user to confirm the diagnosis, based on which solution could be proposed.

Another interviewee further described the method he adopted to find the solution to a technical problem. Asking focused and detailed questions about the details is also strongly recommended in judging the existence of the problem and confirming causes.

“1.Identify whether a problem actually exists (there were several dozens of questions regarding normal behaviour of computers that some users thought was abnormal, or they wanted the computer to do something that we knew it simply was not capable of doing. Or they wanted to do something illegal (such as crack software or passwords, etc.)
2. Ask for more details if a determination can’t be made
3. Formulate probable causes of the problem
4. Ask more questions to confirm or discount different causes
5. Suggest possible solutions to the causes finally identified based on our understanding of how computer software and hardware works.”-Bi***

His method of finding a solution starts with justifying the existence of the problem stated by the questioner. If the solution idea cannot be proposed based on the initial description of the problem, more details about contextual knowledge of the problem will be asked. According to the clarification of the ambiguity regarding the above questions, possible causes of the problem can be identified. Then more questions about contextual knowledge are asked again, in order to exclude irrelevant causes of the problems. Finally solutions are identified and suggested according to the interviewee’s contextual knowledge of how a computer (including software and hardware) works, which is relevant to the cause of the stated technical problem. In this process, asking detailed and focused questions about contextual knowledge is

especially stressed in the process of identifying causes. In addition, the clarification of the contextual knowledge about the problem, which is achieved after the question is asked, helps people to propose solutions. These ideas are formed based on specific contextual knowledge regarding the causes, like software and hardware knowledge.

This interviewee gave a further explanation of how these active community members with varying specific knowledge areas of computers identified the causes and proposed solutions.

> "There were experts on the forum dealing with various specific areas. Each of these experts weighed in when they thought the cause of a problem was related to their area of expertise. There were experts on the various hardware areas (display, sound, etc.) as well as software areas (office software, malware removal, etc.)."-Bi***

These active forum users with high-level expertise usually firstly consider the relevance of the causes to their specific expertise area before participating: for example, hardware areas (e.g. display and sound) or software areas (i.e. office software). When they confirmed the relevance with the problem, after acquiring detailed contextual knowledge from questioner, they made the decision to participate in the discussion. Certainly, the solution was based on his area of knowledge, which is mainly experiential knowledge. The experiential knowledge was mainly acquired from both direct and indirect experience of solving problems in different cases and thus it had strong contextual features. In a word, the proposition of a solution is significantly based on the contextual knowledge about the solution.

7.4.6.6 Knowledge Building Process

According to the findings from the threads analysis, there are four essential knowledge construction episodes involved in building new knowledge to solve problems: "Initiation Episode", "Exploration & Explanation Episode", "New Idea Proposing Episode", and "Evaluating & Testing Episode".

> "The discussion usually starts off the user stating the problem, but not offering enough information on the specifics, such [as] model of computer, operating system, model of specific devices, etc. So the first person to attempt to answer the question, usually has to ask for more information. Someone then usually suggest some things to try and hopes that the initial poster will report back on the results of the suggestions."-Vo***

The solution finding process in the above statement started from the release of the question about technical problems, which triggered the whole discussion thread. However, the

questioner usually did not provide sufficient specific and contextual information about the technical problem, such as information about "operating system". Therefore, more focused questions about the contextual information of the problem were asked by the user who was willing to help. This is reflected in the category of "asking focused question (about the problem)" created in the thread analysis. Although the interviewee did not specifically mention answering the focused question, i.e. "clarifying ambiguity (about the problem)", it usually follows after a focused question is asked and occurs before a new idea is proposed. "Asking focused questions" and "clarifying ambiguity" are the main forms of "Exploration & Explanation Episode" in the knowledge construction process.

Next a solution is proposed by another peer user, and this idea is later justified by linking it with existing facts or tested by applying it to the computer. The feedback about results of applying the suggested idea usually decides whether the discussion stops or continues. If it does not work, new solution ideas will be continuously proposed and tested or justified until a workable solution is identified. Thus, we can draw the conclusion that the knowledge construction described above is a quite typical solution finding process discovered in the threads analysis.

Different roles are played by various forum users in the knowledge construction process. Users of different knowledge levels and experience are involved in different knowledge construction episodes.

> "Some users are in need of help by posing a question/problem, and other users are there to help. When users reply as to what has worked or not worked, then that is a help in itself. As long as people are honest in their responses, the forum will work as designed."-n5***

This interviewee points out three essential knowledge construction episodes in the process of finding solutions, namely "triggering question" (reflected in "posting a question/problem"), "new idea proposing" (reflect in offering help), and "testing the idea" (conducted before replying with "what has worked or not worked"). These three knowledge construction episodes correspond with the different roles of forum users. Some users, usually of low-level expertise, who have technical problems and need others' help, trigger the discussion by posting a problem; other users with high level expertise or relevant experience provide solution ideas; then the suggested ideas are applied and feedback is given by the questioner. In the discussion threads, this process usually repeats itself until the solution can be found. In other words, this discussion process will not stop until the reply reporting workability of a

solution idea is provided. The interviewer also believes that this is how the forum works to solve users' problems, as designed.

7.4.6.7 Knowledge Construction Strategy: "Trial-and-Error" Strategy

The "trial- and-error" strategy can be used to construct new knowledge to solve problems with no official solutions from the company or ready answers from other peer users. New knowledge for solving the problem can be constructed through trying different ideas until a workable solution is identified.

> "…A large number of solutions that are unknown to Dell come about by people experimenting with their computers. People do this all the time and occasionally they stumble upon something of value, and when they do they often disseminate it by posting on the forum. A great example of that process is this very long thread
> http://en.community.dell.com/supportforums/laptop/f/3517/t/19279703.aspx?PageIndex=1
> Dell had a new laptop line named Studio, but the line had noise issues. Dell worked on getting a solution for over a year but claimed to be unable to do so. This thread arose from mostly non-regulars who hashed out the problem and came up with a workaround solution, which was more than Dell was able to do. The thread is like a miniature example of how the forum as whole works."-Jo***

The above interviewee points out a general way for forum users to find a large quantity of solutions to new problems: "experimenting with their computers". They keep on trying different ideas on their computers until they occasionally find some valuable knowledge about its solution. Then they disseminate it in the discussion thread after experimenting with the idea. During the experimenting process, the idea's workability can be tested too.

Furthermore, there is a hierarchical level within these proposed solutions/answers as the discussion proceeds and the trial-and-error strategy is applied.

> "Many problems are asked again and again and it gets easier and easier to simply provide the answer/solution. Some problems require generic debugging skills. It is not clear what the solution might be, but it is clear what the path of diagnosing is. For example, suggesting rebooting, going back to an earlier restore point, reinstalling the app, etc could solve many problems that are specific to the one user."-Pr***

This interviewee describes the approach that he and his peer users adopt to solve technical problems with "debugging skills". To put it in other words, they keep on suggesting different approaches until the workable solution is found. In this given example, the forum users keep on trying different approaches, including rebooting, and reinstalling the application, until they

find the solution to the user's specific problem. This process is parallel to the knowledge construction strategy of "trial-and-error" identified in the discussion threads. Seeking easier method of providing answers reflects the hierarchical levels of the provided answers/ideas (constructed new knowledge) in different discussion stages and the goal of their collaborative knowledge construction activities. This is in line with the findings from the thread analysis: the generated solution ideas evolve to be more reliable as the discussion proceeds.

7.5 Moderators and Moderation

7.5.1 Company Staff's Knowledge Characteristics

A large number of company employees with the label "Dell" in their forum user names participated in the forum and tried to provide answers. Thus, they were sometimes mistaken for "moderators" by forum users, but they did not have moderation responsibility as the forum liaison. The active users usually thought these "moderators" lacked sufficient experience and knowledge to solve technical problems, especially complex ones. Meanwhile, these "moderators" mainly gave generic knowledge of computers, which was probably mainly from menu scripts. Therefore, they lacked specific knowledge to solve various problems in different models of computers. In this forum, most of the problems being asked were solved by active users themselves.

> "However, Dell's tech support people who are now participating don't seem to have the depth of knowledge that the forum regulars historically had. They tend toward generic answer from their scripts and the information as provided in Dell's owner's manuals which is somewhat limited, particularly in the area of laptop audio. Their most obvious weakness is that they don't know the differences between the different models and the problems unique to each, and so tend to give "one answer fits all" replies."-Jo***

The above quotation illustrates the reason why the company employees could not solve the forum users' technical problems, which was due to a lack of specific knowledge. Unlike the active forum users, the moderators just gave general answers from their scripts and manuals rather than deep depth of knowledge in specific area, for example, laptop audio. Their main weakness was that they lacked experience of different models, especially of solving unique problems with different types of computers. As stated before, solving technical problems needs contextual knowledge, which is mainly obtained from experience and limits the moderators' capability to provide specific answers to varying problems.

The following quotation from another active forum user also describes these moderators as "incompetent" in solving users' issues. It also states that solutions from forum users with specific knowledge were more workable and rapid than contacting Dell support staff.

> "…most of the user ['s] problems were solved without the hassle of involving mostly incompetent Dell Technical Support personal. Sometimes the solutions were easier and more rapidly attained [from forum users] than contacting Dell Technical Support."-Vo***

7.5.2 Moderator's Role in the Virtual Product User Community

7.5.2.1 "Censor" (order maintainer) of Liaisons

There were some "trolls" in the forum who published abusive, seditious, extraneous, and off-topic posts. They disrupted other users' normal on-topic discussions regarding knowledge sharing and construction.

> "Then there are those who are just there to "troll" others...There are also the "trolls", who usually try to make life harder for everyone else, by questioning everything which is asked, correcting minor typos/grammatical mistakes, and just trying to drive the topic of course by argument."-Vy***

These "trolls" can impede the problem-solving process. The content they publish, for instance, questioning everything, usually elicits unpleasant responses and causes the discussion to go off track.

The abusive language can be a barrier to the community members' participation in discussion. Thus, censorship of abusive language is needed to create a friendly online environment, so one of the major roles of the forum moderators with forum managing responsibility is to censor and remove unacceptable online contents.

> "Initially, the moderator's role was to step in when people became rude or belligerent. They had the power to delete offensive posts and to ban those who did not follow the forum's terms of service." -Vo***

The above statements points out the moderator's role regarding censoring of "rude or belligerent" language of forum users, including having the power to delete posts containing offensive language and ban forum users whose posts are not in line with the forum terms of service.

In some cases, posts which are judged to be irrelevant to the forum discussion can also be deleted by the moderator.

> "On one occasion one of my posts was deleted because the moderator judged that a link I had included constituted advertising. I am now a bit more careful to vet the links that I include."-Nn***

In this example, the moderator deleted one of this interviewee's posts due to a suspicion they were advertising. This reminded this interviewee to be more cautious about links he included in his posts.

The following examples are also about the moderator's censoring role.

> "The moderators role within the Dell Alienware forum went beyond being the facilitator of what goes on within the forum, and making sure people control their language through enforced censorship." –vy***

> "What is your perception of the moderator's role in participating in the forum? They are just there to keep forum in order, nothing more then [than] that"-os***

> "There were no moderators in most of the forum areas I participated in. There were some Dell representatives who did jump in and remove personal information and spam from the forums, or closed threads when the person seemed to be asking for information that could be illegal, but the forums were quite free and open most of the time."-Bi***

> "it should be to be both involved with the posters to help keep it moving smoothly, being knowledgeable, interested and upholding the forum rules - taking people to task if they violate - i.e., trying to advertise, being a pain etc".-v4***

The above interviewee considered that the moderators should involve themselves in keeping the discussion moving forward smoothly, being knowledgeable, and upholding the forum rules.

7.5.2.2 Bridging Role between the Community and the Organization

There are only a small number of company staff named as "Forum liaisons". They are supposed to have forum moderation responsibility and play a bridging role between the

community and the organization, for instance, 

and 

. The moderators' bridging role between the product user community and the organization is reflected in their title "liaisons".

> "… As you might know, years ago Dell stopped calling them "moderators" and started calling them "liaisons", thus signalling that their primary role was to be a link between forum users and Dell."-Jo***

The above interviewee, who has several years of experience in the Dell support forum, suggested that the linking function was revealed in their title.

Another interviewee also believed that the bridging role of moderators with title of "Liaison" was one of the critical roles in this product user community.

> "Now, assuming moderators are actually Dell staff members, they are sort of a bridge between company divisions and company customers, which of course is a crucial role in this virtual community."-Dr***

Other moderators who just provided technical support and did not have any moderation responsibility also linked forum users and technicians within the company.

> "Sometimes I get contacted by staff members to provide contact details and service tag data, but nothing happens ever after. I've posted a long list of issues in regards to drivers missing for Windows 8 for my latop [laptop], it was late October. It's the end of March now and nothing has moved even a sligtest [slightest] step further. All the issues are there, for all the users of this laptop model. You can safely assume Dell has just ditched their cutomers [customers]. Or staff members never actually passed this to the respective teams behind certain devisions [divisions]."-Dr***
>
> "Oddly enough, these are personal conversations mostly. They contact you, add you as a friend and try to communicate in order to understand the problem in detail. Sadly, only a single conversation with a staff member (the on-site service case I've mentioned) has actually lead to something usefult [useful], which actually resolved the issue I was having . but [But] it took nearly 6 month, ridiculous! The rest of the conversations I had have been just in a form of: "what is your deal - ok - I will make sure to tell person X - bye"."-Dr***

The following story told by one interviewee offers further evidence of the moderator's bridging role. In his story, one moderator contacted an interviewee when a post containing

the problem was released in the forum. Detailed information about the problem and service tag data was asked by the moderator, who then passed the above information to technical support staff of the respective working team. Finally the problem was solved with the help of technical support staff. According to the interviewee, such successful knowledge transfer through the bridging role of moderator was not very common. In most cases, the moderator failed to pass the interviewee's problems on to the respective teams, or failed to transmit solutions from technical support teams to the users.

7.5.2.3 Knowledge Asset Manager on Processing Users' Posts

The moderator with forum managing power (i.e. liaisons) also had the responsibility of processing the forum users' posts including closing the repetitive threads. The discussion contents on solving technical problems can be considered to be a valuable knowledge asset of the forum. Thus, the moderator can be considered as a knowledge asset manager when involved in processing users' posts.

In some cases, when forum users kept on starting new threads asking repetitive questions whose solution has already been discussed, the moderator usually deleted such threads to make the whole forum more effective and organized.

> "After months of questions and answers on the buzzing/stuttering problem for certain Dell models, I was glad to see that they closed the thread. It was constant rehashing of the same thing. People needed to read the thread, that's all. The moderator saw this and ended it."-n5***

The above quotation presents a typical example of repetitive threads being deleted by the moderator. Some questions about buzzing/stuttering problems for certain models of Dell product kept on being asked for months, although there were already answers in other threads. In such a case, the moderator ended the repetitive discussion threads after noticing them.

The moderator was also in charge of editing the threads to make them tidy and organised.

> "There are more questions answered on the forum and more information provided so it is more useful and interesting to browse even if you don't have a question to ask. They keep the threads shorter and cleaner."-ru***

This quotation stated that the moderators were in charging of editing the threads to make them shorter and cleaner; and to make the forum more useful and interesting. This is the reason why this interviewee was attracted to browse the forum, even though he did not have any questions.

The following interviewee also stated that the moderator kept the discussions clean and removed inappropriate content from the forum.

> **“**To keep the discussion clean and weed out the junk that can quickly pollute online forum discussions.”-da***

7.5.2.4 Information Provider, but not a Good Answer Provider

The moderator also worked as an information provider in the forum, but the general information they provided was mainly about warranties, forum information, and so on.

> “I don’t remember being able to contact the moderator directly, apart from a PM, but the usual direction of a conversation between a moderator and myself would always be a message from the moderator to me in the form of a warning, or a piece of general information provided to all members of a thread”-vy***

This quotation states that the occasional conversation between the moderator and the interviewee via private messaging was a warning, while general information was given to all participants in the discussion threads.

The moderators also tried to answer forum users’ questions about technical problems, but their answers were usually considered to be unhelpful by the interviewees, due to a lack of high level expertise.

> “The forum is quite good and mostly informative and the community is cooperative as well, however the DELL moderators especially the Indian staff is next to useless, they just disregard everything that a user reports and suggest him the same things over and over like a preprogramed [pre-programmed] robot.”-Yr***

The above interviewee believed the forum was an effective and informative knowledge resource, but thought the moderators, who were company employees without forum managing power (i.e. not liaisons), were quite incapable of providing workable answers to their questions. These moderators only provide same general information from a user menu script to different technical problems.

One active user of the forum also perceived the moderator to be a “peace keeper” rather than a helpful knowledge provider, due to a lack of sufficient expertise.

> **“**They are good and do very little except when the behaviour is out of control.”-Pr***

The following interviewee was also quite disappointed about the moderator role as information provider, although he or she once had a successful experience of gaining the requisite knowledge from a moderator who was a retired on-site technician.

> "It mostly has been a disappointing experience for me. I can't say I was scred [scared] or anything, but it sure creates an illusion of a total apathy from moderator POV. Though not all of them are like that. I once had a conversation with a mod (a staff member if you will?), who is a retired on-site technician and from this conversation I actually received a lot of information I was interested in. This allowed me to further share this knowledge with other users of my laptop model."-Dr***

Another interviewee also mentioned that these ordinary moderators (not liaisons) provided general information, such as updated product availability, software updates, and so on. In a few cases they offered specific questions to forum users.

> "…They also provided updates on product availability, hardware compatibility, software updates, etc. This took out the hard part of finding the nitty gritty information ourselves, like part numbers, etc." –vy***
>
> "It was only during particular instances where the moderator would answer specific questions to individuals."-vy***

Some active users also thought the moderator's role in user participation in the forum was not important, except for providing general and public information, such as the Dell policy and warranty. They preferred to reduce the moderators' role in community members' participation.

> "Less is better. Unless it is a question of Dell Policy/Warranty they play very little role."-Jf***

In a word, the moderator could mainly provide general information rather than specific solutions to forum users' problems. This is because a technical problem is quite specific and needs experiential knowledge to be solved. This is also the reason that most of the solutions were answered by active forum users with high-level expertise and long-term experience.

7.5.2.5 Lobby for the Forum Users

Some moderators are also considered to be lobbyists on behalf of the community members for particular issues.

> "Bob was succeeded by a series of moderators who kept a pretty low profile. A couple of times we had had moderators who basically kept a low profile but who became active on a particular

> issue, and lobbied Dell on behalf of the laptop owners who had that issue. Those moderators promptly disappeared, never to be seen again. From instances like that I have deduced that whatever the role of the moderators it is not to work too strenuously on behalf of the laptop owners."-Jo***

The above interviewee states that some moderators were very active in lobbying the Dell Company on this forum on behalf of product users who had technical problems in their computers. However, these moderators suddenly disappeared from the forum. Therefore, this interviewee deduced that the moderator's role as a lobby should be limited within the company's interests.

In the findings of the discussion threads analysis, some discussion participants also played this role, lobbying the company on behalf of product users to solve their common technical problems. Therefore, it can be assumed that the moderator's role can also be played by volunteer forum users.

7.5.2.6 Advice Seeker for Managing the Forum

In some cases, the moderator in the forum also sought advice about managing the forum from forum regulars with high levels of expertise. These forum users' suggestions were also usually implemented.

> **"**They also sought out advice about the operation of the forum from the knowledge participants and often implemented changes suggest by the knowledgeable participants**."**-Vo***

To conclude, the moderator's role, as perceived by the community members, can be categorized as in the following table:

Table 7-1: Classification of Moderator's roles perceived by community members

Moderator's role	**Function**	**Type of Moderator**	**Dimensions**	**Replaceability by forum users**
Censor	maintain the social order	Liaisons	Social Dimension	No
Boundary Spanner	link between the community and the business organization	Liaisons	Network Dimension	Yes
Lobby	lobby the company on behalf of the community members	Liaisons	Network Dimension	Yes
Knowledge asset manager	processing forum users' posts	Liaisons	Knowledge Dimension	No
Information provider but not a good answer provider	provide general information	Technical Support staff	Knowledge Dimension	Yes
Advice seeker	Seek advice about managing the forum from forum regulars	Liaisons	Network Dimension	No

[Note: Role replaceability by forum users can be mainly confirmed by threads analysis. In addition, some interviewee's statement can also partially reflect this.]

7.5.3 Influence of the Moderator

Most of the interviewees considered that the moderators did not have much influence on their knowledge behaviours, except in ensuring the users were in line with the rules of the community, keeping the forum in order and maintaining a friendly environment. This is also connected with the moderator's role as "censor", which is highly stressed by these interviewees.

"They are good and do very little except when the behaviour is out of control."-Pr***

This interviewee believes that the moderator's role is just limited to censoring forum users' inappropriate behaviours, which are out of control. However, there is nothing they can do to influence forum users' behaviour.

"What is your perception of the moderator's role in participating in the forum? it should be to be both involved with the posters to help keep it moving smoothly, being knowledgeable, interested and upholding the forum rules - taking people to task if they violate - i.e., trying to advertise, being a pain etc."-v4***

The above quotation strongly emphasizes the moderator's role as the censor, to keep the forum in order, maintain smoothness in discussion, enforce forum rules, and take actions against forum users violating the rules.

> "What is your perception of the moderator's role in participating in the forum? They are just there to keep forum in order, nothing more then [than] that"-os***

This quotation also states the same idea. The censoring role played by the moderators to keep the forum in order is their only influence upon the forum.

> "I was happy to remain in the forum, and I did not want to challenge the moderator when it came to censorship, so I didn't use foul language after I got my warning. And he was very knowledgeable and conveyed himself to be a kind and helpful individual, so I had a certain level of respect for him. If I received a message/complaint/warning from him/her, it was usually within reason, and not ridiculous like other moderators in other forums."-vy***

The above interviewee expresses his agreement with the moderator's censorship. This interviewee stopped using foul language after he got a warning message from the moderator. Furthermore, he perceived this moderator to be a knowledgeable, kind, and helpful individual and considered the warning messages to be reasonable.

Some active users thought the moderator did not have much influence on their forum participation behaviour.

> "Not much"-Pr***

> "What is the influence of the moderator and moderation system on your forum usage experience? Nil."-Jf***

> "The moderator is pretty discreet, I am usually unaware of the moderator's presence."-Nn***

These active users had much experience on the forum and high-level expertise. They generally considered the moderators did not have a strong impact on their knowledge behaviour. A possible explanation may be that their familiarization with the forum regulations, norms, and culture ensured their appropriate behaviour. Meanwhile, their high level of knowledge and helpful role also gave them a central position in the community. Thus, the moderator's power, knowledge level and influence were minimised in the eyes of active forum users.

This is also part of the reason that they preferred to reduce the moderators' role in community members' participation. For example, in order to improve moderator's service, one interviewee suggested that moderators should:

> "Brush up on language skills and stay the heck out of things as much as possible."

The role involved in solving problems, disseminating knowledge, can be played by the collective efforts of the active users with high-level and specific experiential knowledge. Moreover, the threads analysis findings also indicate that mediating irrelevant disputes and arguments can also be conducted by forum members themselves.

> "Keep out spam, trolls and other nuisances. Mediate disputes related to duplicate postings, legal arguments, etc. Otherwise, keep out and let users solve problems."-Bi***

The above quotation also proposes that the moderator's role should be focused on maintaining the social order of the community by controlling rude and inappropriate behaviours, and mediating disputes. As for solving problems, it can be conducted by the forum users themselves.

> "I would not participate in a forum that was heavily moderated. Moderation should involve control of the forum for legal reasons, and to protect against spam, personal attacks, etc. Otherwise, they should stay out of the process as much as possible. If every post in a forum had to be moderated before even being posted and becoming visible on a forum, I would have absolutely no interest in such a forum."-Bi***

The interviewee quoted above also said that moderation should be limited to maintaining the social order, especially about legal issues, and protecting forum users from spamming and personal attacks. The moderator should not be involved in the knowledge process. Minimum moderation is the attractive factor for this interviewee.

7.5.4 Collective Moderation Mechanism

7.5.4.1 Collective Moderation

In order to offset the negative effects caused by some forum users' unpleasant and inappropriate online behaviours, a collective moderation mechanism was adopted, besides the moderator's censorship.

> "Sometime there were rude or belligerent users that would make things unpleasant, but the group of knowledgeable users would team up to defend each other or in some other way calm the situation and get the thread back on track."-Vo***

This interviewee points out two methods for maintaining social order and keeping the discussion on track when some rude or belligerent online behaviour occurred: 1). Active forum users with expertise defended each other (i.e. collective defence); 2. Some forum users mediated the dispute and brought the discussion back on track. Collective moderation has also been identified in threads analysis.

Collective moderation was also used to keep the discussion on topic. In some cases, discussions in the forum went off topic, although they generally focused on the questions being discussed.

> **"**Well, in some cases they go off topics, but generally they're fitted to the questions asked.**"**-K2***

When a post irrelevant to the question was released, it would trigger argument or dispute about the contents of the post. In this situation, the following discussion participants usually mediated the disputation by posting a request or just ignoring the disputation and continuing the topic. This is also identified from thread analysis.

7.5.4.2 Volunteer Moderators

Some moderation work can be conducted by volunteer forum regulars, who have long experience and high-level expertise. A small number of active regulars of the forum, usually RocktStars, who are not company employees, voluntarily take limited forum management duties as well.

> **"*RockStars***. a [A]small number of the RockStars have limited Forum management duties. Like all RockStars they are not Dell employees and are unpaid. Being given moderation duties is one of the rewards I was talking about before. It is clever because Dell has severely reduced the Moderator staff but they make up for that by getting free services from the RockStars."-Jo***
>
> "Well, not all with Dell_ titles are moderators, and some with moderation duties are forum regulars (Dell Rockstars)[7]. Many with Dell_ titles are just tech support people with no moderation duties."-Jo***

[7] The forum regulars with the title of "Dell Rockstars" cannot be approached because they are under a Non-disclosure Contract with Dell Company, which does not allow them to be interviewed. Their roles can only be known from other interviewees' comments and perceptions. Thus, this is one limitation of the current research

The RockStars are just unpaid volunteers for moderating work. They are appointed by the forum management team. Being given limited forum management duties is considered to be a reward for some active forum users. In addition, it also helps the business organization to cut the human resource cost of managing the forum.

> "None. Actually I don't think the Laptop Audio board has had a formal moderator for a couple of years since Bill B left, but if anything comes up Terry B handles it. Dell Rockstar Rick K handles the routine moderation duties."-Jo***

The above statement presents evidence of a volunteer moderator of one sub-forum (i.e. Laptop Audio board) who assisted a formal moderator in their duties. According to the interviewee, a very experienced forum user, the formal moderator Terry B had been in charge of managing one sub-forum since another moderator Bill B had left. At the same time, a Dell Rockstar, Rick K, had assisted moderator Bill B to handle routine moderation duties.

In some cases, some forum regulars with high-levels of expertise were not formally assigned forum managing duties, but they still played a role like a moderator regarding facilitating knowledge sharing and creation.

> "..I see little evidence of the moderators doing that. I would say that I am now performing the facilitator function on that particular board, through organizing and disseminating the information in various ways, by correcting any misinformation that gets posted, by directing posters to relevant information, etc."-Jo***

The about interviewee, who was an active forum participant with high expertise, stated that he voluntarily facilitated knowledge sharing and constructing activities on the Laptop Audio Board, instead of official moderators. He performed the knowledge facilitator's role through organizing and disseminating knowledge, correcting wrong information, and directing posters to correct threads.

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and regular community members acting as volunteer moderators is an area that can be further explored in the future.

7.5.5 Functions of the Moderator which Need to be Improved

Some interviewees also pointed out the problems in the moderator's roles regarded links to respective functioning groups within the organization. In some cases they failed to transfer knowledge about technical problems released by forum users to the engineers in the functioning division of the company. Consequently, knowledge about solutions which should be provided by the internal engineers was not be transmitted to the community members through the moderator. As these interviewees expected, the moderator should be well connected between the company knowledge network and the community on this forum.

> "I do ask questions myself, but I kind of put my hands down with this to be absolutely honest. I see that majority of my questions are either ignored. Sometimes I get contacted by staff members to provide contact details and service tag data, but nothing happens ever after. I've posted a long list of issues in regards to drivers missing for Windows 8 for my latop [laptop], it was late October. It's the end of March now and nothing has moved even a sligtest [slightest] step further. All the issues are there, for all the users of this laptop model. You can safely assume Dell has just ditched their cutomers [customers]. Or staff members never actually passed this to the respective teams behind certain devisions [divisions]."-Dr***

The above interviewee provides examples where moderators on the forum ignored his posts and failed to transit the information about his laptop's problem to the functioning divisions within the organization. Although the moderators who are in charge of technical support in the forum (i.e. not liaisons) asked for information about his problem and other contextual information (e.g. tag data), they did not give any feedback. This interviewee believed that they failed to transfer his information to the relevant working division within the company.

7.5.6 Conclusion

Forum users, especially active members, insisted that the moderator appointed by the company should limit their roles to liaising between the user community and the company, and being censor and peace-keeper. They believed the moderator should reduce their involvement in the discussion process as much as possible, due to their lack of specific knowledge to solve users' problems.

7.6 Community Culture

This section mainly discussed the cultural attributes of the community on this forum. It included valuing the helpful role of forum users, the netiquette of avoiding disputes, the open

nature of discussion, valuing the newbie, membership transition within the community, collective contributions to increasing overall knowledge, preference for less moderation, and the forming and maintenance of sub-communities.

7.6.1 Valuing the Helpful Role

The helpful role is highly valued in this technical forum, where product users share knowledge on usage experience and technical problems. Being helpful is mainly referred as providing help to others in terms of giving useful answers or suggestions to others' question.

> "Posting just to get your "numbers" up is a waste of everyone's time. Those people are easily spotted and shunned/ignored by the regulars. If you mean well and are just wrong there is no problem. If you continually post for the sake of posting you won't get much attention… If you believe that you can be helpful – you give it your best shot. The only important "role" is to be helpful."-Jf***

Community members who can offer help by answering others' questions and suggest workable solutions are considered to be the most important in this product user community. It is the quality rather than the quantity of posts which makes a forum user helpful in other's eyes. Forum users who published a large number of posts in order to have a high rank were not welcomed. However, offering wrong suggestions when helping others was still acceptable. In a word, offering help by providing workable suggestions and trying to be helpful but making mistakes were all welcomed. Both of these behaviours realized the establishment purpose of the forum.

7.6.2 Netiquette: Less Disputing

One of the most obvious features of this technical forum was the fact that it had much less disputes compared to other technical forums on the Internet. This is also reflected in the findings of threads analysis and pointed out by the following highly experienced forum user:

> "Something that interests me is that there seems to be less bickering on the Dell forum than on some other discussion boards on the internet. When bickering happens, it is never the original poster who starts it but usually one of the people who reply. I feel that we have less bickering because however the regulars here view their role, it includes giving advice in a manner that is acceptable to the original poster, and that means avoiding being the cause of contention."-Jo***

This interviewee states that the forum had less disputes than other online discussion forums and usually one of the repliers to the starting question started the dispute rather than the original poster. These regulars, who were also active knowledge contributors, perceived their role as advice-givers to the original poster's problems, so they chose a more acceptable manner to the original poster and avoided causing unnecessary contention. This is also in accordance with the emphasis on having a "helpful role" in the community.

The researcher also noticed that there was even less disputation in the support forum than in the Ideastrom community. Part of the explanation is the difference between discussion contents in these two communities. The threads in the support forum were completely technical solution-oriented discussions, while Ideastorm community members had both idea-oriented and technical solution-oriented discussions. Therefore, there was less possibility for Support Forum users to dispute over technical solutions than Ideastorm community members. Another reason for this difference may be the widely accepted values of being helpful in the Support Forum. People go to the support forum for advice and solutions, while Ideastorm community members share ideas.

The social norms and cultures embedded within the community can influence knowledge contribution behaviours of those active forum users. Therefore, less bickering in the forum can also promote knowledgeable forum user's motivation to offer help.

> "Treatment from others. I have no desire to be verbally abused when I am being polite and trying to be helpful. When some others are belligerent, I feel its [it's] time to go"-Pr***

The above interviewee, who was a forum regular with high-level knowledge, claimed that he did not want to be verbally abused when offering help. If any other forum user started bickering and treating him impolitely, he would leave the forum. Accordingly, netiquette and promoting the knowledge sharing and construction activities in this forum were stressed.

7.6.3 Being Open (/public): Avoiding private messages

One attribute of the community culture in this forum is its open nature. This is also in line with its design purpose: a public discussion space for Dell products on the Internet. Therefore, the forum users try to avoid using private messaging to discuss problems, in order to let others share their knowledge.

> "If you know who to go to you make "friends" with that person and send them an email or private message if you require help in a hurry. Generally, we try to avoid the private route

because public questions & answers will be more likely to help other users who find themselves faced with a similar situation."-Jf***

Forum user may seek advice from another user who is on his friends list or whom he knows well through private email or messaging during an emergency. However, generally, they avoid discussing questions and solutions through private communication channels. They discuss this in the public threads in order to share knowledge with other users who have similar problems.

"I would use a p.m. to direct the attention of another member to a post where I think their input would be helpful, but I don't use p.m.'s to formulate a solution in private. I would not say it is about the community culture, just common sense. The Dell Community Forum is a technical forum which is the appropriate place in which to discuss technical issues. Private messages are for personal communications of a non-technical nature. An exception is when a new poster contacts me directly via a p.m. with a question. Then I will usually answer with a p.m. I think that some people are too shy to post on the public forum."-Jo***

This interviewee claims users avoid talking about technical issues via private messages, the latter being used only for personal communication and to discuss non-technical issues. He might use private messaging to direct another forum user's attention to the threads which can help them with the same technical issue. All technical issues should be discussed in public, namely on the forum. This is also the definition and design purpose of the forum. The only exception is where a forum user is too shy to post his or her question.

However, some technical support staff on the forum like to use private messages to discuss technical problems with other forum users. This means knowledge cannot be shared with others. It is not welcomed and should be avoided.

"The tech support people also like to take the discussion of a problem into private messaging, which results in others in the community being blocked from the resolution of a given problem. This practice directly undermines the sharing of information that used to be a main strength of the forum."-Jo***

The above quotation illustrates that moderators providing tech support usually communicated with forum users to discuss technical problems via private messages. This blocks other community members from acquiring resolution of the same problem. It is considered that this behaviour directly weakens sharing knowledge within the whole community, which is the most attractive attribute of this forum.

7.6.4 Valuing the Newbie

The newbie to the community is highly valued by active forum users. They are considered as an important component of formulating a vibrant community, and that these individuals are also important contributors in the knowledge sharing and constructing process and in the whole knowledge asset formulating process.

> "New users who wish to learn are the most important. Without them there is no point in the forums. What would an elite university be without students?"-Jf***

The importance of new community members was highly emphasized by this interviewee, who was also an active community member. He believed that these newbies were an important part of the community, mentioning that new users who wished to learn are important, comparing the new users to students. This implies that the newbie has a learning feature which allows him to potentially become a knowledge expert and one of the core members of the community.

> "Solutions are not just the province of gurus, experts and tech support personnel. Many solutions have been a result of the gestalt of the forum, where even non-regulars have a vital role to play in providing pieces of the puzzle. The forum's value lies not just in formulating solutions, but in remembering them, something that tech support is not very good at."-Jo***

The above statement points out the newbies, who do not frequently participate in the discussions of the forum, also play an important role in the solution finding process. They can usually provide some incomplete ideas, "pieces of the puzzle". Meanwhile, they are also involved in "remembering" already existing solutions. In other words, they can also help to propose already existing solutions during the discussion process.

> "The regulars answered the questions that were put forth, of course, but beyond that all shared knowledge -- regulars and non-regulars -- and interacted with each other in a grand gestalt that advanced the overall understanding of Dell computers."-Jo***

The above quotation points out that the newbie who does not regularly participate in the discussion also plays a vital role in the knowledge building process although mainly the forum regulars propose solutions to the question. The regulars and newbies interact with each other to promote the overall knowledge construction about Dell products in a grand gestalt way on this forum.

7.6.5 Membership Evolution: from Periphery to Core of Community

"Evolution is common to all communities" (Wenger et al., 2002). Members of a community also go through different stages of their life circle, joining as a newbie, growing while knowledge and experience increase, becoming core members when maturing, and quitting the community in the last stage. Therefore, a newbie can be transited from the peripheral position to the centre of the community, which explains why newbies are considered to be important by active regulars.

The existence of the core members of the community and peripheral members is confirmed by the following interviewee. In this community, there are a small number of core members who have lots of experience and high-level knowledge, and a large number of peripheral members who mostly lack experience and knowledge.

> "At the time I was active participant, there was a group of about 20 very knowledgeable and experienced users who were considered the problem solvers. The rest were mostly inexperienced users looking for solutions to their problems."-Vo***

As indicated, there were a small group of core members within the community during this interviewee's active time who had lots of experience of solving problems. In contrast, the peripheral members were a much larger number and mostly inexperienced newbies who mainly sought knowledge from experienced users.

Some community members can undergo the transition from a newbie at in peripheral position to a much more central position in the community as a knowledge expert making suggestions to others.

> "How do you usually participate in the discussion: by asking a question or proposing an idea – or something else? It has changed over time. When I started I was seeking information. Now I find that people are responding with requests for information based on the experiences I have posted."-Nn***

The above quotation is a general introduction of the transition process. At beginning, this interviewee was just a newbie who always sought knowledge from other forum users. As his experience of solving various technical problems grew, other users started to request his knowledge, built on his experience.

"The forum regulars are generally pretty competent although I don't think they are as topnotch a group as we used to have, but that could easily just be my imagination. After all when I was a newbie the regulars at that time seemed like giants to me and I suppose I will always retain that impression of them." –Jo***

This interviewee believes that the forum regulars are not as competent as the group used to be. The regulars, in other words, the core members, seemed to be knowledge giants in this interviewee's eyes when he was a newbie. He became one of the core members with high-level expertise and much experience. This also reflects the different stages that a core member undergoes and the life circle of active members in the forum.

According to this interviewee's detailed description of his own forum participation experience, the newbie who has limited expertise and is at the periphery position of the community could gradually transit to the central position of the community while his experience and knowledge kept growing.

"Are you asking how one goes from being a newbie to being a core member? When I was a newbie there were two or three old hands that communicated some specific information about some technical problems. Those communications helped me feel accepted into the community and helped me to become rooted initially. For a few years I answered questions that I was able to and let the old hands answer the tough questions. .. I was content doing that but after a number of years I noticed that all of the regulars (on the Laptop Audio board) had drifted away. I had become the senior member and there was no one else to answer the tough questions I had previously avoided. I applied myself to gathering the answers the old guys had given and putting them into an orderly system or knowledge base in my computer and brain. That was the kernel of what later became the Laptop Audio FAQs. A lot of it is the accumulated wisdom of people who are long gone from the forum."-Jo***

At the beginning, this interviewee was just a newbie who asked some questions about technical problems from several forum regulars. The communication empowered him with the sense of being a member of this community. In the next few years, he was able to give answers to others' questions while the core members handled the most difficult ones. Finally, he found the regulars gradually left the forum and he himself become a core member. He accumulated these former regulars' answers and sorted them in order to deal with the tough questions.

7.6.6 Collective Contribution to Increase Overall Knowledge Asset

The community highly values all of its community members' contributions to constructing new knowledge through their collaborative efforts, including forum users of different levels of expertise and experience. Both regulars with high-level expertise and newbies with less knowledge are considered to be valuable contributors in this process.

> "Solutions are not just the province of gurus, experts and tech support personnel. Many solutions have been a result of the gestalt of the forum, where even non-regulars have a vital role to play in providing pieces of the puzzle. "-Jo***

As stated by the above interviewee, many solutions are generated through collaborative efforts of both active users and newbies, in other words, there is a "gestalt of the forum". They all play a vital role in this process by being involved in different knowledge construction episodes. For example, a newbie can propose a question to start the discussion, an active community member can propose a solution idea, and other members will test the idea.

7.6.7 Preference for Less Moderation

Active forum users strongly preferred a community culture of less moderation (i.e. autonomous management). They believed that the moderation should only take effect to keep the forum in order and censor unacceptable behaviour (e.g. personal attacks). The moderator should reduce their participation in the discussion process of knowledge sharing and construction to a minimum level.

> "I would not participate in a forum that was heavily moderated. Moderation should involve control of the forum for legal reasons, and to protect against spam, personal attacks, etc. Otherwise, they should stay out of the process as much as possible. If every post in a forum had to be moderated before even being posted and becoming visible on a forum, I would have absolutely no interest in such a forum."-Bi***

This interviewee preferred a less heavily moderated forum, suggesting that moderators should limit their function to peacekeeping and stay out of the discussion process as much as possible.

Furthermore, the following interviewee stated that the moderator should consult with forum users during the censoring the process.

> "I think they could consult with users on issues such as the one in the previous question rather than arbitrarily removing posts with no right of reply."-Nn***

This interviewee believed the user should have more power to negotiate with the moderator about removing posts. He suggested the moderator should consult with the posters before deleting their posts.

Another interviewee thought the censorship was too strict and caused unnecessary amounts of warnings.

> "Censorship was also a big issue, as we would receive warning messages should we swear or use foul language within the forum, even if it was just casual conversations with foul language included.**"**- Vy***

This quotation exemplifies a censorship issue regarding foul langue within the forum. According to this interviewee, the moderator conducted excessively strict censorship over foul language and sent unnecessary warning messages in response to user's casual use of foul language.

> "Don't enforce censorship. A forum is a place where people share and communicate. If you limit the was [way] they communicate, especially when using foul language is just part and parcel of their usual conversation, you are limiting their natural thought processes, which could in-turn lead to a limit in what they have to offer/share. And if somehow an experienced user gets banned erely [merely] for using foul language, that is just a waste of resources and knowledge for the forum."-Vy***

This interviewee proposed that the moderator should not enforce censorship over the community member's communication process, on the grounds that this disrupted the natural thought process and consequently limited knowledge sharing and creating. In addition, banning experienced users due to using foul language also caused a loss of knowledge from the forum.

7.6.8 Existence of Sub-culture and Sub-community

There was also a sub-community in the User Support Forum which could not be accessed by ordinary forum users, mainly consisting of active forum users. In contrast to the forum where the discussions were all about technical issues, topics in this sub-community did not have a strong technical feature. Thus, the culture in the sub-community was different from the main forum.

> "The VIP group was a hidden discussion board just for forum regulars. Some of the moderators but not all were regular participants on that board. The board is now defunct and was replaced by the Rockstar discussion board over a year ago. I declined the invitation to become a Rockstar and so have been out of the loop for a long time, but I can still communicate directly with the moderators through private messages."-Jo***

Besides private messages and forum posts as communication channels, there was also a hidden discussion board for VIP members (i.e. forum regulars and moderators), which had already been replaced by a Rockstar discussion board, which was only open to active community members with the title Rockstar. Although the above interviewee refused to become a Rockstar and could not join this discussion board, he could still communicate with moderators, as a long term regular, via private messages.

> "The experienced ones would usually be the first to solve a problem or provide feedback. These are the ones who have hundreds, if not thousands of posts under their belt. They are usually a community within the community, and know each other rather well, even if it's just online within the boundaries of the forum. It has been known that these experienced forumers [forum users] do sometimes meet in real life, due to their comfort with eah [each] other, and their similar interests."-Vy***

As stated above, this interviewee noticed the existence of a sub-community within the forum, "a community within the community". Its members were mainly active forum users who were knowledgeable and experienced. The active members who formed this sub-community came to know each other well and built friendships, sometimes meet each other in real life.

The topics on the private discussion board were quite different from the public forum. Discussions among active community members in this hidden forum do not focus on technical issues.

> "I don't have access to the RockStar board. My understanding is that they just changed the name of the old V.I.P. discussion board. On that board we had general discussion usually of a non technical nature. By that I mean that on the public boards we discuss technical issues and try to stay focused and on topic. The private board is the place to pass around jokes, gossip, post links to items of interest, etc. Also that is where the discussion about the Forum itself takes place. For example one might discuss a Forum feature that one doesn't like, or report a feature of the site that is not working properly."-Jo***

According to this interviewee, who was quite an active forum member with many years experience on this forum, the hidden discussion board content was of a non-technical nature. The discussion topics in this discussion board were quite diverse and free-style, including jokes, gossip, interests, and issues about the forum itself. A vibrant sub-culture not of a technical nature can help people to work closely together, with a strong sense of community identity. However, due to there being no access to this hidden discussion forum, this assumption cannot be confirmed.

7.6.9 Summary

The community members considered that a helpful role regarding providing suggestions to help solve technical problems was very important. Meanwhile, the newbie was considered to be an important community member by forum regulars because they added to the personal component involved in forming an active community. Meanwhile, newbies also played an important role in constructing new knowledge. Furthermore, some of the newbies underwent different stages of participation in this community and gradually transited from a peripheral position to a more central one. Collective knowledge building efforts were highly valued. It was considered that knowledge was constructed through collaborative efforts of community members with different levels of knowledge and expertise. Another obvious feature of this community was that it involved much less disputation than other Internet forums, so promoting active forum members' motivation to share knowledge. Due to the forum's open nature, the community members avoided using private messages to discuss technical problems in order to allow other forum users access to knowledge. The community members in this forum also preferred less moderation. They thought the moderator's role should be limited to keeping the forum in order, and that their interference in the solution finding process should be reduced. A sub-community existing on a hidden discussion board of the forum consisted of active users (i.e. Rockstar) and moderators. Its discussion content was quite diverse and non-technical. This sub-culture is assumed to have promoted a strong community sense and encouraged the active community members to work together.

7.7 Conclusion

The thematic analysis of interview data at this stage confirmed parts of the key sub-categories of knowledge construction, including "Bringing outside knowledge", "Testing the idea", "Asking the focused question (about the idea and about the problem)" and "Clarifying the ambiguity (about the idea and about the problem). It also revealed the experiential nature of

the user experts' knowledge, and pointed out the importance of contextual knowledge of technical problems in diagnosing the causes and proposing solutions, and further explained how solutions were proposed. In addition, the knowledge building process and the knowledge construction strategy of "trial-and-error" were confirmed and further elaborated.

The hidden motivators and barriers were also clarified through the interviewees' own narratives. Multiple reasons for participating in discussions in a virtual product user community were given, including information needs, communication needs, learning needs, social needs, intrinsic needs, and compensation needs. The barriers included time limitation, over demand, lacking of confidence, technical issues, and impolite online behaviours. The moderator can play an active role in promoting community members' participation and offset the negative influences of barriers.

The moderator's roles and their influences, as perceived by community members, were also clarified. The moderator's roles can be classified as censor, boundary spanner, lobbyist, knowledge asset manager, information provider, and advice seeker. Their role is mainly focused on censorship and maintaining social order.

The main cultural attributes of the virtual product user community are valuing the helpful role of collective contributions to knowledge construction and the importance of novices; using less disruptive behaviours; preferring openness and less moderation; and desiring collective moderation, sub-communities and a related sub-culture.

Knowledge activities and community culture have a mutual influence on each other. Knowledge construction is conducted through the participation of various community members in different terms, coordinated with the cultural attributes of valuing the collective contribution and the importance of newbies.

In the next research stage, more discussion threads from other virtual communities and online groups with comparable key variables will be selected and analyzed through the newly developed content analysis framework developed in this research project. Their coding results will be compared in order to illustrate the effects of different contextual attributes on knowledge construction. Accordingly, the third research question "What are the contextual factors' influences on community members' knowledge construction?" will be addressed.

Chapter 8 – Content Analysis of Threads in Virtual Product User Communities and Other Communities

8.1 Introduction

The purpose of this chapter is to answer the third research question: "What are the contextual factors' influences on community members' knowledge construction?". The knowledge construction patterns and content analysis framework identified in the Dell sponsored product user community (namely, Dell Support Forum and Dell Ideastorm Community) have already been identified and developed earlier in the earlier stage. It is important to test the workability of this framework in varying context, and to understand how this model works, what variables make it workable in different contexts, and how these variables affect users' knowledge behaviours. Therefore, the analysis framework is tested by applying in several different types of virtual communities and online groups with varying key variables and attributes here.

According to the literature and findings from this research, the following salient variables, which are also considered to be the main and common attributes of the virtual community and online groups, are planned to be examined: topics; purpose; relationships with company sponsors (i.e. business organizations sponsored or self-sponsored); communication technology used to support the community;; and moderation mode. Several IT companies (i.e. Dell, HP, and Lenovo) have established both English and Chinese virtual product user communities, it will be interesting to explore whether the knowledge construction patterns will be different under the different culture and language context. Thus, the attribute of national culture and language was also added.

Given the knowledge construction framework is developed on discussions of solving technical problems, thus the attribute of topic and objective should be the same while the rest attributes have different variables. Accordingly, the selected virtual communities and online groups for the next step analysis should have the following variables:

1. Topic: Computer's technical problems (including hardware and software problems)

2. Purpose: solving technical problems through users' peer support (or share knowledge about computer's technical problems between group members).

2. Relationship with company sponsor: company sponsorship and self-sponsorship.

3. Communication technology used to support community: online forum, Listserv and social networking site.

4. Moderation mode: community user based moderation, formal moderator based moderation, and the combination of formal moderator and volunteer moderator (i.e. active user) based moderation.

5. Culture and language: English and Chinese.

Another import selection criterion is that they should also be typical ones of their type. For example, the user support forums of Dell, HP, and Lenovo contained in the following Table 8-1 are the typical organization sponsored user support forum in the online space, and the products being discussed are typical personal (home) IT products. The Linkedin is one of the most typical and popular social network sites. Slashdot is an influential self-sponsored discussion forum featured by its threaded conversation.

Moreover, these selected virtual communities and online groups, as stated before, should not only have sub-sections focusing on topics of solving technical computing problems, but also have vibrant discussions and sufficient cases of successfully solving these problems through peer support.

The combination of these selected online communities and groups should also allow the researcher to compare the coding results in order to explore individual attribute's influence on knowledge construction. In order to ensure their comparable nature, they are of slightly different contexts. That is to say, some of these communities and groups should have one different variable while the rest attributes are similar to enable the comparison. Moreover, the groups can also be compared with each other (e.g. section 8.2.3 and 8.3.4).

For example, both the English and Chinese technical support forums of Dell, HP, and Lenovo are chosen for comparison. The two versions of forums belonging to the same company share quite similar attributes except their national cultures and the languages are different. Thus, this can help to explore the influence of the variable of culture and language upon community members' knowledge behaviours by comparing the English forum and Chinese ones, which all belong to same company. Moreover, the influence of different moderation modes can also be compared in these user support forums. Virtual communities and online groups on

Slashdot, JISCMail, and LinkedIn are deviant from the above three product user communities in terms of sponsorship, communication technology and moderation modes. Thus, these variables' influences on members' knowledge construction patterns can be explored with this content analysis framework. Meanwhile, the model's workability in different contexts with different variables can be tested.

These selected threads in the following listed virtual communities and social groups have relatively similar discussion subjects: more specifically, the technical solutions for the software and hardware problems of computers. This can ensure the discussion topic of these threads be consistent with that in the virtual product user community. Firstly, the researcher read the FAQ, Introduction page, and community rules and regulations to familiarize himself with the discussion content of the community and to understand how the community operated. Then the researcher read through the selected forum and or sub-forum to obtain a deep understanding of the topical coverage of discussion threads, and forum user's knowledge behaviours. Finally, the researcher selected four typical threads of suitable topics for analysis, including two long ones and two short ones in the forum. Therefore, the workability of the model can be effectively tested, while the similar discussion content and influence of a range of variables can be explored.

The selected virtual communities and online groups including their key attributes are presented as following table. It also tells how these communities and groups fit the selection criteria and paves the basis of comparison in the data coding.

Table 8-1: Selected Virtual Communities & Online Groups with Key Attributes

Virtual Communities & Online Groups	Selected Topic	Moderation	Communication Technology	Company relation	Language & Culture	Purpose
Dell Technical Support Forum in Chinese	Computer's technical problems (hardware and software)	User based moderation system + formal moderator	Internet Forum	Company sponsored	Chinese	Solve technical problems through users' peer support
HP Discussion Board in English	Computer's technical problems (hardware and software)	User based moderation system + formal moderator	Internet forum	Company sponsored	English	Solve technical problems through users' peer support
HP Discussion Board in Chinese	Computer's technical problems (hardware and software)	User based moderation system + formal moderator	Internet forum	Company sponsored	Chinese	Solve technical problems through users' peer support
Lenovo Forum in English	Computer's technical problems (hardware and software)	User based moderation system + formal moderators	Internet forum	Company sponsored	English	Solve technical problems through users' peer support
Lenovo Discussion Board in Chinese	Computer's technical problems (hardware and software)	User based moderation system + volunteer moderators[8]	Internet forum	Company sponsored	Chinese	Solve technical problems through users' peer support
LinkedIn (interest group of "Computer Technicians-PC Techs-Desktop Support")	Computer's technical problems (hardware and software)	Volunteer moderator ("group managers")	Social network	Self-sponsored	English	Share knowledge about computer's technical problems between group members
JISCMail ("Web-Support Archives" topic)	Web support issues	Volunteer moderators (known as "list owners")	LISTSERVE mailing software	Self-sponsored	English	"To facilitate knowledge sharing within the UK centered academic community; strategic collaboration tool" (JISCmail, 2003)
Slashdot (Ask Slashdot)	Computing Hardware	peer moderation and meta-moderation	Internet forum (threaded discussion pattern)	Self-sponsored	English	Share ideas among users

[8] Three types of titles are involved in the forum management and moderation activities: 1. (管理员(Administrator), assigned company employees to manage the forum; ; 2. 超级版主 (Super Moderator), volunteer moderators chosen from active forum users; 3. 版主 (moderator), volunteer moderators chosen from active forum users but with the minimum power.  管理员  超级版主  版主. The whole forum are mainly managed and moderated by a large number of volunteer moderators.

8.2 Dell Technical Support Forum in Chinese

8.2.1 General Introduction of Dell technical support forum in Chinese

The Dell Technical Support Forum in Chinese was launched a few months before the analysis was conducted in June 2013 and it had attracted a small number of forum users. Therefore, only dozens of threads published by the Chinese forum users up to that point. For instance, there were only 54 discussion threads released from 11 Sep 2012 3:45 AM to 15 May 2013 3:00 AM in one of its discussion sections of Dell laptops. In addition, the number of responses to these initial questions in the first post of each thread was very low. Most of the threads had less than 5 replies and only 6 threads have 5 to 7 replies in the laptop discussion section. Given the limited threads publication in this forum, the researcher selected 4 discussion threads from the desktop discussion board (i.e. sub-forum) and laptop discussion board (i.e. sub-forum), which have a comparatively larger number of posts in these two discussion boards. These four threads were chosen at 10pm, 12th June 2013.

8.2.2 Selected Threads Analysis

Table 8-2: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

	Triggering Question Episode	New Idea proposing Episode	Knowledge Exploration &Explanation Episode			Evaluating & Testing Episode	
Sub-categories / Threads	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge	Evaluating suggested idea	Testing the idea
1	1	8	1	1	0	3	1
2	1	2	3	2	0	1	0
3	1	3	0	0	0	1	1
4	1	1	1	1	1	1	1

[Note: 1 post falls into two categories in thread1. 1 post falls into two categories in thread 2.]

Table 8-3: Number of Posts Falling into Main Categories

Thread	Number of posts	Number of Participants	Posts falling into whole Analytical Framework	Posts falling into "Knowledge Construction Episodes"	Posts falling into "Problem Description Episodes"	Posts falling into "Non-Constructive Episodes"	Posts falling into "Moderation Episodes"
1[9]	12	4	100%	13 (100%)	0	0	0
2[10]	7	3	100%	8 (100%)	0	0	0
3[11]	7	4	100%	6 (75%)	2 (25%)	0	0
4[12]	7	2	100%	6 (55%)	2 (18%)	3[13] (27%)	0

[Note: The percentage rate is decided by how many posts falling into different posts rather than the total post number in the thread. 3 posts falls into two categories.]

Knowledge construction episodes in these four selected threads include sub-categories discovered from earlier threads analysis of "Triggering question", "Proposing a new idea", "Asking focused question", "Clarifying ambiguity", "Bring outside knowledge", "Proposing a new idea", "Evaluating suggested idea" and "Testing the idea".

The above analysis result reveals that the discussion was highly concentrated on knowledge construction episodes. Other episodes of "Problems Description Episodes" and "Non-constructive Episode" which are identified in the threads selected from Dell User Support Forum and Ideastorm Community only account for a small part. A possible explanation can be due to a small size of its discussion participants and posts. This helps reduce the possibility that the discussion is distracted or out of topic, which usually occurs in long threads. This also creates apparent interaction between discussion participants. In other words, the discussion smoothly flows in a logical way and the posts have apparent logical connections. Meanwhile, the knowledge construction process is quite evident, especially in thread 2.

In thread 2, the first post described the technical problem: the video games of *Warcraft (*or *World of Warcraft)* usually stuck while playing music or flash videos. Then forum user *go**** proposed a solution idea in the 2nd post: reinstall dedicated graphics card driver. This

[9] http://zh.community.dell.com/support_forums/desktops/f/264/t/9100.aspx

[10] http://zh.community.dell.com/support_forums/laptops/f/270/t/9418.aspx

[11] http://zh.community.dell.com/support_forums/laptops/f/270/t/9360.aspx

[12] http://zh.community.dell.com/support_forums/desktops/f/264/t/9505.aspx

[13] These 3 posts fall into the sub-categories of "Statement of waiting for authentic solution".

suggestion is made based on his same experience: his nephew also had same technical problem, which was solved by reinstalling dedicated graphics card driver. In the 3rd post, the initial poster *CQ*** responded with "*buddy, thanks a lot for your reply*" and asks a focused question about "*where to download the driver?*" In the 4th post, another forum user *Qg**** participated in the discussion and justified the suggested idea proposed in 2nd post:

> "you [You] can consider the cause of graphics card if the problem only occurs when playing music and flash".

In addition, he also proposed a new idea of refreshing the BIOS if the first solution idea did not work. In the 5th post, the initial poster asked more questions about the content in the 4th post:

> "Should I just install the driver? I am unfamiliar with Windows 7, and it seems quite difficult for me to refresh Bios. Is there any upgrade of Bios for my type of laptop?"

In the 6th post, forum users *Qg**** answered the above question about the driver and BIOS. In the 7th post, the initial poster asked another question about how to install the graphics card driver and stated that he did not want to refresh Bios. In the 8th post, the forum user *go**** clarified how to download and install the driver.

From the above description of the whole discussion, the strong logical connections between the posts, especially the asking-and-answering relationship between the 5th post and the 6th post, and the 7th post and 8th post can be observed.

The whole discussion in thread 2 proceeded in the way described as the prototype of knowledge building process. It clearly followed the order of "Triggering question", "New Idea Proposing" and "Exploration & Explanation" stage (which can be reflected from "Asking focused questions" and "Clarifying the ambiguity" process). The whole thread ended with the 8th post and there was no further feedback about testing the suggested idea by the initial poster. Therefore, the "Justifying & Testing" episode was absent in this thread. However, it still clearly illustrated how the knowledge was constructed in a logical way, as the prototype of the model reproduces this. Furthermore, the knowledge construction strategy of "trial-and-error" was also utilized in this forum.

8.2.3 Conclusion

To conclude, the original purpose of choosing the Dell User Support Forum in Chinese was to validate the content analysis framework of knowledge construction in a different language

context, and to evaluate the influence of variables of Chinese culture and language upon the community member's knowledge behaviours. The result shows that the content analytical framework of knowledge construction, which was created in this study, can effectively code the threads selected from the Dell Support Forum in Chinese. The variables of culture and language do not have apparent influence on changing virtual product user community member's collaborative knowledge building behaviours. It also reveals that a small size of discussion participants and posts can make the discussion more focused on knowledge construction and proceed more smoothly (and/or more logically). Accordingly, the variable of size of discussion group and number of posts is also considered in the following thread analysis.

8.3 HP Discussion Board in English

8.3.1 General Introduction of HP Discussion Board in English

HP Discussion Board (/support forum) is an English language discussion site initiated and sponsored by HP Company. It is a place for "peer-to-peer knowledge sharing and idea exchanges" (HP, 2011)[14] between its product users. On its overview and FAQs page, it is defined as "an online community of peer-to-peer technical support and knowledge sharing" rather than a "chat room" (HP User Forum, 2011). It is grouped into several divisions; for example, Mobile, Desktops and Workstations. Each division is further categorized into many boards. Its users are also classified into several hierarchical levels, according to their knowledge contribution and activeness, including "occasional visitor", "occasional advisor", "advisor", "trusted contributor", and "honoured contributor".

HP appoints employees to be community moderators of the support forum, chosen from a wide range of support staffs who have knowledge in specific fields. "Our moderator staff is drawn from a wide variety of support folks who have knowledge in some, but not all, discussion areas." (HP User Forum, 2011). These official site moderators are labelled with an HP logo icon next to their user names: HP moderator. Their primary functions are described as "to help keep the discussion groups running smoothly, answer HP-directly questions, and report any issues with the service." (HP User Forum, 2011). They are obliged to assist the community members as much as possible. However, it also states that the

[14] http://h30499.www3.hp.com/t5/Announcements/Welcome-to-the-new-community/td-p/4803661#.UgbNhn9BmtA

moderators do not necessarily participate in every discussion thread. "On occasion, the site moderators will answer your questions, particularly those regarding how to use and navigate the site" (HP Forum, 2011). The moderators have great freedom and autonomy to decide when to participate and what to contribute to the discussions. "The moderators contribute to various discussions as they see fit, but they are free to contribute or not contribute", according to thethe introduction page of the forum (HP User Forum, 2011).

8.3.2 General Introduction of Selected Discussion Threads

Four treads about computer technical problems were chosen in this user peer support forum. The first thread[15] consisted of 40 posts published from 09-03-2008 to 06-21-2010, including the initial post with the triggering question and 39 replies. 27 forum users participated in the discussion to solve the problem that "*HP Health Check update does not install on Widows Vista*". Among them, there were 25 less active forum users with the title of "Occasional Visitor", most of whom just published 1 to 4 posts. 2 active forum users with respective titles of "Trusted Contributor" (with 186 published posts) and "Honoured Contributor" (with 2687 published posts) also participated in the discussion.

The second thread[16] titled "*2740p fan issue*" contained 12 posts, which were published by 3 forum users from 01-18-2011 to 04-07-2011. All of these three forum users were medium-active users (i.e. with the title of "Advisor" in the forum) and less-active forum users (i.e. with the title of "Occasional Advisor") who had published less than 15 posts.

The third thread[17] discussed the topic "*a6110n overheating problems*", and consisted of 19 posts which were published from 04-13-2008 to 02-2-2010. 13 forum users participated in the collaborative solution finding process for this problem, including 6 active forum users (with the titles of "Trusted Contributor" and "Honoured Contributor") 7 medium active ones (i.e. with the title "Advisor") and some less-active forum users (i.e. with the title of "Occasional Advisor").

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[15] http://h30499.www3.hp.com/t5/Home-PCs-Pavilion-Presario/HP-Health-Check-update-does-not-install-on-Windows-Vista/td-p/996260#.UcGbPNh_Tl4

[16] http://h30499.www3.hp.com/t5/Notebook-HP-ProBook-EliteBook/2740p-fan-issue/m-p/2356697#M165479

[17] http://h30499.www3.hp.com/t5/Home-PCs-Pavilion-Presario/a6110n-overheating-problems/td-p/938540#.UcL4Oth_Tl4

The fourth thread[18] consisted of 31 posts which were published between 05-20-2008 to 01-09-2010. 13forum users, including 7 active forum users, 6 medium active and some less active users, participated in the discussion about solving a laptop problem in this thread, titled "*PC fan is way too loud. Turns off and on*".

8.3.3 Selected Threads Analysis

The above selected threads were coded with the analytical framework of knowledge construction which is developed in this study. The analysis results are illustrated as follows:

Table 8-4: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

	Triggering Question Episode	**New Idea proposing Episode**	**Knowledge Exploration &Explanation Episodes**			**Evaluating & Testing Episode**		
Sub-categories / Threads	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge	Evaluating suggested idea	Testing the idea	Claiming to test the idea
1	1	4	7	4	1	1	18	0
2	1	3	1	0	0	0	2	2
3	1	8	1	2	1	1	1	0
4	1	10	2	2	0	5	4	0

Table 8-5: Number of Posts Falling into main Categories

Thread	Number of posts	Number of Participants	Posts falling into the whole Analytical Framework	Posts falling into "Knowledge Construction Episodes"	Posts falling into "Problem Description Episodes"	Posts falling into "Non-Constructive Episodes"	Posts falling into "Moderation Episodes"
1	39	27	100%	36 (84%)	4 (9%)	3 (7%)	0
2	12	3	100%	9 (64%)	4 (29%)	1 (7%)	0
3	19	13	100%	15 (71%)	4 (19%)	2 (10%)	0
4	31	13	100%	24 (73%)	6 (18%)	3 (9%)	0

[Note: 5 posts in thread 1 fell into two sub-categories. 2 posts in thread 2 fell into two sub-categories. 2 posts in thread 3 fell into two sub-categories. 2 posts in thread 4 fell into two sub-categories.]

According to the above analysis result, the conclusion that this analytical framework developed in this study is an effective tool for analysing the HP support forum can be safely drawn. In the first thread, 2 posts (i.e. post 34 and post 37) only contained gratitude content to the user who proposed a workable solution idea: for instance, "Ok!!!Thank" (post 37). These

[18] http://h30499.www3.hp.com/t5/Home-PCs-Pavilion-Presario/PC-fan-is-way-too-loud-Turns-off-and-on/td-p/954121#.Ucdco9h_Tl5

messages confirm that the suggested solution idea is successful after being applied. Thus, these two posts are considered to fall into the sub-category of "Testing the idea".

In addition, it can be observed that these four threads highly concentrated on knowledge construction episodes. The "Problem Description Episodes", including sub-categories of "Repeating same/similar problems" and "Judging the existence of the problem", also accounted for a higher percentage. The "Non-constructive Episodes", which included sub-categories of "Statement of giving up finding solution", "Statement of waiting for authentic solution", and "Statement of waiting for other user's solution", also emerged in these four threads but accounted for the smallest percentage. The sub-category of "Disputing on/ talking about irrelevant issues" was not involved in these discussions. The category of "Moderation Episodes" was not identified in these four threads.

The knowledge building process in these four threads can be described by the knowledge construction prototype model created in this study, although the "Problem Description Episodes" and "Non-constructive Episodes" were involved in the discussions. It takes quite a similar form as that in the selected threads of Dell Support forums. The "trial-and-error" strategy of knowledge construction is also adopted.

8.3.4 Conclusion

To conclude, there is no obvious difference regarding knowledge construction behaviours between the Dell Support forum (in English) and the HP Discussion Board (in English). This can be explained by their similar variables of topics, communication technology, sponsorship, language and culture, moderation mode, and so on. The content analysis framework of knowledge construction, which was created based on thread analysis of Dell Support Forum, is effective to code the similar context of the HP user forum. However, it has limitations in directly coding social information, such as gratitude content, which still needs deep interpretation to relate to the knowledge construction dimension. According to the coding result, these discussions mainly concentrated on "Knowledge Construction Episode" and "Problem Description Episode" and adopted a "trial-and-error" solution identification strategy.

8.4 HP Technical Support Forum in Chinese

8.4.1 General Introduction of HP Technical Support Forum in Chinese & Selected Threads

The HP Technical Support Forum in Chinese[19] is the HP sponsored virtual community for its Chinese consumers to share knowledge about usage experience and to solve technical problems through users' peer support. This forum is divided into different product sub-sections: for example, sub-sections for printers and computers.

Four threads on the topic of solving technical problems of computers and printers were chosen from the discussion section which centres on family consumer products. The first thread[20] was about "*Windows 8 does not support running restoration disk on CD driver*". It consisted of 22 posts which were published by 10 forum users. The second thread[21] was about the printing malfunction of one type of HP printer after successfully installing the driver. It had 10 posts which were released by 4 discussion participants. The third thread[22], titled "*a strange noise (from my computer)*", consisted of 16 posts which were contributed by 10 forum users. The fourth[23] one was about "*how to push back of the shelf of Deskjet 1000*", and it consisted of 7 posts published by 4 forum users.

8.4.2 Selected Threads Analysis

These four threads were coded with the content analysis framework created for studying knowledge construction in virtual product user communities in this study. The analysis results are presented as follows:

[19] http://h30471.www3.hp.com/t5/community/categorypage/category-id/Intro

[20] http://h30471.www3.hp.com/t5/forums/forumtopicpage/board-id/OS/page/3/thread-id/14103

[21] http://h30471.www3.hp.com/t5/forums/forumtopicpage/board-id/Install/message-id/12929

[22] http://h30471.www3.hp.com/t5/forums/forumtopicpage/board-id/Hardware/page/1/thread-id/9879

[23] http://h30471.www3.hp.com/t5/forums/forumtopicpage/board-id/Install/message-id/12946

Table 8-6: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

	Triggering Question Episode	**New Idea Proposing Episode**	**Knowledge Exploration &Explanation Episodes**			**Evaluating & Testing Episode**		
Sub-categories / Threads	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge	Evaluating suggested idea	Testing the idea	Claiming to test the idea
1	1	4	2	6	1	1	2	1
2	1	3	0	0	0	1	2	0
3	1	8	5	0	0	2	0	0
4	3[24]	1	1	1	0	1	0	0

Table 8-7: Number of Posts Falling into Main Categories

Thread	**Number of posts**	**Number of Participants**	**Posts falling into the whole Analytical Framework**	**Posts falling into "Knowledge Construction Episodes"**	**Posts falling into "Problem Description Episodes"**	**Posts falling into "Non-Constructive Episodes"**	**Posts falling into "Moderation Episodes"**	**Others (Invalid posts)**
1	22[25]	10	82%[26]	18 (75%)	1 (4%)	0	0	3[27] (13%)
2	10	4	90%[28]	7 (70%)	0	0	0	2 (20%)
3	16[29]	10	100%	16 (94%)	1 (6%)	0	0	0
4	7	4	100%	7 (100%)	0	0	0	0

[24] The questioner described the technical problem of his laptop in the first 3 posts.
[25] Two posts fall into two-subcategories.
[26] Two posts containing social message cannot be coded by this content analysis framework of knowledge construction.
[27] There are three repetitive posts in thread 1.
[28] One post containing social message cannot be coded by this content analysis framework of knowledge construction.
[29] One post falls into two-subcategories.

The above two tables illustrate that the content analysis framework of knowledge construction is effective for coding most of the discussion contents in these four threads chosen from the virtual product user community on the HP Technical Support Forum. However, it lacks capacity for dealing with social information.

A few posts which only contain social information cannot be coded by this analysis framework which is designed to explore knowledge construction patterns. For instance, the 18th post in the first thread just has the content of "祝你成功" ("May you succeed." posted by 阿*on 2013-05-24 07:41 AM). The 21th post in the first thread also only contains the social information of "谢谢分享" ("thanks for sharing" posted by An*** on 13-06-2013 03:26 PM). The first post expressed the idea provider's good wishes to the questioner. According to one of the interviewees, Jo***, this is a much easier way for the questioner to accept the advice:

> "…the regulars here view their role [roles], it includes giving advice in a manner that is acceptable to the original poster".

The second post expressed the gratitude information to the idea proposer. This shows other participants' acknowledgement of the idea proposer's knowledge contribution. Others' acknowledgements can promote the "ego" (/fame/reputation) of these active users, which is one of the important motivation factors of knowledge contribution according to the interview analysis:

> "That in-turn gave me credibility and confidence within a community." (Van1ty).

Therefore, these posts containing merely social information are considered to facilitate interaction between the discussion participants and promote participation, although they only account for a small percentage of the whole discussion thread. The whole post containing pure social information is quite rare in other forums, especially in English language ones. The researcher assumes that this could be related to online cultures.

It can also be observed that the discussions in these four threads highly focus on knowledge construction, although there are some invalid repetitive posts. As for the posts falling into the main-category of "Problem Description Episodes", they account for a small percentage and can help obtain contextual knowledge about the problem in order to diagnose its cause and to propose solution ideas. Like other forums, contextual knowledge about the problem is asked for by the advisor (i.e. knowledgeable forum members) and then is clarified by the questioner. For example, the 2nd post in thread 3 states that

> “什么系统？你打开任务管理器查看一下，响声跟 CPU 占用率之间的关系.” (“What is your operation system? Open your task manager to check the CUP usage, which has relations to the noise (in your computer)”. (By WH*** on 2013-05-26 02:07 PM).

The contextual knowledge about the operating system and CUP usage can help this forum user to diagnose the problem, and thus pave the way to finding a solution.

The knowledge construction patterns in the HP Technical Support Forum in Chinese are quite similar to other virtual product user communities. All of the knowledge construction episodes are involved in these four threads. Even in the short thread 4, a simple knowledge construction process is identified. In the first 3 posts of this thread, the questioner described his problem and triggered the whole discussion (“Triggering Question Episode), and then one forum user proposed a solution idea in the 4th post (“New Idea Proposition Episode”). In the next two posts, the solution idea was asked by the questioner and then further clarified by the third discussion participant (“Knowledge Exploration & Explanation Episodes”. In the 7th post, the idea is evaluated by fourth forum user in this thread (“Evaluating & Testing Episode”). The above knowledge process directly reflects the knowledge construction prototype model.

8.4.3 Conclusion

HP Technical Support Forum in Chinese has the same attributes as Dell forum and is a typical virtual product user community. The knowledge construction pattern is similar to that in other product user support communities. Furthermore, this support forum is much better than Lenovo Discussion Board in Chinese in terms of users’ activeness, posts publishing number, problem solution success, the expertise of its members. Although both of these two forums have similar organizational sponsorship, technical platforms, language and culture, the knowledge sharing and construction activities differ a lot between the two Chinese peer support forums sponsored by two business organizations.

Thus, given the same variables existing between these two forums, it can be inferred that only the different variable of moderation plays a significant role in causing such a huge difference. This can be supported from the visible moderation features of the forum WebPages and introductions.

The HP Technical Support forum in Chinese has well designed moderation strategies to encourage forum users’ participation and to promote their community identity. For instance,

there are regular gifts exchange events in each month (HP Technical Support Forum, 2013)[30]. The credits which the knowledge contributors win for providing workable solutions can be used to exchange gifts like vouchers, headsets, USB flash disks, and so on (HP Technical Support Forum, 2013)[31]. There are occasional prize events within a certain period to reward the most active and helpful forum users (HP Technical Support Forum, 2013)[32]. All of these events are organized by forum moderators and managers. In addition, the forum users are also classified into different levels with different titles according to their published post numbers and knowledge contributions of solving other's problems. The names of award winners for their knowledge contribution are also listed on the main page of the forum. All of these moderation features are not so obvious on the Lenovo Chinese Support Forum.

The knowledge sharing activeness and visible moderation features on these two forums can explain the moderator's influence on the HP and Lenovo Chinese support forums. However, this still needs further and thorough exploration in future research.

Another interesting point in this forum is its social information content in some posts, which is rare in English Support Forum. It is probably related to the forum users' Chinese background. Meanwhile, the social information contained in these posts can promote the participation's' motivation and interaction, and enhance the ties of the members.

8.5 Lenovo Forum in English

8.5.1 General Introduction of Lenovo Forum & Selected Threads

The Lenovo discussion forum (http://forums.lenovo.com/), which is formally named as "Lenovo's Discussion Community", is the Lenovo company sponsored "peer-to-peer support community" (Lenovo Community, 2013). It is the place for the Lenovo product users to share their experience and expertise with others. Thus, it is also a typical virtual product user community.

4 threads about computer technical problems were selected for analysis. The first thread (http://forums.lenovo.com/t5/T61-and-prior-T-series-ThinkPad/T61-Fan-Noise/td-p/89286/page/3) was about the problem of "*T61: Fan Noise*" and consisted of 26 posts published by 12 forum

[30] A session can be seen on http://h30471.www3.hp.com/t5/forums/forumpage/board-id/123456
[31] An example can be found on: http://h30471.www3.hp.com/t5/forums/forumtopicpage/board-id/123456/message-id/37#M37
[32] An example can be found on: http://h30471.www3.hp.com/t5/forums/forumtopicpage/board-id/Hello/message-id/343#M343

users by July 3rd, 2013. The second thread (http://forums.lenovo.com/t5/IdeaPad-Y-U-V-Z-and-P-series/Ideapad-Y580-Heat-Issues/td-p/881271/highlight/true), which was titled "*Ideapad Y580 Heat Issues*", consisted of 12 posts contributed by 3 forum users. The third thread (http://forums.lenovo.com/t5/X-Series-ThinkPad-Laptops/x6x-thinkpad-hot-palmrest-issue/td-p/775/highlight/true) discussed the topic of "*x6x thinkpad hot palmrest issue*", and consisted of 25 posts released by 19 users. The fourth thread (http://forums.lenovo.com/t5/IdeaPad-IdeaTab-Slate-Tablets/CPU-Noise/td-p/1008533/highlight/true) with the topic of "*CPU Noise*" attracted 9 forum users, who published 32 posts in total in this thread.

8.5.2 Selected Threads Analysis

The above threads were analyzed with the newly developed content analysis framework for exploring knowledge construction. Knowledge building in these threads took the form of solving technical problems without any ready answers through the collective efforts of the forum users. The analysis results are presented as follows:

Table 8-8: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

	Triggering Question Episode	**New Idea proposing Episode**	**Knowledge Exploration &Explanation Episodes**			**Evaluating & Testing Episode**		
Sub-categories / Threads	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge	Evaluating suggested idea	Testing the idea	Claiming to test the idea
1	1	1	9	10	2	3	0	0
2	1	3	1	1	0	6	0	0
3	1	5	2	1	1	5	1	0
4	1	5	6	6	2	3	8	2

Table 8-9: Number of Posts Falling into Main Categories

Thread	Number of posts	Number of Participants	Posts falling into the whole Analytical Framework	Posts falling into "Knowledge Construction Episodes"	Posts falling into "Problem Description Episodes"	Posts falling into "Non-Constructive Episodes"	Posts falling into "Moderation Episodes"
1	26	12	100%	26 (81%)	4 (13%)	2 (6%)	0
2	12	3	100%	12 (86%)	0	2 (14%)	0
3	25	19	100%	16 (59%)	5 (19%)	3 (11%)	3 (11%)
4	32	9	100%	33 (92%)	1 (3%)	2 (5%)	0

[Note: 6 posts fell into two sub-categories in thread 1. 2 posts fell into two sub-categories in thread 2. 2 posts fell into two sub-categories in thread 3. 4 posts fell into two sub-categories in thread 4.]

It can be observed that this analytical framework created for studying collective knowledge construction activities is an effective tool for selected threads in this Lenovo discussion community. Thus, this further proves the validity of this analytical framework for analyzing knowledge construction in virtual product user communities.

The selected discussion threads in the Lenovo discussion forum in English were highly concentrate on the knowledge construction episodes. All of the sub-categories belonging to "knowledge construction episodes" are identified in these selected four threads. Therefore, the knowledge construction patterns are parallel to that in the Dell and HP product user communities.

"Problem Description Episodes", "Non-construction Episodes", and "Moderation Episodes" are all involved in the collective discussions of finding solutions to the stated problems. The category of "Problem Description Episodes" contains the sub-categories of "Repeating same/similar problems" and "Judging the existence of the problem" in these four threads.

The "Non-constructive Episodes" in these selected threads include sub-categories of "statement of giving up finding solutions", "statement of waiting for authentic solutions", "statement of waiting for other member's solutions or feedback", and "complaining about the service and/or products". The sub-category of "(claiming to) bring in new knowledge from internal organization to the user community", which belongs to the main-category of "Moderation Episodes" emerges in the threads. The forum users voluntarily conducted the knowledge transition from the internal organization to the user community by sharing the knowledge obtained from company representatives and technical support with others in the forum. No content with foul language or personal attacks, or about "Disputing on/talking about irrelevant issue" were found in the threads. Thus, their corresponding moderation episode, i.e. "Mediating the arguing/stopping talking about irrelevant topic", did not emerge. The moderator of the forum did not participate in the discussions in these four threads, so the relevant moderation episodes of "Moderator's labeling status to the discussion thread" and "Moderator's claiming to bring knowledge to the internal organization", which are identified in the Dell product user community, were not identified here.

8.5.3 Conclusion

The Lenovo Discussion Community (in English) is one of the typical virtual product user communities according to its designing purpose, sponsorship, moderation, and users'

knowledge behaviours. It is sponsored by the producer, and serves the purpose of sharing usage experience and solving problems through peer-to-peer support. The moderator did not actively participate in the community members' collective knowledge construction activities. The knowledge building behaviours, patterns, and strategies in this community were quite similar to those in the Dell and HP support forums. This also proves that the knowledge construction patterns identified in the initial study was not significantly different, given the similar variables of discussion topics, communication platform, moderation, sponsorship, language and culture. Moreover, the discussions in these four selected threads also strongly focused on knowledge construction episodes. Other main-categories of "Problem Description Episodes", "Non-constructive Episode", and "Moderation Episodes" were also involved in the discussion, although they only accounted for a small portion. Posts with pure social information were not found in this forum with the variable of English language and culture.

8.6 Lenovo Discussion Board in Chinese

8.6.1 Introduction of Lenovo Chinese Discussion Board

The Lenovo's Discussion forum in Chinese (http://lenovobbs.lenovo.com.cn/) is a peer-to-peer user support forum for Lenovo's Chinese consumers. Its design architecture does not differ greatly from its English version. For example, the whole forum is further divided into a few sub-sections for different types of products, and the way of organizing posts in the threads is also similar. However, the Lenovo Chinese discussion forum appoints several volunteer webmasters in each sub-section.

Although this forum has 1,241,334 registered members up to date, this forum is not so active in terms of the discussion topics, the published post numbers, active forum user numbers, and the replies to the questions. A small number of posts were published each day. For example, there were only 22 posts across the whole forum published on July 8th, 2013.

Most of the discussion threads in the laptop technical issue section were about asking for specific information or seeking ready answers or sharing tips and knowledge resources, rather than solving problems through forum users' collaborative efforts. For instance, many threads had topics like "求最新版 bios，谢谢" ("I am looking for latest version of bios, cheers".http://lenovobbs.lenovo.com.cn/viewthread.php?tid=218537&extra=page%3D1%26amp%3Borderby%3Dreplies%26amp%3Bfilter%3D2592000), "联想 Y500 求个 win7 64 的系统" ("I am looking for windows 7 of 64bits operation system for Lenovo Y500".

http://lenovobbs.lenovo.com.cn/viewthread.php?tid=218439&extra=page%3D1%26amp%3Borderby%3Dreplies%26amp%3Bfilter%3D2592000), “工程师给发一个联想专用的 win8 系统”(“Engineers, please send me a link of Windows 8 for Lenovo laptops”. http://lenovobbs.lenovo.com.cn/viewthread.php?tid=214151&extra=page%3D1%26amp%3Borderby%3Dreplies%26amp%3Bfilter%3D2592000), and so on. Only a few threads focused on technical problems which could be solved in a collaborative way.

In addition, the reply rates to the triggering questions in this forum were extremely low. There were only 15 threads with 4 and above replies in the laptop technical issues discussion section in the previous three months. Most of the threads had no replies. Active users were very rare and quite difficult to find, and most of the users were newbies who just released a few questions. Each discussion section had several volunteer moderators selected from forum users, but some spamming posts were still found.

Accordingly, the Lenovo Chinese Discussion Forum was not as successful as its English version. Its main design purpose of sharing experience and expertise, and solving problems through users’ peer support was not achieved. HP Chinese Support forum, which is a successful and active virtual product user community, has the same communication platform, sponsorship, and user language and cultural background as the Lenovo Chinese technical forum. The only different variable between these two peer support forums was the moderator and moderation mode (and/or management support). The moderation work in HP was mainly conducted by formal moderators. In addition, multiple moderation strategies were adopted to enhance community members’ participation motivation and community identity. Thus, it can be inferred that the cause of the difference can be its moderation strategy (and requisite management support) used to manage the forum and to encourage the user’s participation motivation in Lenovo Chinese Support Forum.

8.6.2 Threads Analysis

There were only a few discussion threads with more than 4 replies in both the personal laptop discussion section and the desktop discussion section. Moreover, some of these threads were about sharing information about the Windows system, verification of the operating system, software download links, and so on. In some threads, replies to the initial question were released by the questioner himself and no other forum user participated in the discussion. Therefore, there were just a few choices for analysis. Finally, four threads which had four and

more than four replies in each one and were centred on topics relating to technical problems were chosen.

The first thread with the topic "*(help) the Wi-Fi in my laptop always automatically turns off*"(http://lenovobbs.lenovo.com.cn/viewthread.php?tid=215698&extra=page%3D1%26amp%3Borderby%3Dreplies%26amp%3Bfilter%3D7948800) which consisted of 5 posts which were published by 2 forum users.

The second thread (http://lenovobbs.lenovo.com.cn/viewthread.php?tid=218326&extra=page%3D1%26amp%3Borderby%3Dreplies%26amp%3Bfilter%3D2592000) was about the question "*can I change the wireless network card for Lenovo G480 by myself*". It had 6 posts that were released by 2 forum users.

The third thread (http://lenovobbs.lenovo.com.cn/viewthread.php?tid=214383&extra=page%3D2%26amp%3Borderby%3Dreplies%26amp%3Bfilter%3D7948800)
was titled "*my Lenovo z475 cannot start properly and is always stuck at starting status despite of reinstalling windows 7 for several times. Does anyone know the reason?*". 3 users published 4 posts in this thread.

The fourth thread (http://lenovobbs.lenovo.com.cn/viewthread.php?tid=213689&extra=page%3D30) discussed the problem that "*the temperature of display card reaches 90 degrees while playing LOL*". This thread had 5 posts which were released by 4 users. The threads analysis results are illustrated as follows:

Table 8-10: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

	Triggering Question Episode	New Idea proposing Episode	Knowledge Exploration &Explanation Episodes			Evaluating & Testing Episode	
Sub-categories / Threads	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge	Evaluating suggested idea	Testing the idea
1	1	1	0	0	0	1	0
2	1	1	2	1	1	0	0
3	1	1	1	0	0	0	0
4	1	2	0	0	0	0	0

Table 8-11: Number of Posts Falling into Main Categories

Thread	Number of posts	Number of Participants	Posts falling into the whole Analytical Framework	Posts falling into "Knowledge Construction Episodes"	Posts falling into "Problem Description Episodes"	Posts falling into "Non-Constructive Episodes"	Posts falling into "Moderation Episodes"
1	5	2	100%	3 (60%)	0	2 (40%)	0
2	6	2	100%	6 (86%)	0	1 (14%)	0
3	4	3	100%	3 (75%)	0	1 (25%)	0
4	5	4	100%	3 (60%)	1 (20%)	1 (20%)	0

[Note: 1 post falls into two categories in thread 2.]

The content analysis framework created in this study is effective to code the selected threads, although there are only a few replies in each thread. Although only parts of the knowledge construction episodes are involved in these threads, some trunks of the knowledge building process can still be reflected. For instance, in the first thread, the question "*the laptop keeps on turning on and off*" in the starting post triggered a discussion, and in the 4th post another user proposed a solution idea of "*reinstalling power management software*". Then this idea was evaluated by linking it to the existing fact by the questioner in the next post: "*I have already installed power management software downloaded from official website*". In this case, the "Triggering Question Episode", "New idea Proposing Episode", and "Evaluating & Testing Episode" were all involved in the discussion, except "Knowledge Exploration & Explanation Episode" is absent.

The sub-category of "Statement of waiting for other member's solutions or feedback", which belongs to the "Non-constructive Episodes", also accounts for a large percentage. This is because of the low participation of forum users in each thread. Thus the questioner had to release the posts expressing the wish to obtain other members' suggestions in order to arouse their attention, as in posts like

"没人么？没人解答么》》》》》》》" ("No other users see my post? No one can answer my question?". The second post in thread 4)

""即使不用，我也想搞明白" ("Even I do not use (this function), but I still want to know the reason.". The third post in thread 2)

8.6.3 Conclusion

The knowledge construction analysis framework was an effective instrument to study problem solving in this forum, although there were limited choices in terms of selecting threads for analysis as each thread had only a few replies. Furthermore, the trunks of the knowledge construction process were also reflected in these selected short discussion threads. The discussion contents of these threads mainly fell into two main-categories: "Knowledge Construction Episodes" and "Non-constructive Episodes". They were not highly concentrated on knowledge building, and a large portion of posts were related to the sub-category of "Statement of waiting for other member's solutions or feedback" due to the low participation motivation in this forum.

The Lenovo's discussion forum in Chinese was not as successful as its English version for multiple reasons, such as the forum users' low participation and knowledge contribution motivation, and the moderation system. Given the similar design architecture and sponsorship with its English version of the discussion forum, the different variables of Chinese culture and language and the moderation system are expected to have caused the great difference. However, both Dell and HP's Chinese User Support Forums, which have the same Chinese cultural and language background, are vibrant in participation, and successful in knowledge sharing and creation. Therefore, it can be inferred that the poor moderation work in the Lenovo Discussion Forum in Chinese accounts for these differences.

8.7 Social Networking Website-LinkedIn

A new type of online community defined as social networking sites are also extensively discussed by many researchers (Parameswaran & Whinston, 2007; Boyd & Ellison, 2007; Haythornthwaite, 2005). Boyd & Ellison (2007:211) define SNS as "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system". They further point out that the unique feature of the social network sites is the ability to enable users to formulate and display their social networks rather than to allow individuals to meet strangers.

8.7.1 General Introduction of LinkedIn & Selected Groups

LinkedIn (https://www.linkedin.com) is a typical social networking website designed for professional networking on the Internet space. It is targeted at users who are professional

people in varying occupations. It also supports establishing various interest groups within the site. These groups cover a wide range of topics, including employment, and professional issues, academic and corporate relationships. The discussion boards of these interest groups are usually moderated by the group owners and group managers.

There are two types of interest groups on the LinkedIn website. Firstly, open groups which are accessible for Internet users to read the content. Joining in this type of group does not need a group manager's permission and all of the registered LinkedIn members can post messages on it; private groups which are members only and need specific identities (for example, employee of a business organization) and permissions from the group manager.

At beginning, two interest groups of "Dell Computer Users" and "Computer Technicians-PC Techs-Desktop Support" were chosen as the targets for analysis because their discussion topics were quite similar to other analyzed forums. Topics about computer hardware and software problems accounted for a large portion of discussions in these two groups. However, the former is members only and the researcher's membership request was not approved by the group manager. In contrast, the latter group is open to all LinkedIn members. Thus, the group of Computer Technicians-PC Tech-Desktop Support (http://www.linkedin.com/groups/Computer-Technicians-PC-Techs-Desktop-2589400?goback=.anp_2589400_1372870236375_25) was finally chosen to be analysed. This group consisted of 12,423 members by July 1st of 2014[33] (LinkedIn, 2013).

8.7.2 General Introduction of Selected Discussion Threads

Four threads with similar discussion topics of finding solutions for computer hardware and software problems were chosen after reading through the interest group's forum. Two threads were comparatively long and two comparatively short among all of the discussion threads in this interest group.

The first thread was titled "*any one [anyone] know about any software to UNLOCK Dell E6400 Laptop BIOS Password?*" (http://www.linkedin.com/groupItem?view=&gid=2589400&type=member&item=220417443&com

33 Other group statistics information can be seen from http://www.linkedin.com/groups?groupDashboard=&gid=2589400&trk=group_most_recent_rich-an-rr-0&goback=.anp_2589400_1372870236375_25.anp_2589400_1372873767648_1

mentID=126141485&qid=968db28b-101f-41c6-b319-bc9d88336643&goback=.gmp_2589400). It consisted of 38 posts contributed by 26 group members by June 23rd, 2013.

The second one had the title of "*Why would a Win 7 machine blue screen when removing cookies?*" (http://www.linkedin.com/groupAnswers?viewQuestionAndAnswers=&discussionID=252598272&gid=2589400&commentID=147675628&goback=.gmp_2589400&trk=NUS_DIG_DISC_Q-ucg_mr#commentID_147675628). It contained of 29 posts and 18 group members participated in the discussion by June 24th, 2013.

The third thread was about finding answers to the question of how to "*eliminate the "grub" command interface which appears when I boot Windows 7*" (http://www.linkedin.com/groups/How-do-I-eliminate-grub-2589400.S.248428190?qid=6a0ac9e6-6c30-45b7-bdb2-1b11cced64bb&trk=group_items_see_more-0-b-ttl). 8 members released 20 posts in total by 28th, 2013.

The fourth one was about solving the problem of "*whenever the power button is pressed, it beeps seven times but does not display?*" (http://www.linkedin.com/groups/I-have-Dell-5030-laptop-2589400.S.207065736?trk=group_search_item_list-0-b-ttl&goback=.gna_2589400). 16 posts had been released by 12 participants by 28th, 2013.

8.7.3 Selected Threads Analysis

The above selected threads were coded with the analytical framework of knowledge construction which is developed in this study. The analysis results are illustrated as follows:

Table 8-12: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

	Triggering Question Episode	**New Idea proposing Episode**	**Knowledge Exploration &Explanation Episodes**			**Evaluating & Testing Episode**		
Sub-categories / Threads	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Binging outside knowledge	Evaluating suggested idea	Testing the idea	Claiming to test the idea
1	1	20	4	2	0	5	1	0
2	1	13	6	6	1	3	1	0
3	1	9	2	2	2	3	1	1

4	1	10	3	1	3	4	1	1

Table 8-13: Number of Posts Falling into Main Categories Knowledge Construction

Thread	Number of posts	Number of Participants	Posts falling into the whole Analytical Framework	Posts falling into "Knowledge Construction Episodes"	Posts falling into "Problem Description Episodes"	Posts falling into "Non-Constructive Episodes"	Posts falling into "Moderation Episodes"
1	38	26	100%	34 (85%)	1 (2.5%)	5 (12.5%)	0
2	29	18	100%	31(100%)	0	0	0
3	20	8	100%	21(100%)	0	0	0
4	16	12	100%	24 (100%)	0	0	0

[Note: two posts fell into two sub-categories in the discussion thread 1. Two posts fell into two sub-categories in the discussion thread 2. One post fell into two sub-categories in the discussion thread 3. Eight posts fell into two sub-categories in the discussion thread 4.]

This illustrates that the content analysis framework of knowledge construction, which is developed in this research project, can completely code the discussion contents in these four selected threads on this LinkedIn interest group. The four necessary knowledge construction episodes, namely "Trigger Question Episode", "Knowledge Exploration & Explanation Episode", "New Idea Proposing Episode" and "Evaluating & Testing Episode", are all involved in the discussion process. Therefore, the knowledge construction pattern is quite similar to that in the virtual product user community on Dell support forum. The discussion participants also adopt a "trial-and-error" solution finding strategy. In order to find a workable solution, multiple solution ideas are proposed and evaluated or tested through members' collective efforts.

All of these discussions are concentrated on knowledge construction episodes, i.e. a technical problem and its solutions. Although it is a social network for technical computer problems, the social content is hard to find. Even the debates between the two members, i.e. Ml*** and Mw***, were concentrated on the technical problem and its solutions rather than irrelevant issues. Meanwhile, even the "Problem Description Episodes" are not quite common. This can be explained by a large number of ideas proposed by the discussion participants providing sufficient choices for the questioner to try. In addition, the dispute over irrelevant issues, which falls into "Non-constructive Episodes", and verbal abuse and trolling, mentioned by interviewees, did not emerge in these discussion threads. One possible explanation is that all of the discussion participants' identities were known on this social networking site and no one wanted to be considered a "troll".

Among the knowledge construction episodes, the sub-category of "proposing a new idea" accounted for a large portion of the discussions. Proposing new ideas or solutions was one of the key phases of constructing new knowledge to solve the problem. A large number of suggested ideas produced in the discussion reflected that the discussion participants were highly involved in finding solutions. In addition, it also proves the high-level expertise of the members in the professional group formed on the LinkedIn website (i.e. the group of Computer Technicians-PC Techs-Desktop Support). In this social networking website, people with the same interests, professions, and expertise form groups and create strong personal links. Their identities and other personal information are also visible on this social network website. On the other hand, the product user community members formed on the support forum are more diverse in terms of professions and interests. Knowledge expertise at different levels in the support forums and the forum users' identities is invisible too.

8.7.4 One-to-one Interaction Feature

Social network site create a convenient platform for one-to-one interaction in group discussion threads. There is an obvious correspondence between the posts of the discussion threads which fall into the sub-categories of "asking focused question (about the problem)" and "clarify ambiguity (about the problem)" is quite salient in the selected threads. In thread 2, six focused questions about technical problems being discussed (i.e. questions about contextual knowledge about the problem, which can help diagnose causes and find solutions) were asked. Corresponding to this, there were also another six posts respectively responding to these questions and clarified the ambiguity about the technical problem.

For Example:

Asking focused question (about the problem):

> "Is this your own machine, or a clients.?You seem to be doing a hell of a lot of work, to find something that could be hardware or software related..." (post 15)-Gs***

Clarifying the ambiguity (about the problem):

> "This is my own computer, custom built. I have had hard drive fail on me before and I am thinking that this is not a hard drive issue…" (post 16)-Tg***

In post 15 one member, George, asked a question about the contextual knowledge about the problem, namely, the ownership of the computer, in order to suggest a solution idea for the questioner to try. In post 16, the questioner Todd provided the requisite information to this

specific question. Consequently, this specific contextual knowledge about the problem, which helps to find a solution, is transmitted and explained.

The one-to-one interaction can also be observed from a large portion of conversational content between the two discussion participants and their mentioning of each other's names in their posts. In thread 3, post 12, 13, 14, and 17 were about debating each other's solutions between two members.

Before the debate started, one member Mw*** suggested one idea in the 9th post.

> "*When booted up go start > Run > msconfig.exe > boot tab and look to see what is listed and remove all you don't want/need.*"

Then another group member, Ml***, proposed a different idea to solve the problem in the 11th post, as follows:

> "*…You need to get the mbr back to the normal Windows state. bootrec.exe should have done this for you. Since it hasn't something unusual is going on. The only thing that comes to mind at the moment is that grub is installed to a partition that's marked active. If that's the case then you need to get a partition tool and make sure that your Windows partition is the one marked active. Mike"*

Then Mw*** evaluated and disproved Michael's idea by providing many successful experiences of using his idea and proof from an external knowledge link in the 12th post.

"*Michael you really don't need to do any of that, if he follows as I have said it will solve the issue and he won't need to mess about with partitions. I have done this hundreds of times on various Windows boxes and not once have I had to mess about with the partitions of the HDD. See also http://www.sevenforums.com/tutorials/2282-default-operating-system-change-default-boot-os.html It's not a complicated issue, and messing about with partitions can lead to more problems than the one your fixing.*"

Immediately Ml*** defended his idea by clarifying its ambiguity in the following 13th post.

"*Matthew, no it isn't that complicated. …As for my advice on making sure the Windows partition is the one marked active, there's nothing dangerous in doing that as long as you don't change the partitions proper. If the OP isn't comfortable doing that then he should bring his computer to someone who is familiar with editing a partition table non-*

destructively. Of course you should always make a full backup before doing anything involving your boot system. This goes double if you're going into unfamiliar territory."

In the 14th post, Mw*** analyzed the nature of this technical problem and restated the workability of his idea:

> "*But from looking at the options he is getting on the menu it's not a grub menu it's the Windows boot menu, he has confused the two. I am familiar with grub in that I know unless you are duel booting to Linux/Windows you don't see a grub menu on a Windows install, if you can prove otherwise by all means go ahead, but from the information the OP has posted the issue is with the Windows boot menu which is fixed using msconfig.exe as I posted above.*"

In the 17th post, Ml*** provided more facts to evaluate Matthew's ideas.

> "*Matthew. Checking a few facts… Some people install Linux and put the boot loader on a separate partition. In that case you could wipe Linux off the drive and grub would survive. Since a properly installed grub will only show bootable choices, the menu would look exactly as described in the original message. .. Still, you suggested he might be mistaken in your last message and he let it stand. Neither BDCEDIT nor BOOTREC fixed the problem. ..I really hope that I'm wrong and your msconfig suggestion works. It's much simpler than my way. Time will tell.*"

It can be observed that these posts (i.e. post 12, 13, 14 and 17) were direct towards conversations between the two members. These two members replied to each other and referred to each other by name. During this process no other members joined in the debate. Post 15 "*I will try Matthew's suggestion and give you feedback.*"(by Oe***) is about an initial questioner's claim of trying Matthew's idea.

Post 16:

"*I would be seriously concerned where the copy of W7 pro upgrade came from the only way I can think of …might be worth using DISM to check the GUID of the pro version then email MS to check the product licence is correct. if it is ok you could try remounting back into a VHD and solving otherwise best to use the anytime upgrade such a simple operation and is normally faultless. good luck let us all know if the copy is a bogey!!!*"(By Rt***)

This post was about a different new idea proposed by another member. Thus, it can be seen that the one-to-one interaction between the discussion participants was quite salient in this social network discussion space.

The social network users also used lots of one-to-one communication symbols of social network sites, i.e. using @ to refer posts to each other. The frequent usage of the technical symbol of @ enhances one-to-one interaction during discussion process. For example, in thread 4, there were several posts which used @ to communicate with particular members to report feedback after testing the suggested idea, to clarify the ambiguity about contextual information of the problem, and to ask focused questions about the problems.

For example,

> "*Thanks so much @ all. @ Nicholas, I suspected the processor as well. But even after replacing it, the fault still persists…"*-Ja***
>
> *"@Ronny Padernal, Name a laptop that has a separate video card to replace. I have never seen a laptop that has a separate video cad."* –Re***

8.7.5 Conclusion

To conclude, the content analysis framework of knowledge construction created in this project was effective for coding discussion contents in selected threads of LinkedIn interest groups, whose topic were technical problem oriented. Its knowledge construction patterns and solution finding strategies are quite similar to the product user community in the Dell support forum. The discussion content in these selected threads is highly concentrated on knowledge construction episodes. The sub-category of "proposing a new idea" accounts for a large portion within the knowledge construction episodes. This can be explained by the similarity of professions in the interest group members on the social network, high-level expertise and the known identities of the members. Similar professions, interests and expertise of the members enable community members to generate many ideas. Visible identities in the LinkedIn websites meant the discussion was less distracted by irrelevant topics, unnecessary arguments, and trolls. However, there is one salient feature in social networking websites: one-to-one interaction. It can be reflected in large portions of corresponding relationships between published posts, and lots of conversational contents between two discussion participants, and many usages of the symbol of @ to refer posts to each other. This is based on the unique communication platform and strong link between members of social networking websites.

8.8 JISCMail

8.8.1 General Introduction of JISCMail

The National Academic Mailing List Service (JISCMail) is the largest email discussion list community for academics and researchers in UK. It is based on LISTSERVE mailing software and aims to create a "strategic collaboration tool within the academic community" (JISCMail, 2013). Its discussion topics included all of the academic programmes, research categories, and issues relating to educational and research work (for instance, the category of general university and information resources). According to its Introduction page, it is aimed at supporting discussion centred on various topics about research and education, to promote collaboration and communication among the researchers and academics (JISCOMail, 2013):

"

- *Share experiences*
- *Enhance collaboration*
- *Keep in touch with peers*
- *Aid research*
- *Make new contacts*
- *Keep up to date with advancements in your field*
- *Announce events*"

The moderation work in JISCMail is mainly performed by volunteer users. Every discussion list in JISCMail is managed by individual users who have a formal title of "list owners" (JISCMail, 2013). These list owners are in charge of anti-spam by controlling the list configuration and are responsible for group security by changing the group configuration at their own discretion (JISCMail, 2013). The list owners also have a strong influence on deciding the discussion content. "List owners may decide on the focus or subject of their lists and they may direct discussion" (JISCMail, 2013). In addition, these list owners are also involved in managing the discussion groups, including membership list configuration, and so on. They should also decide on "membership, list configuration and on appropriate postings for their list" (JISCMail, 2013) and "whether the list is Public or Private" (JISCMail, 2013).

Most of the discussion content in JISCMail is about job information, research project information, seminars, workshops, events, calls for papers, and so on. The researcher read through parts of the discussion content in most discussion categories, and found these

discussion subjects were mainly about publishing information about research events and news with a single message, or asking specific questions about teaching and research rather than computer problems. Furthermore, most topics had one message and only a small portion of subjects consisted of more than 3 messages, and most of their topics were not about solving technical problems. The researcher identified a few discussion topics that are probably related to solving technical problems in computers, printers and other hardware and software used for teaching and research, such as topics of web-support archives.

Within the section about topics of "Web-Support Archives", most subjects just had a single message which released event news about workshops, conferences, seminars, and calls for papers. Most subjects were about sharing knowledge rather than building new knowledge to solve technical problems of hardware or software. The researcher read through all of the subjects published from January 2009 to July 2013 in the section of Web-Support Archives, and found the following subjects were related to computing issues.

8.8.2 Threads Analysis

Subject 1: "*Browser support guidelines - where do you draw the line?*" (https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind1206&L=WEB-SUPPORT&F=&S=&X=0A6D6C6E8468607298&Y=lir09xl%40shef.ac.uk&P=1916)

Table 8-14: Coding Result of Subject 1

Messages	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge
1	1				
2		1[34]	1		
3		1			
4				1	

The first message asked a few questions about browser support:

> "What do you folks do? Do you have browser support guidelines, either written down or not? Where do you draw the line? What are your criteria for what you support? And what about mobile devices?"

[34] The question was answered by publishing a webpage link.

The second message posted a webpage link to answer the above question, and asked another question:

> "But strange that as quoted Google Apps doesn't mention Chrome. And is Opera out of the running entirely?"

This question was not about the original problem or proposed idea and did not have significant relationships with answering the question. Then a third message sent another webpage link which also answered the initial question. The fourth message answered the second question in message two. The interaction between message 2 and message 4 was not about explaining or exploring knowledge about the original question or idea. In fact, they are of the asking and answering relationship on a different question. Thus, it can be concluded that the discussion in this subject was about sharing knowledge by "asking and answering".

Subject 2: "*Cookies again (Was Re: Head of Digital)*" (https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind1106&L=WEB-SUPPORT&F=&S=&X=66740B4482EE59FB34&Y=lir09xl%40shef.ac.uk&P=6571)

Table 8-15: Coding Result of Subject 2

Messages	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge
1	1				
2		1			
3[35]					
4		1			
5		1			

The discussion in the second subject was totally about sharing knowledge. The first message asked a question:

> "Can someone point to more information about the "the updated guidance in October" (i.e. not what it will be but who will be providing it)?"

Then message 2, 4, and 5 answered this question with different answers.

Subject 3: "*FAQ with suggested answers*" (https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind1102&L=WEB-SUPPORT&F=&S=&X=3A099A29F7520AEB04&Y=lir09xl%40shef.ac.uk&P=6845)

Table 8-16: Coding Result of Subject 3

Messages	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge
1	1				
2		1			
3		1			

Subject 4: "*HTML5 validation errors on search form element*" (https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind1102&L=WEB-SUPPORT&F=&S=&X=3A099A29F7520AEB04&Y=lir09xl%40shef.ac.uk&P=6845)

35 This message, which discussed the advantages of installing cookies by giving an example, is not highly relevant to answering the initial question. Thus, it cannot be coded by the analysis framework.

Table 8-17: Coding Result of Subject 4

Messages	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge
1	1				
2		1			
3		1			

The discussions in both subject 3 and 4 were about sharing knowledge. The first message asked questions, and the following messages provided answers. The knowledge about the question or proposed ideas were not explored, explained, or tested.

All of these four subjects are about seeking advice or answers about specific questions, which are not related to technical problems, rather than look for solutions to technical problems. The answers provided were ready answers which were not explored or tested in the discussion. Therefore, the discussions under these subjects were more about sharing ideas on these questions rather than building new knowledge to solve problem.

8.8.3 Conclusion

In general, the discussion content on the JISCMail website was not technical problem oriented. Its users utilized the Listserv mailing service to publish information, to contact with others, and to share knowledge on specific research and teaching questions. The discussions in the selected subjects are about sharing ready answers or information to the questions in the starting email. The researcher found that most of the messages within these four selected subjects can be coded by the content analysis framework created for knowledge construction. Nearly all of these messages fell into two sub-categories of "triggering question" and "proposing a new idea". The remaining sub-categories in the analytical framework are seldom involved in the discussion. In addition, the idea proposed was seldom explored, explained, or tested. With the absence of two key knowledge construction episodes, namely, "Knowledge Exploration & Explanation Episode" and "Evaluating & Testing Episode", the content in the JISCMail was about sharing knowledge through "asking and answering", rather than constructing new knowledge.

This suggests that the technology of listserv adopted by the JISCMail is suitable for sharing information and knowledge rather than building new knowledge on complicated questions.

This is also in line with its own definition of the function that "*JISCMail uses the world wide web and e-mail to enable groups of academics and support staff to talk to each other and to share information.*" (JISCMail, 2013). The larger number of participants and replies in the forum and social network site make them much more convenient for a communication platform.

The moderation work, including group security, anti-spam, deciding discussion content and topics, and others managing the group's membership and configuration, were conducted by the volunteer moderator, i.e. the group owner. Accordingly, their influence was mainly focused on the discussion content, membership, and group configuration. Thus, an indirect influence on the discussion participants' knowledge sharing behaviours in this listserv site was achieved.

8.9 Slashdot

8.9.1 Introduction to Slashdot

Slashdot, built in 1997, is a website which concentrates on topics and news related to science and technology. It is "*a website based on and running the Slashdot-Like Automated Story-Telling Homepage software*" (Slashdot, 2013). A thread consists of an initial story or news and a following comments section, and takes the form of a threaded discussion pattern, rather than chronological order (/temporal order of messages). All of the comments are arranged around topics in a hierarchical structure. The replies to other messages are grouped below the original message. Thus, a set of messages around the same sub-topic are arranged together. "*The construction of the threaded conversation is based on the participants' reactions to the messages. Here, the users have the capacity to segment the messages as they please, by choosing the topics in which they want to react with the desired granularity.* " (Reyes & Tchounikine, 2003:90). In addition, the response relationship in threaded discussions is explicit (Cakir, et al., 2005).

This Website adopted a collective moderation model, i.e. the user-based moderation system (i.e. peer moderation), to filter out abusive contents and to give scores to each comment by users. The moderators were not promoted from regular users. In fact, the moderation system initially assigns 5 moderation points at a time to enable users to give a score between -1 to 2+ to publish comments. Consequently, the submitted comments containing more valuable knowledge and insightful ideas could be promoted through the peer moderation system. "*The*

goal here is to share ideas, to sift through the haystack and find needles, and to keep spammers and griefers in check." (Slashdot, 2013). Specific labels were also given to the comments by the moderators, such as insightful, informative, interesting, and funny. Meta-moderation is also implemented to moderate the moderators' work by allowing regular users among the oldest 92.5 % accounts on the system to rate a set of moderation. "*It seeks to increase fairness by letting logged-in users "rate the rating" of randomly selected comment posts.*" (Slashdot, 2013).

In order to compare with other selected forums, the discussion sub-forum of "Ask Slashdot", which contains articles looking for advice from peer users on computer hardware and software, latest IT development and News, jobs, philosophical questions, and so on, was chosen for analysis. It was initially considered to cover varying topics of solving technical problems of computer hardware like other selected forums. However, by reading through the recent dozens of WebPages in the section of "Ask Slashdot", the researcher found most of the discussion questions were not about technical problems of computer hardware that they came across in their daily lives. In fact, most questions were about ideas of technologies, computer hardware development, I T news, software upgrading, and so on. For instance, "*What Should Happen To Your Data After You Die*?" (http://ask.slashdot.org/story/13/04/12/2018218/ask-slashdot-what-should-happen-to-your-data-after-you-die) and "*Building a Web App Scalable To Hundreds of Thousand of Users?*" (http://ask.slashdot.org/story/13/04/13/2015253/ask-slashdot-building-a-web-app-scalable-to-hundreds-of-thousand-of-users). Finally, the discussion topic of "*Best Way to Block Web Content*" is chosen for analysis. This topic is not related to solving technical problems in computers, but it is much closer to practical questions discussed in other forums than most idea-oriented articles in "Ask Slashdot" section. In addition, this question can be proposed in daily life, and its answer can also be applied and tested.

8.9.2 Thread Analysis Result

This thread consists of 101 posts, including 100 comments. 65 registered users released 96 posts while the rest 5 posts were published by 5 anonymous users. Like other threads in Slashdot forum, this thread also took the form of "Threaded Discussion" (/"Conversation Threading"). This thread is analyzed with the content analysis framework of knowledge construction developed in this study. The detailed analysis result is presented as follows:

Table 8-18: Number of Posts Falling into main Categories

Thread	Number of posts	Number of Participants	Posts falling into the whole Analytical Framework	Posts falling into "Knowledge Construction Episodes"	Posts falling into "Problem Description Episodes"	Posts falling into "Non-Constructive Episodes"	Posts falling into "Moderation Episodes"
1	108	70	96%	57 (53%)	0	46 (43%)	0

[There were 7 posts falling into two sub-categories. 6 posts of social dimension could not be coded]

Table 8-19: Number of Posts Falling into Sub-categories of Knowledge Construction Episodes

Main Categories	**Triggering Question Episode**	**New Idea Proposing Episode**	**Knowledge Exploration &Explanation Episodes**			**Evaluating & Testing Episode**		
Sub-categories / Thread	Triggering question	Proposing a new idea	Asking focused question	Clarifying ambiguity (by answering the focused question)	Bringing outside knowledge	Evaluating suggested idea	Testing the idea	Claiming to test the idea
1	1	20	5	4	0	27	0	0

It can be observed that this newly created knowledge construction analytical framework is capable of coding most of the posts in this thread. That is to say, the Slashdot users' knowledge building behaviours and relevant patterns can be identified by this framework. However, 5 posts with the label of "Funny" containing humorous social content cannot be coded.

Unlike the threads in other virtual product user communities, the posts falling into the knowledge construction episodes do not account for a large portion in this thread. In fact, the discussion in this thread is discursive, to some extent. The whole discussion does not merely focus on the question of "blocking website content" and finding answers to this question. In this discussion thread, there are many posts covering other issues. For instance,

- The social ethics of blocking website advertisements, like:

"Agreed, and generally you should think carefully what you want to block. It's unethical to cut the main revenue stream of a website. Of course at some point ads can become unbearably annoying, but at that point you shouldn't visit that website at all." (Post 96 posted by j6**** on Sunday March 17, 2013 @11:39AM)

- The aesthetics and annoyances of advertisements, like:

"The aesthetics and annoyances of ads are only part of the issue, and not even the most important…" (Post38 posted by d3***on Sunday March 17, 2013 @10:55AM)

- The legality of blocking websites, like:

"I am continually surprised that it is still legal to block ads, and that there is no visible movement to make blocking illegal. Not even any pervasive "The websites must be able to make money on what they do!", "Blocking ads is like stealing from the websites!" or "You wouldn't watch a movie/TV-show without watching the commercials" campaigns. Google and their customers must not have as good lobbyists as Hollywood." (post 31posted by jy3**** March 17, 2013 @10:48AM)

- Bandwidth & data costs, like:

"Adblock used to have an option to do just that. It disappeared many versions ago. Pity, because it was a good idea if you really wanted to stick it to the advertisers. You'd lose the bandwidth savings as the ad content would still download, but if you're unmetered and sporting a vendetta against marketroids it was a great option to use." (Post 35 posted by Cr*** on Sunday March 17, 2013 @03:13PM)

- Website revenues, like:

"…I've clicked on ads and purchased something twice in my life from ads on a site. Once it was cheap shirts with funny designs on them (I needed new gym shirts) and the other was an eBay auction with a Buy It Now price lower than what I was looking at on that site (not sure how that works). I consider myself a pretty sophisticated person who is "above" advertising but anecdote-wise it's worked on me twice that I can think of. Removing that rare occurrence completely ruins the revenue model." (Post 14 posted by e4*** on Sunday March 17, 2013 @09:35AM)

- Internet freedoms, like:

"This is patently false. The internet, and before it the countless BBS services, was built on freedom and idealism. A server operator would pay out of pocket for their hobby and users would either access it for free, pay membership fees, or pay 900-number dial-in fees. The early internet had no ads because it was a hobbyist driven system. Not until the mid 90's did the internet monetize." (Post18 posted by Ad*** on Sunday March 17, 2013 @10:33AM)

There are as many as 46 posts (43% of the thread) falling into the sub-category of "Disputing /talking about irrelevant issues", which is the single sub-category of "Non-constructive Constructive Episodes" in this thread. This can be attributed to the nature of the topic of this thread: it is not completely limited to technical problems of computers in daily life. To be more specific, this thread is mixed between "technical problem oriented idea discussion" and "idea oriented discussion". Thus, this causes parts of the whole discussion threads to become quite discursive, in other words, not to focus on the technical problem and its solution. Accordingly, regarding this point, the discussion pattern is quite similar to threads in the IdeaStorm Community in Dell Forum, which also contains discursive topics. Another reason can be related to the Slashdot forum discussion feature and community culture. The discussions here are mainly about news and stories rather than technical problems.

The knowledge construction episodes include "Triggering Question Episode", "New Idea Proposing Episode", "Knowledge Exploration & Explanation Episode" (which includes the sub-categories of "Asking focused question" and "Clarifying the ambiguity"), and "Evaluating & Testing Episode" (which includes the sub-category of "Evaluating suggested idea" in this thread). It can be seen that all of these four key knowledge building episodes are involved in this thread. It is quite obvious that the sub-category of "Testing the idea" is absent and the sub-category of "Evaluating suggested idea" accounts for a large portion of knowledge construction episodes. This is strongly related to the nature of the topic: it is a mixture of "idea" and "practical question". This allows suggested ideas to be evaluated by reasoning rather than tested by application.

Lots of new ideas are proposed in this thread. The large portion of posts falling into the sub-category of "proposing a new idea" can reflect the high expertise level of the discussion participants. Lots of jargons and specific technical terms are frequently used in these posts. Meanwhile, these ideas are also evaluated by reasoning, which also needs a certain level of knowledge.

The reply relationship is quite clear and can be easily identified in this thread. The replies to other comments are arranged in a hierarchical order. Moreover, all of the comments belonging to the sub-category of "evaluating the idea" are grouped below the post containing the new solution (i.e. "proposing a new idea").

The category of "Moderation Episode" does not emerge in this thread due to the fact that the user based moderation system is used in the Slashdot forum. It can be observed that the user based moderation system enables more freedom in using language.

Examples:

> "I don't really give a flying fuck. Most of it is crap anyway" (Cr*** on Sunday March 17, 2013 @05:43PM).

> "If it's your computer, sure. (That includes those which are owned by the state but which you have access to, e.g. at the library.) If it's not your computer, fuck off. It's not your computer." (do*** on Sunday March 17, 2013 @10:13AM).

> "Unplug your modem. Internet is now filtered. Enjoy your day! This is an appropriate response given the bullshit question." (Ad*** on Sunday March 17, 2013 @11:44AM).

The foul language (/profanity language) containing "*flying fuck*", "*fuck off*", and "*bullshit*" are used in the above three posts to express emotional information to complement the main idea. In contrast, the Dell support forum, which is managed by a moderator, exerts very strict censorship rules on users' published content. No foul language is identified in the threads on the Dell support forum, or other company sponsored user support forums. According to the interviewee, forum users in the Dell Support Forum will be warned by the moderator if they publish any content with foul language.

> "Censorship was also a big issue, as we would receive warning messages should we swear or use foul language within the forum, even if it was just casual conversations with foul language included**."**- Vy***

The user based moderation system enables the Slashdot forum users more freedom to choose language they like as long as no personal attack is involved. This is also in line with the community member's requirements.

> "Don't enforce censorship. A forum is a place where people share and communicate. If you limit the was[way] they communicate, especially when using foul language is just part and parcel of their usual conversation, you are limiting their natural thought processes, which could in-turn lead to a limit in what they have to offer/share. And if somehow an experienced user

gets banned erely [merely] for using foul language, that is just a waste of resources and knowledge for the forum."-Vy***

Freely choosing language can ensure the smoothness of communication and "natural thought processes". Consequently, knowledge sharing and contribution can occur without constraints of language censorship. Meanwhile, the user with high-level expertise can fully participate in the discussion and contribute their knowledge, rather than be banned for using foul language.

8.9.3 Conclusion

The threads in AskSlashdot are mostly idea-oriented, rather than technical problem-oriented discussion. Thus, this topic feature makes the discussion discursive and not focus on the question and finding answers in parts of the thread. Lots of posts fall into the sub-category of "Disputing on/talking about irrelevant issue". The discussion pattern in the selected threads is parallel to the IdeaStorm Community, where sometimes discussions are also off-topic. All of the knowledge construction episodes emerge during the discussion process. However, one sub-category of "Testing the idea" is absent in this thread due to this topic feature. The threaded discussion pattern and hierarchical arrangement of comments makes the reply relationship very clear. All of the comments of the same topic are arranged together and form discussion trunks with "sub-topics". The user based moderation system creates a much looser censorship towards the users' language, compared to sponsored user communities. Several expletives like "fuck" and "bullshit" are identified in this thread. According to the user in the Dell Support Forum, this could enable smooth thought processes, communication and the sharing of knowledge through more language freedom.

8.10 Conclusion

8.10.1 Content Analysis Framework & Knowledge Construction Patterns

The content analysis framework created for exploring knowledge construction activities in product user communities is an effective tool for coding most of the selected threads in various communities, including product user communities on Lenovo, HP, and Dell forums, LinkedIn interest group, and Slashdot forum. All of the posts in the selected threads fell into the categories of the analytical framework, except for the threads in the HP Chinese technical support forum and Slashdot forum. Only a small percentage of the posts of the threads in these two forums could not be coded, due to the pure social information contained. Even in

the short discussion threads which had just a few replies on the Lenovo Discussion Board in Chinese, the episodes of knowledge construction process could still be captured by this content analysis framework. In addition, it is capable of describing knowledge sharing behaviours in JISCMail by its sub-categories of "Triggering question" and "Proposing a new idea" and so on. However, the social dimension is not included in this content analysis framework, which only aims to explore knowledge construction. This makes it unable to code social information.

According to the coding results of selected threads from varying forums, it can be observed that this analytical framework is more capable of analyzing technical problem oriented discussion rather than idea-oriented discussion. The "Evaluating & Testing Episode" is one of the essential knowledge construction episodes in the collective solution finding process. The ideas generated to solve technical problems can be evaluated by existing facts, and more importantly, can be tested by applying the idea. Meanwhile, "trial-and-error", which significantly depends on "Evaluating & Testing Episode", can be adopted as an effective knowledge construction strategy in the technical problem oriented discussion. In contrast, the idea-oriented discussion is more discursive, and some trunks of the discussion thread can be irrelevant to solving the question being discussed (i.e. tend to depart from the main topic and cover a wide range of subjects). Furthermore, the posts with a social dimension (i.e. posts containing only social information) rather than a knowledge construction dimension can also emerge in the discursive discussion trunks.

In addition, this analytical framework is more suitable for the technical problems in family or personal products rather than enterprise equipment, which can receive immediate technician support from producers. The researcher read through threads in the technical forum of Huawei, one of world's leading information technology and communication service providers and equipment producers, and found its discussion content was quite different from that in the family products forum. This makes it quite different to code contents with the analytical framework.

To conclude, the content analysis framework of knowledge construction is not only effective for exploring knowledge behaviours in virtual product user community, but also useful for other similar virtual communities, such as the social network community on LinkedIn and the Listserv website of JISCOMail. It is suitable for activities for solving technical problems whose solution ideas can be evaluated by linking with the facts or be tested by applying the

idea. Therefore, this analytical framework can be used in other similar contexts with practical issues too. This analytical framework does not include social information, which can have a strong influence on the knowledge building dimension. This limitation leads to being incapable of exploring the social dimension, mixed with the knowledge dimension.

According to the coding results of these forums, the key knowledge construction episodes of "Triggering Question Episode", "New Idea Proposing Episode", "Knowledge Exploration & Explanation Episodes", and "Evaluating & Testing Episode", which form the key necessary elements of building new knowledge, are quite common in these virtual communities and online groups. These three knowledge construction episodes are involved in these discussion threads and account for a higher percentage, compared with other main categories.

Another two main categories of "Problem Description Episode" and "Non-constructive Episode" also emerge in these selected threads and account for a much smaller percentage than knowledge construction episodes. They form parts of the discussion content and are necessary elements for achieving knowledge building. The "Problem Description Episode", together with the sub-category of "clarify the ambiguity (about the problem)" can help the knowledge expert to obtain contextual knowledge about the problem, and thus to diagnose the causes and provide workable solution ideas. The moderation episodes are not quite common in these selected forums, and it only emerged in the Lenovo Forum in English.

Accordingly, the exact knowledge construction patterns in the virtual knowledge community can take various forms, based on the combination of these episodes. However, the essential process of solving technical problems through collaborative efforts is still based on these identified knowledge construction episodes and is in line with the knowledge building prototype proposed in this research. Therefore, the knowledge construction model developed in this research is confirmed as an effective lens to understand the way that knowledge is built in these selected communities and groups.

8.10.2 Variables of Virtual Community's Influence onto Knowledge Construction Behaviours

The influence of different variables of these selected forums on the users' knowledge behaviours are explored, including culture and language background, topics, communication platform (technology), sponsorship, moderation, and size of participants and posts[36].

The community member's knowledge building behaviours and patterns are consistent in the English support forums of HP and Dell. This is because they all have the same variables of topic, communication technology, organizational sponsorship, language and culture, moderation, and size of users.

The variable of forum users' cultural and language background does not cause a great difference of knowledge behaviours and knowledge construction patterns. According to thread analysis results of the Dell Support Forum (in Chinese), and the HP Technical Support Forum (in Chinese), there are no obvious different knowledge construction patterns in the English forums, although the cultural and language variables are different. Social information is identified in the HP Chinese forum. It can promote community member's interaction and participation motivation according to the interview data. This still needs further exploration in the future studies.

The discussion topics of the selected threads create the differences in discussion contents and knowledge construction patterns. In the discussion thread centred on the topic of the technical problem and its solutions, the posts concentrate strongly on "Knowledge Construction Episodes" and "Problem Description Episodes". The knowledge construction patterns in the selected virtual product user communities and social network communities are similar. On the contrary, the idea-oriented discussion threads on the Slashdot forum are quite discursive and sometimes the discussions go off-topic. In addition, it contains many more posts with pure social information. Corresponding to this, the user based moderation system in Slashdot conducts a loose censorship over foul language to enable a smooth communication process and active knowledge behaviours.

The moderation system and the moderator's role have a great influence on the forum users' participation motivation and knowledge behaviours. This variable can play a vital role in

[36] This variable was added for consideration after thread analysis of Dell User Support Forum in Chinese

deciding the success of a virtual product user community. According to the analysis result of Lenovo Discussion Board in Chinese, a poor moderation system and insufficient moderator efforts can cause inactive participation, low response, and scarce knowledge construction activities. The moderation system in this forum fails to promote users' motivation to participate in the discussion, and to collaboratively find solutions to their problems. The forum managing team and volunteer moderators lack of sufficient activities in managing the forum threads, promoting users' participation, retaining users with expertise, and facilitating the growth of the community. On the contrary, the HP Technical Support Forum in Chinese, which is a quite successful peer support forum, adopts multiple strategies to promote users' discussion motivation and community members' identities.

In these selected virtual communities, both formal moderators appointed by the organizations and volunteer moderators chosen from active users are involved in managing and moderating duties. They can have an influence on discussion participants' knowledge sharing and building activities in direct or indirect ways. For instance, the volunteer moderators in JISCOMail can indirectly influence members' knowledge sharing by deciding the discussion topic and content, and group configuration.

According to the rules and regulations in Dell, HP, and Lenovo support forums and interviewees in this research, the sponsored virtual communities have a much more stringent censorship, which is conducted by the moderator, than self-sponsored virtual communities and groups. For instance, Dell moderators exert very strict censorship on user's language. In contrast, peer moderation systems in Slashdot, a self-sponsored community, allow more language freedom. The censorship in other self-sponsored virtual communities and groups, i.e. JISCOMail and LinkedIn, are not as evident as in company sponsored product user communities. This suggests that the censorship and relevant moderation mode has a strong relationship with the sponsorship of virtual communities and online groups.

The unique features of communication technology can exert an influence on knowledge construction patterns. The social network website of LinkedIn enables the function of visible identities of its members. Furthermore, the network feature creates strong ties between members of similar professions, interests, and expertise. These two attributes of the social network websites make the discussion concentrate strongly on knowledge construction episodes. The visibility of its users' identities makes the discussion less discursive and involves less trolling behaviours. One-to-one interaction (and/or interpersonal interaction) is

salient in the discussions process on social network website of LinkedIn. Threads in the Slashdot forum have threaded discussion patterns and a hierarchical order of posts under the same sub-topics. These attributes enable clear reply relationships of posts. Meanwhile, a whole discussion thread can be divided into several trunks, where comments on the same topic are arranged in a hierarchal order. The discussion content in JISCMail, based on listserv technology, is more oriented to sharing knowledge rather than constructing new knowledge. It can be assumed that listserv is not as convenient a communication platform for discussing complicated questions as other technologies.

The researcher found that a smaller size of discussion participants among whom there should be peer experts and posts in a thread can make the discussion focus on the topics (i.e. technical problems) and make knowledge building proceed in a smooth way. Certainly, the vibrant discussions participated by a large number of community members are still needed to solve complicated technical problems.

All in all, except language and culture, all of these variables identified from the literature and findings have different influences upon community members' knowledge construction patterns. Moreover, some of these variables also have an influence on each other. The sponsorship can decide the censorship, moderation mode, and discussion topics. Discussion topics also have a relationship with the moderation feature. The idea-oriented discussion topics in Slashdot require the moderation system to provide more freedom to use language for smooth communication and interaction.

8.11 Summary

This chapter analyzed the knowledge construction patterns in different types of virtual communities and online groups, including several virtual product user communities such as HP Technical Support Forums in both Chinese and English, through coding selected threads through the newly developed content analysis framework. Accordingly, the influences of contextual attributes (i.e. key variables) on knowledge construction were clarified by comparing the coding results. In addition, the content analysis framework of knowledge construction developed in this research was also evaluated. In the next research stage, the findings from all of the data analysis stages will be combined and synthesized in order to gain an overview of knowledge construction.

Chapter 9 – Conclusion and Synthesis of the Findings

9.1 Introduction

A new type of virtual community, namely the virtual product user community, is identified and defined in this research. Its attributes are also discussed, including its community members, purpose and sponsorship relationship, all of which have been compared with the features of other types of virtual communities and online groups. With the aim of exploring knowledge construction activities, including its patterns, process, strategy, influencing factors, and so on in this type of virtual community, two types of data were collected and analyzed, i.e. published discussion threads and interview data.

The findings from qualitative content analysis of selected discussion threads and thematic analysis of interview transcripts were developed in three research steps:

1. The creation of a content analytical tool to explore knowledge construction patterns in product user communities and the development of a knowledge construction model. In the initial research stage, existing knowledge construction analysis tools and frameworks, which are all built in a CSCL context, were critically analyzed and assessed in order to shed light onto finding a prior categorization matrix for the new analytical framework. Then a theoretically interesting thread in the Dell User Support Forum was selected and analyzed to evaluate prior categories and to identify new categories in the context of the virtual product user community. This content analysis framework was initially created based on the above efforts, then further elaborated to embrace more categories that were able to represent different knowledge construction patterns through analysing more threads in the Dell Product User Support Community and Dell IdeaStorm Community. Meanwhile, a knowledge construction model, which consists of the essential and necessary constituents for building new knowledge in the product user community, was also proposed with the aid of this analytical framework.

2. Findings from the interview data collected from active users, medium active users, and less active users on the Dell User Support Forum were used to complement the findings from the content analysis of threads. They help us to understand the reasons for individuals participating in the virtual product user community; perceptions of the moderation process and the moderator's roles; and the virtual community culture. These issues are quite difficult to study through mere threads analysis. More importantly, thematic analysis of interview data

enabled the researcher to achieve the goal of evaluating the categories included in the analytical framework, in order to further explore the relationship between the categories and clusters of categories and their functions in the knowledge construction process. In addition, through the interviewees' descriptions of their own behaviours in technical problem enquiries and problem-solving, the experiential nature of community members' knowledge, and the exact knowledge construction method of relying on the contextual knowledge about the problem to diagnose the cause and identify of the requisite experiential knowledge, were revealed. These two issues also could not be discovered through analysis of discussion threads.

3. Findings from the application of this analytical framework in threads analysis in multiple virtual communities and online groups with varying attributes, which are considered to be the key variables of virtual communities in the literature. The workability of this content analysis framework was confirmed after being applied in these virtual communities and online groups. Moreover, the influences of these key variables on knowledge construction patterns are also studied through comparing with the analysis results from different virtual communities.

9.2 Findings in Research Phase One (Content Analysis of Discussion Threads)

9.2.1 Content Analysis Framework & Its Categories

In order to explore knowledge construction activities within this type of community, the content analysis framework of knowledge construction was developed at the first research step, as follows. This content analysis framework of knowledge construction consists of the main-categories of "Knowledge Construction Episode", "Problem Description Episode", "Non-constructive Episode", "Moderation Episode", and "others".

Table 9-1: Knowledge Construction Episode

Main Category	Sub-category	
	Sub-category	**Definition**
Initiation Episode	Triggering Question	It refers to the first post (or first a few posts) which asks (or ask) question about the technical problem and triggers the following discussion on its solutions.
New Idea Proposing Episode	Proposing a New Idea	It refers to an idea for solving the problem not mentioned before.
Exploration & Explanation Episode	Asking focused question (about the idea /about the problem)	It refers to asking a specific question about the suggested solution, or requiring more detailed information about the problem.
	Clarifying ambiguity (about the idea/ about the problem)	It refers to providing relevant information to answer focused question (about the idea/about the problem).
	Bringing outside knowledge	It mainly refers to releasing a webpage link directed to other information source or bringing outside knowledge to the discussion thread in order to enhance the possibility of solving the problem.
	Repeating/ refining or elaborating already stated idea	It refers to repeating, refining or adding more detailed information to the already stated idea.
Evaluating & Testing Episode	Evaluating suggested idea (by reasoning or existing facts)	It refers to evaluating the idea by reasoning or linking the idea with existing facts.
	Claiming to test the suggested idea	It refers to statements of planning to test the suggested idea.
	Testing the idea (usually by applying the idea)	It refers to testing the suggested idea by applying it.
Resolution Episode	Accepted answer (/s) for the question	It refers to a suggested idea which has been tested to be workable, and or with the authentically accepted label.

These five main-categories directly involved in constructing new knowledge can be grouped into “Knowledge Construction Episodes”. The sub-category “clarifying ambiguity (about the idea)” can be distinguished from the sub-category “repeating/refining or elaborating already

stated idea" through identifying the replying relationship to the focused question in other post. However, it is able to be incorporated into one sub-category "clarifying ambiguity (about the idea)" in other studies.

Table 9-2: Problem Description Episode

Main Category	**Sub-category**	
Problem Description Episode	**Sub-category**	**Definition**
	Repeating same/similar problem	Content of describing same/similar technical problem the users have.
	Judging the existence of the problem	Statement about the fact of the problem's existence.

These two subcategories providing knowledge and information about technical problems are grouped into one category of "Problem Description Episode". The subcategory of "Repeating same/similar problem" differs from "clarifying ambiguity (about the problem)" in its non-interactive nature. In other words, it is not about answering other's questions about technical problems.

Table 9-3: Non-Constructive Episode

Main Category	**Sub-category**	
Non-Constructive Episode	**Sub-category**	**Definition**
	Statement of giving up finding solution	Comments about quitting finding the solution.
	Statement of waiting for authentic solutions.	The statement of waiting for the company to release the formal solution to solve the problem permanently or reporting the problem to the company for assistance.
	Statement of waiting for other member's solutions or feedback	Statement of waiting for other product users to find the solution or the feedback about the effectiveness of the proposed idea.

	Disputing on / talking about unnecessary issues	The discussion of other irrelevant topics which have no direct relationship with the solution being discussed and cannot help to construct new knowledge for solving the problem.

Table 9-4: Moderation Episode

Main Category	**Sub-category**	
Moderation Episode	**Sub-category**	**Definition**
	Comment about promoting/demoting the discussion idea	Direct statement about promoting or demoting the idea in the forum.
	Mediating the arguing/ stopping talking about unnecessary topic	Comments related to mediating arguing /talking about an irrelevant and unnecessary topic.
	Moderator's labelling status to the discussion thread.	Statement of processing the thread by giving it a status label.
	Claiming to bring knowledge from the community to the internal organization	Moderator's statement of bringing knowledge about the technical problem from the community to the engineers in the business organization.
	Claiming to bring knowledge from the organization to the community	Statement of bringing knowledge about the solution from the business organization to the community.

Table 9-5: Others

Main Category	**Sub-category**	
	Sub-category	Definition
Others	Invalid posts	Posts lacking validity

The categories included in this analytical framework are described as follows:

1. "Knowledge construction episodes" are directly related to building requisite new knowledge to solve technical questions and problems. They include five main categories which are the key bricks for constructing new knowledge: "Initiation Episode", "New Idea

Proposing Episode", "Exploration & Explanation Episode", "Evaluating & Testing Episode", and "Resolution Episode". Each of these main categories respectively consists of sub-categories as showed in Table 9-1.

2. The main-level category of "Problem Description Episode" is relevant to providing knowledge about technical problems. This main-level category contains the sub-categories of "Repeating same/similar problem" and "Judging the existence of the problem". According to findings from thematic analysis of interview data, it helps the evaluation of the existence of the problem, clarifying the symptom of the problem, giving relevant contextual knowledge about the problem, and thus paves the way for diagnosing the cause and providing solutions.

3. The main-level category of "Non-constructive Episode" consists of the categories of "Statement of giving up finding solution", "Statement of waiting for authentic solution", and "Disputing on/ talking about unnecessary issue". It refers to the discussion content which does not have a direct relationship with constructing new knowledge and cannot actively push forward knowledge building processes for solving problems. However, it can exert an influence on the knowledge construction process, such as lowering other participants' motive, and even can hinder the process, to some extent.

4. The main-level category of "Moderation Episode" refers to the moderation activities conducted by both the formal moderator and community members. It contains the categories of "Comments about promoting/demoting the discussion idea", "Mediating the arguing / stopping talking about unnecessary topic", "Moderator's labelling status to the discussion thread", "Claiming to bring knowledge from the community to the internal organization", and "Claiming to bring knowledge from the organization to the community". These episodes are conducted by both the moderator and the community member. These sub-categories fall into the knowledge management (/processing) dimension, knowledge construction dimension, and social dimension. They can also influence the knowledge building process. In some cases, they can offset the negative influence from a "Non-constructive episode".

5. The main-level category of "others" in this research mainly refers to invalid posts, which do not form valid discussion content, such as repetitive posts. In this research it includes the sub-category of "Invalid post".

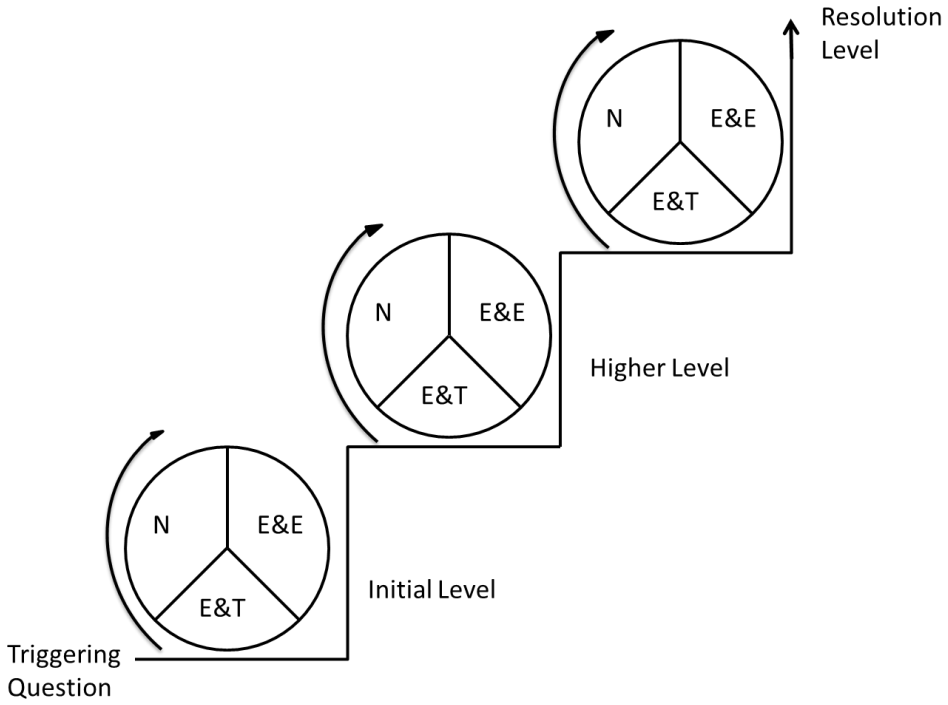
This content analysis framework, which is developed for analyzing knowledge construction activities, includes the categories directly related to building new knowledge to solve

problems (i.e. the five " Knowledge Construction Episodes"); the categories relating to providing knowledge about problems (i.e. the "Problem Description Episode" and the sub-category of "Clarifying ambiguity (about the problem)"); the categories that can influence the knowledge construction process (i.e. "Non-constructive Episode" and "Moderation Episode"). This content analysis framework of knowledge construction does not include categories of pure social information, which is not very common in virtual product user communities according to the threads analysis in other forums like Dell Chinese, HP English and Chinese, and so on.

According to the data analysis results in virtual product user communities on the forums of HP, Dell, and Lenovo, which were selected to be analyzed in the third stage, the posts containing pure social information only account for a very small percentage in these virtual product user communities. A very high percentage of the posts in these forums fall into the categories of this framework. This suggests that this newly developed analytical framework is an effective tool to analyze online discussion contents, especially those relating to knowledge building activities in virtual product user communities.

9.2.2 Knowledge Building Model

Based on the results of the content analysis of the threads in the Dell User Support Forum and the technical solution oriented discussion threads in the IdeaStorm Community, with the aid of this newly developed content analysis framework, this study proposes a knowledge building model which consists of the key episodes in knowledge construction process, i.e. "Initiation Episode", "New Idea Proposing Episode", "Exploration & Explanation Episode", "Evaluating & Testing Episode", and "Resolution Episode", as shown in the following figure:



(N= New Idea Proposing Episode; E&E= Exploration & Explanation Episode; E &T= Evaluating & Testing Episode)

Figure 9-1: Knowledge Building Model

This knowledge building model illustrates the progressive process of knowledge construction episodes in the context of the virtual product user community. It captures all the essential components that form the knowledge building process in the discussions of solving technical problems. The hierarchical level of solution ideas constructed in each knowledge construction step is also highlighted by this model. This model simply reproduces the process of knowledge construction from a theoretical perspective. In reality, the knowledge construction practices can be conducted in mutable order. The order of knowledge construction episodes in the knowledge building model in reality is mutable and is subject to change according to the knowledge activities in practice. The knowledge construction activities occurring in reality may take the form of various combinations of these episodes, and involve more influencing factors, such as non-constructive episodes and more social messages. Thus, the exact patterns of knowledge construction in reality can deviate from this theoretical model to some extent. However, these knowledge construction activities can still be described by the whole model or parts of the model or other deviant forms of this model. Meanwhile, this model can also be adjusted by changing the combination of knowledge construction episodes in different cases. Therefore, it can be considered as a simple abstraction to shed light on understanding these knowledge construction activities in reality.

9.2.3 Knowledge Construction Strategy: "Trial-and-Error"

Another finding in the first research step is the identification of the knowledge construction strategy of "trial-and-error". This strategy is a common approach adopted by the virtual product user community members to discover workable solution ideas. The effectiveness and efficiency of this strategy is based on the nature of the problem whose solution idea can be immediately tested by applying ideas on the user's product or be evaluated through linking with the existing facts. In addition, the proposed ideas in this continuous process also undergo a hierarchical ordering as they are usually based on prior ones and thus become more and more reliable and workable. This "trial-and-error" solution identification strategy is also in line with the above knowledge building model. The community members continuously propose different ideas which are based on previous ones and are later evaluated and tested until they identify a solution. Consequently, the proposed ideas become reliable.

9.3 Findings in Research Phase Two: Thematic Analysis of Interview Data

In the second research phase, the content analysis framework of knowledge construction, the knowledge building model, and the "trial-and- error" strategy were confirmed through the thematic analysis of the interview transcripts. Meanwhile, the experiential nature of community members' knowledge, and the classification of the knowledge about problems were also clarified through interview analysis. Based on this, the exact way of diagnosing problems and proposing solution ideas, which cannot be found through the content analysis of discussion threads, is also identified.

The four key knowledge construction episodes involved in building new knowledge to solve technical problems are confirmed in the interview analysis, i.e. "Initiation Episode", "Exploration & Explanation Episode", "New Idea Proposing Episode", and "Evaluating & Testing Episode". The process of these four knowledge construction episodes in solving technical problems, which is illustrated by the Knowledge Building Model, is also confirmed.

The experiential nature of community members' knowledge was identified in the interview. The knowledge of these peer users with high level of expertise does not come from their work but is acquired from both direct and indirect experience of participating in the discussions of solving technical problems in the forum. The interview analysis helps to classify the knowledge about the problem into two types according to their different contents functions: knowledge about the symptom and contextual knowledge about the problem. The

former helps to understand what the problem is. The latter is identified as playing an essential role in diagnosing the causes of problems and identifying the area of requisite experiential knowledge for proposing solutions. Both the diagnosing process and proposing solution ideas are based on the peer advisor's experiential knowledge because the problems being discussed are quite specific rather than general ones. This also explains why the community members prefer less moderator involvement in solving problems, due to their lack of this kind of specific knowledge. Clarifying ambiguity about the problem is more centred on asking for and providing contextual knowledge about the problem. This helps the advisor to identify the requisite experiential knowledge.

In the thematic analysis of interview data, the composition of community members is also revealed. The virtual product user community, which exists on the selected peer user support forums, consists of forum users of varying levels of expertise, levels of participating in the discussion and contributing to knowledge sharing and construction, and company employees of different roles and moderation powers. The combination of forum users of different levels of knowledge can create active interaction among community members which can stimulate and facilitate the knowledge construction process.

One of the purposes of the moderators' (i.e. with the label of "Liaisons") participation in the community is to serve as the boundary spanner in knowledge transfer across the boundary between the community and the business organization. The moderator's other roles are also explored: a censor maintaining the social order; a lobbyist on behalf of the community members; a knowledge asset manager for the processing community members' generated content; a provider of general information; and an advice seeker in relation to managing the forum. These roles fall into three dimensions: the social dimension, the network dimension, and the knowledge dimension. The virtual product user community members propose that the focus of the moderator's role should be the liaison between the user community and the company (i.e. the network dimension), and the censor to keep the forum in order (i.e. the social dimension). The moderator should constrain their involvement in knowledge constructing activities (i.e. the knowledge dimension).

The community cultures are explored through the thematic analysis of interview data. The community culture values the collective knowledge contribution efforts made by both active members with high-knowledge level and newbies. Helpful roles in solving technical problems are valued and newbies are also treated as important community members. The

open culture and preference for less moderation and censorship also form part of the community culture. A sub-community consisting of active community members and relevant non-technical culture which can promote community identity were also identified.

9.4 Findings in Research Phase Three: Content Analysis of More Forum Threads

In order to test the usability of this newly developed analytical framework in different contexts in the third research phase, it was applied in analysing threads in other virtual communities and groups with varying but comparable key variables, including national languages and culture, topic, communication platform (/technologies), sponsorship, moderation modes and discussion participant size. These virtual communities and online groups were selected in order to compare the influence of each type of variable.

The coding results reveal that this analytical framework is an effective tool in exploring knowledge construction activities embedded in discussions of technical problems in these chosen contexts. It is also suitable for exploring knowledge behaviours in other contexts regarding solving technical problems whose solutions can be easily evaluated by linking with existing facts or being tested by applying the idea, such as problems in the family and personal products. This makes it suitable for exploring knowledge construction in a low-level criticality context rather than high-level criticality context, which needs higher cognitive involvement. However, this framework is subject to the limitation in analysing posts with pure social information, which more frequently emerge in idea oriented discussions. This makes the analytical framework more suitable for analysing technical problem-oriented discussions rather than idea-oriented discussions.

Another finding of this research, i.e. the knowledge building model, is also confirmed by the identification of the four key knowledge construction episodes which frequently emerge in the discussion threads in these virtual communities and online groups. Although the exact knowledge construction activities vary in these selected communities and online groups, the essential knowledge building process is still based on these "Knowledge Construction Episodes" and proceeds in a hierarchically continuous way. This suggests that the model can be confirmed as an effective lens to explore the knowledge construction patterns and process in this research stage.

In addition, the influence of national languages and culture; topic; communication platforms (technologies); sponsorship; moderation modes; and discussion participant size on the knowledge construction patterns were also explored by analysing and comparing knowledge

construction patterns in selected virtual communities and online groups. In general, the above attributes of virtual communities and online groups do not have a strong influence on the workability of this analytical framework.

However, except for the variables of culture and language, the rest of the variables have an effect on knowledge construction patterns in these selected virtual communities and online groups. The discussion size can affect the process of knowledge building embedded within the discussions. A small discussion group can make knowledge building more focused and smooth. The attribute of a discussion topic can influence the discussion contents and knowledge construction patterns. The topic of technical problems usually generates discussions focusing on "Knowledge Construction Episodes" and "Problem Description Episodes". In contrast, topics on technical ideas are more oriented to produce discursive content which contains more social information. The moderation mode and moderator's role can strongly affect community members' participation motivation and knowledge behaviours, and ultimately determine the success of the virtual product user community. The sponsorship relationship can decide the discussion topics and the level of censorship executed in the community, and thus it also influences language freedom.

The communication technology adopted by virtual communities and online groups can have an influence on the knowledge construction patterns and interaction patterns. The feature of visibility of the community member's identity and strong social ties between members of similar professions, interests, and expertise in the social network forum, make the discussion highly focused on the knowledge construction episodes, and less discursive and reduces trolling. One-to-one interpersonal interaction is also quite prominent in the social network site. The threaded discussion patterns in the Slashdot forum create clear reply relationships of posts and hierarchical divisions of the threaded discussion contents. The listserv technology generates more knowledge sharing discussions rather than complex knowledge building contents.

Furthermore, some of these key variables of virtual communities are also identified with mutual influences on each other. The mutual influencing relationship between censorship and the discussion topic is identified. A loose censorship of the user based moderation system is usually adopted in forums which has more idea-oriented topics. Censorship over the discussion contents and language in virtual product user communities is much more stringent than self-sponsored communities. Sponsorship also decides the censorship degree,

moderation mode, and discussion topics. Self-sponsored virtual communities usually adopt a much looser censorship over the language and discussion contents than business organization sponsored ones.

9.5 Synthesis of Findings from Thread Analysis & Interview Analysis

9.5.1 "Knowledge Construction Episodes"

In this section, the findings from both threads analysis and interview analysis are synthesized in order to illustrate the relationship between these categories included in the content analysis framework and their respective function in the knowledge building process.

Two types of knowledge are transmitted between community members and across the boundary between the community and the business organization, namely the knowledge about the problem and the knowledge about the idea.

The main category of "Problem Description Episodes" as well as two sub-categories in the "Knowledge Construction Episodes" , i.e. "asking focused question (about the problem)" and "clarify the ambiguity (about the problem)", are involved in providing knowledge about the problem and clarifying its ambiguity. This paves the way for diagnosing the causes of the problem and identifying which type of experiential knowledge is relevant.

As stated in the findings of interview analysis, the knowledge about the problem can be classified into 1) the knowledge about symptoms of the problem; and 2) the contextual knowledge about the problems. The former knowledge can enable other peer users to know "what is the problem" (symptoms). The latter illustrates "what the context of the occurrence of problem is" and helps knowledge experts to diagnose the cause of the problem and thus to propose a tailored solution based on their experiential knowledge.

Clarifying the knowledge regarding the problem between the questioner and the idea proposer is usually centred on the contextual knowledge about the problem. It is achieved through the sub-category of "asking focused question (about the problem)" and its corresponding sub-category of "clarifying the ambiguity (about the problem)". This process, which focuses on knowledge about the problem, can be reflected by the main category of "Exploration & Explanation Episode".

The category of "Proposing a new idea" (which belongs to the main category of "New Idea Proposing Episode") is based on the experiential knowledge of the peer user advisor in the

community. The knowledge of the active forum users who are the main solution idea contributors has a strong experiential nature, and is built on both direct and indirect experience of solving technical problems in the virtual product user community. Clarifying the ambiguity about contextual information of the problem can help idea proposers to identify what area of experiential knowledge should be considered to find solutions to these specific problems.

Knowledge about the solution idea is usually developed in the "exploration & explanation episodes". According to the thread analysis, in most cases, the knowledge about the solution idea provided by the peer users is usually clarified. The clarifying process is connected with the asking & answering relationship. It is reflected by two sub-categories in the "Exploration & Explanation Episode": i.e. "asking focused question (about the idea)" by the questioner and "clarify the ambiguity (about the idea)" by the idea adviser. Then the knowledge construction process moves to the next stage of "Evaluating & Testing Episode", where the suggested idea is evaluated by reasoning and existing facts, or tested by applying the idea.

To conclude, the relationships between the four main categories (i.e. "Knowledge Construction Episodes", "Problem Description Episodes", "Non-constructive Episodes" and "Moderation Episodes") included in the analytical framework are clarified by combining the two types of findings from threads analysis and interview analysis. The "Problem Description Episodes" can facilitate the process of "Knowledge Construction Episodes" by proving two types of knowledge about the problem: the knowledge about symptoms and the contextual knowledge about problems. The latter helps the solution advisor to identify what area of experiential knowledge is needed. There is also a corresponding relationship between the "Non-constructive Episodes" and "Moderation Episodes". The negative effects caused by some categories in "Non-constructive Episode" can be offset by the "Moderation Episodes". This ensures the knowledge construction process proceeds smoothly and with focus. In other words, the categories of "Problem Description Episode", "Non-constructive Episode", and "Moderation Episode" all exert influence on the knowledge construction process.

9.5.2 "Moderation Episodes" and "Non-Constructive Episodes"

The moderators are mainly perceived by community members as censors maintaining social order rather than knowledge experts providing reliable solutions in the virtual product user community. They are also considered as "Knowledge Asset Managers", which can be reflected by the sub-category of "labelling status to the discussion thread". The moderator's

perceived role as the "boundary spanner" is reflected by the sub-categories of "Claiming to bring knowledge from the community to the internal organization" and "Claiming to bring knowledge from the organization to the community".

There is a corresponding relationship between the "Non-constructive Episode" and "Moderation Episode" with regards to the social dimension. In some cases, trolling behaviours in the virtual community, for example, posts falling into the sub-category of "disputing on/talking about unnecessary issues" (which belongs to the main category of "Non-Constructive Episode"), can be stopped through community members' collective moderation behaviour of "mediating the arguing/ stopping talking about unnecessary topic" (which belongs to the "Moderation Episode"). Some sub-categories in "Non-constructive Episodes" can lower the forum users' initiative of solving problems, such as the sub-category of "Statement of giving up finding solution". Corresponding to this, though, its negative influence can be offset by the sub-category of "comments about promoting/demoting the discussion idea" included in the "Moderation Episode". Therefore, all of these suggest that there is a corresponding relationship between the "Non-constructive Episode" and "Moderation Episode". This corresponding relationship ensures the smoothness of the knowledge construction process, even without the involvement of the moderator.

The moderators are also involved in knowledge asset (i.e. user generated contents on the forum) managing and processing activities. For instance, moderators' posts falling into the subcategory of "labelling status to the discussion thread" were identified in the thread analysis. Some active forum users, like those entitled "Rockstars", also involved themselves in knowledge processing and managing activities, according to the findings of the interview data.

The moderators also play a bridging role as boundary spanners between the product user community and business organization. They transfer the knowledge about the problem from the community to the organization, and the knowledge about the solution from the organization to the community. These knowledge transference activities can be respectively reflected by the two sub-categories of "Claiming to bring knowledge from the community to the internal organization" and "Claiming to bring knowledge from the organization to the community". Furthermore, according to the interview data, the moderators are also in charge of collecting suggestions about forum management from forum regulars and transmitting these suggestions to the organization. Some product users in the community also involve

themselves in the knowledge transference by reporting solutions they obtain from the technical support staff to the community. However, they do not have the advantage of the moderator: of being part of the organizational knowledge network.

To conclude, the purpose of moderation activities identified in the threads analysis and interview analysis are mainly related to maintaining a friendly online social order; promoting the user's participation, managing and processing the community knowledge assets; and transferring knowledge (including knowledge about users' problems and engineers' solution ideas, and forum regulars' advice about forum development) between the virtual product user community and the organization. They can be classified into three dimensions: the social dimension, the knowledge dimension, and the networking dimension. There is a corresponding relationship between "Non-constructive Episodes" and "Moderation Episodes". Both of these two categories can influence the knowledge construction process in the virtual product user community. Both the formal moderators and active community members are involved in the moderation activities. According to the interview data, virtual community members believe that moderators should focus on the networking dimension, i.e. the bridging role between the community and the business organization; and the role of social dimension, i.e. censoring in order to maintain forum order. Their involvement in the knowledge dimension, i.e. knowledge sharing and building, should be constrained due to lack of experiential knowledge for these specific problems being discussed in the community.

9.5.3 Community Culture

There is a mutual influence between community members' knowledge activities and the community culture. Baym (2000) suggests that the online process promotes members' shared practice and shapes the community culture. Virtual product user community members' activities cultivate the community culture. Vice versa, the community culture can exert strong effects on the community members' knowledge behaviours. Both active users with high-level expertise and newbies with minimal knowledge are considered to be important contributors in the overall knowledge construction process. This can be confirmed by the involvement in knowledge construction episodes by community members of different levels and the interviewees' opinions. Thus, the community members' collaborative knowledge construction activities foster the community culture of valuing "helpful" roles and appreciating participation in efforts to solve technical problems by all discussion participants with different levels of expertise. Thus, the newbies who propose the questions or clarify the

contextual knowledge about the problem are also considered to be important knowledge contributors, and their role and identity are also valued in the community culture. Meanwhile, the virtual product user community culture also fosters the evolution of the community members from the peripheral position to the core within the community. Another cultural attribute of a virtual product user community is the preference of less censorship and less involvement of the moderator in knowledge building activities. The sub-culture's non-technical nature within the virtual community can create closer relationships and stronger community identity, thus promoting knowledge construction activities in an indirect way.

9.6 Synthesis of All Findings

The main categories of "Problem Description Episode", "Non-constructive Episode" and "Moderation Episode" are all found to have a relationship with knowledge construction activities. Moreover, the key attributes of the virtual communities are found to have an influence on knowledge construction, including the discussion topic, communication platform (technologies), sponsorship, moderation modes and discussion participant size. Therefore, all of these should be taken into consideration as influencing factors on knowledge construction as well as community cultures.

Given these influencing factors and the relationship between main-categories, a global picture of this knowledge construction model can be presented, as follows:

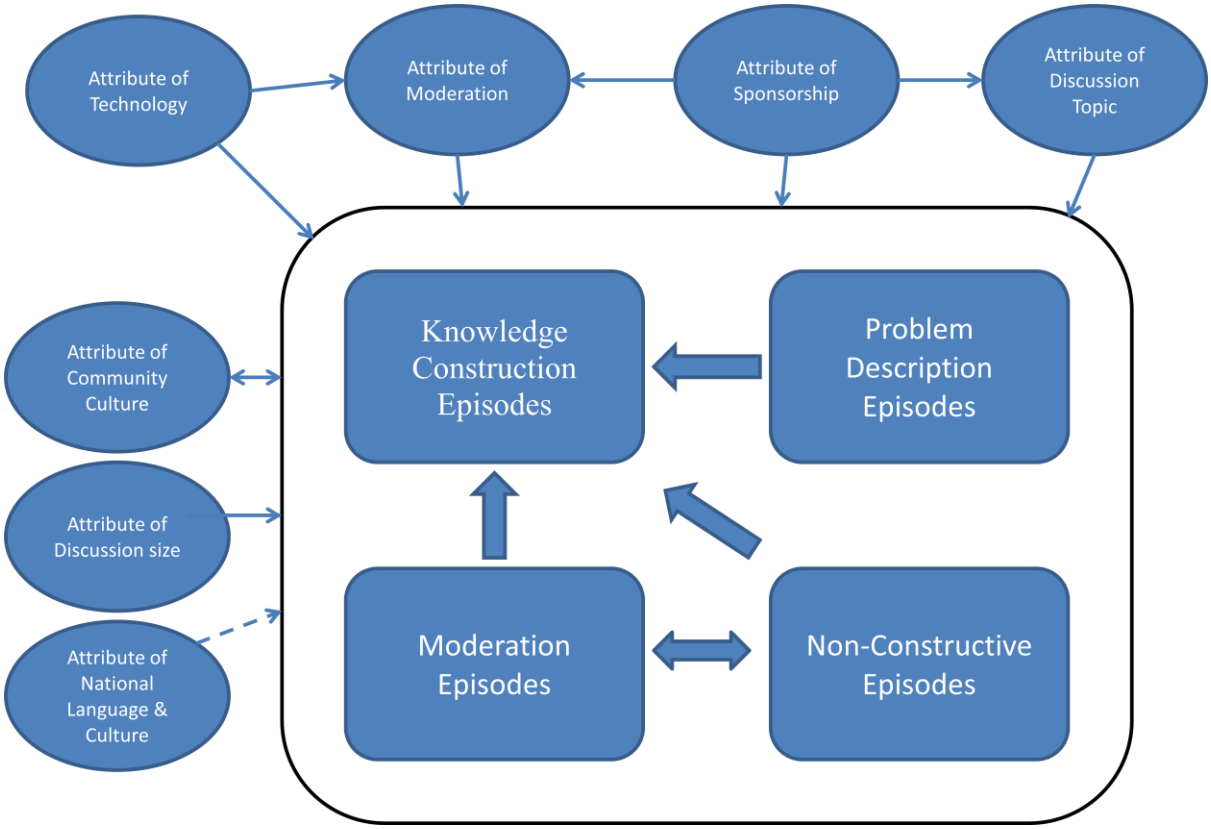


Figure 9-2: Relationship of Knowledge Construction Elements under the Contextual Influences

"Problem Description Episodes" can facilitate "knowledge construction Episodes". The "Non-constructive episode" does not actively push forward the knowledge building process, and sometimes can hinder this process. Some moderation episodes (e.g. the moderator's labelling status to the discussion thread) are directly related to processing user generated content. Some are related to offsetting the negative influence of "Non –constructive" episodes, such as "Mediating the arguing/stopping talk about unnecessary topics".

The knowledge building process under the contextual influences of the virtual product user community can be illustrated as in the following figure:

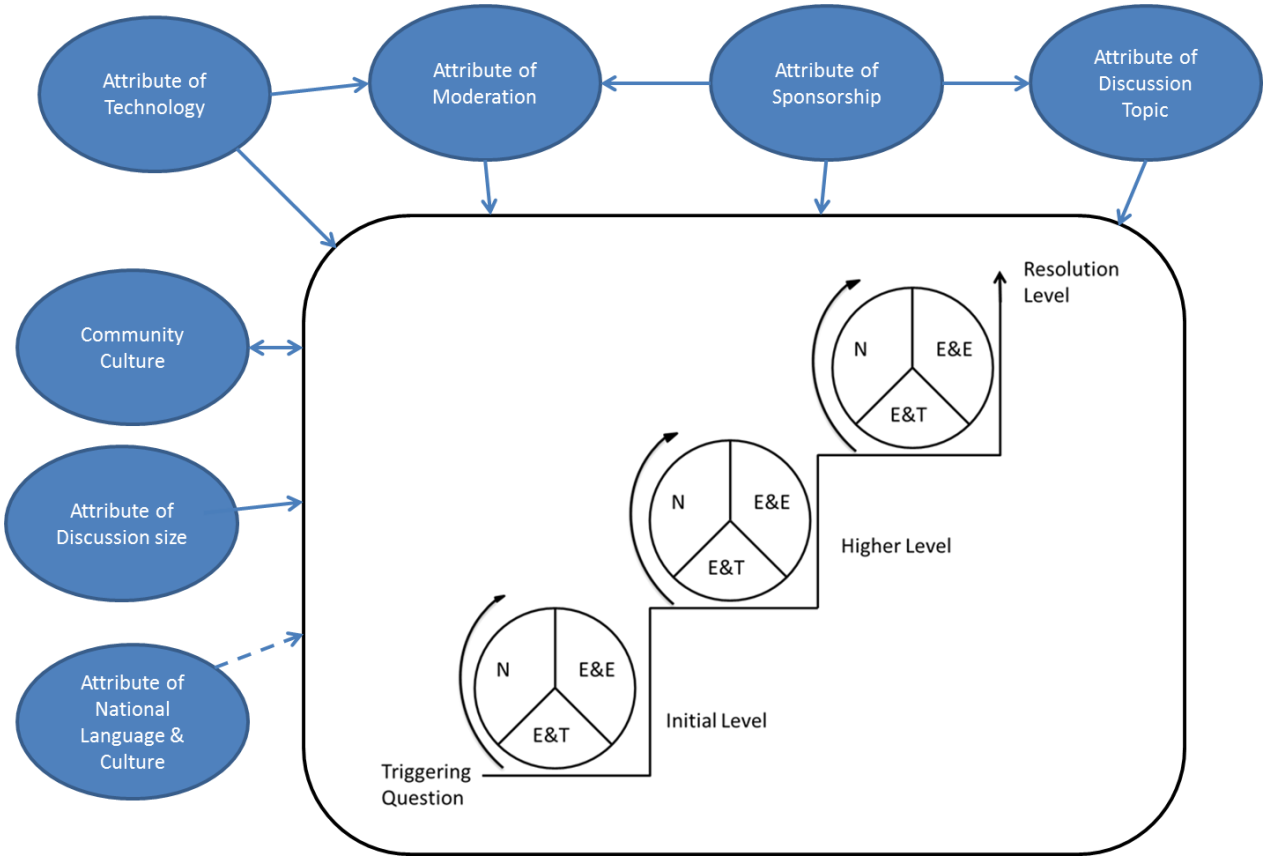


Figure 9-3: Knowledge Construction Process under Contextual Influences

9.7 Conclusion

This chapter synthesised the findings from all research stages during the project. It first provided the conclusion to each finding obtained from each different research stage, i.e. content analysis of discussion threads selected from the virtual community in the Dell Forum; the thematic analysis of interview data; and content analysis of threads from more forums and websites. Secondly, the first two types of findings (i.e. threads analysis and interview analysis) were combined and synthesized in order to clarify how knowledge is constructed. Based on the above sections, a general synthesis of all findings was conducted to illustrate knowledge construction, including relations and processes, under the contextual influence of the virtual product user community. In the next research stage, all of these findings will be compared with the existing literature in order to show how the results of the current study relate to previous research findings.

Chapter 10 – Discussion

10.1 Introduction

The previous chapters discussed the main findings from three research steps:

1) A content analysis framework was built and the knowledge construction model was proposed, based on a comprehensive analysis of theoretically interesting threads on the Dell Support Forum & Dell Ideastorm Community.

2) The categories in the knowledge construction analytical framework were evaluated and their relations clarified through thematic analysis of interview data. In addition, other research issues which cannot be obtained from threads analysis were also added to the findings, including a knowledge construction method in proposing solutions, community members' perceptions towards the moderator's roles and community cultures, and so on. These factors are believed to have a strong influence on knowledge construction activities.

3) The validity of the analytical framework was tested by being applied in other contexts with varying key variables, at the same time the knowledge construction model was also evaluated. Furthermore, the effects of these key variables of virtual communities on knowledge construction were also illustrated.

This section relates the findings to the existing literature. It consists of seven sections: comparison between the Knowledge Construction Model and the SECI Model; comparison between the new content analysis frameworks and existing ones in the CSCL context; knowledge nature and knowledge construction; the relationship between question type, interaction type, and knowledge construction type; the influences of community attributes on knowledge activities; the virtual product user community and innovation; and implications for formal online learning.

10.2 Comparison between the Knowledge Construction Model and the SECI Model

10.2.1 The Importance and Relevance of the SECI Model in this Research

In reflecting on the findings of this study, an unavoidable reference point is the Nonaka & Takeuchi's (1995) SECI model, which aims to reveal the overall organizational knowledge creation process. Though not without controversial aspects, the SECI model has been so

influential in concepts of organizational knowledge creation, that it is impossible to avoid relating the findings of the current project to that model. A key way to evaluate the findings about knowledge construction in organization-sponsored virtual product user communities must be to fit them into the wider picture supplied by the SECI model.

As illustrated by Table 2-2 Four Modes and Relevant Attributes in SECI Model and Figure 2-6 Spiral of Organizational Knowledge Creation, the SECI model, consists of four modes, involving a number of levels of knowledge creation, namely the individual level (i.e. corresponding to the internalization and externalization modes); the group level (i.e. corresponding to the socialization mode); the organizational level (i.e. corresponding to the combination mode); and inter-organizational level (see Figure2-6). From the macro perspective, knowledge creation in the organizational sponsored virtual product user communities operates at these different levels theorised by the SECI model.

Applied to the context of this study, according to the SECI model, knowledge creation at the individual level would be seen as mainly about two modes: individual virtual product user community members' knowledge externalization (from tacit knowledge to explicit knowledge) and knowledge internalization (from explicit knowledge to tacit knowledge). These two processes were very difficult to be identified or analysed in the asynchronous online discussion contents published in the virtual product user community. They were mainly encountered in the interview data in this research, but not at a deep level. Section (7.4.5.2 Provide the Answer When Someone Knows Relevant Knowledge) discussed how experiential knowledge can be easily shared with others with similar problems, when someone has encountered a similar problem and solved it. This sharing process involves the knowledge externalization process (i.e. converting tacit knowledge to explicit knowledge). As for knowledge construction, which is the focus of this research, in the findings about constructing new knowledge in the interview data analysis (i.e. mainly in sections 7.4.6.4 Clarifying the Ambiguity about Problem and 7.4.6.5 Contextual Knowledge about Problem & Finding Solutions), contextual knowledge about the problem was identified to facilitate experts' knowledge externalization (i.e. from tacit experiential knowledge to explicit articulated knowledge) through helping identifying requisite experiential knowledge. This is very important to clarify the knowledge construction process in the virtual product user community. The knowledge internalization (i.e. from explicit knowledge to tacit knowledge) is mainly about the solution seeker absorbing and applying the explicit solution knowledge suggested by other community members. Although this research involved knowledge

creation at the individual level, including both the externalization and internalization, they were not the main focus of this research project.

In this research, knowledge at the group level is mainly about knowledge construction through collaborative discussion groups of virtual product user community members. The main concern of this study is knowledge construction at the group level, more specifically, in the discussion groups in the community. Knowledge at the organization level is mainly about knowledge sharing or flow between the staff within the organization, especially between the product user community moderator and technicians in the functioning department. Knowledge at the inter-organizational level is mainly about knowledge transfer between the virtual product user community and the organization in this research project.

However, although individual knowledge creation interacts with and affects social knowledge construction (Salomon, 1993), this study had a particular core focus, namely the knowledge construction embedded within the group level discussions articulated and published in the virtual product user communities, on the user support forum. As explained in the section (2.3.4 Individual-level Knowledge Creation & Social-level Construction of Knowledge), knowledge construction is usually socially constructed through collaborative efforts by bringing different perspectives together through group dialogue (Pea, 1993; Pena-Schaff & Nicholas, 2004). In addition, another reason is that the main available data is community members' asynchronous online discussion threads which embed social knowledge construction at the group level. Consequently, most of the findings of this research relate primarily to the explicit discussions at group level of the SECI model. Due to the close relationship with knowledge construction in this study, a second focus was the knowledge transfer between the virtual product user community and the organization at the "inter-organization" level, characterized by the SECI model in its spiral organizational knowledge creation. While other levels were present, they were not the direct research objects of this study, because the focus being on the codified construction in published group discussion threads.

In addition, the SECI model also identifies that the driving force of knowledge creation is conceived as always arising from the conversion between tacit and explicit knowledge. Informed by the SECI model, the conversion between tacit knowledge (which is mainly gained from the experience by virtual product user community members) and explicit knowledge (which is codified, manifest and articulated knowledge in the discussion threads)

is an essential issue, especially for diagnosing the technical problem and proposing solution. The knowledge experts need to identify which part of their tacit experience is needed to give advices to tackle the problem in the discussion threads. The findings reveal that contextual knowledge is the key to converting tacit knowledge to explicit knowledge in this process. In addition, advice seekers' converting tacit knowledge of experiencing the technical problem to explicit knowledge of describing the problem is also important. The category of "Testing the Idea" also needs absorbing the knowledge about the solution in the discussion threads, and certainly the conversion from explicit knowledge to tacit knowledge.

However, the purpose of this research differs from that of SECI model, which seeks to provide a holistic picture of knowledge creation in the organization. The SECI model aims to "to formalize a generic model of organizational knowledge creation" (Nonaka &Takeuchi, 1995: ix). In contrast, this research had a narrower focus. As discussed in Section 3.5.6.1.2 (Latent content and Manifest Content) of the research methodology chapter, this research aimed to explore both the manifest and latent content related to knowledge construction embedded within the selected online discussion threads published by virtual product user community members. Knowledge internalization (explicit knowledge to tacit knowledge), or the self-learning process of an individual, is not the main focus of this research. In addition, the knowledge construction embedded within asynchronous online discussion threads mainly concentrates on the explicit knowledge released by the community members, i.e. the articulated and published knowledge in the posts. That is to say, this research focused on the knowledge construction process mainly consisting of the explicit knowledge elements, which is embedded within the published asynchronous discussion threads.

10.2.2 Complement to the SECI Model

The knowledge construction model (see Figure 11-1: Model of Knowledge Building Process within the Virtual Product User Community) established in this research aims at, at a detailed level, to reveal the exact knowledge construction process of solving technical problems through collaborative group discussion. According to the above paragraph, the process described by this model, can be located in the "Combination" mode (i.e. from explicit knowledge to explicit knowledge) in the SECI model. This research can be understood as a detailed examination of one part of the knowledge construction process. It deals primarily with the combination mode (from explicit to explicit knowledge), i.e. where explicit

knowledge in the discussion threads are "combined" and further pushed forward to the construction level rather than just involving a "sharing" or "combination" of knowledge.

The SECI model has been criticised for being too abstract and oversimplified in describing the organizational knowledge creation process. As the detailed discussions in the section on evaluating the SECI model have shown, commentators have argued that the SECI model has main weaknesses in terms of ambiguity, oversimplified and abstract concepts, lack of precision, and so on. Furthermore, these issues also cause a problem of operationalization in employing the SECI model in analysing empirical studies. However, by focusing on just one aspect of knowledge creation (i.e. knowledge construction in the codified discussion threads) in a specific context (i.e. virtual product user community), a more detailed and thorough picture about knowledge construction process and patterns can be depicted, and this enables the researcher to address these common criticisms of the SECI model with a detailed picture of one aspect of it.

In contrast to the ambiguous and oversimplified explanation of the process of the "Combination" mode in the SECI model, the models developed in this research reveal the knowledge construction process, providing detailed and operationalizable concepts, and a description of a concrete knowledge construction process in the explicit knowledge embedded within online discussion contents from a micro perspective. The core model developed in this research, i.e. the Knowledge Construction model (see Figure 11-1: Model of the Knowledge Building Process within the Virtual Product User Community) captured the essential knowledge construction constituents, and also clearly illustrated their relationships and a concrete process of knowledge construction. Another example is the model Knowledge Construction Process under Contextual Influences (see Figure 11-3: Overall Knowledge Construction Process Model in the Context of the Virtual Product User Community). On the basis of the former model, this model was further developed by adding the influencing factors of the knowledge construction process in the virtual product user community, including the attributes of the community, national culture, and sponsorship type and so on.

These two models consist of clear, concrete concepts with precise definitions of both main-level categories and sub-level categories. Therefore, they can overcome the operationalization problems of SECI model. These features enable these newly developed models to be testable in empirical studies. For instance, the knowledge construction model and the content analysis framework were applied and tested in relevant similar virtual communities and online groups

in the fourth research stage (i.e. The Application of the Analytical Framework in Other Virtual Communities & Online Groups) in this study. Moreover, the above two models are also able to, at a detailed level, explain the concrete mechanism of knowledge construction within the virtual product user community, thus to answer the main research question "how exactly is knowledge constructed in the virtual product user community".

In addition, corresponding to the knowledge construction model, a content analysis framework consisting of relevant categories and sub-categories was also created to analyse the knowledge construction within the discussion contents in the selected forums (e.g. see Table 9-1: Knowledge Construction Episode). This framework contains a number of categories which corresponds to the episodes contained in the models (see Figure 11-2 and Figure 11-3), including knowledge construction episodes, problem description episodes (Table 9-2: Problem Description Episode), non-constructive episodes (Table 9-3: Non-Constructive Episode), moderation episodes (Table 9-4: Moderation Episode) and others (Table 9-5: Others). The operational concepts (including both the main categories and sub-categories) and their concrete definitions in this analytical framework enable their empirical validity to be tested, and the theories to be verified. The empirical findings in the fourth stage, i.e., the analysis of knowledge construction in the selected online communities and online groups with the developed analytical framework, not only confirmed their empirical validity and operationality, but also revealed the generalizability and applicability of the newly developed knowledge construction model and the analytical framework. More importantly, the testable models, in combination with analytical framework, enable them to be easily applied and tested in other contexts by other researchers, thus, providing sufficient room for further developing or for extending them in the future.

Therefore, this research project not only developed a model to elaborate the mode of "combination" in the SECI model by clarifying the detailed process with concrete and operational concepts and their clear relationships, but also provided an analytical tool to explore the knowledge construction embedded in explicit discussion contents. Consequently, the models and the content analysis framework created in this research are effective supplements to the SECI model, especially to its "combination" mode in the specific context of virtual product user community.

Logically, this also suggests that the other three modes of SECI model can also be elaborated by creating more micro-models with concrete process in order to avoid this model's

weakness and to improve its empirical operationalizability. Moreover, a conceptual tool box or an analytical framework can be created for each mode of the SECI model in different contexts in future research.

10.2.3 Ba & Virtual Product User Community

Nonaka et al. (2000, 2001) extended their theory by proposing the notion of ba as the articulation of context (or place) in knowledge creation. The systemising ba, proposed as one of the four types of ba by Nonaka et al. (2000), is defined by the dimensions of collective interaction and the virtual media. This allows codified explicit knowledge in formalized form to be transmitted to large scale social groups. In this study, the empirical findings successfully confirmed that the virtual product user community existing on the user support forum is an effective and efficient systemising ba to enable knowledge creation and dissemination among a large number of community members. As illustrated in the Figure 11-2 and Figure 11-3, the systemising ba of a virtual product user community has a number of attributes which can affect community members' knowledge construction, including sponsorship, moderation, community culture, discussion size, national language & culture, and technology. Thus, this suggests that ba is not only a place for creating knowledge; in fact, its attributes also have effects on knowledge creation. This creates the requirement that the influences of contextual attributes of ba in knowledge creation should also be considered by researchers.

In addition, as the findings shows, the knowledge generated in the ba of the virtual product user community is not only effective and efficient, but unique, due to its basis in the user's experience, which is mainly context dependent. Thus, the constructed knowledge, based on the experience of members in the virtual product user community, i.e. the systemising ba existing on user support forums, is a valuable knowledge asset for organizations, enabling them to obtain both immediate and sustainable competitive advantage.

10.2.4 Summary & Conclusion

From the macro perspective, the SECI model can shed light on the overall knowledge creation process, including the interaction between tacit and explicit knowledge, and knowledge flows between the individual level, group level, and inter-organizational level. However, the SECI model is often said to be too broad, too vague, and too difficult to use. Therefore, the knowledge construction model developed in this research is an important

supplement to it, primarily for its mode of "combination". The findings also suggest that other modes of SECI model can be elaborated with macro model and corresponding analytical framework. Moreover, the virtual product user community is confirmed as an effective and efficient systemising ba for creating and articulating valuable experiential knowledge of community members. This can greatly promote the organization's competitive advantage. Thus, at an organizational level, the findings of this study are consistent with the theorisations of Nonaka & Takeuchi's (1995) SECI model.

10.3 Comparison between the New Content Analysis Frameworks and Existing Ones in the CSCL Context

10.3.1 Two features of the virtual product user community

The findings from the content analysis of discussion threads selected from Dell, HP, and Lenovo reveal two salient features of the virtual product user community which are quite different from learning communities in CSCL context:

1) The social message, which refers to "statement or part of a statement not related to formal content of subject matter" (Henri, 1992: 126), is very rare in the discussion contents in this type of virtual product user community. According to Hara et al. (2000), social cues can include self-introduction, greetings, jokes, expressions of personal feelings, the use of symbolic icons, and so on.

2) The discussions regarding the solving of technical problems in virtual product user communities are of low criticality. Unlike the online learning discussion contents in a CSCL context, the discussion of solutions to technical computer problems and other personal products does not involve much high-level cognitive engagement, to be more specific, critical thinking.

These two identified attributes of virtual product user communities can explain the difference in knowledge construction patterns in virtual product user communities and online learning communities, and support the validity of content analysis framework created in this research.

10.3.2 Analysis of Existing Knowledge Construction Analysis Frameworks

Henri's (1992) model contains a social dimension and is characterised by high-level knowledge construction. According to Marria et al. (2004), besides the exploration of an individual's cognitive development and critical thinking processes, another aim of Henri's

(1992) model is to reveal social activity and interpersonal interaction among the discussion participants in CSCL context. However, the thread analysis in the virtual product user communities studied in this research shows that the social message is very rare in discussion threads. Thus, in contrast with Henri's (1992) model, the social dimension is not included in this newly developed model. The categories that relate to knowledge construction in Henri's (1992) model are the meta-cognitive dimensions and cognitive dimensions. The former refers to statements about reasoning in online studying, and the latter is about statements of clarification and judgement in online learning discussions. These two categories reveal the critical thinking stages in cognitive development in online learning (Aviv et al., 2003), i.e. high-level knowledge construction.

The social dimension is also included in the community of inquiry coding template (Garrison et al., 2000), which is designed for analyzing critical thinking in online learning contexts. The cognitive presence included in this template is quite similar to the cognitive dimension in Henri's (1992) model. It refers to the key element of critical thinking and is considered as the reflection of high-level knowledge activities in an educational context. The cognitive presence of this coding template is operationalised by identifying four phases, namely triggering event, exploration, integration, and resolution. These four phases share some similarities with the knowledge construction episodes in the model developed in this research and they also shed light on creating this model. However, these four phases are mainly about constructing meaning, critical reflection, thought experiments and consensus building in solving academic questions. These activities are all based on high-level cognitive engagement. Besides the elements of "Cognitive Presence" and "Teaching Presence", this community of inquiry coding temple also includes the element of "Social Presence", which is supportive of the collective critical thinking process of the "Cognitive Presence". The combination of these three elements shapes the learning experience in the CSCL context (Garrison et al., 2000).

Gunawardena et al.'s (1997) content analysis of the online discussion model (i.e. Interaction Analysis Model) was created to study the knowledge construction in computer conferencing in a formal learning context. Lally (2001) points out that this model concentrates on a holistic knowledge construction processes in online learning context. It is more concerned with constructing knowledge based on the process of negotiating meaning where there is substantial inconsistency in discussions. These attributes make it more appropriate for exploring student-centred learning contexts (Lally, 2001). This Interaction Analysis Model

does not contain a social dimension, but it focuses on the knowledge construction of high-level cognitive engagement, i.e. critical thinking in an online learning context.

Newman et al.'s (1996; 1997) Critical Thinking Analysis Protocols Model provides clear indicators to evaluate discussion contents' contribution to critical thinking development in online learning. It is designed to explore in-depth online learning contexts, and the social dimension is not included.

Zhu's (2006) Analytical Framework for cognitive engagement in discussions is developed to study interaction types and cognitive engagement in students' discussions in a CSCL context. Except for the social dimension, this analytical framework contains the question dimension, cognitive dimension, meta-cognitive dimension, and moderation dimension. The social dimension is not included in the framework developed in this research. Its categories belonging to cognitive dimension are based on Bloom's (1956) learning hierarchy and created for student's high-level cognitive engagement. Its moderation dimension is related to the instructor's role in the online learning context.

In Veerman & Veldhuis-Diermanse's (2001) classification framework, the sub-category of "social" is included and is grouped under the category of "not tasked-related". A social statement is considered to promote ties and intimacy between community members. "Task-related" messages contain three sub-categories related to knowledge construction processes: "new ideas", "explanations", and "evaluation". These sub-categories reflect the high-level cognitive development process of conceptualization, explanation, and evaluation of knowledge through critical reflection to reach an answer or conclusion in discussions in a CSCL context. In this research, the discussions in these chosen virtual product user communities are aimed at identifying workable solutions, and usually the proposed solutions are evaluated against existing facts, or tested by implication. Accordingly, they differ from knowledge construction episodes identified in the product user communities in terms of criticality levels.

To conclude, all of the above analytical frameworks are created for exploring high-level cognitive engagement in formal learning discussion contents in the context of CSCL. The knowledge construction activities in formal online learning discussions are mainly based on conceptualization, meaning negotiation, interpretation, explanation, analyzing, synthesizing, and so on. The evaluation of knowledge is also through critical reflection. These all depend

on high-level cognitive engagement, and its main purpose is to develop critical thinking in the process of generating an answer or a conclusion within online learning.

In marked contrast, the main aim of the discussions in a virtual product user community is to find a workable and permanent solution for technical problems in the most effective and efficient way. This requires the knowledge construction process to be simple and not to involve high-level cognitive engagement. Knowledge about solution ideas has a strong experiential nature, and is based on either direct or indirect experience of participating in the discussion of technical problems rather than being built on complicated conceptualizations and meaning negotiation, as in the formal online learning context.

"Proposing a new idea" as a solution by active community members is based on contextual knowledge about problems, which enables the participant to identify the requisite area of their experiential knowledge. The "Exploration & Explanation Episodes" included in this new analytical framework are mainly realized through the "asking and answering" relationship for clarification, which is reflected by "Asking focused question (about the idea/about the problem)" and "Clarifying ambiguity (about the idea/about the problem)". This process does not involve complex meaning negotiation, comprehension, knowledge synthesis and so on, which are important cognitive elements in knowledge construction of formal online learning contexts. The "Evaluating & Testing Episodes" in this new framework are achieved through evaluating the suggested solution ideas against existing facts or through testing by applying the idea. Therefore, all of the three episodes in this content analysis framework do not involve high-level cognitive engagement.

On the contrary, according to Bloom's (1956) Taxonomy the evaluation of formal learning in real-life refers to making decisions about values and views. In CSCL context, the evaluation of knowledge can be achieved through critical reflection (Veerman & Veldhuis-Diermanse, 2001). Thus, evaluating knowledge in both the real-life learning context and the CSCL context requires high-level cognitive engagement. However, it should be noticed that the knowledge construction through a lower-level cognitive engagement in a virtual product user community does not necessarily mean that the knowledge building is "inferior" to that in a CSCL context. The fact is that this type of knowledge building is an effective and efficient way for these community members to reach required solutions to technical problems. There is no proof that community member's learning behaviours do not emerge in the discussion of

technical problems. The question as to the level critical thinking can reach still needs further exploration in future research.

The above analysis clearly shows that this new content analysis framework of knowledge construction created in this thesis aims to reveal knowledge building activities of low-level cognitive engagement. This analytical framework aims to study knowledge behaviours of low-level criticality which can be used not only in virtual product user communities, but can also be applied to other similar contexts with lesser criticality requirements. Thus, it can complement existing analytical frameworks and tools exploring high-level cognitive development and critical thinking in the CSCL context.

10.3.3 Social Dimensions

The inclusion of social dimensions in the analytical framework is strongly related with the aim of the framework. Not all of the above six analytical frameworks include the category of social message. The social message dimension is contained in the Henri's (1992) model; and Garrison's (2000) Community of Inquiry Coding Template; Veerman & Veldhuis-Diermanse's (2001) classification framework; but not in Gunawardena et al.'s (1997) Interaction Analysis Model; Newman et al.'s (1996; 1997) Critical Thinking Analysis Protocols Model; or Zhu's (2006) Analytical Framework. Whether to include the social dimension is decided by the main purpose of these analytical frameworks. For frameworks which only aim to explore critical thinking development, they focus purely on cognitive developments and exclude the social dimension. In contrast, the frameworks, which aim to describe the overall picture of cognitive development in the online learning process, usually include the influencing factors of social dimension, and sometimes teaching presence as well. For instance, in order to illustrate the learning experience, which is considered to be shaped by the cognitive dimension, the social dimension, and teaching presence, all three dimensions are included in this analytical framework (Garrison, 2000). The social interaction is an important element to be included in order to reveal an overall picture of the online learning process in CSCL, for it can facilitate the learning process and even partially shape the learning experience.

In order to explore overall knowledge construction in the discussion of technical problems and questions in virtual product user communities from a widest perspective, the analytical framework created in this research includes the knowledge construction dimension and other influencing dimensions, such as moderation episodes, problem description episodes, and non-

constructive episodes. Because the social message is not common in the selected communities, the social dimension is not included in this framework. In future studies, when applying this analytical framework to other types of virtual communities, which probably have more social messages, a social dimension could be added to the framework. If so, the relations between the social dimension and other dimensions must be explored too.

There are multiple reasons why social messages in virtual product user communities are rare. It can be related to the aim of their establishment purpose, the sponsor's moderation, or community culture. This type of community is mainly established by the producer to help its customers to solve technical problems in the most effective and efficient way, rather than to focus on building social relations among community members. Its community culture values the "helpful role" in solving technical problems rather than "social role" in building social ties. Without active interaction of social messages to enhance the tie, the function of the community can still be achieved through the clear definition of its aim, a well fostered community culture, active community members' contributions, and effective moderation work.

The exclusion of the social dimension in this framework does not mean to deny its importance in the knowledge sharing and building process. The social interaction among the community members is not salient in the discussion threads of user support forums. Nevertheless, according to the interview analysis result, social interaction is quite active in the sub-community, consisting of active community members in the Dell User Support Forum, and its discussions are not generally related to technical issues. This suggests that the social dimension still plays an important role in facilitating knowledge construction by promoting connections and a community sense of active knowledge contributors, although this occurs in an indirect way.

Another point that is worth noting is about developing analytical frameworks. When deciding what dimensions should be included in the model, the researcher must consider the purpose of the framework and the links between the categories. For instance, if the researcher only plans to explore pure cognitive development from a micro perspective, only the cognitive dimension should be included in the analytical framework. If the researcher aims to reveal a holistic picture of online learning from a micro perspective, besides the cognitive dimension, all of the relevant influencing dimensions should be put into the framework. When applying these frameworks, a clear goal of the framework and its consistent and systematic categories

can greatly reduce the ambiguity in coding the data. For instance, Henri's (1992) model has been criticised for its lack of systematic categorization (Howell-Richardson & Mellar, 1996), and this causes difficulty when applying his model in classification of CSCL interactions (Persico et al., 2009). Moreover, a clear goal for developing a framework also helps to create a clear and rigorous relationship between included categories, and reduces the blurring of the area between these categories.

As stated in the literature review, there are also other differences between the virtual product user community and the CSCL context:

- Their community members are different: the community members in a CSCL context are mainly a small group of students in the same module or same class. The members in virtual product user communities are usually a large number of diverse product users with varying characteristics.

- The network attributes are different: the online learning community in CSCL is a smaller, more closed social network with strong ties between its members; the virtual product user community is a much bigger network with comparatively weaker ties.

- The off-line influence on the online discussion in CSCL is much stronger than that in a virtual product user community.

- The online discussions in CSCL have a mandatory nature and are usually graded or assessed for academic performance. They are also much more structured and focused than in a virtual product user community.

- The facilitation level in CSCL is much higher than that in virtual product user communities. The instructor plays an active role as facilitator to foster students' cognitive development and critical thinking skills. The interaction between the instructor and students helps to achieve learning goals. A limited number of moderators are installed in virtual product user communities. They cannot provide extensive facilitation as instructors in the CSCL context.

- Their goals are different: The discussions in CSCL are supposed to develop critical thinking skills; the discussions in virtual product user communities, on the other hand, are aimed to find solutions to technical problems in the most efficient and simplest method.

As discussed in the sections of (4.6.2.1Contextual Differences between Virtual Product User Peer Support Forum and CSCL and 10.3.2Analysis of Existing Knowledge Construction Analysis Frameworks), the formal online learning communities is designed to develop students' critical thinking in their argumentative discussions or generating answers to the questions, which involves high-level cognitive engagement. Constructivist educators believe that discussions in the formal online learning communities contribute to students' higher-order thinking and help them actively engage in knowledge creation process (Stein et al., 2006). Therefore, in the online learning context, instructors are required to play an active role in providing sufficient scaffolding to facilitate students' peer problem-solving process at a high level of criticality (Ge & Land, 2003; Davis & Linn, 2000; Ge & Land, 2004). For instance, the instructor can use question prompts to direct student attention to the key issues of problem solving and thus guide the process (Ge & Land, 2004). The instructor can also meet both the individual and group needs and particular task demands, provide coaching and constructive feedback (Cooper, 1999).

On the contrary, in the virtual product user community, due to different responsibilities and purposes, the moderator cannot pay as much attention as the instructor does in the online learning communities due to the much larger number of community members. Thus, without tailored and sufficient scaffolding, the problem solving process in the virtual product user community cannot develop into a very complicated discussion with high-level criticality.

These contextual differences together create different levels of cognitive engagement in the knowledge construction activities in the CSCL and virtual product user communities. The online system design features (for instance, the scoring system for discussion threads and searching engines); the experiential nature of knowledge about solutions; the clear aim of participating in discussions; community cultures advocating helpful roles; and so on, all cause complicated cognitive elements to be absent in the discussions of virtual product user communities.

10.4 Knowledge Nature and Knowledge Construction

Clarifying ambiguity about technical problems, especially its reliance on contextual knowledge, is quite important in constructing new knowledge to solve specific technical problems. This can be explained by the knowledge's situated, tacit, specific and ambiguous nature, as discussed in the literature.

Knowledge has a situated and tacit nature (Suchman, 1987; Cook & Brown, 1999). This property of knowledge has a significant effect on knowledge transfer (Zander & Kogut, 1995; Birkinshaw et al., 2002). This makes it quite difficult to transfer knowledge from one situation to another. Carlile (2002) also states that knowledge is localized, embedded, and invested in practice in new product development: "…these same characteristics of knowledge in practice that lead to the effective specialization of knowledge become problematic when working across practices" (Carlile, 2002).

Ambiguity is also one of the most critical characteristics that influence knowledge transfer (Levin & Cross, 2004; Simonim, 1999; Szulanski et al., 2004). "Knowledge ambiguity refers to the inherent and irreducible uncertainty as to precisely what the underlying knowledge components and sources are and how they interact" (Van Wijk, 2008). Reed & DeFilippi (1990) point out that knowledge ambiguity is created from the co-occurring result of the tacit, specific, and complex nature of knowledge that is transferred. Moreover, knowledge ambiguity also makes knowledge acquisition more difficult than knowledge transfer (Van Wijk et al., 2008).

In the knowledge construction process, the peer user experts' knowledge on technical solutions has a strong experiential nature. Their knowledge is acquired from direct or indirect experience of participating in online discussions about various technical problems. That is to say, their knowledge has a strong situated and tacit nature. Contextual knowledge about technical problems can assist diagnosis and identifying the requisite knowledge for proposing solutions. Therefore, the contextual knowledge transferred between the solution provider and questioner can offset the negative influences of knowledge nature. The subcategories of "asking focused question (about the problem)" and "clarifying ambiguity (about the problem)" focus on contextual knowledge about the problem. These two subcategories are essential in the category of knowledge "Exploration & Explanation Episode" and also the whole knowledge construction process in terms of overcoming knowledge ambiguity.

This is also the main reason that most solution ideas to specific technical problems within the products are provided by peer user experts with relevant experience, rather than the moderators, who have general technical solution scripts.

10.5 Relationship between Question Type, Interaction Type, and Knowledge Construction Type

The findings of this research support Zhu's (1996) ideas about the relationship between question type and interaction type. Moreover, threads analysis, with the aid of the content analysis framework developed in this research, further identifies the interrelationship between the question type, interaction type and knowledge construction type.

The findings confirm that "horizontal interaction" between the community members is triggered in the threads, starting with a "discussing question", and evolves into the knowledge construction process. The threads selected for analysis in virtual product user communities, for instance the Dell User Support Forum, mainly contain "discussing questions" (Zhu, 1996) rather than "information seeking questions" (Zhu, 1996). The discussions in these selected threads are quite active because no ready answers are expected and many forum users are needed to participate in finding solutions by suggesting ideas, exploring knowledge, testing the idea, and so on. This also creates quite active interpersonal interactions between community members, such as the interaction of asking-answering reflected by the sub-categories of "Asking focused question (about the problem / idea)" and "Clarifying the ambiguity (about the problem/ idea)". According to Zhu (1996), these are all typical features of "horizontal interaction". Consequently, the discussion evolves into the knowledge construction process conducted by a group of product users. This knowledge building process is affected, stimulated and facilitated by horizontal interaction among peer users of all knowledge levels, rather than simply the assimilation of information provided by a few members with high-levels of expertise.

However, except these confirmations of Zhu's work, the result of the threads analysis in multiple virtual communities and online groups suggests a contradicting point to Zhu's claim that both horizontal interaction and vertical interaction are "conductive to knowledge construction" (1996:838). Zhu (1996) claims that the simple assimilation of information is one type of knowledge construction. However, threads analysis finds that vertical interaction in the JISCMail mainly generates simple information/knowledge-sharing through posting announcements or providing ready answers, or information assimilation, rather than conducting complicated new knowledge construction. In addition, Zhu's (1996) idea about the equivalency between simple information assimilation and knowledge construction is not supported by this research. The findings in this thesis support the idea that simple information assimilation is more oriented to knowledge-sharing than knowledge construction.

10.6 The Influence of Community Attributes on Knowledge Activities

10.6.1 The Influence of Leadership & Moderation in the Virtual Community

The findings of the third stage confirm Kim's (2000) idea that the community moderator is one of the key influencing factors in deciding the success of virtual communities. One important reason causing the poor performance of the Lenovo User Support Forum (in Chinese) is the lack of a formal and clear governance structure. In other words, the roles of the moderators at different levels, including formal moderators and informal moderators, are not clearly defined. Consequently, they fail to realize their roles in processing user generated discussion contents, managing the community and fostering community development. The community sponsor's roles cannot be achieved either. In contrast, other virtual product user communities which share similarities in other aspects but have clear leadership structure through moderators are quite successful. Therefore, this supports the importance of formal leadership through moderators in the success of virtual communities.

The importance of implanting a formal governance structure (i.e. leadership) through appointing moderators, facilitators, and community managers in the community is highly emphasized for achieving the organization's purposes and community development in the context of a virtual Community of Practice (McDermott , 2001; Wenger & Snyder, 2000; Bourhis & Dubé, 2010; Bourhis, et al., 2005). The finding of the research in the third research stage confirms its importance for the success of virtual product user communities. Without a clear governance structure in Lenovo User Support Forum (in Chinese), i.e. leadership in the community, different roles of community managers, formal moderators, volunteer moderators of different levels and duties cannot properly emerge through interaction or be performed in practice.

Well performed leadership can reduce the negative influences of the community's structuring characteristics (Bourhis et al., 2005). In the Dell User Support Forum (English), the leaders of the community adopt successful strategies to promote active community member's contributions of their knowledge, which has a strong "experiential" feature. This effectively decreases the negative influence of formal moderators' lack of experiential knowledge, which is required to solve very specific technical problems. The active community members, i.e. mainly the RockStars in Dell Support forum, who have specific experiential knowledge and are considered as main solution idea contributors, are invited to share some moderation power with the formal moderators. Moreover, the forum managing team members also adopt

other motivating strategies to promote these community members' participation in solving technical problems, such as through the visibility reward of salient ranking in the forum, materialistic rewards, and so on. Based on these successful leadership strategies, the weakness of the community membership structure, namely that most of the community members are inexperienced newbies and the company staff whose knowledge is based on a general manuscript, can be overcome.

The moderator's role, identified in the content analysis of discussion threads and thematic analysis of interviews, can be captured in three dimensions: 1) A social dimension which is mainly related to maintaining the social order; 2) A knowledge dimension which is related to the moderator's processing user generated comments and providing information; 3) A network dimension which is mainly related to transferring knowledge across the boundary as a boundary spanner, including knowledge about problems, solutions, advice about managing the forum, and lobbying the company on behalf of the community; 4) The role regarding promoting community development can be reflected from the moderation strategies that are adopted by the managing team, such as giving active users the title of "Rockstar", recruiting volunteer moderators, providing rewards for knowledge contributors, supporting the sub-community, and so on.

The above findings are partially consistent with the general roles of moderators in virtual communities, as identified by Williams & Cothrel (2000). They state that moderators have three types of duties in the online community: 1) member development, by promoting participation; 2) community asset management, by processing the discussion content; 3) community relationship management, by fostering the development of online communities. These three types of roles are quite similar to the findings of this research. However, the moderator's role regarding networking, i.e. the boundary spanner, is not included in (Williams & Cothrel (2000)'s classification. The networking role of the moderator is closely related to one salient attribute of the virtual product user community: company sponsorship. This can also be reflected from the moderator's title in the Dell Support Forum: "Liaison". The company's sponsorship and community establishment objectives require the boundary spanning role of the moderator.

Table 10-1: Conclusion of Moderator's Roles in Different Contexts

Virtual Product User Community	**General Virtual Community**	**Virtual Community of Practice**	**Learning communities via face-to-face communication**	**Online Learning Community**
Social Dimension (Maintaining social order)	Member development by promoting member participation (Williams & Cothrel, 2000)	Social Function (Berge, 1995; Gray, 2004)	Social roles relating relevant to management of interactions (Berge, 1995; Mason, 1991)	Same as learning communities via face-to-face communication
Knowledge dimension (processing user generated contents and providing information)	Community asset management by processing the discussion content (Williams & Cothrel, 2000)	Managerial role (Berge & Collins, 2000)	managerial roles relating to management of interactions (Berge, 1995; Mason, 1991)	Same as learning communities via face-to-face communication)
Community Development Dimension[37]	Community relationship management by fostering the development of the online communities (William & Cotheral, 2000)	Organizational Function (Berge, 1995; Gray, 2004)	intellectual roles relating to encouraging learning through facilitation (Berge, 1995; Mason, 1991)	Same as learning communities via face-to-face communication
Network dimension	Not present	Not present	Not present	Not present
Not present	Not present	Technical Function (Gray, 2004)	Technical roles relating to providing technical support (Berge, 1995; Mason, 1991)	Same as learning communities via face-to-face communication
Not present	Not present	Pedagogical Function by facilitating learning (Gray, 2004)	Not present	Not present

Berge (1995) classifies the moderator's roles in a learning community into four categories: the technical, organizational, social, and pedagogical functions. These roles do not change much when learning communities become virtual (Gray, 2004; Collison, et al, 2000; Salmon, 2000). Gray (2004) points out that the focus of the moderators in the virtual COP, as an educational facilitator in the last phase of the virtual CoP's development phase, is to keep the company employees participating in learning experiences. One of the moderators' roles in the

[37] This role is naturally bounded with the moderator, and can be reflected from business sponsor's aims.

learning community, via the face-to-face, online learning community, and virtual community of practice is related to learning function. The reason can be explained by their differences in terms of community members and the organization's goal towards them. The members in the learning communities and VCoPs are respectively students in educational institutions and formal employees in organizations. Thus, facilitating community members' learning becomes an important organizational purpose of appointing moderators in these communities.

All in all, the moderator's role is closely connected to the organization's goal. One of the goals of the virtual product user community is to create a close relationship with the business organization. Thus, this explains the moderator's networking role in the virtual product user community. This is also the same in formal online learning communities and virtual communities of practice, whose main purpose requires the pedagogical function of moderators.

The findings also reveal the moderator's role in practice in the context of a virtual product user community. Their involvement in the discussion and knowledge construction activities are not welcomed by the community members, according to interviewees. The content analysis of discussion threads also confirms that most of the solutions are provided by community members rather than the moderator. They are expected to concentrate on maintaining a friendly online environment, fostering the development of the community, and linking the virtual product user community with the business organization.

10.6.2 The Influence of Technology

Multiple factors are involved in knowledge sharing and creation in virtual communities, including technology, culture, and managerial and psychological issues. However, technology has less influence in creating a vigorous online environment and animated virtual community than do the social, cultural, and organizational factors (Wenger, 2001; Wenger et al., 2002). The findings in this research are consistent with the above statement. Different technologies adopted by the selected virtual communities and online groups in this research do not have a strong influence on creating community activity, compared to other factors, such as moderation strategy and community culture. However, the communication technologies that facilitate interaction in these communities and online groups, including Internet forum, social network, and LISTSERVE mailing software, can affect knowledge activity patterns, depending on exact technical features. The specific patterns of knowledge sharing and construction activities are strongly related to technical attributes of

communication platforms. For instance, the JISCMail, based on Listserv technology, is only convenient for sharing simple knowledge, like conference news, rather than building new knowledge through long and complicated discussions. The salient attributes of social networking technology, including visibility of identity and strong ties between similar social group members, makes the discussion highly focused on knowledge construction episodes and reduces the discursive and trolling behaviours. The knowledge construction activities in the virtual product user communities that rely on the Internet forum are consistent in these selected forums. Three main episodes, i.e. knowledge construction episodes, problem description episodes, and non-constructive episodes, are usually involved in these discussions.

10.6.3 The Influence of National Culture and Language

Cultural issues in terms of language in use on the forum and community members' language and cultural background is investigated in this research. However, this research identifies that different cultural and language backgrounds of community members does not cause a change of knowledge construction patterns in virtual community of practice. That is to say, the knowledge construction model developed in this research can be applied to describe knowledge creation activities in both English and Chinese virtual product user communities. The threads analysis illustrates that there is more pure social information in the Lenovo Chinese Support Forum, with a Chinese cultural background, than on English forums. The social information is more related to promoting interaction and participation motivation. This needs further exploration to understand the exact function of social information and its relationship with cultural attributes in virtual product user communication.

There are many theories classifying (/analysing) national culture, such as Hofstede's (1980; 1984) cultural dimension theory, Hall's (1976) classification of high-context culture and low-context culture, and Triandis's (1995) classification of individualism and collectivism.

However, there are not many empirical studies on national cultural influences on knowledge management (Ardichvili et al., 2006). Some researchers have explored knowledge transfer and sharing within multinational corporations or joint ventures (Inkpen & Dinur, 1998; Simonin, 1999; Gupta & Govindarajan, 2000; Kogut & Singh, 1988; Kogut & Zander, 1993; Ford et al., 2003). Other researchers have conducted comparative studies of knowledge sharing within organizations in different countries, such as cases of America and China (Chow et al., 2000), and cases of Russia and China (Michailova & Hutchings, 2006).

Knowledge sharing in organizations is heavily influenced by individual employee's cultural values (Hofstede, 2001; Hambrick et al., 1998; Pfeffer & Sutton, 2000). Cognitive styles in learning and knowledge creation also differs in different national and ethic culture (Korac-Kakabadze and Kouzmin, 1999; Ginsburg et al., 1981). However, there are very few studies concentrating on exploring national cultural factors which influence knowledge transfer and knowledge management (Bhagat et al., 2002; Ford & Chan, 2003). There are even fewer studies that explore this subject in the context of virtual communities: Ardichvili et al. (2006) conducted an empirical study of exploring cultural factors affecting knowledge sharing strategies in virtual communities of practice. There are no empirical studies on comparing of knowledge creation or construction patterns in virtual communities under the influences of different national cultures. Due to the lack of studies explicitly focus on national cultural differences that influence knowledge construction (/knowledge creation) in virtual communities, the literature does not seem to provide a clear picture of how cultural difference impacts on knowledge construction.

This research did not find big influences of knowledge construction patterns in solving technical problems caused by different cultures and language. However, this study did identify differences in online social interaction patterns in different national cultures (i.e. in the support forums of English and Chinese). This might affect knowledge construction, but only indirectly. More social information in the discussion threads in Chinese virtual product user communities can promote interaction and motivation when participation is low and thus push forward the knowledge construction process. Therefore, this is in accordance with Chua's (2002:387) identification of "the positive correlation between the level of social interaction and the quality of knowledge created".

10.6.4 The influence of Organizational Sponsorship

The company initiated brand communities are also sponsored by the producer for relationship marketing, distributing, and communicating purposes (Anderson, 2005), and to gather new ideas (Jang et al., 2008).

In the producer sponsored online brand community, community members have to join in the community in order to obtain mandatory service (and or content) that only the producer can provide, and its operating mechanism of community stimulation is different from a consumer-initiated community (Jang et al., 2008: 74). Jang et al. (2008:75) point out that stimulation in consumer-initiated brand community strongly relies on community attributes,

such as system quality, but commitment in semi-voluntary or mandatory communities is not heavily affected by community characteristics. However, they do not specify the exact influencing factors in company sponsored brand communities.

Jang et al. (2008) only point out that redundant management and sponsorship conducted by the business sponsor will exert a negative influence on the spontaneity of community members. The findings of this research, i.e., the interview results of the community members, are in agreement with this point. The community members prefer less censorship over the use of language, and reduction of the moderator's involvement in the discussions. One interviewee clearly states that stringent control over community member's activities and censorship by the sponsor over user generated content will force him to quit the community. A virtual product user community with minimum control conducted by the sponsor to ensure online social order can encourage the community members' participation motivation.

As for sponsorship's influence on knowledge construction patterns, this research finds that there is no significant difference in the way new knowledge is built between the producer sponsored virtual product user community (i.e. the user support forms sponsored by laptop producers) and volunteer communities (i.e. Slashdot forum and LinkedIn). One salient difference about discussion contents is that moderation episodes involved by the company appointed moderators, regarding processing discussion content and transferring knowledge between the community and the organization, are very common. On the other hand, this is very rare in the selected volunteer communities.

10.7 Virtual Product User Community and Innovation

The Dell Ideastorm Community confirms the ideas of Von Hippel (2005: 96), who suggests that product users can be members and innovative idea contributors in a community of innovation. The members of Dell Ideastorm Community provide innovative ideas and knowledge on innovative ideas and knowledge on technical solutions, new business plans, and New Product Development. These bring great business values to the manufacturer. The Dell User Support Forum can enable the enterprise to incorporate users' experiential knowledge on usage and problem solving. The findings about the functions of virtual product user communities are also in line with Lilien et al.'s (2002) claim that virtual customers not only provide marketing information, but can also incorporate their innovation ability and knowledge of resolving problems into the organization's innovation process.

In order to fully explore business value, commercial organizations also exert their influence and control over an open source community through providing sponsorship (West & Lakhani, 2008; Välimäki, 2003; West & Lakhani, 2008). In addition, the virtual community, which consists of customers, is also adopted as the communication platform and knowledge resource for enhancing the business organization's innovation (Anderson, 2005; Bennett & Gabriel, 1999; Evans & Wurster, 1997; Millen et al., 2002).

Millen et al. (2002) clarify the benefit regarding "productivity" for organizations in terms of a) the improved quality of knowledge and advice; and b) improved idea generation and problem solving. These two points can be confirmed by the workability of active community members' suggestions on technical problems. c) Improved innovation of the new business mode and product. This is confirmed through the large number of ideas implemented in Dell Ideastorm Community; and d) efficient information seeking and sharing. This can be reflected through the users' usage of the user support forum as the first knowledge resource.

10.8 Implications of Formal Online Learning

The findings have potentially important implications for fostering a rigorous and self-managing online learning community in the CSCL context. The self-management of knowledge activities through collective moderation by the community members (for instance, the sub-category of "Mediating the arguing/stopping talking about unnecessary topic" in the "moderation episode"), and the community culture focusing on helpful role and collective knowledge contribution, can offset the negative influences of the "non-constructive episodes". In addition, most of the solutions are found by the peer users through collaborative efforts into the four knowledge construction episodes. This helps to reduce the moderator's involvement in the knowledge construction process. This is also the virtual product user community members' expectations towards the moderator's functions. More importantly, it can assist self-directed learning: learner autonomy over instruction (Song & Hill, 2007).

From another perspective, this suggests the possibility of autonomy (/self-management) of formal online learning communities, and an independent process of knowledge sharing and creating without the involvement of facilitators or instructor. The online community in a CSCL context can achieve self-management through collective peer user moderation, and autonomous knowledge sharing and building through interaction between community members. Consequently, the instructor's role in maintaining online discussion order and participating in knowledge construction activities can be reduced to a minimum level. This

enables the instructor in online learning to focus on other roles in maintaining an active discussion environment to promote more rigorous knowledge sharing and creating behaviours; to process online discussion content; and to foster the development of the online learning community.

Despite developing knowledge acquisition skills and critical thinking ability, this also helps to achieve other learning goals, such as self-management skills and initiative learning, and collaboration skills in the problem solving process. The educator can consider creating more space for the self-governance structures within online learning communities in order to enable students to manage themselves in the CSCL context. It is also in accordance with the idea that students' success in online learning requires a high level of self-direction (Shapley, 2000). Garrison (1997) points out that self-management means learners taking control of the learning context to achieve their learning goals. He further suggests that learner control relies on peer collaboration with each other in the learning context. Thus, some patterns of self-management in the virtual product user community can shed light on designing self-directed learning in the formal online learning context.

Some motivational strategies for promoting knowledge contribution in virtual product user communities can also be utilized in the CSCL context, whose online discussion has a strong compulsory nature. The student's participation in discussion around academic questions is usually related to their academic performance, to some extent. A student's motivation to contribute in-depth thoughts is usually not high in an online learning context (Song & Hill, 2005). Elvers et al. (2003) ascribe the difficulty of motivation to the easy-to-procrastinate nature of online learning. On the other hand, knowledge contribution in virtual product user communities is mainly based on willing volunteers.

The community culture which values the newbies who has low-levels of knowledge and collective contribution in various ways in the virtual product user communities can also shed light on how to foster similar community culture in CSCL to promote students' participation in online discussions. This should be correlated with a series of changes of online formal learning in CSCL, such as the online course design, communication infrastructure design, the instructor's role, the discussion evaluation system, and so on.

To conclude, the above implications from the virtual product user community provides more approaches for achieving educational goals, as proposed by Candy (1991): developing individuals with moral, emotional, and intellectual autonomy. The findings about the

moderator's role, collective moderation, motivators and the community in this researcher can be taken into consideration when designing a self-directed online learning context.

10.9 Conclusion

Firstly, this chapter related the knowledge construction model to the SECI model. It suggested that the knowledge construction model is a supplement to the SECI model by elaborating the mode of "Combination" and providing the content analysis framework. Then it discussed the contextual differences between existing knowledge construction models in CSCL and the newly developed framework. The main differences are related to social information richness and the criticality level. This highlights the theoretical basis of the content analysis framework created in this research and its importance. Other macro theoretical views about knowledge construction are also provided: the relationship between the tacit, situated, and ambiguous nature of knowledge and the key knowledge construction episodes; the general relationship between question type, interaction type and knowledge construction type; and the virtual product user community contextual attributes' influences on knowledge construction. This chapter also discussed the practical implications of the consideration of the nature of the virtual product user community for user innovation and formal online learning.

Chapter 11 – Conclusion

This chapter draws conclusions regarding the whole research project, whose aim was to explore knowledge construction and related issues in virtual product user communities. The chapter demonstrates that the research aim has been achieved and the research questions have been answered. The chapter includes the following sections: 1) a summary of the whole thesis, answering the research questions; 2) a statement of theoretical and methodological contributions; 3) practical recommendations; and 4) limitations of the study and future research suggestions.

11.1 Summary (Response to Research Questions)

The core research question presented in the Introduction Chapter was: "How do people collaboratively build knowledge in a virtual product user community?" In order to better answer this question, a series of sub-questions were developed from the main research question. These three key sub-questions concerned knowledge-related activities within the virtual product user community and the business organization sponsor. Each sub-section below summarises the answers to the research questions.

11.1.1 Sub-question 1: What is the virtual product user community and what are its attributes?

The virtual product user community is defined as a producer sponsored customer aggregation existing on the Internet to share usage experience and to collaboratively find technical solutions to problems with specific brand products. It is a knowledge focused virtual community that mainly exists on asynchronous online discussion boards and is tightly bounded with the sponsoring organization.

The objective of the producer who establishes and sponsors a virtual product user community is to build a convenient communication platform for communicating with customers, building customer relations, collecting marketing intelligence, and incorporating users' innovative insights and problem solving skills into the organizational knowledge repository. Product users participate in the community mainly in order to find solutions to technical problems with the products through collaborative efforts and sharing the best usage experience with each other.

In order to compare with Table 2-1 where the attributes of other types of similar communities are identified, the attributes of this specific virtual community are included in the following diagram:

Table 11-1: The Attributes of Product User Communities

Platform	Online discussion boards
Place	Completely virtual (offline activities are advised)
Profit Model	Reduce costs of customer support and improve products
Degree of Formalization	Formal/informal
Knowledge Activity	Knowledge Sharing and creation
Contract Value	Limited contract value
Population interaction structure	Public Weak ties in online boards
Motive of participation	Solving technical problems within products, share best usage experience, and so on.

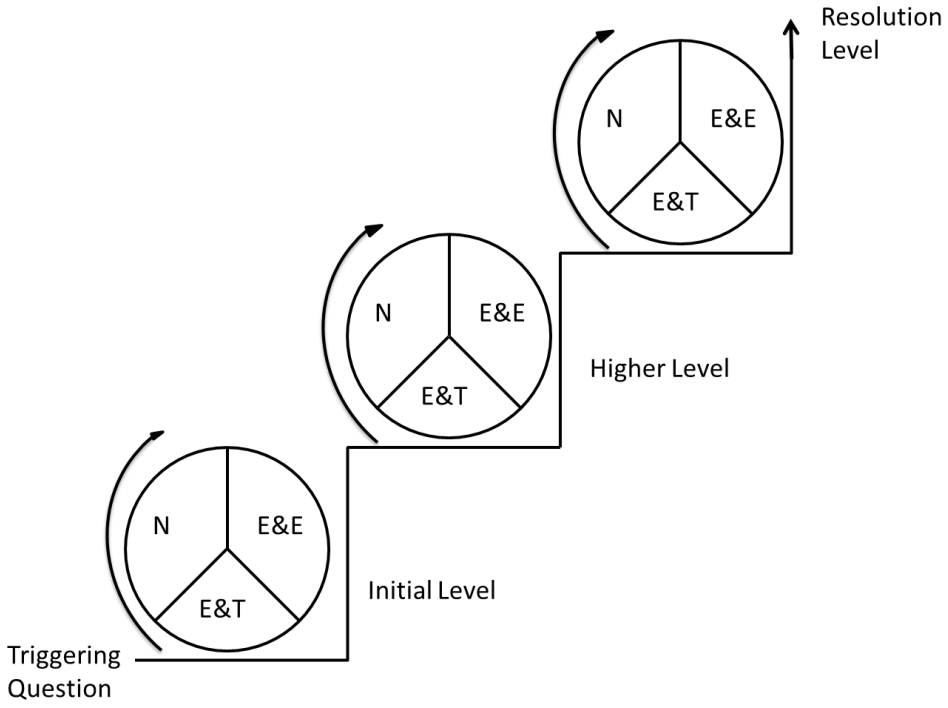
Control	Organization-initiated community (with organizational sponsorship)
Openness of Network	Public & linkage between the organization and customer community
Defined Membership	Open for new members; shifting relationships and membership
Composition	Both experts and novices
Discussion Topic	Product/service related
Purpose of Establishment	Communicating with customers; building customer relations; collecting business intelligence and innovative insights; and problem solving skills
Network Structure	Many-to-many

11.1.2 Sub-question 2: How is knowledge constructed in discussion threads published in a product user community?

As shown in the following figure of the Knowledge Building Model, a new knowledge building process consists of the following knowledge construction episodes: “Initiation

Episode", "New Idea Proposing Episode", "Exploration & Explanation Episode", "Evaluating &Testing Episode", and "Resolution Episode".

The process starts from "Initiation Episode" (i.e. the triggering question), and ends with "Resolution Episode" (i.e. finding accepted answers to the question). Between these two episodes, the discussions usually follow "New Idea Proposing Episode", "Exploration & Explanation Episode", and "Evaluating &Testing Episode" in an progressive and cumulative order. This process repeats itself in a cyclical way until a proposed idea is identified as the feasible and permanent solution, after evaluation and testing. This model illustrates the progressive process of knowledge construction in the virtual product user community. The hierarchical level of ideas proposed in each stage is also reflected in this process. The newly proposed idea is usually based on previous ones and is oriented so as to be more reliable.



(PS: N= New Idea Proposing Episode; E&E= Exploration & Explanation Episode; E&T= Evaluating & Testing Episode)

Figure 11-1: Model of the Knowledge Building Process within the Virtual Product User Community

[Note: it is reproduced from Figure 4-5]

This model represents knowledge construction as an iterative and progressive process. It mainly proceeds in one direction: it starts at the stage of a "triggering question", and moves towards and stops at the resolution stage. These stages, which knowledge construction

process consists of, develop in an iterative way, and overall in a hierarchical order– yet it is not a linear process. Of course, in addition, the model is an idealisation of what happens in practice. As discussed in the section (4.6.5.3 Other Possible Knowledge Construction Processes in the Virtual Product User Community), in reality there can be wrong turns, dead-ends and irrelevant arguing. Thus, it is not a simple linear model, and it is consistent with a conception of knowledge creation as a fuzzy, complex, non-linear, continuous, and iterative process (Nonaka, 1994; Nonaka & Takeuchi, 1995; Huber, 1991; Kim, 2000; Fischer, 2001; Samaddar, & Kadiyala, 2006).

Even though, knowledge construction in the virtual product user communities is seen to be created through low-level criticality, nevertheless, it does not follow that it is a simple or linear process.

The strategy of "trial-and-error" is utilized in constructing new knowledge in order to find the most feasible solutions. This is highly relevant to the nature of newly constructed knowledge in the virtual product user community: the proposed ideas can be immediately applied to the products or be evaluated with existing facts. Solutions are continuously proposed until one is tested to be widely accepted and workable answer. The latter suggested idea is usually proposed based on previous ones, and becomes more and more reliable as the discussion proceeds. Thus, as shown in the above figure (11-1), the hierarchical level of knowledge construction steps is reflected through this process.

The findings from the interview analysis reveal that diagnosing the causes of technical problems and the proposal of solutions by active community members is based on their experiential knowledge. The knowledge of those active community members with high-level expertise has a strong experiential and contextual nature. Their knowledge is obtained from direct or indirect participation in the discussions about solving specific technical problems, rather than from their work. The solutions are usually quite specific due to the varying hardware and software environments of products. Thus, the idea proposer needs contextual knowledge about the problem to identify what area of their experiential knowledge is able to find a solution. This is also in accordance with the nature of knowledge: "localized, embedded and invested in practice" (Carlile, 2002); situated and tacit (Suchman, 1987; Cook & Brown, 1999); and ambiguous (Van Wijk et al., 2008). Providing contextual knowledge about the problem can help the knowledge expert to recall his relevant experience and practices, and thus enable him to identify and utilize the requisite contextual knowledge

embedded in previous direct or indirect practice. The sub-categories of "asking focused question (about the problem)" and "clarifying ambiguity (about the problem)" are usually related to providing contextual knowledge about the problem.

Despite the knowledge construction episodes, other factors are also involved in the solution-oriented discussing process, including "Problem Description Episode", "Non-constructive episode", "Moderation Episode", and "Others" (i.e. invalid posts). They also exert on influences on the knowledge construction process:

- The "Problem Description Episode" can facilitate the knowledge construction process. It helps other peer uses to evaluate the existence of the problem, clarify the symptoms of the problem, and provide contextual knowledge about the problem in order to diagnose the cause and propose solution ideas. Two types of knowledge about technical problems are provided through a "Problem Description Episode", namely knowledge about the symptoms of the problem, and contextual knowledge about the problem. As stated before, the category of "clarifying ambiguity (about the problem)" in knowledge construction episodes also functions to provide contextual knowledge about the problem. The former type helps other peer users know "what the problem is". The latter tells "what the occurrence of problem is", and enables the peer advisors to diagnose its causes, and identify what areas of their experiential knowledge are needed in order to propose a solution. Thus, knowledge about the problem, especially contextual knowledge about problems, is vital in order that the active community members can propose solutions.

- The "Non-constructive Episode" does not actively contribute to the knowledge building, and can even hinder the process by triggering unnecessary disputes, or lowering other user's motivation and confidence to find solutions.

- The "Moderation Episode" refers to moderation activities which are conducted by the formally appointed moderators and community members. These episodes are mainly related to processing and managing community member generated knowledge, and maintaining the social order. The latter can offset the negative influences from "Non-constructive episode".

Although solutions are usually proposed by active community members with high-level knowledge, constructing new knowledge for solving technical problems in the virtual product

user community relies on the group of discussion participants' collective effort. Not only do the knowledge construction episodes need participation from varying community members with different knowledge levels, but also other episodes of "Problem Description Episodes" and "Moderation Episodes", which play an important role in supporting knowledge construction, also need their participation and contributions. Therefore, knowledge construction takes a gestalt form and is based on the collective contribution of community members. This is also in accordance with its community culture in terms of valuing the collective contributions and newbies.

11.1.3 Sub-question 3: what are the contextual factors influencing community members' knowledge construction?

As the following figure 11-2 shows, a number of community contextual factors identified are mainly related to the key attributes of the virtual communities, including communication technology, sponsorship, community culture, moderation mode, national language and culture, discussion participants size and discussion topic.

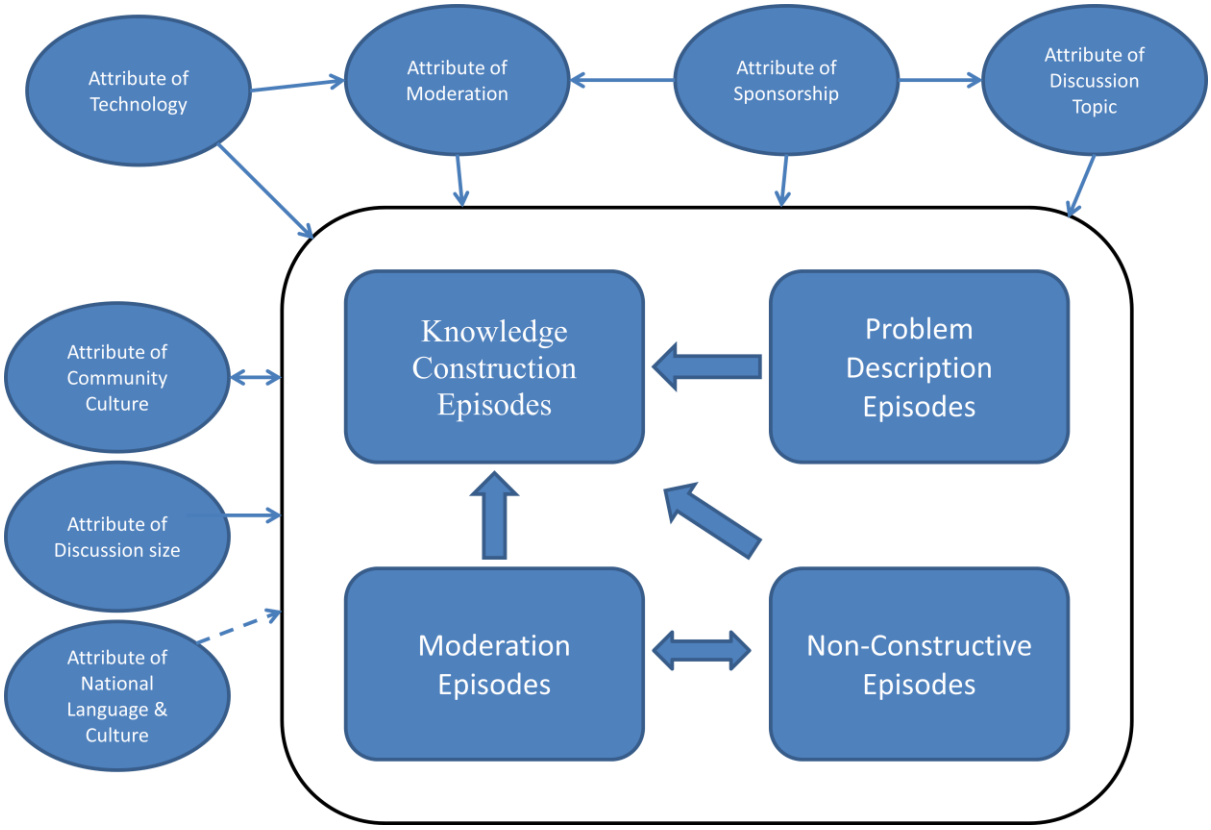


Figure 11-2: Knowledge Construction Model in the Context of the Virtual Product User Community

[Note: it is reproduced from Figure 9-1: Relationship of Knowledge Construction Elements under the Contextual Influences]

The findings in the third research stage prove that different national languages and cultures do not cause a change in knowledge construction patterns. The factor of discussion size can influence the smoothness of the knowledge building process. The findings of the threads analysis reveal that the small number of discussion participants make the discussion more focused rather than diverse. The attributes of a discussion topic can decide the discussion contents and knowledge construction patterns. Technical problem-oriented topics usually generate discussions concentrating on "Knowledge Construction Episodes" and "Problem Description Episodes". Idea-oriented topics create more discursive discussion contents and more social messages. A diverse discussion can be quite important for developing creative ideas.

The attribute of moderation mode and moderator's role can strongly influence the community members' motivation for solving technical problems through collaborative efforts. Thus, the moderation mode is vital in creating a vibrant and successful virtual product user community. The sponsorship type of community decides the discussion topics and the degree of censorship in the virtual community, and thus greatly influences the freedom level of its community members.

The communication technologies utilized in the virtual community also have strong effects on the knowledge construction patterns and interaction patterns. On the social network site, its technical features enable visible identity; facilitates one-to-one interaction; and creates strong ties between community members. This makes the discussion focus on knowledge construction episodes, and reduces the discursive content and trolling behaviours to a minimum level. The listserv technology is more suitable for knowledge sharing than complicated knowledge building. The threaded discussion pattern in some forums can facilitate one-to-one interaction by making the reply relationship more salient, and dividing the discussion contents in a hierarchical way.

All in all, except for the attribute of national language and culture, the remaining attributes can exert their influence on knowledge construction within the micro scope, for instance, changing the exact portions of discussion contents, interaction patterns, or the discussion process. The mutual influences among these attributes are also identified.

However, these attributes do not greatly change the knowledge construction process illustrated in the following figure. The knowledge construction process under contextual influence still proceeds in a hierarchically recurring cycle of key knowledge construction episodes.

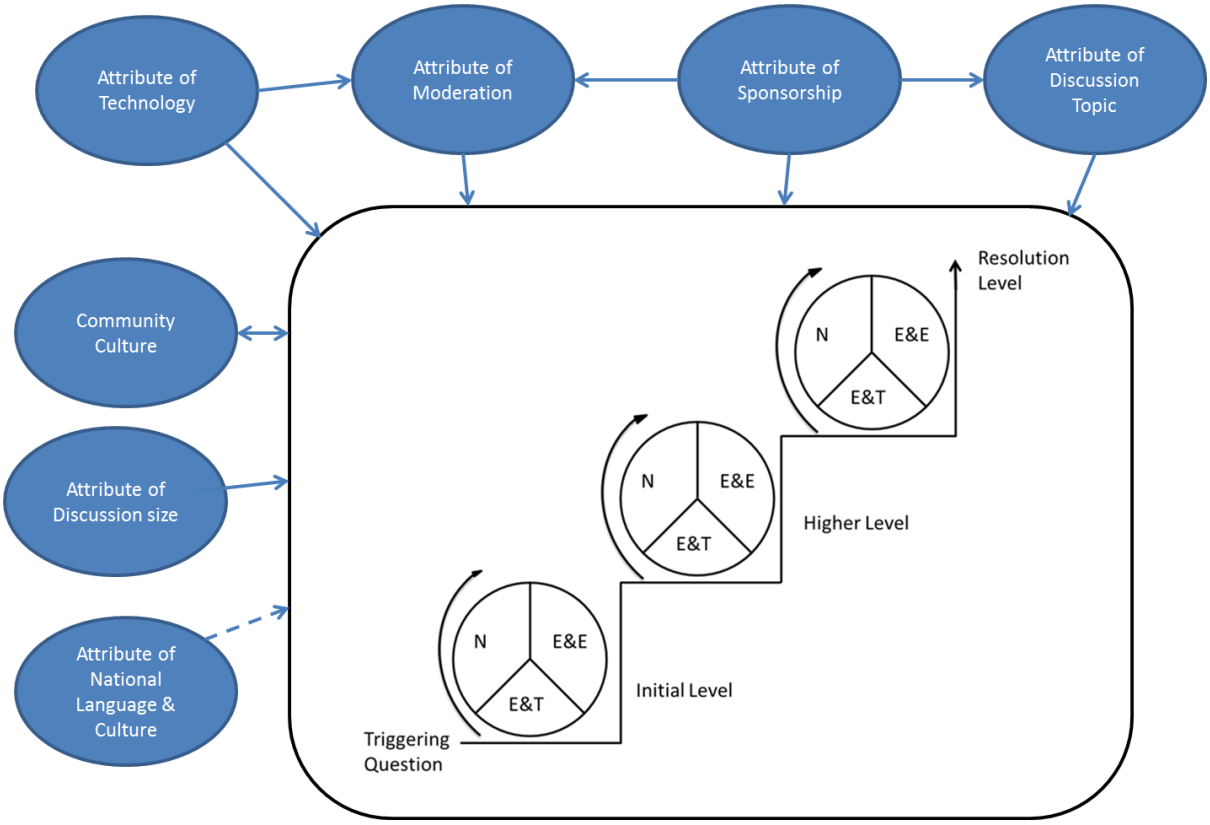


Figure 11-3: Overall Knowledge Construction Process Model in the Context of the Virtual Product User Community

[Note: it is reproduced from Figure 9-2: Knowledge Construction Process under Contextual Influences]

11.1.4 Sub-question 4: How does knowledge flow between the virtual product user community and the organization?

There are usually two types of knowledge transferred by the moderator across the boundary between the virtual product user community and the organization: knowledge about the problem (including knowledge about symptoms and contextual knowledge about the problem); and knowledge about solution ideas. This also creates different types of knowledge transfer modes and knowledge flow processes. Accordingly, two models are created in this research to illustrate different types of knowledge transference processes between the virtual community of product users and the organization.

11.1.4.1 Type One

When the community members cannot find a workable solution through their collaborative efforts, the moderator will sometimes notice this and report the technical problems to the engineers within the organization, and then bring back the solution ideas suggested by the engineers to the community members. The moderators themselves usually lack sufficient tailored knowledge to propose workable solutions for these specific questions, so they involve themselves in knowledge transfer across the boundary between the virtual product user community and the organization, as shown in the following figure:

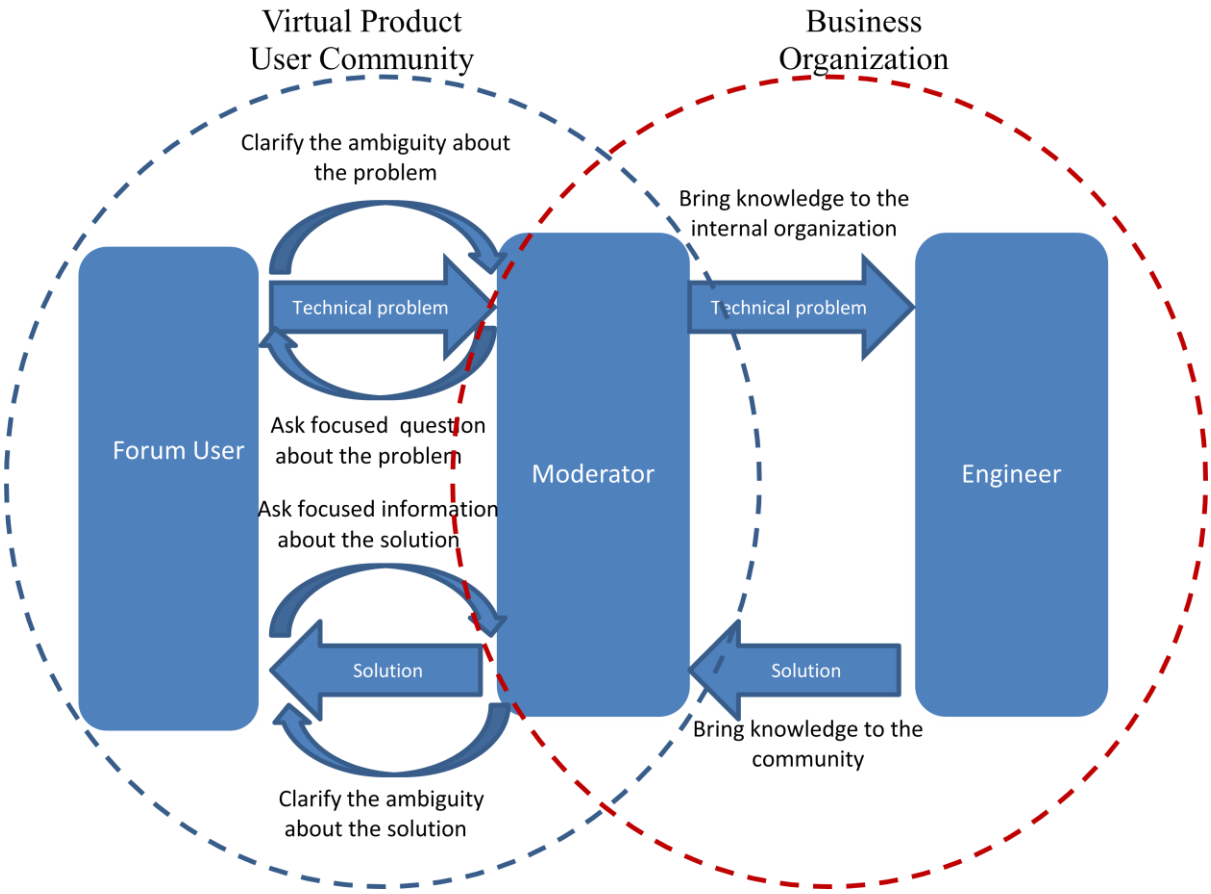


Figure 11-4: Knowledge Transfer about Technical Problem and Engineers' Solution Ideas between Virtual Community and Business Organization

[Note: it is reproduced from Figure5-3: Knowledge Transfer about Technical Problem and Engineers' Solution Ideas between Virtual Community and Business Organization]

In this case, the moderator transfers two types of knowledge across the boundaries from two different directions. Knowledge about technical problems is transferred from the virtual product user community to the business organization. Knowledge about solution ideas is

transferred from the organization to the community members. The moderator's role in the knowledge transference process can be reflected in two sub-categories: "Claiming to bring knowledge from the community to the internal organization" and "Claiming to bring knowledge from the organization to the community".

Contextual knowledge about problems is usually clarified through the sub-categories of "Asking focused question (about the problem)" by the moderator and "Clarifying ambiguity (about the problem)" by the community members, before being transferred by the moderator from the virtual product user community to the organization. On the other hand, knowledge about solution ideas is usually clarified through the sub-categories of "Asking focused question (about the idea)" by the community member and "Clarifying ambiguity (about the idea)" by the moderator after being transferred by the latter from the organization to the community.

11.1.4.2 Type Two

In some cases, knowledge about the solution is constructed by community members through interaction and collaboration, and the moderator usually transfers it to engineers within the organization and then brings feedback to the community members. The knowledge transference and flow process is illustrated as follows.

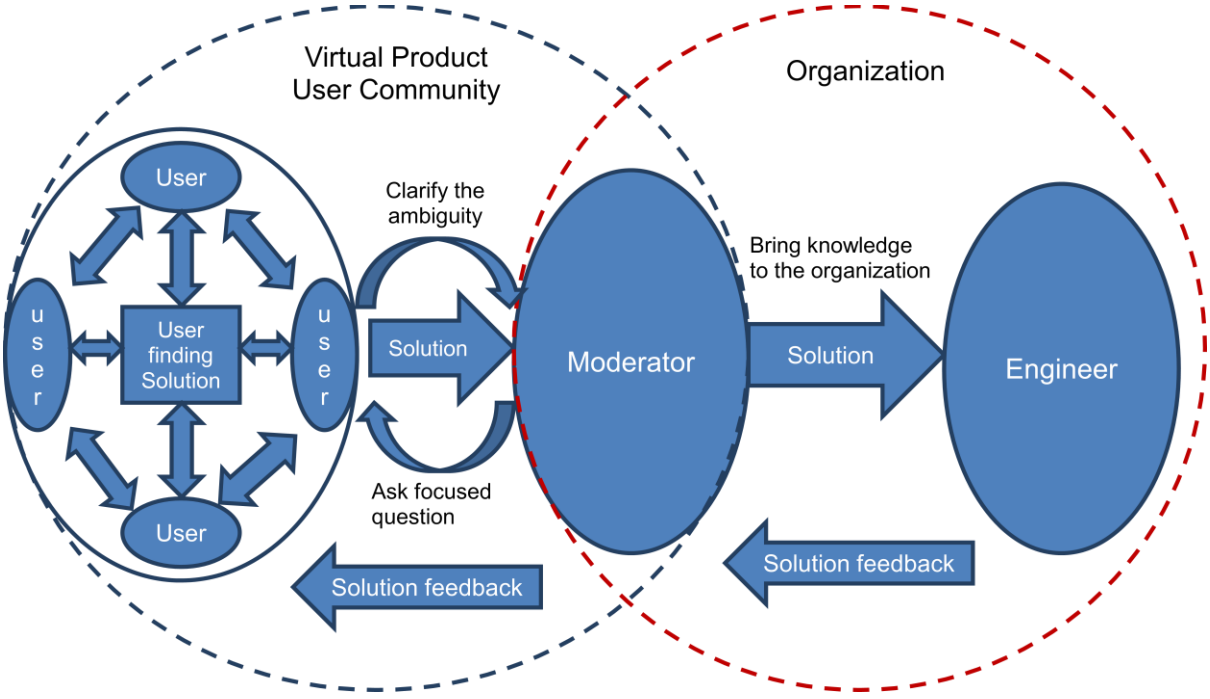


Figure 11-5: Knowledge Transfer about Solutions Proposed by the Forum User between Virtual Community and Business Organization (II)

[Note: it is reproduced from Figure 5-6: Knowledge Transfer about Solutions Proposed by the Forum User between Virtual Community and Business Organization (II)]

If the engineer's feedback is not transmitted to the community, the knowledge flow process of solution ideas generated by community members is presented as follows:

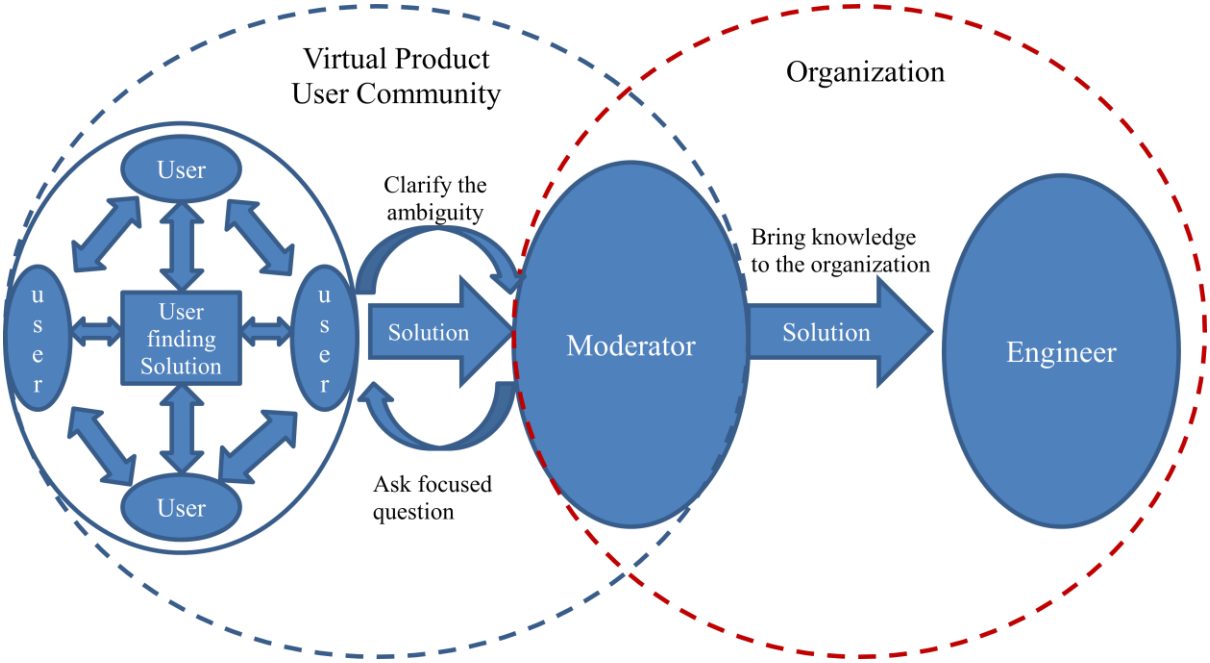


Figure 11-6: Knowledge Transference about Solutions Proposed by the Forum User between Virtual Community and Business Organization (I)

[Note: it is reproduced from Figure 5-5: Knowledge Transference about Solutions Proposed by the Forum User between Virtual Community and Business Organization (I)]

Knowledge about solution ideas is usually clarified between the moderator and the community members before it is transferred to the engineers in the organization. The clarifying process can be reflected by two sub-categories: "Asking focused question (about the idea)" by the moderator and "Clarifying ambiguity (about the idea)" by the community member.

The reason that the moderator can perform the role of transferring knowledge is due to their network advantage as the boundary spanner (/bridging role) between the virtual product user community and the organization. Their knowledge transference role can be reflected in two sub-categories identified in the threads analysis: "Claiming to bring knowledge from the community to the internal organization" and "Claiming to bring knowledge from the organization to the community".

11.2 Theoretical Contribution

This research makes several noteworthy contributions to the existing knowledge of information science, especially in the area of collective knowledge construction in virtual communities. Firstly, it identifies a very specific type of virtual community. Secondly, it creates a content analysis tool for studying knowledge construction. This analytical tool has the potential to be applied in exploring knowledge construction activities of low-level cognitive engagement in other contexts. Thirdly, the findings substantially enhance our understanding about knowledge construction in the virtual product user community by creating a knowledge construction model to simply illustrate how knowledge is constructed. Fourthly, this research also adds new perspectives on the moderator's role, and provides empirical evidence regarding leadership strategies in the virtual community.

11.2.1 Defining & Describing a New Type of Virtual Community

This research defines precisely one specific type of virtual community consisting of product users on the Internet. It also locates its position among various types of virtual communities by discussing their classifications and comparing them with other relevant kinds of virtual communities. Its attributes are also concluded and differentiated from other similar virtual communities. Thus, the clarification of the virtual product user community and its attributes in this research builds a solid basis for future researchers to explore knowledge activities and other issues related to management in this specific type of virtual community.

11.2.2 Developing an Analytical Tool

This research contributes a very specific analytical tool for studying knowledge construction in this specific type of virtual community (as is shown in 9.2.1). Moreover, this tool can also shed light on analysing knowledge construction behaviours in other contexts with low-level cognitive engagement. This content analysis framework for exploring knowledge construction captures the key knowledge construction episodes, classifies the influencing elements (including non-constructive episodes, problem description episodes, and moderation episodes), and points out their interrelationships. This analytical tool is proved to be effective in analyzing knowledge activities when applied in various types of virtual communities and online groups with comparable key attributes. In addition, it encapsulates the key knowledge construction constituents and clarifies the relationships between its main categories, thus

creating sufficient room for other researchers to add further social dimensions to this analytical tool.

Given the fact that all of the existing content analysis frameworks and tools are created for formal online learning contexts (i.e. CSCL) with high-level criticality (/cognitive engagement), this analytical tool targeted at low-level cognitive engagement is a useful complement to explore knowledge construction activities. The main categories in this analytical framework respectively include mutable sub-categories. This enables flexibility when applying this analytical tool in exploring knowledge activities in other contexts with deviant discussion contents. In addition, other researchers can build new models based on the key knowledge construction categories captured in this analytical tool.

11.2.3 Building a Knowledge Construction Model

This research also contributes a knowledge construction model which illustrates how knowledge is constructed in solving technical problems in this specific form of user community (as is shown in figure 11-1). This model is created based on the above analytical tool. It encapsulates the key knowledge construction constituents and depicts the process as well. This knowledge construction model provides a theoretical lens to understand the process of knowledge building in a virtual product user community. The exact process can be altered according to different situations. Thus, it has the capability to be adapted by other researchers in other contexts.

This research also provides an overall picture of the knowledge construction process conducted in the context of a virtual product user community (as is shown in figure 11-2). The key influencing attributes of virtual communities (for instance, the communication technology), and the knowledge construction episodes and the influencing episodes of discussion contents (for instance, moderation episode) are all included. In addition, the relationships of these factors are also illustrated (as is shown in figure 11-3).

These influences of key attributes (including culture, communication technology, national language and culture, sponsorship, moderation, and discussion topic and discussion size) on knowledge construction are also analyzed in an empirical way. The exact influences of other categories of discussion contents, i.e. problem description episodes, non-constructive episodes and moderation episodes, on knowledge construction are also explored and their relationships clarified. In addition, the interrelationship between theses key virtual

community attributes have also been discussed. Thus, this suggests the potential influencing elements and their relationships for other researchers to consider when exploring knowledge construction from a general perspective in different online community contexts.

This research also provides a model of overall knowledge flow between the virtual product user community and the business organization. The overall knowledge transference of different types of knowledge, including knowledge about technical problems and knowledge about solution ideas, across the boundary between the virtual product user community and organizations, is illustrated. The moderator's knowledge transference role in this process was highlighted and elaborated. This adds a new perspective to exploring the moderator's role as knowledge network spanner in organization-sponsored virtual communities.

11.2.4 Enhancing Understanding about the Moderator's Role

One empirical contribution is that the moderator's roles, which are reflected in the discussion threads and interview data, are concluded and categorized in a comprehensive way. Their roles in the virtual product user community are concluded in the following dimensions: the knowledge dimension, the social dimension, and the network dimension. This provides the scope of the moderator's roles for other researchers to consider in their research. Additionally, the moderator's functions are also evaluated in the interview data analysis, and the community members' expectations towards moderator's roles are also identified. Thus, this also suggests very concrete and practical ideas for defining the moderator's roles in designing successful virtual communities.

11.3 Methodological Contribution

11.3.1 Data Collection

The interview data collection result in this research suggests the plausibility of conducting high-quality interviews through E-mails. This research identifies that projecting the researcher's personal profile to the interviewee candidates on the Internet is the key point in shortening the psychological distance between the researcher and potential research participants, and to persuade these individuals to participate in the research. In order to achieve this, the researcher first built a personal research project website containing the researcher's background information; an introduction to the project; research ethics information; and the researcher's Facebook, Google Plus, and LinkedIn addresses. The researcher also registered similar personal information on the personal profile page of the

forum. Interview invitation messages were then sent out, to the targeted candidates, containing a simple description of the research project, research ethics approval information, and the research project website link. This successfully aroused the interest of potential participants, enhanced their familiarity with the researcher and the research project, built trust in the researcher and enhanced the credibility of the research.

Three strategies used to build trust and attract the interviewee's participation can also be adopted to guide similar email interviews in the future. It involves the following:

- Building trust between the researcher and potential interviewees by providing detailed information about the researcher, research project, and research ethics approval information on the research project website.

- Attracting potential research participants by "advertising" research questions. "Politeness" should be the first rule. The researcher must adhere to netiquette throughout the interview process, including when designing and sending the interview invitation messages, when conducting the interview, and after the interview. "Relevance" can be another important attracting factor. The researcher pointed out the relevance of this research project to the potential interviewees' forum usage experience, and even their work, and also promised to provide the research findings to the participants. "Public good" is another key attracting factor. The researcher stressed the academic nature of this researcher, which can push forward the relevant social knowledge. This also helped to recruit research participants, according to the interviewees' feedback.

- A "Non-alienating" strategy. Interviews via email can cause loss of "many additional layers of meaning added to the purely verbal exchange, such as the tone of speech or body language such as gestures and facial expressions" (Sade-Beck, 2004: 58). Providing a rich profile of the researcher, for instances, personal webpage on Facebook and LinkedIn, is an effective way of achieve "non-alienating" effects.

The interview results prove that email interviewing is an effective way to produce interview data of thorough description and in-depth reflection. Moreover, it can offset the geographic and time limitations of on-site interviews (/face-to-face interview) and produce much more thorough answers than telephone interviews.

The telephone interview can generate short and simple response rather than comprehensive answers based on long and deep reflection (Arksey & Knight, 1999). On the other hand, Mann & Stewart (2000) state that email interviews can stimulate interviewees' exploration and ongoing reflection of their experiences, careful thinking about the answers, and encourage fine tuning of the final draft response. In the interview process, most of the interviewees who had had much experience of participating in the community provided many insightful and detailed answers to the interview questions and topics, and many explanatory examples as well. According to the interviewees' narratives, their answers were mainly based on careful consideration and thorough reflection of previous experiences rather than quick responses. This aspect of email interviewing ensures that sufficient themes can be provided for the research questions. The theoretical saturation which was achieved during the middle phase of analysing interview transcripts also directly proves the high quality of the interview data obtained from the e-mail interviews.

In addition, e-mail interviews are considered to be very suitable for semi-structured interviews. Their asynchronous nature enables more freedom and sufficient time to tailor interview questions to interviewees' ideas, according to their background information, answers and interview situations.

11.3.2 Data Analysis

This research confirms that the content analysis of discussion threads and thematic interview analysis can complement each other to best explore knowledge construction within virtual communities. The findings reveal that the combination of these two types of data analysis methods has more advantages than any individual one.

In this research, the categories about knowledge construction and other influencing categories were created from content analysis of discussion threads. Based on these categories, the knowledge construction analytical framework and the knowledge construction model could be developed. However, the content analysis of discussion lacked the capability to provide more explicit descriptions about the relationships among these categories, especially the other categories' influences on knowledge construction categories. There are also hidden areas that cannot be reflected in the discussion threads and be explored through content analysis, including where the active community member's knowledge comes from; what the community members' perceptions and expectations towards the moderator's roles are; what their feelings and comments about community cultures would be, and so on. In contrast, these

topics can be explored through the thematic analysis of interview data which is the discussion participants' own narratives about their experiences, feelings and comments. The "theoretical" thematic analysis is quite an appropriate method for "a detailed analysis of some aspects of the data" (Braun & Clarke, 2006: 89). In other words, it is also suitable for the above questions. Furthermore, the themes developed from the thematic analysis of the interview data can be used to confirm some of the key categories as well.

In the existing literature about exploring knowledge construction activities, most of the research is in a CSCL context, i.e. the analytical frameworks of knowledge construction and cognitive development which are analyzed in the literature review are mainly based on the content analysis method. This causes the above areas to be concealed from such content analysis of discussion contents.

A formal online learning community in the context of CSCL can also be considered as a social network (Aviv et al., 2003), thus Manca et al. (2009) suggest that social network analysis is an effective possible methodological approach for evaluating the levels and patterns of social interactions, especially in coordination with other data analysis methods. In recent years some researchers have further proposed that social network analysis can be combined with content analysis in order to achieve deeper and more holistic insights into its network patterns and knowledge construction processes (Aviv et al., 2003; Zhu, 2006; Daradoumis et al., 2004; Martinez et al., 2006; De Laat et al., 2007). However, the social network is more applicable to the online formal learning community of small group size and with close ties, and is less suitable for the open virtual product user community which consists of thousands of product users who have mainly loose ties with each other.

Accordingly, in addition to the sole content analysis method, and the combination of the content analysis and the social network analysis, this research suggests an effective and practical approach to exploring knowledge construction in virtual communities which are extremely large and open social communities and do not have strong ties between most of community members.

11.4 Practical Implications

The findings of this research have several significant implications for the future practices of business organizations (i.e. community sponsors); virtual product user community moderators; product users and forum members; and formal online learning community instructors.

11.4.1 Suggestions for the Business Organization (i.e. Community Sponsor)

The virtual product user community is shown to be an important knowledge resource for the company and its product users as well. Its members' knowledge has a strong experiential nature and is effective for the specific technical problems of products. In addition, the active community members with high-level knowledge can also reduce the company's financial costs and human resource costs in providing more technicians for users' problems. Meanwhile, the relationship with customers can also be enhanced and innovative ideas on best usage experience and technical problems can be collected through promoting users' participation in the discussions of virtual community. Therefore, the importance of the virtual product user community should be fully realized by the company's top management, and its knowledge and marketing value should also be fully explored.

Direct support from top management should be provided to the community managing teams in order to achieve its leadership role and the organization's objectives. The implementation of moderators is extremely important for realising the organizational sponsor's goals, and creating a close bond between the virtual community and the organization. The effectively managed and well moderated virtual community has the potential to generate economic benefits for the virtual community sponsor (Rothaermel & Sugiyama, 2001). Therefore, the community sponsor should give sufficient support to community leaders and moderators.

Meanwhile, monitoring the moderation work in a continuous way is also important to ensure its expected function. This can ensure that the virtual product user community's development is in accordance with organization's overall goal and strategic plan. In the context of VCoP, Bourhis & Dubé (2010:12) suggest that "…top management must evaluate how the community leadership team performs throughout the VCoP's life and take necessary actions as needed". If the malfunction of moderation in Lenovo Support Forum in Chinese, which consists of thousands of product users, can be realized by the top management through the monitoring system, the moderation structure could be adjusted and the virtual community's value in knowledge resource and marketing can be achieved. In order to effectively monitor community leadership, a reporting channel should be integrated with the organization's hierarchical reporting structures, either in a vertical or hierarchical way.

11.4.2 Suggestions for Community Moderators

11.4.2.1 About Active Users

Active users with high-level knowledge and expertise only account for a small percentage of the community members, but they are the main solution idea contributors, due to their specific experiential knowledge. Furthermore, they also participate in moderation activities to some extent as volunteer moderators. Therefore, they are very important knowledge resources for solutions to very specific technical problems and volunteer moderators. Given this, the multiple motivators should be adopted, in order to retain them within the community. The interview analysis findings reveal that tailored motivation strategies should be utilized to meet different community members' needs. The material rewards (i.e. small gifts) sent to active knowledge contributors should be based on the individual's own wishes. Although it represents the company's acknowledgement of their contribution, it does not work on every member and sometimes can arouse negative feelings. For some active community members, "engagement itself is a rewarding experience" (Füller, 2006: 645). Compensation and monetary reward are only effective to attract a certain types of consumer (Füller, 2006).

The community manager and moderator should also explore other types of motivators, which have already been successfully applied in other types of virtual communities, such as organizing off-line events for these active community members in order to create close bonds with the company.

11.4.2.2 About Newbies (/Novices)

In addition to the active community members, the community managing team members and moderators should also pay attention to newbies from the knowledge construction perspective and the community development perspective.

The analysis of community members' participation in discussions supports the general idea that successful online communities are based on active members continually making contributions (Tedjamulia et al. 2005). However, the findings of this research also reveal the gestalt pattern of knowledge construction in virtual product user communities. In other words, the knowledge construction needs the participation of community members of various knowledge levels, including both active members with expertise and novices with a little knowledge. The contribution to knowledge construction does not merely mean active

community members of high-level knowledge proposing solutions. The knowledge construction process theoretically consists of four episodes which need participation of community members from different levels. For instance, knowledge construction needs to be triggered by the newbies' questions. The solution proposed by the active member usually needs to be tested by the questioner to confirm its workability. The feedback on the testing result provided by the questioner also decides whether the knowledge construction process will stop or move on. Moreover, the problem description episodes and moderation episodes participated in by various community members can also facilitate knowledge construction for solutions.

Moreover, this is also important for maintaining community activeness, and promoting community development from the perspective of the life cycle of member development within the community. The active users will finally quit and newbies will move from a peripheral status to the centre of the community.

The retention of active community members decides the community's current success while the recruitment of new members and the fostering their development decides future success. Thus, the community managers and moderators should not only value the active community members and retain them, they also need to pay attention to recruiting new community members, promoting their participation and growing the knowledge pool. The newbies' development process in the community should also be facilitated. This is also in accordance with the identified community culture which values the importance of newbies. Therefore, the relevant community culture which is helpful for the novice's development should also be acknowledged and fostered.

11.4.2.3 About Moderators

The interview analysis reveals that moderator's involvement in knowledge construction activities is not welcomed by community members. The content analysis of discussion threads also confirms that most solutions are provided by community members rather than moderators. They are expected to concentrate on maintaining a friendly online environment, fostering the development of the community, and transferring knowledge across the boundary between the virtual product user community and the business organization.

In addition, active community member's participation in moderation work can also be promoted. Those members playing the role of volunteer moderators should be formally

empowered by the sponsor and encouraged to take more responsibilities in managing the forum. This research illustrates that their knowledge level, initiative and commitment to the community are sufficient for moderation work in more areas and deeper levels. This is also in line with the community members' desire for more freedom and autonomy.

The findings of this research demonstrate that the forum management team should reduce censorship and allow more freedom in the virtual product user community. The interview analysis reveals that the moderator prefers a less heavily moderated environment and less stringent censorship. The moderator should negotiate with the community members when removing posts. Jang et al. (2008) also propose that superfluous management by the company can lower the community member's spontaneity of participation. Moreover, too much censorship can impede their free flow of creative ideas and cause loss of knowledge. Some categories of "Moderation Episode" participated in by community members, for instance, such as "Mediating the arguing/stopping talking about unnecessary topic", reflect the community's autonomous capacity to some extent and thus supports their proposition in favour of less censorship.

The relationship between interaction and knowledge construction also suggests that management teams should provide more interaction channels and communication frameworks in the community. Active interaction among the community members can facilitate and promote knowledge construction. However, according to the interview findings, sharing and creating knowledge should be conducted through public channels rather than providing messages.

11.4.3 Suggestions for Product Users & Forum Users

For product users who are looking for solutions to technical problems of specific brand products, the product user forum is the best knowledge resource. However, for general knowledge about computers rather than about specific brand products, other online knowledge resources are better places to go because the virtual product user community mainly discusses specific problems about the sponsor's products.

Forum users should actively participate in discussion activities in spite of worries about their low-level expertise. Their participation in discussion, whether by asking a focused question or repeating the problem, is an important and necessary part of the knowledge construction. According to the findings in this research project, the gestalt pattern of knowledge building

requires various kinds of participation by community members who are of different knowledge levels.

11.4.4 Suggestions for Online Learning Community Instructors and Designers

Several findings from the context of a virtual product user community can be applied by the formal learning community instructor/designer in their practice. The online instructor's role should be constrained in the area of maintaining social order, encouraging students' participation in discussions, processing online discussion content, and facilitating knowledge sharing and creating process. They should reduce their direct participation in knowledge constructing activities. The finding regarding the existence of "Moderation Episodes" also suggests the possibility of students' self-managing their activities in the online learning community. Accordingly, a self-governance structure can be implemented in the learning community to enable autonomy over instruction (Song & Hill, 2007). Self-management can be achieved through peer moderation and collaboration. This also helps to achieve the formal educational goal of self-directed learning.

In contrast with the compulsory participation in the virtual online learning context, discussions about solving technical problems in the virtual product user community are based on members' voluntary participation. Thus, a variety of motivating strategies which are utilized to promote active knowledge construction in the virtual product user community can be adopted in the online learning community, such as altruism, reciprocity, fame, challenge, and self-satisfaction. These motivators can be implanted into the online learning designing infrastructure. The online learning community culture, which values the importance of novices, can also be fostered in the online learning community to promote the development of students with low-level knowledge.

11.5 Limitations & Recommendations

Access to moderators on the Dell User Support Forum could not be obtained due to the company's regulations. Thus, the interview data about these moderators' perceptions towards the community members' knowledge construction, their own roles in the community, their knowledge transference activities between the community and the company, and the community culture, is absent in this study. Although interview data about community members' perceptions was obtained, the above limitation still weakens the comprehensive understanding about these issues. In addition, the moderators' knowledge transference role

can only be explored from the discussion contents of selected threads in this research project rather than their own narratives. This creates a degree of vagueness in understanding how they work within the business organization.

Moreover, the most active community members who are officially recognized by the sponsor (i.e. Rockstars) could not be approached due to a Non-disclosure Contract signed between them and the Company. However, the Rockstars' narratives can be partly inferred from the interview data from other active community members who refused to accept this title and are not constrained by the contract. If these Rockstars can be interviewed in the future study, the knowledge about their participation motivations and their perceptions about knowledge sharing and construction activities, moderators and so on, can be added to this research, and bring in more community members' narratives to the research question.

Despite the methods of content analysis and thematic analysis adopted in this research, the ego-centric network analysis can also be added to explore the network attributes' influence on knowledge construction. In addition, Manca et al. (2009) suggests that social network analysis is an effective approach to evaluating the levels of social interactions, especially in combination with other data analysis methods. Thus, the utilization of social networks to complement the other two methods can provide more in-depth insights about the relationship between the social interaction dimension and knowledge construction dimension, and extend the exploration to the network dimension. Accordingly, a comprehensive and overall picture about these three dimensions and their inter-relationship can be depicted.

Social network approaches can be divided into "whole" network analysis and "ego-centric" network analysis. In the whole-network studies, actors "that are regarded for analytical purposes as bounded social collectives" are studied (Marsden, 2005: 8). In contrast, the ego-centric network analysis only focuses on specific actors (egos) and individuals relating to them (/alters) (Carrasco et al., 2008). Given the large number of members and loose ties between most of the community members in the virtual product user community, the "ego-centric" network analysis is more appropriate than "whole" network analysis for analyzing its structural attributes and relevant influences on knowledge activities. Some specific types of community members' network attributes, and their roles in the knowledge network, can be revealed through ego-centric network analysis. For instance, the moderator's role in the network of the virtual product user community and the business organization can be explored through analyzing their interaction relationship and information exchange relationship with

other community members, moderators, and company staff in the functioning departments of the organization. The ego-centric network data can be collected from both the response relationship within the forums and the interviews.

Thus, the moderators' role as knowledge spanner across the organizational boundaries can be explored through the analysis of their ego-centric network. Moreover, their role as knowledge broker to fill the structural hole between the product user community and its sponsor (i.e. producer) can be examined.

Despite exploring the relationship between network attributes and knowledge construction activities, and moderator's roles in knowledge transference, future researchers could also depict an overall knowledge flow picture regarding knowledge sharing and creation within the community; knowledge transference between the virtual product user communities; knowledge flow within the company; and its implementation into company practice: R & D and marketing. As this research has already covered parts of the knowledge flow process, future studies might focus on how knowledge flows within the organization and is implemented into the new product design and marketing activities.

The researcher in future research should pay attention to two different types of knowledge constructed in the virtual product user community: knowledge about technical problems and relevant solutions; and knowledge about innovative ideas for R&D, marketing, and business models. These two different types of knowledge are processed differently within the company. This needs more research to be undertaken, in order to explore the exact process in future research.

Based on the above work, future research can further explore business organizations' innovation strategies, based on knowledge about users' innovative ideas in virtual customer communities. It should focus on the following areas: collecting useful user generated innovative ideas on new product/service development; new marketing strategies and new business models; knowledge transference across organizational boundaries; and the exploitation of user-generated innovative ideas.

11.6 Postscript

With the storm of activity around Web2.0, user generated content and social media the importance of knowledge construction by users is likely to become more and more relevant to

Information Science. Ideas developed in this research will need to be refined for new technological systems, but similar underlying issues around knowledge construction are very likely to be apparent. More research methods should also be developed in order to cope with this. The approach of combining multiple existing research methods for exploring knowledge construction should be explored. To facilitate this, new coding software tools can be created and utilized in analyzing large amounts of user generated content.

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Appendix A

Information Sheet

1. Research Project Title:

A Study of Knowledge Construction in a Virtual Product User Community

2. Invitation paragraph

You are invited to take part in a research project investigating product user communities. Before you decide to take part in this survey it is important for you to understand why this research is being conducted and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Please take time to decide whether or not you wish to participate. Thank you for reading this.

3. What is the project's purpose?

Many customers visit online IT product forums to seek solutions from other users. Therefore, knowledge about products is shared among users within these forums. Some product forums are sponsored by the companies which provide these products and services. These sponsors appoint both formal and informal moderators and forum managers to support users' peer to peer assistance. Such companies can also collect marketing and R&D insights from these forums.

This research project investigates knowledge sharing, transference, and creation within online commercial product users groups and explores how to develop better supporting and management strategies to achieve goals of the community sponsors and product users. A qualitative research method will be employed in this study and online interviews will be a major data source combined with text analysis of the postings on the forum.

4. Why have I been chosen?

There are mainly three types of participants, namely, forum users, moderators of the forum, and senior forum managers.

To forum users and posters: You are considered to be a member of the virtual product user community existing on the product forum, by virtue of your participation in the forum. It is believed that your experience and ideas will be very helpful for understanding knowledge sharing and creation in the context of virtual product user's community.

To forum moderators: You are identified to be the moderator of a user forum, who plays a major role in supporting and managing a virtual product user's community. It is believed that your moderating and managing activities in the forum will give you knowledge that can

improve general understanding of the support and management of virtual product user communities.

To senior forum managers: You are identified to be the manger that is in charge of a user forum. Your experience and unique ideas in managing this forum are valuable for understanding the purpose and functions of a virtual product user community.

5. Do I have to take part?

Your participation in this research is entirely voluntary. If you decide to take part in an interview you will receive this information sheet to keep and be asked to sign a University ethical consent form. You can still withdraw at any stage of this research project, and you do not have to give a reason. If you do not wish your public postings to be used you can contact the researcher. We will always contact you if we want to quote anything you have written in the public forum.

6. What will happen to me if I take part?

Part of the project looks at public postings. We will not quote your words written in the public forum in any writing or publication without your consent.

You may also be asked to participate in an online interview with appropriate video or instant messaging software. The interview is expected to last for approximately one hour depending on exact situations. After the initial interview you may be contacted again for additional data through e-mails, online chatting software, phone, or other communication tool depending on what you prefer.

7. What do I have to do?

In an interview you will be asked to provide your comments, ideas, and personal feelings according to your experience.

8. What are the possible disadvantages and risks of taking part?

There are no anticipated discomforts or disadvantages brought to participants by the project. None of the interview questions involve any sensitive issues. Additionally, the participant is assured that any data collected will be kept in secure places and in an anonymous format. The researcher will ensure that the participation will not bring any disadvantages or risks in this research project.

9. What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that the research will contribute new insights into the knowledge behaviours and knowledge management within product user communities. Moreover, the participant whose

work involves in managing this kind of virtual community will benefit from the management and supporting strategies proposed in the study.

10. What happens if the research study stops earlier than expected?

If this is the case the reason(s) will be explained to the participant immediately.

11. What if something goes wrong?

The participants of this research will be treated with respect and anonymity, and their rights and benefits will be protected. However, participants are still encouraged to contact with the person (supervisor of this research project) named below should they have any complaints regarding to any improper treatment by the researcher or something serious occurring during or following their participation in the project.

Dr. Andrew Cox.

Room 222 Information School

Regent Court

The University of Sheffield

211 Portobello Street,

Sheffield S1 4DP

The United Kingdom

Tel: ++44 (0)114 2226347

Email: a.m.cox@sheffield.ac.uk

If participants think their complaints are not handled to their satisfaction by the project supervisor, they can further contact the University Registrar and Secretary.

12. Will my taking part in this project be kept confidential?

All information that can identify the participants will be kept and handled in anonymous form and only the principal researcher will have the access to the data. The transcripts of interviews will be kept in a secure place and the digital audio recordings will be kept with password. No information that identifies the participant will be disclosed in the research report or other relevant publications. Once the project is finished, the original data collected from participants will be destroyed completely.

13. What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

We will ask you about the experience of participation in the product users' forum, and the perceptions of knowledge sharing. As for the moderators and the forum managers, questions about their moderation activity and management strategy aimed to support the customer community and promote the knowledge sharing and creation will also be asked during the interview.

All of information collected from the interview is of great importance into providing a deeper insight into the knowledge sharing and creation patterns within the virtual community formed by product users, and the effectiveness of management of community managers and supporting from the virtual community sponsors.

14. What will happen to the results of the research project?

A short report summarizing the results of the research project will be sent to all participants via e-mail. The participants can also download it from the personal website which will be built during the research process. Furthermore, part of the research results will be published as academic journal articles. The researcher assures participants that the identity of participants will not be disclosed in any publications.

15. Who is organising and funding the research?

This research is part of a PhD research project.

16. Who has ethically reviewed the project?

This research has been ethically approved via Information School's ethics review procedure. The University's Research Ethics Committee monitors the application and delivery of the University's Ethics Review Procedure across the University.

17. Will I be recorded, and how will the recorded media be used?

If necessary, some of the interview will be recorded given the permission of the interviewee. The audio recordings of the interview will be used only for analysis in this research project. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. Once the research project is finished, all of digital audio files will be completely destroyed.

18. Contact for further information

Researcher Research Supervisor

Mr. Xuguang Li Dr. Andrew, M. Cox

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The University of Sheffield

211 Portobello Street,

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A copy of the information sheet will be sent to you via e-mail along with a consent form for you to keep. Thank you very much for your kind assistance for this research project. The information you provide will help us to improve the effectiveness and efficiency of the virtual product user's community with respects to knowledge sharing and creation.

Appendix B

Participant Consent Form

Title of Research Project: A Study of Knowledge Construction in a Virtual Product User Community

Name of Researcher: Xuguang Li

Participant Identification Number for this project: **Please initial box**

1. I confirm that I have read and understand the information sheet ☐

dated *[insert date]* explaining the above research project
and I have had the opportunity to ask questions about the project.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. *Insert contact number here of lead researcher/member of research team (as appropriate).* ☐

3. I understand that my responses will be kept strictly confidential. ☐
   I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. ☐

4. I agree for the data collected from me to be used in future research

5. I agree to take part in the above research project. ☐

_____ _____ _____

Name of Participant Date Signature

(*or legal representative*)

_____ _____ _____

Name of person taking consent Date Signature

(*if different from lead researcher*)

To be signed and dated in presence of the participant

_____ _____ _____

Lead Researcher Date Signature

To be signed and dated in presence of the participant

Copies:

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/pre-written script/information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g. a site file), which must be kept in a secure location.

Appendix C

To the Forum Users

Introduction

You are being invited to take part in an interview which aims to explore how knowledge is constructed and transferred in the product users' forum. This interview is conducted in the context of a PhD project of knowledge construction in online product users' community. This research project is undertaken by research student Xuguang Li and is supervised by Dr. Andrew Cox and Professor Nigel Ford at the Information School, the University of Sheffield (UK).

This study has been granted ethical approval by the Information School. The interview will take an anonymous form and no participants can be personally identified. All interview data will be kept confidential and you are free to withdraw at anytime. A copy of the information sheet will be sent to you via e-mail along with a consent form for you to keep.

If you agree to participate, you will be asked a series of questions about your experience, feelings, and opinions about using the forum and collaboratively finding solutions through peer support.

Thank you very much for your kind assistance for this research project. Your information will help us understand forum users' online knowledge behaviours and improve the moderation effectiveness and efficiency of the virtual product user's community.

For further information, please contact Xuguang Li at lir09xl@shef.ac.uk or my supervisor Dr. Andrew Cox at a.m.cox@sheffield.ac.uk.

Section I: About You

1. What is the relationship of your work and using the Dell user forum?

Section II: About the Forum and Its Usage

1. Why is this forum valuable?
2. How would you describe forum users?
3. How does using the forum fit into the different ways you seek information about computers? Can you give an example?

Section III: About the Participation in the Forum

1. How would you describe the discussion that happens in the forum?
2. How do you usually response to other's questions?
3. What is the easiest way for forum users to find a solution? And the most complicated way?

4. If there is no existing answer on the forum, what is the commonest process for the forum users to find a resolution?
5. What strategies do you and other peer users usually adopt to find the solution for a technical problem of the computer/laptop?
6. How would you describe the different roles played by forum users in solving the problems in discussion threads?
7. What factors do you think influence your participation in the discussion on the forum (including both the incentives and barriers)?

Section IV: About moderator

1. What is your perception of the moderator's role in participating in the forum?
2. What is the influence of the moderator and moderation system on your forum usage experience?