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Fuzzy Front End of Innovation Process Management in High Technology Companies: Knowledge Sharing in Virtual Communities of Practice.

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Fuzzy Front End of Innovation Process Management in High Technology Companies:
Knowledge Sharing in Virtual Communities of Practice

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DECLARATION

This thesis is submitted in fulfilment of requirements for the degree of Doctor of Philosophy in Durham University Business School at the University of Durham, Durham, United Kingdom. I declare that this thesis is based on my own original work except for quotations and citations which I have duly acknowledged. I also declare that this thesis has not been previously or concurrently submitted, either in whole or in part, for any other qualification at the Durham University or other institutions. I am responsible for any errors and omissions present in the thesis.

Signed_____

Leonard Chijioke Raphael

April 2016

ABSTRACT

This thesis seeks to examine the challenges inherent in creating and managing knowledge at the front-end stages of innovation. Specifically, the work develops new knowledge to understand how the formation of Virtual Community of Practice (VCoP) informs the front end of New Product Design (NPD) and the use of uncodified knowledge to achieve Fuzzy Front End (FFE) innovation outcomes. The 'fuzziness' comes from the fact that this cannot be codified and therefore predicted. This is relevant because a lot of new product failures have been attributed to the lack of management at the Fuzzy Front End of Innovation (FFEI) and the technologies at play in this stage. It is for these reasons that the FFE is a very important aspect of potentially successful innovations (Coates, 2009).

Studies have shown that 'speed to market' and 'product quality' play a role in the positive impact of investment at the FFE phase on subsequent profitability (McNally et al., 2011). This is particularly significant, as it has also been established that expenses incurred in the later stages of the innovation process do not have any significant effect on the profitability of new product innovations (McNally et al., 2011). The 'fuzziness' and intangible nature of the FFE phase of NPD creates and adds to the complexities and challenges experienced in the management of these activities. Scholars have therefore called for a richer understanding of this phase through more extensive research at the FFE to advance the innovation management discipline as a whole (Bertels et al., 2011).

In order to identify the problem areas at the FFE, the researcher has uncovered recurring themes and concepts in the knowledge management field, observing a positive connection between tacit knowledge, knowledge transfer and Situated Learning Theory (SLT) of Community of Practice (CoP) at the FEI within high technology organisations. This is supported by empirical evidence, which states that individuals or groups with more social connections are more likely to be innovative, creative and share knowledge than isolated people or groups (Bjork & Magnusson, 2009). This in turn points to the knowledge transmission benefits of a CoP, particularly in relation to the transfer of tacit knowledge. However, understanding remains undeveloped theoretically, conceptually

and empirically with regard to how a CoP in a physical environment, and in particular within a VCoP in a virtual environment, can operate effectively to resolve problems at the FFE of the innovation stage.

Findings from the research suggest that the FEI should not be structured, and that businesses need to build an enabling environment to sustain the FFEI. Innovation on the front or back end should not be left to itself either, it has to be managed or governed in some way. In order to develop and manage VCoP at the FFI, this research recommends a sustainable, flexible and adaptable innovation process. This may be understood as creating a vehicle for the innovation process filtered through several gates where all experiences and the innovation journey itself is properly scrutinised. It is further proposed that this approach can also assist in the mitigation of risk.

Finally, the use of virtual communication tools such as emails, online repository, virtual workspace and video conferencing for VCoP activities has become standard working practice for many businesses. Organisations who pay close attention to finding better ways to utilise, adapt and apply these tools to specific VCoP projects will be more likely achieve positive results.

ACKNOWLEDGMENTS

This PhD journey have been a challenge and an adventure. After 13 years in the Telecommunication industry specifically with TeliaSonera Limited in Finland, Sweden and a year of international assignment with a subsidiary of TeliaSonera in Nepal as an IP Network Manager and Unit Head respectively. I took a bold step and resigned from my permanent employment in 2012 to embark on this uncertain journey. The motivation for embarking on this research stems from my M.Sc. Thesis on Transitioning from IPv4 to IPv6 using a Diffusion of Innovation approach in the Telecommunications business at KTH, The Royal Institute of Technology, Sweden. The researcher wanted to acquire a deeper knowledge on the innovation treatise and it has been a great deal of effort and challenge but equally a rewarding and learning experience. I am equally very pleased to have taken that bold step few years ago.

I would like to express my special appreciation and gratitude to my PhD supervisors Dr. Christos Tsinopoulos and Dr. Mathew (Mat) Hughes for their immense support, endurance and untiring effort, enthusiasm and immense knowledge throughout this process and without them this thesis would have been impossible. They directed my research effort as well as constantly mentored me at every step of the way. Their advice on both research as well as on my career have been priceless, I could not have imagined having better supervisors and mentors for my PhD study. I would also like to thank Professor Nick Ellis who have supported me to shape my research during the first year of my PhD studies.

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DEDICATION

This Doctoral Thesis is dedicated to Humanity and Planet Earth. The researcher believes that Innovation can help the human race to explore beyond the limit of our horizons and hopefully the entire Universe.

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LIST OF ACRONYMS

Acronyms	Description
ABS	Anti-Lock Braking System
ANT	Actor Network Theory
AT	Activity Theory
CEO	Chief Executive Officer
CMC	Computer Mediated Communication
CNC	Computer Numeric Control
CoP	Community of Practice
DCA	Directed Content Analysis
FE	Foundation Elements
FFE	Fuzzy Front End
FFEI	Fuzzy Front End of Innovation
FEI	Front End of Innovation
ICT	Information Communication Technologies
IP	Intellectual Property
IRI	Industrial Research Institute
IT	Information Technology

KM	Knowledge Management
LPP	Legitimate Peripheral Participation
NDA	Non-Disclosure Agreement
NPD	New Product Development
PD	Product Development
QCA	Qualitative Content Analysis
R&D	Research and Development
RLI	Residual Life Indicator
SCT	Social Constructivism Theory
SLA	Service Level Agreement
SLT	Situated Learning Theory
SOC	Sense of Community
TNA	Thematic Narrative Analysis
VC	Virtual Communities
VCoP	Virtual Community of Practice

1. CHAPTER I: INTRODUCTION

The motivation for this thesis came about because of the researcher's insights into the longstanding difficulties faced by businesses when extracting and sharing knowledge through virtual communities of practice (VCoP). This is particularly the case within high technology organisations at the fuzzy front end (FFE) of the innovation process (Khurana & Rosenthal, 1998; Koen et al., 2001, 2002; Reid & de Brentani, 2004). Here, FFE refers to the first stage of the new product development (NPD) process where the original innovative ideas are conceived (Khurana & Rosenthal, 1998; Koen et al., 2001, 2002; Reid & de Brentani, 2004). Coterminous to this, NPD is defined as the early stages of new product ideation during the innovation process and includes the remainder of the NDP cycle until execution or termination of the project (Murphy & Kumar, 1997). The Fuzzy Front End (FFE) is therefore typically characterised as extremely informal, intellectually challenging and full of uncertainties (Frishammar et al, 2011; Lingo & O'Mahony, 2010).

Several articles reviewed during this study suggest that the FFE remains the most critical part of the NPD process while the sharing and extraction of knowledge represents the most significant part of the challenge at the FFE (ibid). Knowledge in this context is referred to as tacit and explicit knowledge.[1] Tacit knowledge resides within our abstract mentality and sub-consciousness and is considered difficult to tap into or cultivate within the spheres of organisational knowledge management (Rosenberg, 1982).

While explicit knowledge can be explained and retold by the knowledge owner precisely because it can be coded, recorded, communicated and distributed (Griffith et al, 2003), tacit knowledge cannot be so readily categorised, treated and shared. Although explicit knowledge is required at the FFE, it is not commonly attributed to creativity and idea generation (O'Connor & Rice, 2001). Instead, it is tacit knowledge that is vital. Therefore, for this type of knowledge to be developed and brought to bear on the FFE of innovation, i.e. where people and their matrices of knowledge (related and unrelated)

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[1] Tacit knowledge is the unwritten and inferred 'know how' we use and exhibit in everyday life (Polanyi, 1966).

come together, is a fundamentally important task. For these reasons, the use of the term 'knowledge' can be interpreted in most of this thesis as referring to tacit knowledge except where the researcher explicitly stated or differentiated.

The internationalisation of businesses and commerce and the ever more accessible and economical means of Internet mediated intercommunication have amplified the practice of dispersed collaboration throughout all phases of the NPD process at the Front End of Innovation (FEI) (Meyer & Marion, 2013). Dispersed collaboration has numerous advantages for businesses, for example, facilitating teamwork interaction and cooperation among individual professionals with the required expertise, talent, and capabilities for the FEI activities to collaborate regardless of geographical restrictions. In addition, it facilitates innovation due to the proximity of dispersed team members to clients and markets in their local setting (Bertels et al., 2011).

This provides the opportunity to investigate Community of Practice (CoP) and VCoP (the virtual setting for dispersed CoPs) using Internet-mediated tools for communication among virtual communities. CoPs consist of groups of selected members who share information, insight, experiences and tools about a chosen area of common interest and expertise (McDermott, 2000; Wenger, 1998). However, while a VCoP can be referred to as a CoP, but over a virtual network, the use of Internet and computer mediated communication tools for CoP can to some degree create more challenges and hamper some of the benefits that face-to-face meetings can produce (Kimble, 2011).

The concept of CoP is based on SLT, which suggests that it is essential to deliver knowledge in an applied professional situation (Lave & Wenger, 1991). The circumstances within which 'legitimate peripheral participation' (LPP) engages with such knowledge form the basis of SLT (ibid). Therefore, community collaboration in virtual settings becomes an important aspect of this study as teams at the FEI become involved in a community of practice. SLT in CoP will be introduced in more detail in Chapter 2 as the theoretical framework underpinning the thesis.

1.1 Research Objective

This thesis will seek to examine the challenges of how to create and manage knowledge at the front-end stages of innovation. Specifically, the researcher's aim is to develop new knowledge in order to understand how the formation of VCoP informs the front end of the NPD process and the use of uncodified knowledge to achieve FFE innovation outcomes therein. The 'fuzziness' therefore comes from the fact that this knowledge cannot be codified and therefore predicted.

This research is also interested in the key theoretical elements of a CoP related to this study. These include behaviour, beliefs, social interaction and collaboration and will be used as part of the units of analysis of this empirical research. According to Coates (2009), this is relevant because most product failures at the NPD stages have been attributed to the lack of management at the FFI and the technologies at play in this stage. It is for these reasons that the FFE continues to be a very important component for potentially successful innovations (ibid). Studies have shown that 'speed to market' and 'product quality' play a role in the contributing impact of expenditure at the FFE phase on subsequent profitability (McNally et al, 2011). However, it has also been reported that expenses incurred in the later stages of the innovation process do not have any significant effect on profitability from new product innovations (ibid). The 'fuzziness' and intangible nature of this phase of NPD creates and adds to the complexities and challenges experienced in the management of these activities.

Scholars have therefore identified a richer understanding of this phase as critical to the progress of the innovation management discipline (Bertels et al., 2011). In order to understand the underlying factors behind innovation and how they can be invoked at the FFE, the researcher will review the current literature on innovation theories connected to the FFE such as SLT as applied within the contexts of CoP and VCoP.

SLT and the notions of CoP and VCoP are chosen as theoretical lenses to critique current conceptual and empirical studies into the FFE of innovation in an effort to reveal key

gaps in knowledge which this study will endeavour to address as suggested in the literature review for this thesis.

1.2 Brief Overview of the Literature Review and Research Background

An examination of academic research into VCoP and FFE revealed a surprising lack of relevant studies considering their importance and the manner in which VCoP might operate to relieve problems encountered at the FFE of innovation. Some of these difficulties faced are due to the fuzziness of the FEI stages and challenges such as the codification of knowledge, lack of proper management and the complexities of the technologies at the FEI stage. These are partly attributed to commercialisation failures at the NPD stages (Coates, 2009).

Alongside this, modern advances in knowledge have facilitated an innovative means for sharing information, identified as computer-mediated-communication (CMC), or virtual communication (Dietz-Uhler & Clark, 2001). Explicitly, CMC denotes any means of communication that requires the use of the Internet combined with online applications as a means of sharing information (ibid).

CMC brings a lot of benefits to the firm due to the increasingly global nature of their activities and the necessity to share knowledge between numerous organisations and across national boundaries. For example, cost savings and a flatter structure in the firm that gives voice to a wide audience to share information, have both been identified as positive outcomes of utilising CMC (Bergiel et al., 2008).

CMC has also helped many multinational organisations to save up to US$50 billion (ibid) and remains a cost effective way for conducting business across transnational organisations (Baltes et al., 2002; Cascio, 2000; Hill, 2000). However, how effective can CMC be in sharing tacit knowledge for creativity, most especially as an extension of CoP known as VCoP? This question will be a central part of this research. Also, hopefully, the findings from this thesis might be able show how CMC can be better facilitated to support innovative activities at FEI.

The standardisation of NPD has evolved since the early 1990s and several high technology industries have already adopted a 'Stage-Gate' model as part of standard NPD methodology (Cooper et al, 2002, 2005).[2] Although the NPD process and standards differ depending on the type of industry or business in question, one aspect to consider is that the notion of a 'formal' NPD process is now at a mature stage within the high technology sector.

Again, FEI, also described in the literature as the FFE, is simply the initial stages of the NPD process where the ideas, concepts and business cases are defined before the actual implementation phase (Reid & de Brentani, 2004). The amalgamation of several of the early stages of business activities are combined to make up the FFE (Khurana & Rosenthal, 1998). A number of examples of this would be in areas such as market requirement analysis where the choice of technology and other NPD decisions are to be considered, proposed and evaluated at this stage. Unlike the formal NPD process, the FFE lacks a standardised accepted universal model and as a consequence the term 'fuzzy' emerged and remains an appropriate descriptor of the nature of the front end aspects of innovating (Coates, 2009).

Studies on FEI have become increasingly important in recent times. This is due to the strategic position of FEI at the early stages of NPD as well as its importance to the success of product or business service commercialisation (Vojak et al., 2012). Accordingly, FFE innovation requires a great deal of flexibility to be applied during the product conceptualisation, definition and planning stages. In addition, it must be adaptable enough to address any future possibilities for improvement, enhancement or modification at each stage of the innovation process (ibid).

Making the right choices in the early stages of the business development of the FEI is crucial to the subsequent NDP stages and the eventual commercialisation of the product

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[2] A Stage-Gate model is defined as the process of delivering new products and services to consumers (Sperry & Jetter, 2009).

(Cohen & Levinthal, 1990). According to Henard & Szymanski (2001) a number of factors such as the target market, the corporate strategies deployed, the product in question and the features of the NPD process all influence the success of new product's commercialisation. However, all of these revolve around the activities at the earlier stages of the FEI; in particular, the knowledge that informs those stages.

Due to the challenges established at the FEI and the implications of a VCoP this research has invoked SLT in VCoP as the theoretical lens. This will be briefly described in the next section and in more detail in Section 2.3.

1.3 Theoretical Lens

The review of the literature on FFE has uncovered recurring themes and concepts which identify particular problem areas in the field of knowledge management. Taken alongside personal observations within high technology organisations, the researcher has identified a possible positive connection between tacit knowledge, knowledge transfer and SLT of CoP at the FEI stage (Wenger et al., 2005; Laine, 2006; Goffin & Koners, 2011; Howells, 2002). This is supported by empirical evidence which states that individuals or groups with more social connections are more likely to be innovative, creative and share knowledge than isolated people or groups (Bjork & Magnusson, 2009). In turn this points to the knowledge transmission benefits of SLT in CoP, most particularly in relation to the transfer of tacit knowledge at FEI.

However, the researcher believes that SLT should evolve to meet the challenges of the information age, most especially because Situated Learning has become more closely linked with CMC technologies, the very mediums which are used to facilitate the individual's ability to share information in a virtual setting. This pattern of learning and knowledge sharing through virtual settings becomes an extension of the face-to-face practice in CoP here referred to as VCoP (Collins & Halverson, 2009) and thus creates new challenges precisely because of the virtual nature of the communication process.

This research will explore the possibility of a connection between the Situated Learning in CoP and another term, which the researcher will coin as 'Situated Learning in VCoP', which represents the virtual settings of the latter. However, understanding how a CoP, and in particular a VCoP, can operate effectively to resolve problems at the FFE stage of the innovation process remains undeveloped theoretically, conceptually and empirically. This view is supported by the lack of a consistent or coherent set of explanations that address the problem from the review of current literature on the subject.

There therefore exists a knowledge deficit within the discipline which this study will seek to correct. Lastly, it aims to provide a series of solutions in respect of some of the challenges which have been identified. In the next section, the researcher will describe the research questions and outline the contribution to knowledge the research will deliver.

1.4 Research Questions and Contribution to Knowledge

Following an in-depth review of the literature in the areas of FEI, SLT in CoP, VCoP and knowledge management the researcher identified two research questions to guide the empirical study:

(1) Does a VCoP generate learning advantages meaningful to improve the FFE and if so, how?
(2) How might a VCoP be organised to contribute to the sharing of knowledge at the FFE?

Following a qualitative study of learning theories by the researcher, several meaningful contributions have been made to the Lave & Wenger (1991) knowledge theory of Situated Learning. These indicate that even though Lave & Wenger (1991) state that knowledge and creativity can be extracted through CoP, and potentially VCoPs, there are very few studies into VCoP. The problem however, is that CoPs benefit from face-to-face formal and informal interactions whereas the inability to use physical meetings in VCoPs places them at a significant disadvantage. In short, what is needed is the development of a similar or parallel environment in VCoPs. To date then, it has not been at all clear to what

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extent SLT can be applied to a VCoP. This point is particularly relevant to innovation activities at the FFE where we anticipate the major benefits of this activity can be seen.

My research investigated the implications of Situated Learning of CoP among VCoPs and concluded as follows; firstly, that knowledge can still be extracted among VCoPs using online or virtual communication tools as a means for communication. Secondly, VCoPs do not necessarily have to be managed nor conform to CoP characteristics in order to achieve successful knowledge sharing outcomes. These insights demonstrate different mechanisms and theoretical expectations about VCoP in the innovation process and asserts their value over and above CoP. The major benefit of VCoP to an organisation is that it can capitalise on communities of common interest across the organisation as a whole, regardless of its boundaries and borders, and therefore increases the potential for new CoPs (in virtual form) to emerge - opportunities far greater than if the firm relied solely on physical CoPs. However, this remains a widely under researched area and therefore represents a central research question for the work. This point will be further developed in the literature review (Chapter 2).

1.5 The Structure of this Thesis

The subject is introduced in Chapter 1 together with the aims and goal of the study, the knowledge stories from literatures on the FEI and the research contribution to knowledge. Also in this chapter, the researcher outlines the research objectives, current research and how the study is connected to previous research. It concludes with an overview of the thesis structure itself.

Next, Chapter 2 looks at literature from across the fields of knowledge and innovation management were reviewed and studied in order to examine knowledge and innovation concepts relevant to understanding the FFE of innovation. Specifically, these include; SLT, tacit and explicit knowledge, FEI, CoP and VCoP. The purpose of the literature review was to reveal gaps for empirical research into the extraction and transfer of knowledge among participants at the FFE of innovation. Key areas relevant to this study that eventually led to the research question of the study are also discussed. Also in this

chapter, the researcher reviewed literature in the areas of; Fuzzy Front End of Innovation, Stage-Gate process, Knowledge Management, collaboration methods, and the SLT of CoP.

In Chapter 3 the researcher reflects on the research methodology and discusses in detail qualitative methodology as a key instrument for this study. Also in this chapter, the researcher looks at key research philosophy concepts and describes the primary research methods which were applied in this study. A qualitative approach was necessary to grasp the complexities of this subject and to provide a deeper insight into the extent of interaction required from the selected companies and empirical data collection and analysis.

Chapter 4: Research Design, Method & Data Analysis. This chapter introduces the research design, methods, units of analysis and discusses the empirical data. Specifically, the researcher outlines the methods used for extracting and analysing the empirical data. Facetoface interviews were conducted because they were deemed to be more personal than using questionnaires when engaging with respondents. The questions revolved around how a VCoP might be organised to contribute to the sharing of tacit knowledge at the FFE and if so, how a VCoP can generate learning advantages meaningful to improve the FFE? In addition, the storytelling method was used as a means for extracting tacit knowledge.

The analysis is based on 45 interviews conducted with high-tech companies across the globe. These included respondents from Automotive, Aviation and Aerospace, Telecommunication, Chemical, Service Engineering, Building and Construction, Energy and Power, Information Technology, Research & Development and Service Innovation consultancy firms among others.

In Chapter 5 the researcher turns to the research findings themselves. The data were collected and then processed in response to the problems posed in the method and analysis chapter of this thesis. Two fundamental goals drove the collection of the data

and the subsequent analysis of the empirical data. Those goals were to develop a base of knowledge about the research epistemology and link it to the main themes and SLT in CoP. The findings presented in this chapter demonstrate the potential for merging theory and practice and linking Situated Leaning in CoP to VCoP.

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Chapter 6: Discussions and implications of the study. The penultimate chapter contains a brief overview of the study, including a statement of the problem and major methods involved. Most of this chapter presents discussions and further analysis of the implications of this research for knowledge and practice.

Chapter 7: Conclusion. The final chapter gives a general overview of the research and outlines the implications of the research for knowledge theory and business. Limitations of the study are also discussed here before a final conclusion is provided.

The empirical studies element of the research was focused on high technology industries and the research methodology was tied to qualitative research. The researcher avoided any quantitative outlook, as well as studies related to new start-up enterprises who are traditionally known to be drivers for innovation (Hughes et al, 2015). Perhaps, future researches might also want to focus on how knowledge is managed and shared among stakeholders of new start-up businesses. This is because the choices made during the implementation stages at FFE of innovation are concluded mutually by a dedicated team of developers or by an entrepreneur or group of entrepreneurs as a single entity in a formal setting (Griffin et al, 2009; Khurana & Rosenthal, 1997). The rest of the limitations of this study are addressed in more detail in section 7.3 – 'The limitations to the study and implications for future studies'.

2. CHAPTER II: LITERATURE REVIEW OF THE RESEARCH

A comprehensive review of the literature on innovation concepts led the researcher to focus on a full literature review on knowledge sharing and creation at FEI. The purpose of this approach was to reduce the knowledge gap within the field and focus on how new knowledge is managed and created at the FEI.

Literature from across the fields of knowledge and innovation management have been reviewed and studied in order to examine knowledge and innovation concepts relevant to understanding the FFE of innovation. These include: Fuzzy Front End of Innovation (FFEI), Knowledge Management (tacit and explicit knowledge), Collaboration Methods, Community of Practice (CoP), Virtual Community of Practice (VCoP) and Situated Learning theory (SLT). The purpose of this review is to reveal opportunities for empirical research into the generation and transfer of knowledge among participants at the FFEI of innovation.

2.1 Fuzzy Front End Innovation (FFEI)

At this point, it is important to introduce the activities that transpire during the initial stages of the innovation process in an organisational setting. The use of the 'fuzzy front end' innovation concept became a widely acceptable term after it was popularised by Smith & Reinertsen (1992) and is usually referred to as the first stage of the NPD process. NPD is commonly defined as incorporating the early stages of product ideation during an NPD process and throughout the product development cycle until execution or cessation of the project (Murphy & Kumar, 1997). Numerous researchers in the field of innovation management have stressed the significance of the fuzzy front end. For example, Atuahene-Gima, 1995; Dwyer & Mellor, 1991; Shenhar et al., 2002; Verworn et al., 2008. The reasons attributed to its importance for the successful commercialisation of new products to market is because making the right choices in the early stages of the business development of the FEI is crucial to the subsequent stages of the NPD process and the eventual commercialisation of the product (Cohen & Levinthal, 1990). The FFE

is also a turbulent phase of NPD activity that reaches the end of its life cycle after the new product is conceptualised into the development stages (Kim & Wilemon, 2002). The FFE is categorized into three main activities: (1) conundrum characterization, which consists of the processes undertaken to identify market opportunities; (2) the business and innovation exploration and ideation process, in which data collected from exploration activities are further examined to reach a set of conclusions and decisions; and (3) conceptualization into product definition and development, focused on conceptualizing the innovation into a tangible product concept, projecting the NPD programme forward and filtering the NPD through funnels of delineation procedures to create the new product business case (Griffin et al, 2012; Koen et al., 2002; Reid & de Brentani, 2004).

In addition, the conceptualisation of choices leading to the development stages revolves around issues such as defining the concepts, alterations required during product implementation, portfolio investment decisions and commercialisation procedures and timeline (Krishnan & Ulrich, 2001). The importance of the FEI as one of the most important and essential parts of the NPD process cannot be overemphasised as literature from the knowledge area has shown so far given the fuzzy nature of the FEI (Frishammar et al, 2011; Lingo & O'Mahony, 2010). For example, businesses that do not take the FEI seriously are more likely to fail in the commercialisation of new products and this can lead to increased costs and exaggerated risks due to a faulty NPD development life cycle.

The FFE is often considered as the basis for the success of organisations involved with discontinuous innovation (de Brentani & Reid, 2012) In contrast to incremental innovations, discontinuous innovations (also known as radical innovations) are not usually a consummation of definitive and complex organisational practices but to some extent add an elaborate 'bottom up' concept which arises at the initial stages of NPD (de Brentani & Reid, 2012). Reid & de Brentani (2004) also describe discontinuous innovation as a cessation of a current product and service lifecycle and the creation of a whole new product line and marketing structure of a business which is regarded as completely new and original. In addition, this phenomenon creates new value(s) which never existed in the current or previous product line categories within the particular

market segmentation. Incremental innovation, on the other hand, can come in many different forms, for example, the shift from analogue to digital TV, cameras and mobile communications (ibid.). In the aggressive international economic marketplace replete with turbulent high-tech transformation activities, radical innovation becomes a significant enabler to beat competitors and drive ambitious transformation technologies into the marketplace and enables grander organisational capabilities and financial progression (Christensen, 1997; De Jong & Vermeulen, 2003).

There are several terms that have been used in the characterisation of technology and service transformation activities in the FEI landscape, for example, research conducted by (Reid & Roberts, 2011, p.428) suggested a term coined as technology vision, which they defined as 'a mental image held by individual organizational members regarding technical goals related to developing a new technology.' Offering a vision of the new technology helps provide direction and focus for individuals involved in the early phase of the NPD (Reid & Roberts, 2010, 2011). Technology vision is, therefore, also a key to successfully determining the appropriate path of NPD during the FFE for firms that are engaged in developing radical, high-tech products. How this technology vision can be formed at the FEI in idea generation and innovation might be linked to a focus on individuals involved in the early phase of the NPD process. This is central tenet and key to successfully determining the appropriate path of NPD during the FFE for firms that are engaged in developing radical, high-tech products (Reid & Roberts, 2010, 2011).

Even though several studies have emphasised the importance of the FFE, the success of the FFE is still highly dependent on a number of factors including the technology at play, the type of innovation, industry, speed to market and amount of Research and Development (R&D) effort and resources invested in the process at the FEI (Bertels et al., 2011). Yet, recent studies focusing on FEI still suggests that there is no evidence of what exact successful criteria lead to the successful commercialisation of new products (Kock et al., 2015). For example, an Industrial Research Institute (IRI) project team from eight companies (Air Products, Akzo Nobel, BOC, DuPont, Exxon, Henkel, Mobil and Uniroyal Chemical) studied the FFEI with the target objective to develop industrial best

practices at the FFE. In this collaboration among these high technology companies, in-house product development initiatives have found it difficult to define the best practices at the FEI within these firms. Comparing one company's front-end processes to those of another proved impossible since there was no mutual language or meaning of the key rudiments of the FFI (Koen et al., 2001). Hence, the activities and modus operandi of the FFEI remains dynamic and pervasive.

According to Backman et al. (2007, p.18), 'the greatest opportunities for improving the overall innovation process lie in the very early phases of NPD.' At this early stage, the effort to optimise is low and effects on the innovation process are high (Smith & Reinertsen, 1992; Verganti, 2008). Thus, a deeper understanding of the FFE and its impact on the NPD process and success could help firms to be more successful in their efforts to develop new products, specifically around how new knowledge is created and managed at the FEI. It is also interesting to note that central issues pertaining to the FEI, i.e., ideation, scoping the project, conceptualising the new product and developing the business case are probably the most critical part of the influential Stage-Gate process of innovation management (Cooper, 2008). However, it remains one of the least understood and most susceptible to problems.

Most analysis within this review will focus on FFE. However, this is not to suggest that all other stages of the innovation process are less important or insignificant. The success of R&D and product innovation is highly dependent on a variety of factors such as markets and technologies, techniques and tools, organisational structures, processes and decision mechanisms in NPD (Fixson & Marion, 2012). These factors have been widely researched and studied and further strengthen the argument of the importance of turning the attention more sharply on the FFE (Barczak et al., 2009).

Figure 1 below illustrates the stage of the FFE in relation to the whole product development lifecycle.
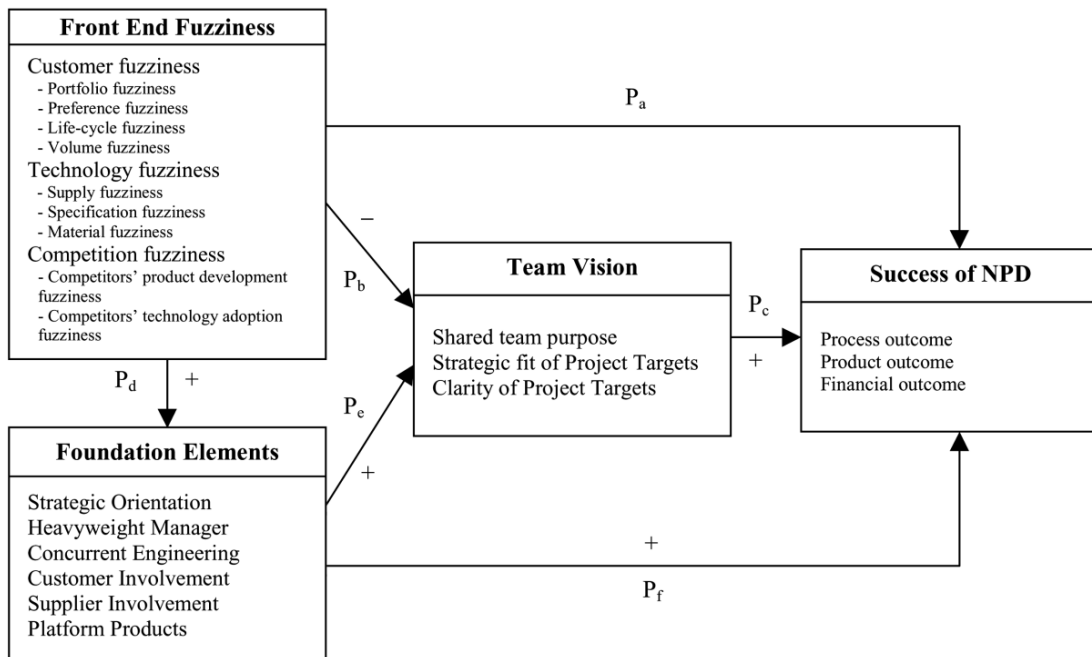
Figure 1. The fuzzy front end and success of new product development: a causal model (Zhang & Doll, 2001)

Figure 1 above illustrates key elements and variables at the FFEI as described by Zhang & Doll (2001). FFEI is categorised into customer fuzziness, technology fuzziness and competitor fuzziness. In turn, these drive the Foundational Elements (FE) of the FEI such as strategic orientation, heavyweight manager, concurrent engineering, customer involvement, supplier involvement and platform products respectively. These two elements, that is to say, the FEF and the FE guide the team vision towards success during an NPD lifecycle.

According to Cooper (2011), unlike the FFE which remains 'fuzzy', the stages that follow the FFE in the NPD process are well-researched and have been systemised and structured into the business process. Indeed, the continued use of the term 'fuzzy' may be taken as symptomatic of the lack of understanding and research which exists on the FFE in the first place. Currently, the completion and achievements of NPD within many organisations are still very ineffective and perform less well than expected (Fixson & Marion, 2012). This statement is supported by the high volume of unsuccessful products

which are delivered to consumer markets (Adams, 2004) and concerns relating to time and cost in numerous product development initiatives (Cooper, 2005). Too many failures have been attributed to the lack of front-end management and technology and therefore the FFE stage is considered a very important component for potentially successful innovations (Coates, 2009).

Research by Van Den Ende et al. (2015) argues that there are two main outstanding problems to consider in the management of ideas for new products and services in an organisation. Firstly, the concepts underlining the development of innovation methodologies, resources and procedures to enable a large volume of innovative ideas are expected to generate more diversity of new ideas with the main aim of isolating the best ideas from the majority. Nevertheless, with a growing number of specialists with technical and scientific understanding, coupled with the influence of information communication technology integrated tools, the amount of ideas created and assimilated through a firm's internal and external collaboration activities could become proportionally potentially overwhelming to manage within organisations (Van Den Ende et al., 2015).

Secondly, problems related to the application of suitable management principles at the idea creation stages (coined as the FEI). The motivation to consider the early phases of idea creation and innovation as the 'fuzzy stage' was not merely a coincidence but has well-founded motives. The FEI practice certainly remains remarkably intellectually demanding (Frishammar at al., 2011; Lingo & O'Mahony, 2010) and as such has become a crucial part of this study in knowledge management and creation at the FFE of innovation.

The relationship between NPD and the FFE is an interdependent one since an invention is not considered an innovation until it succeeds in the market (Coates, 2009). Other studies suggest that innovation is still not considered a success even at the commercialisation stages but only when the product or service is profitable (ibid.). This, to some degree, suggests that any investment in front-end activity is connected to the chances of success

for any NDP and commercialisation (Song & Parry, 1997). Product profitability is also considered an essential element in the evaluation metrics of the FFI. This is true even though lower priority is given to the rate at which the product accelerates into the market place (ibid).

According to Cooper (2011), it is possible to identify innovative products and services by isolating major challenges and problems through the application of explicit knowledge using the FEI process model delivered through a Stage-Gate process. Cooper (ibid) delivers a clear message: 'finds big problems, create big solutions', thus creating the link between tacit and explicit knowledge.

Due to the complicated connection between the FFE and the Stage-Gate process, the researcher will use the next section for a comparative review of the subjects in order to give a better understanding of the complexities of their relationship.

2.1.1 The Stage-Gate Process & the Fuzzy Front End in New Product Development

The researcher has mentioned the Stage-Gate process and NPD in several chapters and sections in the thesis and has used the Stage-Gate process as a reference point in relative discussions at the FEI for NPD. In order to add clarification, richness and completeness as well as to highlight the relationships of the FEI and Stage-Gate process, it is important for this research to dedicate a section for the Stage-Gate process, a key framework of the innovation process in many high technology organisations. This section will introduce the Stage-Gate process, the challenges it faces and its relationship with the FEI.

Gates within the Stage-Gate process are the points in the innovation process where the senior management team meets to decide on the continuity of a project based on up to date, accurate, information. This decision making process also includes the options to cut loses or abandon a failing project. Furthermore, it can also serve as a commitment meeting where a decision is made to either increase the investment in an ongoing project or show commitment to continue support for the project (Cooper, 2008).

The standardisation of NPD has come a long way and several high technology industries have already adopted a Stage-Gate process. Although the process and standards differ depending on the type of industry or business in question, one aspect to consider is that the NPD process is now at a mature stage within the industry. A notion to think about is not to mistake NPD for FFE. The FFE is simply the initial stages of the venture creation process where the ideas, concepts and business cases are defined before the actual implementation phase. From this, a solid structure and well defined stage of the NPD in production phases emerges. In some industries this is often termed the Stage-Gate process.

While some literature suggests that FEI includes NPD, for the purpose of this analysis and for clarity, the researcher prefers to keep them as separate entities. Hopefully, it can now be agreed that the technological innovation process of a high technology company is realised through the NPD process. This is defined as the process of delivering new products and services to consumers (Sperry & Jetter, 2009). In order to create and develop new innovative products for commercialisation NPD is considered a significant factor in the success of any organisation (Cooper, 2001). At the present time the completion of Product Development (PD) in many organisations is still very ineffective and underdeveloped (Fixson & Marion, 2012). This statement is supported by the high volume of unsuccessful products which are delivered to consumer markets (Adams, 2004), as well as the compounding concerns relating to time and cost in numerous product development initiatives (Cooper, 2005). Figures 2 and 3 below illustrate the Stage-Gate product development process.
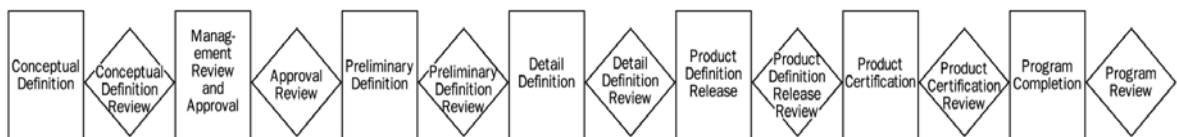
Figure 2. The Stage-Gate approach (Cooper, 1990).

Table I
Stage and review descriptions for the generic four-stage framework

Stage number and name	Stage description	Review gate number and name	Review gate description
Stage 1. Preliminary concept development	Identification of the need and generation of a concept accompanied by a specification and economic justification (Wheelwright and Clark, 1992)	Gate 1. Preliminary concept review	The concept is reviewed in respect to the mission and capability of the organisation and the orientation of the market itself. This is to ensure that the concept is distinctive and complementary to the already existing capabilities of the organisation
Stage 2. Design and development	The design phase can be split into two sub-phases,varying in level of design *Initial design phase.* A geometric scheme of the product with a functional specification of each major sub-system and some initial process plans will be developed *Firm-up design phase.* A complete specification of geometry, materials, process plans and all unique parts in production will be produced	Gate 2. Design and development review	A decision is made as to whether to progress into detailed design for manufacture
Stage 3. Validation	Validation is a process of testing the strategies implied in the design to reduce risk and maximise expected benefit. It can potentially lead to increased quality of the product (Cooper, 1994). The initial validation stage can be early testing of prototypes, which may be made up of production "intent" parts. After initial testing there is further prototype testing, with supplied parts	Gate 3. Product launch review	The final review prior to launch of the product into the market, to ensure that the product is fit for purpose
Stage 4. In-service product support	When the product is launched, manufacturing is ramped up and the product is monitored in service	Gate 4. Product support review	Periodic reviews take place within the service life of the product to monitor the product's performance

Figure 3. Proposed view of the Stage-Gate process using Bombardier's product development process. (Philips et al., 1999).

The success of R&D and product innovation is highly dependent on a variety of factors such as; markets and technologies, techniques and tools, organisational structures, processes and decision mechanisms in NPD (Fixson & Marion, 2012). These factors have been widely researched and studied (Barczak et al., 2009). This raises questions and doubts for the researcher with regard to the efficiency of the current standardised systems

within industry. This is most especially the case as NPD is vast and encompasses a wide range of organisational structures and decision processes. For example; strategy, marketing, operations, organisational behaviour, psychology, engineering and design (Fixson & Marion, 2012). The researcher does not question the credibility of the previous studies but still finds the need for a more elaborate examination of R&D to substantiate the claims made in the relevant literatures for this area.

As a result of the rigorous complex development and production process involved in NPD, it can be argued that there might be no real objectivity in the need for a structured process in NPD. Furthermore, the commercialisation of technology is somewhat difficult given the high degree of complexity involved in both the production process itself and the unpredictability of technology markets (Teece et al., 1997). Not only is this compounded by managerial challenges within organisations resulting from the latter (Frishammar et al., 2012), but further complexities and hindrances are apparent due to inter-organisational diversity and questions related to the visionary capability of organisations to identify and project technology licensing opportunities in the first place (Chesbrough, 2003).

Recent research findings and industrial benchmarking have found that the Stage-Gate is a robust and well structure system used for managing an innovation process from the initial ideation stages through to the launch stage (Cooper, 2008). Yet other research suggests that the FEI is still fuzzy; the reason why the FFE remains one of the main challenges in an innovation process. This is backed up by the literature review which found evidence that the initial stages of the Stage-Gate model, Gate 1 – 2, remains a challenge in the overall Stage-Gate innovation process. Furthermore, claims that the 'Stage-Gate' process is now 'mature' are exaggerated (ibid).

According to Cooper et al. (2002, 2005) Gates have not been successful in a number of organisations due to the high percentage of poor products which are not detected at Stage-Gate quality control checkpoints. The research determined that only 56% of products meet their commercialisation targets, a finding which validates the assertion that

too many poor projects progress through the Stage-Gate control checkpoints. The reason given for this is that the traditional meaning and concept attributed to 'Gates' in the model have been neglected or overlooked. A possible explanation for this may be that the traditional conceptual meaning attributed to Gates in the Stage-Gate model may have been neglected or overlooked.

Figure 4 below shows an illustration of a typical Stage-Gate model populated with the overall Bombardier product development process.
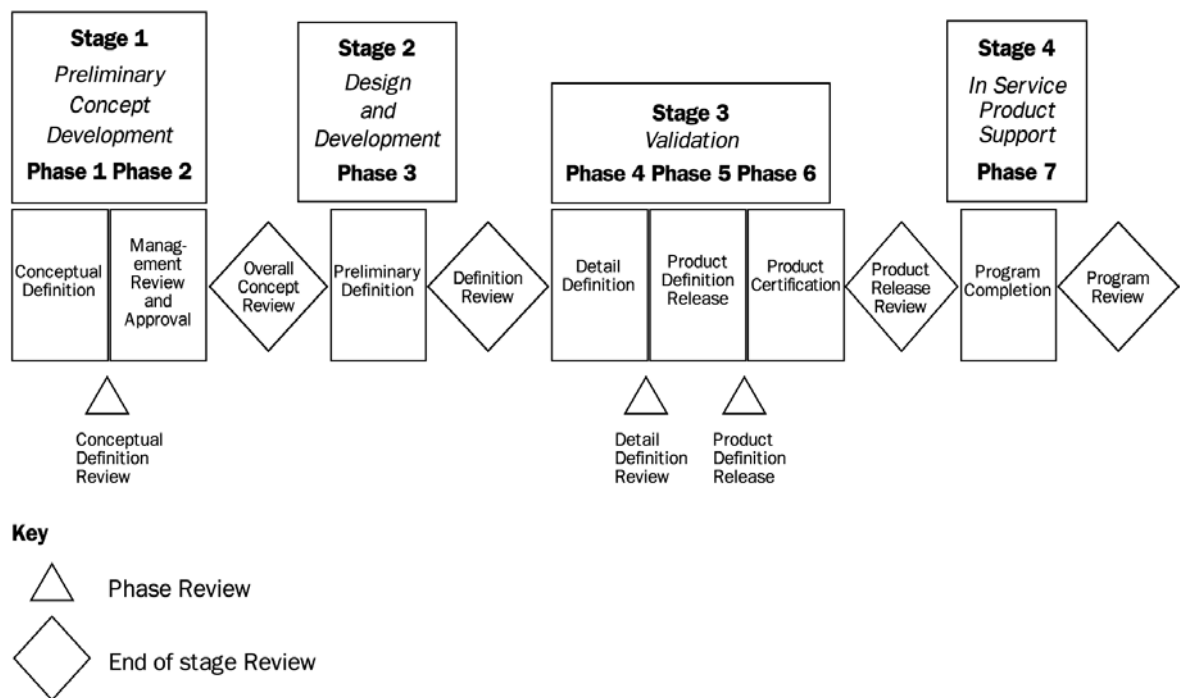
Figure 4. Typical Stage-Gate model populated with the overall Bombardier product development process (Cooper, 2008).

Most FEI best-practice models of innovative companies have implemented a robust idea-to-launch system such as Stage-Gate (Cooper et al., 2002, 2005; Griffin & Hauser, 1996). The benefits of such a process have been well documented with many well-managed companies such as Procter & Gamble (P&G), Emerson Electric, ITT and 3M prospering and profiting from using Stage-Gate (Cooper, 2008). Although it is not a linear or rigid

process, Stage-Gate has become an accepted system for managing and processing new products to market and the advantages of this stable and well-structured system in NPD stages have been well researched and documented Markides (2006).

Benchmarking studies have also revealed that just as many companies have got it wrong by missing key facets, principles and methods in the system (Cooper, 2008). Stage-Gate in its simplest form consists of a sequence of stages which enable project members to access information, analyse and integrate project resources and progress to the decision and sustainability stages of the project lifecycle (ibid). Each stage is designed to collect data to minimise risk on core project impact areas and costs more than the preceding ones. The activities within these stages are undertaken in parallel, and by a team of people from different functional areas within the firm. It is also worth mentioning that each stage is cross-functional and no department owns any one stage. Therefore, every stage is made of cross-functional collaboration among the R&D, marketing, production and engineering stages (ibid.). This is connected to VCoP via the link between these stages and the application of online-mediated communication tools in achieving the FFEI outcomes.

2.1.2 Conclusion on the Fuzzy Front End of Innovation

The NPD process is a sequence of 'Stages' and 'Gates'. Each stage consists of NPD activities that provide NPD managers with information about the new product project progression. Information input is used for review decisions at 'Gates' (Jespersen, 2012). The view is that a new product project is shaped by the path of NPD activities it has travelled. Because learning is assumed to take place over the course of the NPD process stage-to-stage information dependency is an assumption of NPD research (ibid). However, it is important that development activities for each NPD stage are rigorously followed by NPD managers and it is a concern that this is not always the case. In other words, stage-to-stage information dependency may potentially trap NPD managers rather than create effective learning from the beginning to the end of the development process (ibid).

Even though the Stage-Gate process is claimed to be at a mature state in high technology industry, the process still remains ineffective in diluting the problems at the FEI due to the continuous fuzzy state of Gate 1. Indeed, at this early stage, which managers have described as the locale for the greatest weaknesses in product innovation, where the impact on the FEI could be significant, attempts at improvement are minimal (Khurana & Rosenthal, 1997).

The FEI is managed with the Stage-Gate process in many industries and VCoP has been an essential part for managing the Stage-Gate process (Cooper et al., 2011). A successful outcome of VCoP can be enabling factors for the Stage-Gate process as well as a minimisation of some of the risk and challenges posed at the early stages of the FEI. The disparity between VCoP and FEI is the disconnect apparent in the fuzziness at the early stages of the Stage-Gate process. Organisations who have managed to apply these gates correctly have been successful. Although the application of the gates differs from industry to industry, a better understanding of the process can help to mitigate some of the challenges encountered in the Stage-Gate process. A considerable portion of the knowledge responsible for the innovation and expertise required at the FFE is closely linked to tacit knowledge (Rosenberg, 1976, 1982).

The next section will provide a review of this subject. As the researcher has already demonstrated activities at the FFEI are ambiguous and sometimes unpredictable. As a consequence, it is imperative to look closely at the academic publications in the fields of knowledge management which focus on both tacit and explicit knowledge.

2.2 Knowledge Management and Innovation

A review of knowledge-based literature on organisations suggests that those who invest substantially in the management and creation of knowledge are most likely to have better innovation outcomes (Conner, 1991; Dierick & Cool, 1989; Teece et al., 1997; Wernerfelt, 1984). This is evidenced by the higher number of successful new products commercialised by firms exhibiting such characteristics. However, other research suggests that knowledge creation alone is not enough for a sustainable and productive

innovation process, arguing rather that the integration and sharing of knowledge is also an attribute of successful organisations (Clark & Fujimoto, 1991; Iansiti & Clark, 1994; Okhuysen & Eisenhardt, 2002).

Existing studies on organisational knowledge highlight the importance of the difference between tacit and explicit knowledge (Levitt & March, 1988; Nelson & Winter, 1982; Nonaka, 1994). Tacit knowledge is the unwritten and inferred 'know-how' we use and exhibit in everyday life (Polanyi, 1966). We often cannot justify or comprehend the reasons behind tacit knowledge as it is ingrained into our sub-consciousness (Rosenberg, 1982). Since tacit knowledge is assumed to exist within our abstract mentality and sub-consciousness, it is considered somewhat difficult to tap into or cultivate within the spheres of organisational knowledge management.

According to Bertels et al. (2011) as the sharing of tacit knowledge within an organisation is a necessary condition in order to improve innovation performance, tacit knowledge is an important element at the FFE stage of the innovation process. The methods of propagating and transferring tacit knowledge within FFE development becomes an important challenge in knowledge management at the FFE (Bertels et al., 2011). This is mainly because the diffusion of knowledge by the holder can only be made feasible when the knowledge owner has become aware of their knowledge and therefore they are able to verbalise it. This holds true even though many other basic knowledge transfer methodologies have proven moderately difficult to implement (Haldin-Herrgard, 2000).

Accordingly, tacit knowledge is a critical element of the innovation process especially at the FFE stage. In light of this, the codification or comprehension of tacit knowledge remains a challenge in the study of innovation management. Furthermore, other research based on 'innovation', 'knowledge transfer', 'technology transfer' and 'technology diffusion' also considers tacit knowledge as a vital area in the study and exploration of innovation (Rosenberg, 1976, 1982). This is seen by the researcher as further validating the importance of tacit knowledge as a viable element for this thesis. Knowledge is an

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important factor in the integration of NPD and tacit knowledge in particular may contribute to product development knowledge as it helps foster understanding of the abilities to identify innovative products within corporate business development activities (Frishammar et al., 2012).

Explicit knowledge can be explained and retold by the knowledge owner; it can be coded, recorded, communicated and distributed. For example, in an organisational setting this can be achieved through manuals, documents, books, pictures, digital materials and other conventional learning methods (Griffith et al., 2003). Although explicit knowledge is required at the FFE, it is not attributed to creativity and idea generation (O'Connor & Rice, 2001). Innovation is not limited to any particular sector of an organisation; great ideas may come from within or outside of the organisation or even from senior management at an executive level. The efficiency with which organisations can extract and apply tacit knowledge at the FFE can therefore be seen as an important catalyst for the firm's innovations (Ahmed & Shepherd, 2010, pp. 5-20).

With this distinction in mind, knowledge can either be retained by an individual within a firm or mutually by clusters of people within the firm. Leiponen (2006) emphasises the importance of having control of knowledge because organisations can regulate who can use or access knowledge within the firm. If a single entity in an organisation retains an expertise there is a risk for the organisation in that such knowledge remains isolated without the cooperation of the entity itself. Thus, the diffusion of knowledge is considered as one of the major hurdles facing high technology industries within their organisational structure. Studies pertaining to this area suggest that some of the most successful organisations are those that excel in the codification and externalisation of intangible knowledge resources such as tacit knowledge and are 'ahead of the game' when deploying and diffusing knowledge within their organisation (Haldin-Herrgard, 2000).

In their work, Goffin & Koners (2011) made recommendations regarding possible future research and how there is a need to address the gap in the area of organisational learning

especially in relation to the analysis of tacit knowledge. Their findings suggest that there is a strong case for this based on organisational learning literature reviews which have emphasised the significance of tacit knowledge and social networking. During their research, empirical studies were carried out among NPD professionals. Their subsequent findings raised the issue of how NPD professionals acquire knowledge and recommended future ethnographic research focusing on 'discourse analysis' and the use of storytelling.

2.2.1 Knowledge Management Theories

Knowledge literature reviewed as part of this study includes some important social theories linked to collaborative learning activities in a virtual social setting. These include Activity Theory (AT), Actor Network Theory (ANT), Social Constructivism Theory (SCT) and Situated Learning Theory (SLT). In general terms, social theories are methodological frameworks or models used for analysing social phenomena.

The concept of 'social theory' is often used to interpret and explain changes and development in societies as well as to provide a methodological approach for explaining social behaviour, power and social structure, culture, modernism and innovation (Harrington, 2005). In modern day social theories, some fundamental themes take preference over others. For example, the nature of social life, the connection between identity and culture, the organisation of communal establishments and the role and likelihood of social and technological innovation (Henderson, 2006; Gupter, 2012) The researcher sees a connection of some of these themes with the activities at the FFI in virtual setting, for example, the transformational capabilities of social interaction within an organisation.

In the following paragraphs, the researcher gives a brief description and comparison of the social learning theories listed above. The researcher hopes that this comparative analysis can add more value to the argument that SLT is more closely linked to learning in a collaborative virtual social setting than other social learning theories reviewed for this research.

AT is a framework which reflects on actions within the entire collaborative process, i.e. teams, organisations and communities, some which may extend beyond an individual member of the group. AT usually encompasses the location of the activity, the history of members, culture, 'artefacts', intricacies of the actual activities, member' enthusiasm etc. (Engeström, et al., 1999). Even though the unit of analysis is inspired by the actions directed to an objective, the practical intercession of members' actions and objects are interrelated. In this case, most actions are consciously goal driven and the components of the activities are very dynamic (Nardi & Kaptelinin, 2006). These interruptions can be a barrier for communities at the FEI given the amount of flexibility required at the FFEI. AT differs substantially from ANT. It is a very complex theory which is somewhat difficult to explain. However, it may be defined as;

"Truth and falsehood. Large and small. Agency and structure. Human and non-human. Before and after. Knowledge and power. Context and content. Materiality and sociality. Activity and passivity…all of these divides have been rubbished in work undertaken in the name of actor-network theory" (Law 1999, p.3).

In addition, it is "reducible neither to an actor alone nor to a network…An actor-network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of" (Callon 1987; p.93). Re-definition and re-transformation of heterogeneous networking elements creates a challenge at the FEI where the actions of the innovator and actors remain very fuzzy.

Turning next to SCT, this theoretical framework implies that knowledge is created through a process of dynamic construction (Mascolo & Fischer, 2005). This works through participants of a knowledge sharing group being capable of probing each other using questions and answers. Constructivism, also referred to the study of learning, revolves around how people interpret the realities of the universe, and their perceptions of the real world view have actually not been altered (Brooks & Brooks, 1999). This theory is more focused on the collaborative nature of knowledge sharing and the significance of cultural and social settings. Furthermore, all intellectual functions are thought to be

instigated in the individual and are seen as outputs of communal collaborations. In this context, learning is more than absorption of information by the learning community members but rather a process by which the learners are assimilated into the knowledge community (Vygotsky, 1978).

Finally, literature reviewed in the knowledge area defined SLT as an essential and inseparable aspect of social practice which encompasses the creation of identity through changing forms of participation in 'hands-on' social groups (Lave & Wenger, 1991). It challenges cognitive theories of learning in the pedagogical tradition that classroom-based learning is as effective as learning within the communities in which what is practiced is learned and vice versa (Lindkvist, 2005). Following SLT, true understanding involves 'living it', i.e., it requires the learner to be situated within the context because learning is a social process which will be affected by social and cultural contexts (Hippel & Katz, 2002).

The social learning theories outlined here are applicable to group collaboration in social settings. However, the learner's role in a VCoP makes SLT the most appropriate theoretical framework for the study. Due to the legal structures within businesses a significant factor to consider during the evaluation of these social learning theories is the underlying social constructs and characterisation of the knowledge sharing groups which leans more towards SLT.

Therefore, proponents of SLT argue that learning cannot be decoupled from practice and context; that is to say, learning is not the simple reception of factual knowledge (Lave & Wenger, 1991). Central to SLT is the concept of 'legitimate peripheral participation', which captures the observation that ''the mastery of knowledge and skills requires newcomers to move from a more peripheral participation toward full participation in the sociocultural practices of a community'' (Lave and Wenger, 1991, p.29).

On the other hand, a cognitive theory of learning assumes knowledge and skills are acquired by mental or cognitive processes through instruction or observation. The action

of learning is on the cognitive level, in the mind (Fox, 1997; Greeno, 1997). A cognitive theory of learning therefore proposes that it is the active processing of information which enables somebody to learn.

Cognitive learning is known to be effective for the transfer of knowledge which is codified/explicit but less effective for non-codified practical and social knowledge with high degrees of tacitness (Brown & Duguid, 1991, 2001). In contrast, Situated Learning is claimed to be especially appropriate for the transfer of tacit knowledge (Lave & Wenger, 1991; Wenger, 1998). Business units can try to increase tacit knowledge available in the FFI by supporting the establishment of organisational groups that enable Situated Learning and by enlarging person-to-person networks within the organisation (Hansen et al., 1999). Hence the researcher's preference for Situated Learning as the chosen theoretical lens for this research.

Table 1 below presents a comparative analysis of the other social learning theories and their relationship with SLT. The figure also illustrates the key concepts and learning activities in a SLT using a comparative presentation to show key themes that link the theory as an appropriate tool for extracting knowledge among VCoP in the business communities.

Table 1. A comparison and application of different learning theories (Chatti, 2010, pp.19-42)

Social Theories				
	Situated Learning	**Social Constructivism**	**Activity Theory**	**Actor-Network Theory**
Key Concepts	Legitimate peripheral participation (LPP), community of Practice (CoP)	Social negotiation, zone of proximal development (ZPD), more knowledgeable other (MKO)	Activity systems, subject, object, mediating artifacts, expensive learning	Actors, sociology of translation/associations, generalized symmetry.
How does learning occur?	LPP within CoPs	Moving from the level of actual development to the level of potential development.	Construct the object of an activity using mediating artefacts	Actor-network forming process
Which factors influence learning?	Mutual engagement, joint enterprise, shared Repertoire	Scaffolding, MKO	Set of subjects, objects mediating artefacts, actions, rules norms, and division of labour.	Actions, mediators
What is the role of memory?	Identify formation	Reaching the level of potential development.	Generating actions within an artefact-mediated, object-oriented activity, e,g,, questioning, analysing, modelling.	Generating actions within actors-networks
How does transfer occur?	Social participation in CoPs	Social interaction and collaboration.	Participation in activity systems	Interactions actors-networks
What types of learning are best explained by the theory?	Social Learning Training	Social learning training	Activity based learning	Group-based learning
Focus	CoPs	Mental development (Intrinsic)	Sequences of actions in an expansive cycle	Heterogeneous actor-networks
Core Activity	Participation, negotiation of meaning	Travelling through ZPD		Translation, i.e. creation of actor-networks and generation of ordering effects
Learner's role	Engagement in CoPs	Knowledge co-construction	Construction of the activity object using mediating artefacts.	Mediator in an actors' networks
Underlying social entity and its characteristics	CoP, closed, structured, hierarchical, knowledge Push	Group of teachers and peers (MKO), centralised controlled, top-down more knowledgeable to the level of potential development	Knots, temporary relationships, predictable.	Actor-network, heterogeneous

There are therefore several innovation concepts and theories that could be applied to the transfer of tacit knowledge within an organisation. The researcher has explored several of these such as Social Learning theories, FFE, Knowledge Management, Situated Learning of CoP and VCoP and identified Situated Learning of CoP as the most suitable theoretical concept applicable for this research. The researcher reached this conclusion after reviewing the literature referenced in this paper because the most important factor which fosters innovation remains knowledge sharing (Howells, 2002).

According to Lave & Wenger (1991), a CoP is considered a highly suitable method of transferring tacit knowledge by the members of the community, and the researcher will later present an argument to validate this statement. CoPs help to yield creativity and innovativeness among their members through active interaction and the sharing of knowledge, particularly when focused or dealing with an appropriate challenge brought before the community (Bertels et al., 2011). This kind of community also provides the professional contact required to support its members with specific skills or areas of expertise. This will be examined in detail in Section 2.4 following a brief review of different methods of collaboration. The section will then conclude with an outline of links between methods of collaboration and research on CoP reviews.

2.3 Collaboration Methods

There is no universally accepted definition of collaboration or types of collaboration, as an Internet search will quickly demonstrate. In order to 'situate' collaboration, and put it into perspective, the researcher will therefore use concepts developed by Pisano & Verganti (2008) who specialise in the field of innovation practice and knowledge management. This section will briefly look at the different types of collaboration from a knowledge management point of view to enable the researcher to justify the connection between CoP and VCoP.

The 21st century information age is a period when ideas can spring from anywhere around the world and Information Technology (IT) has greatly decreased the effort required to extract this knowledge. However, it is not surprising that no company can afford to innovate alone. In recent times inter-organisational partnerships, global collaborations and different methods of collaboration have greatly increased so it is worrying to mention that due to the

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numerous collaboration methods available it has become increasingly difficult for managers to make good judgement decisions relating to best practices (Pisano & Verganti, 2008).

Numerous challenging questions are relevant. For example; Should Intellectual Property (IP) be shared with partners? how does one select the number of partners involved or, indeed who do you collaborate with? These issues increase in complexity if an innovative body seeks to take advantage of the power of crowdsourcing. Therefore, finding a balance to integrate external partners into internal projects is a multi-faceted problem. There is also the danger of lagging behind in the competition to be first in the market due to the developers of a new product's failure to choose the right open innovation and collaboration strategies (Pisano & Verganti, 2008). To aid managers and organisations in making the right decisions during collaboration, Pisano & Verganti (2008) developed a framework that defined some inaugural principles and collaboration structures to manage some of these problems.

The limitation of membership in any form of collaboration defines the type of network which will emerge. Therefore, in completely open network collaborations anyone may join or leave at any time. These bodies may include suppliers, customers, designers, research institutions, inventors, students, hobbyists and even competitors which are all allowed to partake as members. For example, open sources projects such as Linux, Apache and Mozilla all used the open collaboration model. On the other hand, close collaboration groups are made up of interactions among carefully selected groups or partners who might share common needs or substitute each other's competence in chosen innovation fields (Pisano & Verganti, 2008).

The control structure is a second factor that differentiates different forms of collaboration groups. This hierarchical power structure determines the agenda, the subject, the level of importance and the quality of result to be derived from the project. On the other hand, those networks with a flat power structure share equal authority throughout the decision process and project timeline. Although, most academics and collaborators often categorise 'openness' as equal to 'flatness' and assign to them more weight over their hierarchical counterpart. However, this has not been tested and remains a subjective judgement (Pisano & Verganti, 2008). It is also worth mentioning that the size of the network is proportionate to the cost of running the networks as well as the challenge to choose suitable collaborators. Furthermore, open groups are often larger than closed groups of collaborators. .

According to Pisano & Verganti (2008), there are four different methods of collaboration:

1. Closed and hierarchical network (an elite circle)

2. Open and hierarchical network (an innovation mall)

3. Open and flat network (an innovation community)

4. Closed and flat network (a consortium).

The diagram below illustrates a model of the four different methods of collaboration as presented by Pisano & Verganti (2008).
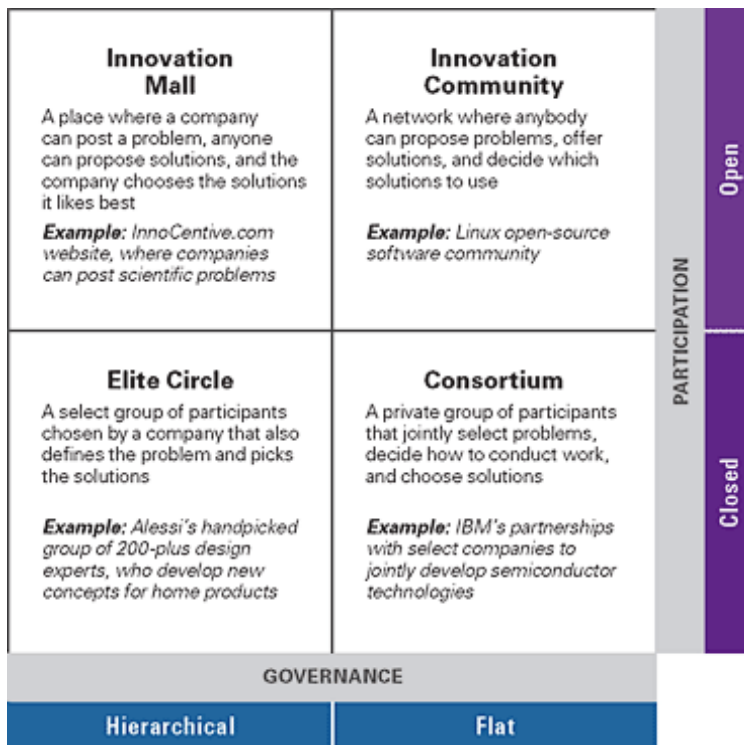
Figure 5: Pisano & Verganti's (2008) collaboration model

In order to choose the method of collaboration middle managers have to make a selection of suggested strategic decisions of each type.

The diagram below illustrates key factors and criteria within the selection process that aid in the decision process.
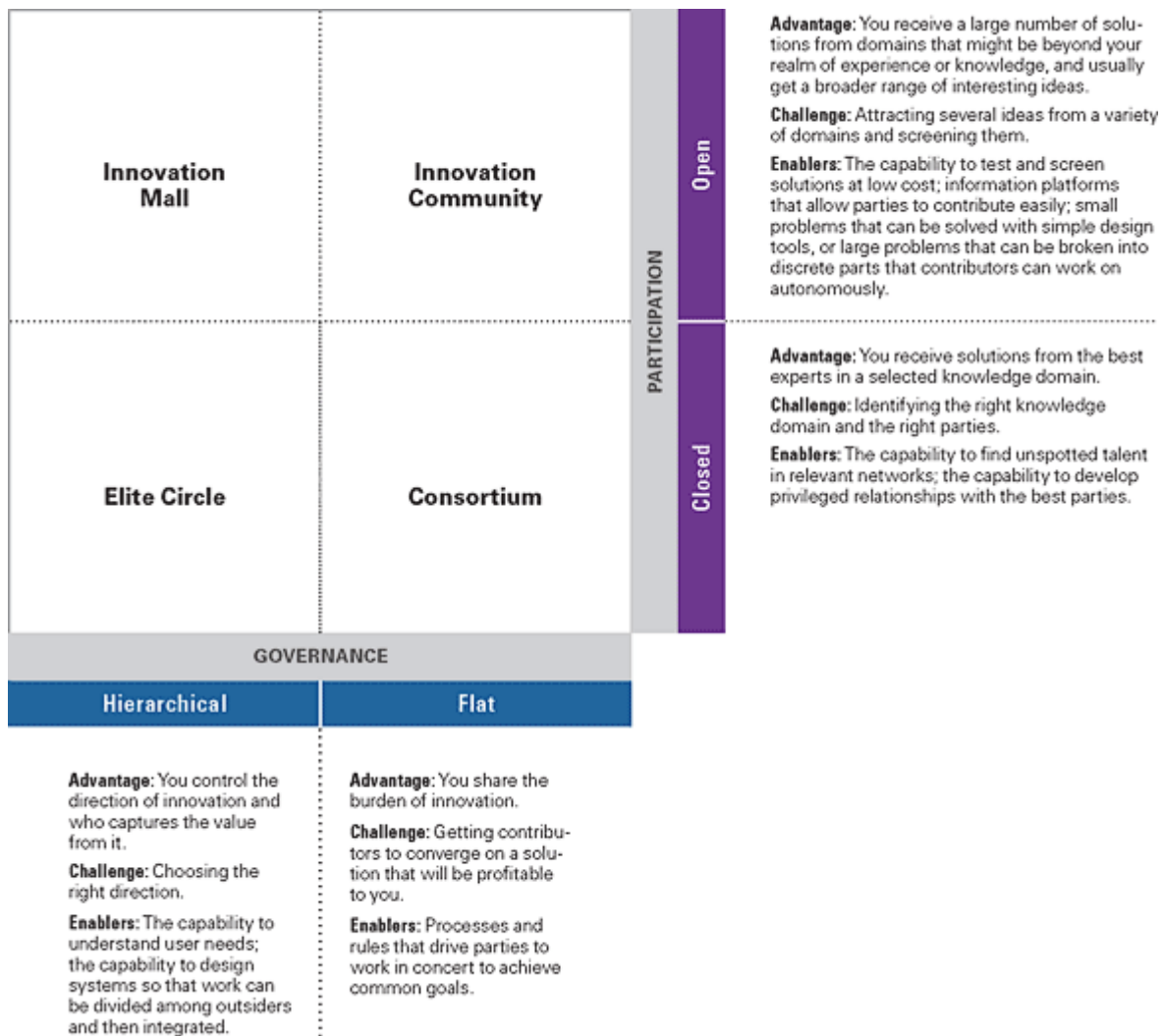
Figure 6. Pisano & Verganti's (2008) collaboration model

This section tries to highlight the theme 'collaboration' as it is an important subject in this paper. The researcher believes that this short introduction has been able to demonstrate the relevance of different forms of collaboration which may exist in any type of innovation concept that involves collaboration. This is seen to hold true whether it is open or closed, as the case might be in CoP and VCoP concepts.

2.4. Community of Practice (CoP)

CoPs are made up of groups of selected members who share information, insight, experiences and tools about an area of common professionalism, expertise and a chosen subject area (McDermott, 2000; Wenger, 1998). According to Wenger & Snyder (2000), the main objective of these groups within the realm of a CoP is to exchange and spread knowledge

within an organisation, itself outlined and developed through the construct of participation, identity and practice. Nevertheless, Contu & Willmott (2003) debate that some of these critical constructs have been suppressed by Lave & Wenger's (1991) original theory, in particular the role of power relations which are essential to the management of a CoP. Still, Contu & Willmott (2003) go on to state that it is noticeably arduous, perhaps futile, to attain a particular knowledge base and thereby join a CoP as a recognised participant expecting affability and adequate cooperation if power relations block or disallow admittance to the group's more proficient advocates.

Of course, to a certain degree, the matter in contention is the dynamics of power within the group (Huzzard, 2004). Referring back to Contu & Willmott (2003), it is worth adding that we should be less focused on the alliance of power enclosing the CoP, but instead focus should remain on those inside the community within the organisation. From this point of view, the researcher would like to point out that although these CoP groups are not under the direct control of the authorities within the organisation, they often share a common passion and interest and are highly motivated and committed (Wenger & Snyder, 2000); factors which themselves may well reduce the influence of power play within the community.

That said, more recent research continues to counter this negative view of CoP claiming that the benefits, commitment and motivation of the community will still override the social constructivist claims (Bertels et al., 2011). Indeed, they go on to claim that CoPs help to yield creativity and innovative practices among members through active interaction and the sharing of knowledge when focused or dealing with a particular challenge brought before the community. This kind of community also provides the professional contact required to support its members with specific skills or areas of expertise. As well as enhancing both the creation of tacit and explicit knowledge, a CoP encourages teamwork and associations between members with shared professional interests even when members are situated in different geographical zones within the corporate entity (ibid). Generally, this provides an organisation with adequate and timely tacit knowledge resources to tap into when undertaking projects (ibis).

Even though CoPs foster the rapid propagation of ideas and information flow within the organisation using minimal resources and time (Hof, 2004). In his study, Howells (2002) claims that the knowledge required for innovation, creativity and ideation are not necessarily

extracted from our current 'knowhow' and that any information residing with the owners of current knowledge can be gained through the sharing of new information, interaction and learning. Ireland et al., (2003) also proposed that innovation can be made to emerge strategically when efforts are put in place to encourage the sharing and combination of unrelated matrices of knowledge across the organisation in order to spark new insights that would have been unlikely to have happened in isolation. CoP is considered a highly appropriate method for extracting tacit knowledge from within the members of the community (Lave & Wenger, 1991) and, in Ireland et al.'s (2003) terms, can be considered as a means by which potentially unrelated matrices of knowledge, albeit centred on a common interest, can all be brought together. Table 2 below shows the seven principles for cultivating innovation (Wenger et al, 2002).

Table 2: Seven Principles for Cultivating CoPs. Summarised from Wenger et al., (2002; p.51-63)

Principles	Features
1. Design for evolution	Communities usually develop from existing personal networks. The dynamic nature of communities is central to their evolution. Design elements should be catalysts for a community's natural evolution. Social and organisational structures, such as a community coordinator or problem-solving meetings, can facilitate the evolution of a community. Design for aliveness.
2. Open a dialogue between inside and outside perspectives	Good community design requires an understanding of the community's potential to develop and steward knowledge gained from both inside and outside the community. An outside perspective, whether achieved through community education or the dialogue with an 'outsider', allow insiders to see new possibilities.
3. Invite different levels of participation	Expecting all community members to have the same level of participation is unrealistic. Three levels of participation and their approximate corresponding proportion of total membership are identified: core group (10-15% of members) at the heart of the community; active group (15-20% of members); peripheral group (up to 65% of members) who rarely participate. Members can move between these various levels. The key to good community participation and a healthy degree of movement between levels is to design community activities that allow participants at all levels to feel like full members.
4. Develop both public and private community spaces	Dynamic communities are rich with connections that occur in both public and private places of the community. The key to designing community space is to orchestrate activities in both public and private spaces that use the strength of individual relationships to enrich event and use events to strengthen individual relationships.

5. Focus on value	Many of the most valuable activities are the small everyday interactions – informal discussions, or one-to-one exchanges. Designing for value requires encouraging community members to be explicit about the value of the community.
6. Combine familiarity and excitement	This combination allows members to develop the relationships they need to be well connected as well as generate the excitement they need to be fully engaged, and to challenge their current practices with a view to developing new products and processes.
7. Create a rhythm for the community:	There are many rhythms in a community – the syncopation of familiar and exciting events, the frequency of private interactions, the ebb and flow of people from the side-lines into active participation, and the pace of the community's overall evolution. Finding the right rhythm is key to a community's development.

Hansen et al., (1999) claim in their analysis that organisations which encourage CoP through increased group and human interpersonal collaboration within business units can help to foster the sharing of tacit knowledge and the transfer of knowledge at the FEI. This is achieved by encouraging mutual trust and empathy, a willingness to share information and help others and fostering an open atmosphere which is required for the sharing of tacit knowledge.

On the other hand, Contu & Willmott (2003) debate the methodology of CoP as being non-crucial to social conformation in innovation as innovation can threaten any deep-rooted customary standards or patterns. After all, the empirical evidence suggests that individuals or groups with more social connections are more likely to be innovative and creative than isolated people or groups (Bjork & Magnusson, 2009). Based on this argument, i.e. that CoP are more innovative, the researcher suggests CoP are a relevant concept in which to study innovation at the FFE. To support this stance, according to Bertels et al. (2011), business units which display a more accomplished CoP, and show a greater interest in the community, have a greater influence on the FFE than organisations which do not support the formation of communities. In order to gain positive results, the stakeholders must ensure that the members of the CoP are given the autonomy to engage with these groups and that resources are made available for the sustainment of the CoP.

Even though CoPs used to be known as a community that emerged extemporaneously within the organisation (Wenger & Synder, 2000), research by Brown & Duguid (2001) suggest that this extemporaneity of CoPs are now being managed and influenced by organisations. Businesses are now facilitating and enabling a conducive atmosphere for CoPs to prosper, using methods such as inspiring and propagating the team vision, encouragement and structuring the CoPs for growth and sustainability, in order to maximize the full potential of CoPs (Cox, 2005). This clearly does not mean a careful organisational power structure is implanted on the CoP or that CoPs are subsumed into one, but rather official support from the business and its managers is an enabling factor for CoPs to thrive and stay motivated.

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Although the implementation of a CoP does not necessarily require the group to be situated in a common geographical place, a review of the literature focusing on this area suggests that CoP are much more efficient and productive when the members can meet face-to-face for their interactions (Cooper et al., 2011). Consequently, one of the major challenges for a CoP in the current global corporate environment remains within multinational corporations, where business units are spread across countries and regions, as they seek to maintain the appropriate legal structures and common mission statements/visions within heterogeneous cultural and ethnic affiliations (Ekvall, 1987).

A CoP displays a number of common characteristics. These are listed in Table 3 below.

Table 3: Key Characteristics of a Community of Practice (Wenger, 1998, pp.125-6).

- Sustained mutual relationships — harmonious or conflictual
- Shared ways of engaging in doing things together
- The rapid flow of information and propagation of innovation
- Absence of introductory preambles, as if conversations and interactions were merely the continuation of an ongoing process
- Very quick setup of a problem to be discussed
- Substantial overlap in participants' descriptions of who belongs
- Knowing what others know, what they can do, and how they can contribute to an enterprise
- Mutually defining identities
- The ability to assess the appropriateness of actions and products
- Specific tools, representations, and other artefacts
- Local lore, shared stories, inside jokes, knowing laughter
- Jargon and shortcuts to communication as well as the ease of producing new ones
- Certain styles recognised as displaying membership

- A shared discourse reflecting a certain perspective on the world

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Previous literature studies in this area have focused on the effects of organisational climate and culture in relation to a particular country, how organisational climates affect a CoP in different cultures and how to bridge the gaps between diverse and dispersed groups which are often referred to as virtual communities (Bertels et al., 2011). The challenge today remains within organisations that are dispersed either nationally or globally and therefore have difficulties implementing a CoP since some form of face-to-face meetings are required to foster effective development. Disparity now arises on how to address the gap between a VCoP, and the paradox faced in such settings as the face-to-face environment of the Situated Learning approach. The critical question is therefore can Situated Learning be effectively applied by collaborative groups dispersed around the globe in a virtual setting and if so, how? Based on the literature reviewed for this thesis there are few studies that cover this area. Factors such as location and national culture still remain problematic in these settings. As we live in an increasingly global community with multinational corporations disseminated all over the world, there is therefore a need to understand the effectiveness of CoP in these circumstances in order to utilise them more efficiently in harnessing innovation at the FFE.

One of the main factors linked to the success of any business in the current knowledge society is their aptitude to generate, systematise, adapt, retain and distribute information amongst their associates (Chalmeta & Grangel., 2008; Henrichs & Lim, 2005). These means of generating and disseminating information can be achieved through numerous processes such as building effective CoP and VCoP climates. CoP have gained considerable interest as a means for developing and managing knowledge amongst a wide range of communities; open supporters (Hara & Hew, 2007), Internet experts (Cox, 2007) or textile workers (Chalmeta & Grangel., 2008). This is because numerous research studies suggest that CoPs create favourable conditions and opportunities within organisations that are appropriate for sharing tacit knowledge, especially at the FEI (Bertels et al., 2011).

As earlier mentioned, it is in our tacit knowledge that our instinct, perception and 'gut feel' initiate (Leonard & Sensiper, 1998); each of which are essential to overall innovative capabilities, and most especially at the FEI (Bertels et al., 2011). Furthermore, CoPs can be generally described as a group of entities who are organised within a common platform to share information among each other, and are conceived of as a method for innovating, sharing and creating knowledge within a business or corporation. This practice eventually leads to a combination of innovation, information dissemination and a productive work output (Brown & Duguid, 1991).

The current increase in the use of modern collaboration tools has created unlimited opportunities in what used to be restricted by time and location (McDermott, 2000; Von Krogh, 2002). As a result, CoPs are progressively moving into the virtual space, termed in this thesis as VCoPs, due to their heavy reliance on information and communication technologies (ICT) tools for communication (Cox, 2007). These and other dynamics such as the global distribution of the workforce and the limited time for traveling, makes the use of CMC tools an effective means of communication instead of face-to-face meetings within an organisation or among businesses. With the objective of linking CoPs with VCoPs in mind, in the next section the researcher will try to establish a mechanism that can connect dispersed CoPs without the need for groups to physically meet.

2.5 Virtual Community of Practice (VCoP)

Initial studies of CoPs were based on face-to-face interactions and collocated groups (Lave & Wenger, 1991; Wenger, 1998). Conversely, due to the propagation of Internet-mediated communication devices, and the rapid growth in the internationalisation of businesses, these have led to the advent of a completely new means of group learning and information dissemination; VCoPs (Von Wartburg et al., 2006).

In order to avoid a misunderstanding between virtual collaboration and virtual communities (VC), it is important to make a clear distinction between the two. Chiu et

al., (2006, p.1880) defined virtual communities as "online social networks in which people with common interests, goals, or practices interact to share information and knowledge, and engage in social interactions". McLure-Wasko & Faraj (2005; p.36) described "electronic networks of practice" and defined them as "computer-mediated discussion forums focused on problems of practice that enable individuals to exchange advice and ideas with others based on common interests". Von Wartburg et al. (2006, p.299) indicated that VCoPs are characterised by "at least partially virtual interactions and are often said to be a more effective organizational form for knowledge creation than traditional and formal ways of structuring interaction". Whereas virtual teams are usually created by organisations to achieve specific performance goals, VCoPs are organised around community members' common interests, but, as a rule, are not working toward achieving specific performance goals. As part of this investigation the researcher will examine this area further during the empirical analysis of this research.

A VCoP can be referred to as a CoP but over a virtual network. However, the use of Internet and computer mediated communication tools for a CoP can, to some degree, create more challenges and hamper some of the benefits that face-to-face meetings can produce. No further definition or elaboration is required at this point. However, during the course of the empirical analysis, and in later chapters, the researcher will investigate the enormous potential for virtual network communication tools to develop a CoP. Such a preliminary scoping enquiry is beneficial given the rapid rate of change within Internet and CMC tools.

Organisations are becoming ever more dependent on the use of distributed innovation models to facilitate the creation of new ideas at the FEI. This requires linking other individuals external to the firm in a VCoP platform to co-create new ideas with internal businesses (Boudreau & Lakhani, 2009: Dahan & Hauser, 2002). These external entities of the VCoP can often become more productive and resourceful than the internal personnel of the organisation at the FEI (Poetz & Schreier, 2012). In some cases, businesses adapt the use of a third-party virtual community forum to solicit new ideas

through a form of innovation contest by reaching out to a wider audience (Jeppesen & Lakhani, 2010; Nambisan, 2002; Verona et al., 2006).

In contrast, other firms have developed an internally based VCoP where the members of the FEI interrelate, share knowledge and cooperate (Jeppesen & Frederiksen, 2006). This may involve an 'idea contest' which includes some form of incentive (Bullinger et al., 2010).

Organisations can utilise the strength of these VCoPs as part of their FEI activity for generating both internal and external ideas. However, most VCoPs with external links are not sustainable due to the lack of motivation and interest over a prolonged period of time, even where incentives are involved (Dahlander & Piezunka, 2014; Iriberri & Leroy, 2009). Also, some VCoPs lack the ability to sustain a longer period of life cycle and usually degenerate into extinction. This may be partly due to the lack of a communal distinctiveness and feeling of belonging which individuals can usually attain while working as an employed member of an organisation or under the same legal entity (Langner & Seidel, 2015). Due to these limitations the researcher will narrow this research to VCoP within an organisation.

VCoPs performs key functions in the Knowledge Management stratagems of several global businesses. These include Caterpillar (Powers, 2004), Chevron, Ford, Xerox, Raytheon, IBM (Ellis, 2001) and Shell (Haimila, 2001). In addition, knowledge management experts also contend that sharing information through virtual communication means is considered an essential method of communal learning (Rosenberg, 2005). Therefore, understanding how VCoPs function and what leads to successful knowledge sharing in these communities becomes an important part of this research at the FEI.

However, these deliberately formed VCoPs can be very disrupting and demanding for the members. This is because inexperienced members may have to adapt to new methods and processes of sharing information, and communicate with group members through the use

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of virtual communication tools to develop social conditions that might be easily achievable through a CoP, for example, through building social ties and skills (Bourhis & Dubé, 2010). Moreover, VCoPs that are too aligned to the organisation's objectives assimilates the firm's processes and culture and will also be heavily influenced by the political climate and challenges within the organisation. As a result, these impediments may have important consequences and influence on the independence and productivity of the VCoP. These conditions would rather influence the activities of these deliberately formed VCoPs and might generate an additional challenge for the group compared to those VCoP that are formed and operate autonomously (ibid).

In order to compensate for the geographical restriction imposed by not being situated in one location there is also an obligation to ensure that employees within an organisation are adept at using the tools required to sustain membership of a VCoP by being skilled in IT. Examples would include difficulties with intercommunication and cultural divides. In addition, Bertels et al. (2011) embrace the concept that an accessible culture which supports risk taking, entrustment and free flowing communication can have a positive effect on FEI processes. A symbiotic relationship between such conditions and CoP might also be imagined.

High technology multinational organisations are increasingly using Internet-mediated communication to meet the challenges faced by having their teams dispersed across wide geographical locations. Some of these applications such as 'Sales Force', 'SharePoint', 'Microsoft net meeting' and video conferencing software are frequently used to enhance communication and information sharing. This has added an additional complexity to knowledge management and governance, which as a consequence, has created virtual communities across the globe within numerous multinational organisations as well as among diverse corporations which are often characterised by interdependent collaboration across global projects (Meyer & Marion, 2013).

These software and communication systems are used in the service of a CoP, which can also be termed a VCoP, due to the implied nature of the community with the fundamental difference being the virtual setting of this communication. By using these enabling virtual tools, the VCoP model can provide a structure for communalising which can function equal to a collocated CoP community (Murillo, 2008). Irrespective of the propagation of VCoP within corporations across the globe there is insufficient knowledge of the circumstances influencing the successful implementation of VCoPs. However, members' motivation to be a part of these online groups remains one of the significant elements governing the success of a virtual community in knowledge sharing sessions (Ardichvili, 2008).

2.5.1. Organisational Clusters in Virtual Community of Practice (VCoP)

The review of the literature suggests that social network connections are viable links for propagating knowledge assets and are important for the extraction of tacit knowledge and creating innovative technologies, services and process (Zaheer & Bell, 2005). These social network connections are considered by some academics as clusters. Gilbert et al. (2008) proposed that cluster locations expedite the transmission of tacit knowledge through face-to-face communications. In this proffer 'location' and face-to-face are considered as important factors that lead to innovation.

Although methods of Internet communication utilised in VCoP such as video conferencing can simulate location based face-to-face interaction, few literature studies have been able to establish the effectiveness of these IT applications. Even Bathelt et al., (2004) stated that the distance between the clusters of networks is highly significant as regards the level of propagation and diffusion of tacit knowledge between collaborators. As a consequence, the level of tacit knowledge required from the communication process is closely related to the geographical distance or proximity of the collaborators within the cluster of networks (Maskell, 2001).

It is also important to consider the contrasting roles that distance and location of the cluster network play in both explicit and tacit information networks. Here, these will be examined as separate entities before a comparison of those organisations collaborating in close proximity in non-virtual settings is provided. Knowledge networks that have a high demand for tacit knowledge will find it increasingly difficult to transmit this knowledge if they are physically located or dispersed across multiple geographical areas (Tallman et al., 2004). The majority of the articles reviewed about this subject by the researcher have claimed that explicit knowledge is more adequately extracted in these cluster networks than tacit knowledge regardless of the proximity.

The quest for tacit knowledge makes the process of information sharing more difficult and therefore creates some limitations that will contravene the transmission of knowledge between members within the cluster network. In contrast, explicit knowledge is freely transferred within clusters of inter organisational knowledge networks based within a particular location. This is most especially the case among more developed groups of small and medium size businesses where explicit knowledge transfer becomes even more structured and robust and emerges as a well codified shared asset after a sustained period of time. Furthermore, it becomes less prone to glitches in the communication process (Burt, 2008).

Most organisations in the central hub of this knowledge resource have a competitive advantage in terms of being able to harness the benefits derived from these cluster networks (Bell, 2005). Organisations that are bonded with higher numbers of collaborators within their network are more capable of harnessing the full potential of the cluster (Cowan & Jonard, 2006). Ahuja (2000) further strengthens this theory by stating that the central position of the organisation within the network cluster is an important factor that propels knowledge transfer and innovation in the communication process and further affirms that the connection between the centrality of the cluster network and innovation has been tested and proven by several case studies.

In recent research, conducted by Meyer & Marion (2013), empirical data was collected from 146 companies using some of the most advanced IT tools. Some of the actions undertaken by the cluster of virtual communities which the work focused on included; raising issues through online groups, participating in simultaneous online discussions, engaging in virtual video conference meetings and providing and receiving simultaneous feedbacks through virtual communication sessions (Ardichvili et al., 2003; Hayes & Walsham, 2000).

The results indicated that certain challenges exist within the area of VCoP due to the loss of tacit knowledge which currently requires face-to-face time in order for a CoP to flourish. Although Meyer & Marion (2013) specifically did not use the term 'VCoP', the concept was implied in their work and is proportionally related to the concept of VCoP in this thesis. This supports the view that a VCoP can be in part applied to CoP in knowledge transfer but it's effectiveness in comparison is weaker or undermined. This raises the question of how a VCoP might be organised in order to increase knowledge sharing and transfer potential particularly in relation to more tacit forms of knowledge?

The digitalisation of Internet communication in globalisation is a new trend in the current world order, and can sometimes be considered unavoidable, as most companies who stay local might eventually find themselves isolated from the global market. This is because staying local prevents these businesses from tapping into the global talent pool and the diversity of human resources required at the FFEI. Hence, firms face an increased need to resolve the challenges within the realm of fostering innovation and knowledge management in high technology organisations. Meyer & Marion (2013) mentioned in their report that the use of content management systems for innovation that preceded the traditional IT solutions proffered in NPD can be used as a measure to address the disparity found within their article. Although the report was focused on R&D within globally dispersed corporations, the researcher perceives a clear link between their narratives and his current review relating to the justification for developing innovation at the FFE and knowledge transfer and management in VCoP.

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Even though a significant amount of research in the field of virtual community, maintenance and user innovations in offline communities exists (Laine, 2009: Luthje, 2004: Fuller et al., 2007), there is not enough empirical research to show any successful application of VCoP tools or virtual communication processes within organisations VCoP at the FEI innovation space (Laine, 2006: Füller et al., 2007).

The level of interaction and approach that companies need for a successful outcome of this VCoP relationship at the FEI remains uncertain (Dahlander & Magnusson, 2008). Academia and industry are still struggling to comprehend these challenges and subsequently to develop a better framework and rules of engagement for sustainable virtual communication (Stürmer, 2009) within the FEI space.

Furthermore, current empirical research on the advancement of VCs remains unclear and uncertain. This is due to the high level of complexity surrounding interdependency among the various stakeholders in the process. Indeed, the researcher recognises this as a significant challenge for the thesis itself (Leimeister et al., 20011).

During the course of this work the researcher will probe deeper into this area and search for further literature to validate the direction of this analysis. The next section will introduce STL in CoP and examine how this is connected to CoP and VCoP, thus further revealing gaps in current knowledge.

2.6 Situated Learning Theory and Communities of Practice

This section will evaluate the connections between (and the importance of) SLT and a CoP, and will focus in detail on issues related to identifying and extracting tacit knowledge from within globalised high technology organisations.

Situated Learning is defined as an active, dynamic, social interaction between individuals within a practicing community that results in the shaping of new knowledge (Lave & Wenger, 1991). This characterisation attempts to override the traditional cognitive theory

of learning pedagogy that it is just as effective as community based learning (Lindkvist, 2005). Gardner (1987) maintains that the connective nature of intellectual abilities within a place of learning provides a firm basis for positive assurance when evaluating the proficiency of intellectual 'knowhow'. From the perspective of intellectual ability within a traditional formal education, cognitive based learning has traditionally been the accepted method of transferring and acquiring explicit knowledge, however, it has been determined as insufficient when extracting the most important aspects of tacit knowledge (Brown & Duguid, 1991, 2001). Situated Learning on the other hand has been shown to be a better learning method in acquiring tacit knowledge (Lave & Wenger, 1991; Wenger, 1998) because it has the advantage of utilising the full potential of face-to-face meetings in the knowledge transfer process.

However, Handley et al. (2006) disputes the Situated Learning approach used by Lave & Wenger (1991), stating that the focal point in abstract knowledge is ambiguous as it discounts the importance of extensive tacit or allusive scopes of knowledge within the working environment. Handley et al. (2006) go on to argue that Situated Learning ideology should include an intrinsic assessment of cognitivist approaches requiring balanced aspects when learning within a CoP which differentiates from the presupposition of independence in prevailing theories.

While many scholars have recognised the analytical backbone of SLT conceptual questions continue to remain ignored within the literature. In addition, previous perceptions of Situated Learning have often disregarded the ramifications of wider social and power affiliations. In spite of these assertions, most recent literatures, including studies conducted by Bertels et al. (2011), tend to claim that organisations which encourage Situated Learning within the empathetic social constraint of an informal free flow of communication and trust within their organisational climate have a tendency to be more innovative. In addition, they tend to narrow the gap and limitations created by dispersed collaborations by increasing the generation of tacit knowledge at the FEI. This

is achieved through nurturing a suitable environment for increased information dissemination within the context of a CoP (Bertels et al., 2011).

The question of power control within CoP has been a further issue among critiques in validating the effectiveness of a CoP in organisational settings (Huzzard, 2004). Yet, it is reasonable to see that these formal negative social constructs within a CoP such as power and structure have sometimes been misunderstood, and mixed up with the traditional power and political structure of an organisation which Situated Learning in a CoP does not represent. According to Lave & Wenger (1991) when knowledge, labour and social interactions within a CoP are placed in a formal context or where they are financially institutionalised, the potential for achieving the optimum from the community is diminished because this can hinder the free flow of information sharing and knowledge transfer. Nonetheless, they do not rule out the possibility of extracting knowledge in such conditions (ibid).

Research by Bertels et al. (2011) recognise some of the challenges related to power and political structure in high technological organisations where a CoP is customary for knowledge transfer including high technology industry. These organisations, who are clearly motivated for success in highly competitive global innovative environments, have put in place measures to curb these exigencies such as an open climate favouring risk taking, trust and open interaction in order to succeed in FEI activities (ibid). Figure 7 below illustrates the three main elements of SLT; 'Legitimate Peripheral Participation', 'Community of Practice' and 'Knowledge needs to be presented in authentic contexts', all of which are linked to the main ideology that knowledge takes place in the same context as it is applied.

Situated Leaning:
Learning that takes place in the same authentic context as it is applied.

Situated Learning
(3 Main Charateristics)

"Legitimate Peripheral Participation"

"Community of Practice"

Learning is embedded in:

Culture

Activity

Context

Believes and behaviours are acquired through social interactions and collaboration.

Knowledge needs to be presented in authentic contexts.

Figure 7.   Lave & Wenger (1991)

For SLT, in a CoP, characteristics, beliefs and behaviours are acquired through social interactions and collaboration. However, LPP is linked with the notion that leaning is embedded in culture, activity and context.

Due to the nature of this study, and as the literature review has suggested, SLT in CoP was chosen as the theoretical lens of this study because it has been proven as a means for extracting knowledge from communities within and external to organisations. This research is also interested in the key theoretical elements of a CoP related to this study. These include behaviour, beliefs, social interaction and collaboration and will be used as part of the units of analysis of this empirical research.

As stated by Lave & Wenger (1991), learning by becoming an integral part of a committed CoP is essential to the development of internalised knowledge rather than just the formal method of learning within a social context to create tacit knowledge. This is sustained by the shared motivation, expertise, skill sets and interests that drive and shape the members within the community. Situated Learning in this context does not mean that members of a community are located in the same geographical location or place but, rather, within the same sphere of professionalism, discipline and expertise.

The cognitive theorist holds the opposite view, as they believe that 'situated' by its very definition refers to being physically located in the same place in order for learning to be possible (Lave & Wenger, 1991). Although the execution of a CoP does not necessarily require the group to be situated in a common geographical place, literature focusing on this area, suggest that the CoP is much more efficient and productive when the members can meet face-to-face for their interactions. Consequently, one of the major challenges for a CoP in the current global corporate environment remains with geographically dispersed corporations where business units are spread across different countries and regions while maintaining the same legal structures and common mission statements and visions within individual varied cultural and ethnic affiliations (Van Den Ende et al., 2015).

The essence of extracting 'assumed abilities' is usually referred to as tacit knowledge inside the CoP in the context of Situated Learning (Frishammar et al., 2012). In addition, Handley et al. (2006) concludes in their research that new associates of a CoP will establish an appreciation of the group which will lead to an understanding and undertaking to modify and re-model different mechanisms. These will include rules related to articulation, roles and accountabilities, alternative explicit artefacts alongside all manners of categorical alliances, tacit conventions as well as underpinned beliefs and ideals.

This position is considered pivotal when formalising the framework for those critics of a CoP that have scrutinised CoPs when arguing against them. In the end, it has still not

been disputed that SLT can be used to understand and frame the extraction of tacit knowledge from the members of a CoP (Lave & Wenger, 1991). Since CoP is based on SLT there are reasons for this to remain the case. Going forward, the researcher has concluded with two research questions that will explore the CoP framework in virtual context through empirical research. He will also seek to investigate the suitability of SLT for the interpretation of the empirical data used in this research. These questions are outlined in the next section.

2.7 Problem Statement and Justification

The main theoretical lens into this research is the SLT of a CoP. This investigation has focused on accessing tacit knowledge from within high technology organisations dispersed across the globe, which is referred to as a VCoP, itself considered alongside a CoP as a core concept within SLT. A VCoP can also be referred to as a CoP but over a virtual network, however, the use of Internet and CMC tools for CoP can to some degree create more challenges and hamper some of the benefits that face to face meetings can produce.,

This review has focused on studies at the FFE and the challenges posed within the NPD processes. Due to the issues surrounding VCoP, the acquisition and transfer of tacit knowledge in organisations remains a highly significant area to extract knowledge for innovation. The methods by which organisations meet these challenges remain a vital gap and several concepts related to SLT are debated throughout the course of this thesis.

In addition, the researcher has observed some interesting connections between tacit knowledge and SLT in VCoP, and recommends this area as being the most appropriate for acquiring the knowledge required at the FFEI. This thesis has also raised some research questions which need to be addressed in order to close the gaps found within this topic. The researcher hopes that during the course of the empirical research more evidence will emerge to narrow down the problem areas and challenges posed by the

research questions outlined below. The researcher will then be in a position to recommend solutions to these problems.

2.7.1 Research Questions

From the above review, the following research questions areas are drawn:

1. Does a VCoP generate learning advantages meaningful to improve the FFE and if so, how?

2. How might a VCoP be organised to contribute to the sharing of knowledge at the FFE?

3. CHAPTER III: RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, the researcher will describe the research methodology and give details of the primary research approaches that can be applied to this field. A qualitative approach was necessary to grasp the complexities of this subject and to provide a deeper insight into the extent of interaction required from the selected companies involved.

This thesis will seek to examine the challenges of how to create and manage knowledge at the front end stages of innovation. Specifically, the researcher's aim is to understand how the formation of virtual teams informs the front end of the NPD process and how virtual teams might be conceptualised as an iterative tacit process which makes use of uncodified knowledge to achieve FFE innovation outcomes.

Research Questions:

1. How might a virtual team be organised to contribute to the sharing of tacit knowledge at the FFE?
2. Does a virtual team generate meaningful learning advantages to improve the FFE and, if so, how?

According to Bryman (2004) qualitative and quantitative research methods are differentiated as follows; the foundation of qualitative analysis is situated in the viewpoint and activities of the representative being analysed. On the other hand, quantitative studies are usually set in motion by the researcher's impressions of how the integral theme of the research should be categorised and proportioned. In this thesis, the researcher applied a combination of storytelling and interviews in order to utilise the full potential of storytelling in extracting information about tacit knowledge.

The research questions in this thesis are focused on how a virtual team might be organised to contribute to the sharing of tacit knowledge at the FFEI as well as trying to

establish if a virtual team can generate any meaningful learning advantages which improve the FFEI and if so, how? It is important to use an approach where the researcher's actions are established within real life situations as an observer (Alvesson & Skoldberg, 2009). The use of a storytelling method entails immersing the researcher into the journey at the FFI, capturing the real life events of process as told by the experts and professionals making up the virtual team been examined. The researcher used these narratives to capture the actual events that occurred. A qualitative method combining storytelling and interviewing is therefore an appropriate research method for this thesis.

Qualitative techniques are comprised of defined research methods which make the world recognisable from their real life settings (Denzin & Lincoln, 2005). This method depicts the world as an array of illustrations through the use of data such as field notes, interviews and other verbal communication, recordings and memos to one's self. In this paradigm, qualitative research includes an analytical, pragmatic approach to the world (Denzin & Lincoln, 2005). In order to address the research questions, the researcher will rely on qualitative methodology in relation to situations and people using interviews and storytelling which depict their experiences. The researcher will also attempt to make sense of or interpret phenomena in terms of the meanings people bring to them.

Due to the nature of the inquiry, the researcher needed to generate data from fieldwork through scheduling interviews with relevant stakeholders within the high technology industries who are interested in finding a resolution to the current problems associated with virtual teams at the FFEI. These people worked in different sectors of the pre-selected organisations and high technology innovative industries such as; Telecommunication, Health Care, Chemical, Aerospace, Mechanical & Robotics as well as automotive industries respectively. The selection of respondents was based on their position in relation to the innovative activities of the high technology company in question. For example, most of them are managers and leaders of innovation at their respective organisations. The reason for choosing qualitative research as the methodology for this research is based on the reasoning that to precisely understand the complexities of the social interactions involved in a virtual team within a high technology organisation,

the researcher will need to be involved and have close interactions with practitioners in the subject area. The researcher used semi-structured and unstructured questions, face-to-face interviews and virtual, online, meetings with videos so as to position himself closely with practitioners in the subject area.

3.2 Research Philosophy

Generally, academic social science research is based on the assumptions of the perception of the world around us, how it functions and how we can best comprehend the realities of our universe. Social scientists approach this understanding of our worldview through several philosophical methodologies such as; realism, empiricism, positivism, idealism, rationalism, functionalism, objectivism, subjectivism and interpretivism (Hughes, 1987). The basis of assessment for these philosophies is grounded in an ontological and epistemological hypothesis. However, although these approaches may lead the researcher to understand the essence and meaning of an inquiry, the questions they raise might not be resolved by an empirical research (ibid).

Since the 20th century there has been a change in scientific views on the positivist approach, with the philosophical ideology of science shifting to a more post-positivist reasoning which rejects the positivist school of thought. A Post-Positivist argues that there are many similarities between the way we think in our everyday life and how scientists think at work (Bhattacherjee, 2012). In a positivist view of the world, science was seen as the way to get at truth, to understand the world well enough so that we might predict and control it. The key tool of the scientific method is the experiment, the attempt to discern natural laws through direct manipulation and observation (Trochim & Donnelly, 2008).

A theme emerged from post-positivism called critical realism which believes that the independent process of our individual thinking has another reality which can be examined in science (Trochim & Donnelly, 2008). This position again takes a different approach to subjectivist thinking which holds the view that there are no realities. That said, positivists

also subscribe to a realist perspective. The difference is that the post-positivist critical realist recognises that all observation is fallible and all theory revisable (Trochim & Donnelly, 2008). In other words, the critical realist is critical of our ability to know reality with certainty. Whereas the positivist believed that the goal of science was to uncover the truth, the critical realist believes that the goal of science is to hold steadfastly to the objective of getting it right about reality, even though we can never achieve that goal.

Because all measurement is fallible, the post-positivist emphasises the importance of multiple measures and observations, each of which may possess different types of error. Therefore, the need to use triangulation across these multiple error sources becomes paramount for the purpose of getting a better understanding of what is happening in reality. The post-positivist also believes that all observations are theory-laden and those scientists (and everyone else for that matter) are inherently biased by their cultural experiences and world views. In short, post-positivists are constructivists who believe that we all construct our view of the world based on our perceptions of it. Because perception and observation is fallible our constructions must be imperfect (Alvesson & Skoldberg, 2009).

In contrast, critical realism asserts that there is a world independent of human beings comprised of deep structures which can be represented by scientific theories. These structures are therefore central to this perspective. Critical realism has been presented as a possible successor to social constructionism, however, if this will transpire remains to be seen (Alvesson & Skoldberg, 2009). In emphasising underlying patterns, critical realism has much in common with hermeneutics and critical theory. Furthermore, by searching for some kind of scientific law, and through its belief in shared characteristics between social science and natural science research it shares ground with positivism (ibid).

A paradigm of social science research which believes that the quest for knowledge is astutely connected around the same system, and knowledge is developed based on the quest for answers to the inquiry posed has been established. Therefore, two types of

research inquiry emerged. Firstly, an inquiry into a problem and secondly, a theory followed by a set of inquiry (Creswell 1994). For social constructionism, all knowledge is linked to our social constructions. In contrast, positivist thought proposes that all knowledge comes to us as single sense-data and theories are just human-made linkages between these single data (Alvesson & Skoldberg, 2009).

This thesis will be analysed from a social constructionism view of the world. Under this philosophical position, while an objective social world might exist, people's views, knowledge and interpretation of the world are socially mediated by their experiences and the actions of others. Knowledge is therefore subjective; a point further supported later on through the use of Content and Narrative Analysis as research methods. This approach is not particularly theory-oriented; the focus is rather on the 'disclosure' of how social phenomena are socially constructed around virtual communities working at the FEI.

3.3 Storytelling Methodology

In knowledge management research, one of the main challenges for innovation at the FFE would be how to capture tacit knowledge within a virtual team (Linde, 2001). Although it can be argued that tacit knowledge cannot be measured in its implicit sense, it can be captured through storytelling because narration provides a bridge between tacit and explicit knowledge (Gabriel, 2000). Storytelling is defined as a verbal communication of ideas, beliefs, personal experiences and lessons learned (Groce, 2004). Storytelling presents some challenges such as a vague comprehension of the narrative with its implications and interpretations within organisations (Iofredda & Angelo, 2008). An example of how this can be related to a CoP and a virtual team at the FFEI would arise when a more experienced colleague might have difficulties in transferring their tacit knowledge to less experienced ones (LeBlanc & Hogg, 2006).

However, storytelling is still considered a powerful means to share knowledge (Ruggles, 2002), and the researcher seeks to achieve this through interviews with the respective participants as part of the data collection process. Kendall & Kendall (2012) determine

that storytelling is an authoritative way for researchers to extract data for information systems using conceptualisation through storytelling inside the structure of the communicative development of technology. This is achieved by adopting an explanative angle. Kendall & Kendall (2012) go on to advocate that researchers should identify or distinguish stories as belonging to one of four categories; experiential, explanatory, validating or prescriptive.

By using storytelling as a method for qualitative analysis, the researcher can obtain an integral story as claimed by Moen (2006) and Boje (1991). Establishing this approach as a research method enables the researcher to be perceptive to the relevant components of the story. By extracting these key facets, the researcher can capture tacit knowledge as the interviewee shares their entire story (Kendall & Kendall, 2012). For example, in one of the interview questions the researcher has asked the respondent to "narrate a story about the occurrence and process of a particular commercialisation of product in your organization beginning from the idea creation to the product launch?" The interviewees have been very generous to provide elaborate answers by telling their stories which the researcher believes can translate to important answers relevant to the research questions outlined above.

3.4 Primary Research

The primary research was carried out by conducting interviews among key personnel from high technology companies within several innovative industries. As part of this activity, face-to-face meetings, online video conferencing and phone interviews were conducted with some of the key leaders of innovation from the selected list of companies deemed suitable for this research. As most of the target companies are multinational corporations, for practical reasons, some interviews were conducted over the phone and via online video conferencing using Skype and WebEx. In order to present a detailed analysis and to be able to interpret the information received during the interviews the communication was recorded wherever feasible. The interviews were conducted over a period of six months. From the start of the analysis it was quite difficult to schedule

appointments with busy employees and high level executives. This created some hurdles in receiving early feedback from the targeted participants.

The interviews were mostly semi-structured and open ended but sometimes included closed questions requiring single short answers and the use of storytelling to extract data. However, it was mainly the open questions which allowed respondents to give their opinions freely with unstructured answers. This technique allowed the employees some latitude and space free from undue influence when responding (Ott & Mendenhall, 1995).

3.5 Characteristics of the Research Data Collection – Business Selection, Data Sampling and Interviewee Selection Process.

This section will detail how potential respondents and companies were sourced, recruited, invited and their contribution and support obtained. This section will also give details about the companies involved and provides information about the individual respondents, including what criteria they had to fulfil to be an appropriate interviewee. Table 5 in this section presents some of the descriptive characteristics of the selected businesses such as role, age, gender and tenure.

Booz & Company's annual study on R&D spending reveals the tools that are transforming innovation-from customer insight to product launch (Jaruzelski et al., 2013) & (Boston Consulting Group, 2012). Their findings from profiling over 1000 global innovative companies identified the top R&D spenders as some of the most innovative industries in the world. These included; Software and Internet, Aerospace and Defence, Healthcare, Pharmaceutical, Chemical, Energy, Telecommunications, Automobile manufacturers and Computer and Electronics.

Based on their findings the researcher was able to develop a comparative value model of the type of industries and companies most suitable for this research. The interviewees in these companies were chosen based on their position as leaders and managers of innovation working as experts at the FFE of their respective companies. The selected

companies where identified based on their industrial and innovation ranking in their respective industries. For example, their R&D spending, brand rating, financial output, their emphasis on innovation, the use of technological platforms and their market position respectively were all taken into account.

The researcher approached the interviewees through linkedin.com and sometimes directly through phone calls and emails to request an interview. Before the scheduled interview date, the researcher discussed the objectives of the research as well as the ethical issues involved in order to validate the quality and suitability of the interviewee for this research. It is worth mentioning that the innovation department of these respective organisations are organised among small groups working in cross-functional settings across the business and sometimes independently depending on the organisation and industry.

The telephone and face to face interviews were conducted with a group of specially requested employees from the companies selected. These included; Innovation Managers, Innovation Directors and Innovation Specialist, Chief Technology Officers, Senior Designers and Creators, Product Managers, Business and Product Development Managers, Innovation Research Scientist, Product Specialist, Corporate Strategist, Senior Managers, Section Heads and CEOs who have formed a virtual team in their respective fields at the FFEI.

The researcher focused on those who work or deal directly with the products and services found at the FFE of their particular business innovation management processes. The researcher sees them as key to the research because they are directly involved with the research subject and were seen as most likely to have a better insight and perspective on the topic. In total, the researcher interviewed 45 innovation professionals located worldwide with an estimated average of around 50 interviews including discarded data.
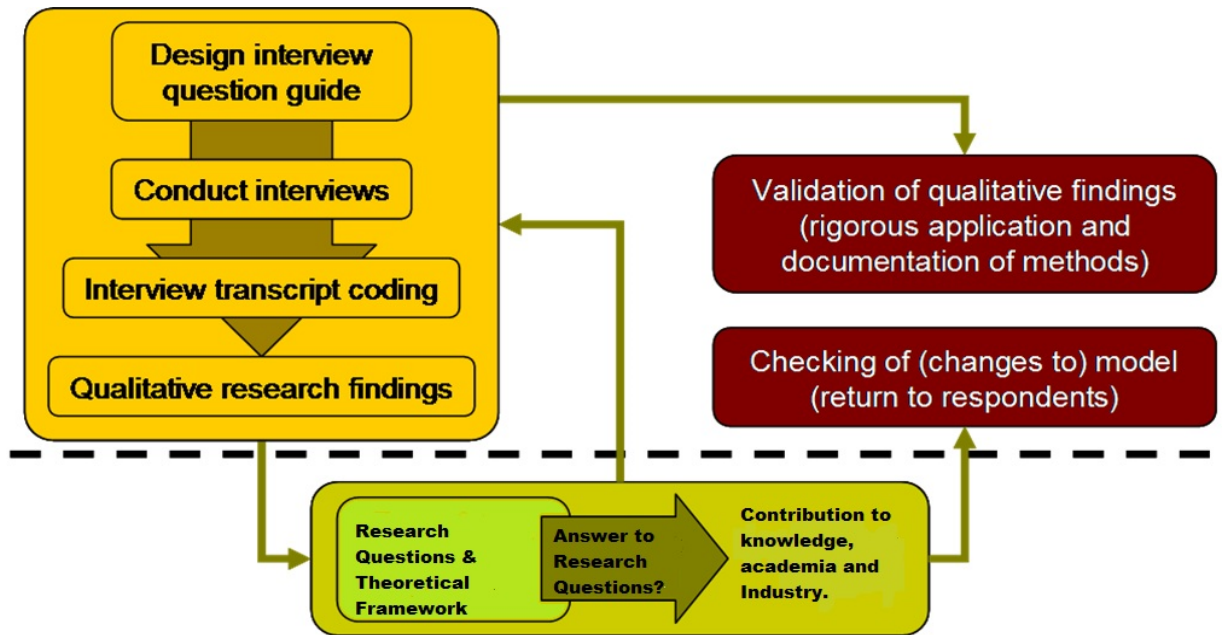
Figure 8. Summary of methodology. Please note that the dashed line in figure 9 represents the boundary between the theory and the real world (Polhill et al., 2010).

Table 4. Characteristics of interview participants and their respective industries. On average, each interview lasted for about one hour.

Size of the organisation (O) and Department (D)	Respondent Title	Age of Interviewee (Years)	Educational Level	Industry	Sex	Age of the firm (years)	Work experience as an innovative authority in the firm (Years)	Work experience as an innovation authority in the industry (Years)
D = 75	Head of Design	38	Master's Degree in Engineering	Telecommunication	F	20	4	12
D = 400 O = 50000	Innovation R&D	48	PhD Electronics	Telecommunication	F	139	14	14
D = 400 O = 50000	Innovation R&D	56	Electronic Engineer	Telecommunication	M	139	30	32
D = 80 O = 500	CTO	42	MSc Telecommunication Engineering	Telecommunication	M	20	3.5	18
D = 40	R&D Manager	66	Masters in Automation & Robotics	Telecommunication	M	40	20	40
O = 1 D = 1	Business Owner	61	Post grad Marketing	Energy Sector	M	4	4	4
D = 4000 O = 55000	R&D Director	48	PhD Chemical Engineering	Chemical	M	350	20	20
O > 5000	Innovation	44	PhD Robotics	Automation & Robotics	M	17	8	20

	Director							
O = 30 D = 20	Creative Lead	34	M.Sc. Information Management	Telecommunication	M	6	3	11
O = 37	Innovation Director	43	Master's Degree	Innovation Consulting	M	21	10	20
D = 4 O = 15	Director of Business Development	34	Bachelor's Degree in Media & Theatre	Innovation Consulting	F	15	5	5
D = 15 O > 50	Marketing Manager	41	B.Sc	Automation	M	7	7	7
O = X D = X	Senior director of engineering, Product Development Department	60	M.Sc Mechanical Engineering, MBA	Automation and Robotic	M	20	3	36
O > 3 D = 1	Director of Product Development	42	MBA in Business	Health care and Cosmetics	F	4	5	20
O = X D = X	Strategic Innovation Deployment	40	MBA	Telecommunication	M	>100	17	17
O = X D = X	Innovation Director	44	MBA Durham	Telecommunication	M	X	5	20

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O = 25000 D = 100	Senior Business Development manager	44	M.Sc Telecommunication	Telecommunication	M	130	15	20
O = 200 D = 12	Head of health care innovation	44	B.Eng, MBA	Health Care/Medical Science	M	7	23	23
O = 2200 D = X	Innovation Manager	44	Bachelors of Aeronautical Engineering	Aerospace	M	100	3	23
O = 70000 D = 1500 Unit = 200	Director of Open Innovation	42	PhD Electronics	Telecommunications	M	90	18	18
O = X D = X	Innovation Consultant	46	MBA LSE	Telecommunication	F	X	8	20
O = 1000 D = 30	Innovation & Development Manager	40	PhD Cell Biology	Health Care & Cosmetics	F	60	0.9	10
O = 1400 D = 30	Director of Innovation and Safety.	61	M.Sc Chemical Engineering	Government Department of Innovation	M	100	2	37
O = 250 D = 15	Director of Product Development	47	Chemical Engineering & MBA	Chemical	M	75	10	25
O = X D = X	Design Director	42	Bachelors of Art	Innovation Consulting	M	110	10	16

O = 10000 D = 100	Head of R&D Innovation	49	Bachelors of Art	Packaging	M	10	8	27
O = 1500 D = X	R&D Director	61	Engineering	University/Telecom	M	800	3	42
O = 1200 D = 300	Director of Business Development and Innovation	55	Bachelors in Chemical Engineering	Chemical	M	100	3	34
O = X D = 5	CTO	47	PhD semiconductor Physics	Digital Electronics	M	5	5	20
O = 30 D = 5	Head of R&D	53	Innovation Certificate	Mechanical	M	10	8	33

The researcher has taken into consideration the diversity of the candidates being interviewed as this could have an impact on the nature of the challenges faced. This is particularly important given that the interviewees are from transnational corporations operating within divergent political and social contexts. For example, a respondent in Colombia explained some of the social pressure faced within the society that discourages innovative attitudes within the culture of the organisations.

In most cases the researcher interviewed only one person from each organisation and it is acknowledged that this can raise another challenge as to the possibly biased opinion of a particular individual. However, during the course of the data collection process the researcher noticed that this can be addressed by asking for a second interview and/or the possibility of interviewing an additional member of the team. Due to the organisational structure of these companies sometimes only a small team is appointed to manage the activities of these organisations at the FEI. Typically, these teams are led by just one member. This clearly makes the leader of the team the most suitable candidate to interview during the first phase of the interviews. Of course, were it possible it would have been preferable to interview more than one member of these innovative teams. However, getting access of this nature is a daunting task. The researcher will bear this in mind while conducting the data analysis of this project.

In addition to an engineering background, the researcher has over 14 years of work experience in the telecommunications industry. As a result, he was able to digest the inferences of each interviewee while as much as possible maintaining an objective perspective throughout the data collection process. The researcher listened as carefully as possible and only asked additional questions when it became apparent that such an approach would lead to further information. At no time did the researcher lead the interviewee into personal and subjective discussions which were out of the context in regard to the topic. At the same time the researcher was very careful not to suggest right or wrong answers to the interviewees but rather allowed them to divulge freely their experiences and perceptions of their domain of expertise.

3.6 Interview Analysis and Thematic Coding

Data collected from interviews were analysed in order to answer the researcher's goals and questions. Interviews were transcribed and interpreted hermeneutically using NVivo software. Processing field data involved transcribing audio recordings, coding transcripts, and building themes that formed the empirical chapters. The process of coding is key as it breaks down data by assigning interpretive tags that generate meaning in respect of transcript material.
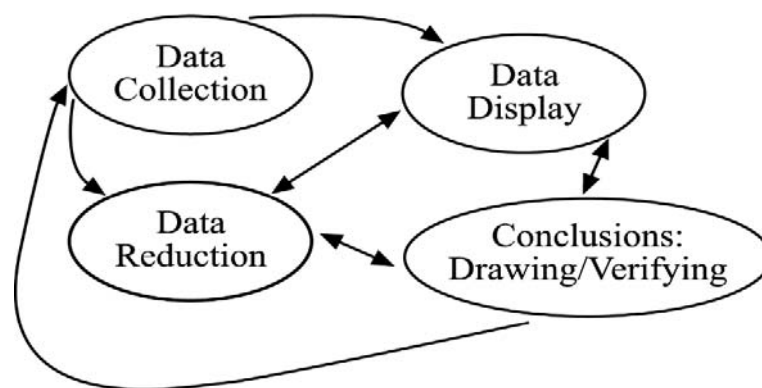
Figure 9. Miles & Huberman's interactive model of data analysis (1994, p.12)

After the first set of analysis, transcription and decoding of data, the researcher reflected on the findings and considered, if the need existed, conducting a second set of interviews with some respondents for the purpose of analysing and re-evaluating the initial primary data and comparing them to the second round of data in order to draw a final conclusion.

3.7 Ethical Issues

Before conducting the interviews, the researcher defined the purpose of the research and explained to the candidates the key elements of his theory. The fact that this research has both academic knowledge and business implications, and was not designed for pursuing any personal agenda was highlighted to the respondents. For ethical and legal reasons, it was also made clear prior to the interviews taking place, that the researcher would not make reference to the names of the selected company employees who participated in the

interviews. The researcher has also taken into consideration all ethical issues as prescribed by Durham University Business School ethics policy.

The researcher always asked for permission from the participants to digitally record their communication. In addition, the Durham University Business School model of human subjects' protection in qualitative research was applied in each case. This protocol requires all research participants to sign a formal statement documenting their comprehension of the methods, goals and potential risks as well as the benefits of the research. This consent form also confirmed the voluntary nature of their participation even though such formal procedures can sometimes be seen as obtrusive in qualitative methodology as the researcher observed.

4. CHAPTER IV: RESEARCH DESIGN, METHOD & DATA ANALYSIS

4.1 Review of Research Methodology

Qualitative research interviews and the analysis of respondents' stories were the main research methodologies applied in this research. This is because interviews seek to understand the meaning of central themes in the life world of the subjects. The main objective in interviewing is to interpret the context of the interviewees' story and journey (Kvale, 1996). A qualitative research interview seeks to capture both an accurate and a contextual level even though interviews pose challenges at the level of meaning (ibid). Interviews are particularly useful for getting the story behind an interviewees' journey and enables the researcher to pursue in-depth knowledge of the topic.

Interviews were far more personal than questionnaires would have been. Interviews were also generally easier for respondents for this research, because it is important to use an approach where the researcher's actions are established within real life situations as an observer (Brown & Duguid, 1991). This was most especially the case where the investigator obtained agreement to conduct face-to-face interviews. Although interviews were time consuming and resource intensive, because of his own experience vis-à-vis the subject the researcher, also considered himself part of the analytical process. This reflexive approach was very helpful in responding to contingencies that arose. One of the first decisions in any social science research is the unit of analysis of a scientific study. Units of analysis refer to the person, collective or object that is the target of the investigation. Typical unit of analysis include individuals, groups, organisations, countries and objects (Bhattacherjee, 2012).

The respondents' main responsibilities included developing, evaluating and testing new ideas and collaborating with colleagues located across various departments within their organisations for the purpose of facilitating innovation and NPD. On average each

interview lasted for about one hour and the questions were designed to explore how ideas are generated at the FEI, challenges to innovation itself and the innovation and communication process at the FEI in relation to the virtual community of the respective firm.

The interview questions also examined the methodological approach being employed in constructing the knowledge story. Interview sessions were transcribed and analysed hermeneutically by the researcher based on the context and Narrative Analysis method. Nvivo10 was used in organising and analysing the data.

Table 5: Research design – illustrate four approaches to the research design

Epistemology – The research philosophy	Social constructionism: all knowledge is linked to our social constructions (Alvesson & Skoldberg, 2009).
Qualitative inquiry – Theoretical Perspective	Qualitative Interviews (Ott & Mendenhall, 1995), supported with storytelling methods (Gabriel, 2000).
Methodology – Empirical data collection strategy	Explorative research approach – Qualitative research approach (Bryman, 2004)
Method – The means for extracting empirical data	Through the lens of Content Analysis (Cavanagh, 1997) and Narrative Analysis (Riessman, 2005).

In general, processing of field data involved transcribing audio recordings, coding the transcripts and developing the themes which informed the findings chapter. The process of coding is important as it breaks down data by assigning interpretive tags that generate meanings from materials in the transcripts. The transcription of audio recordings took about 6 months to complete due to the considerable amount of data accumulated by the researcher.

As earlier mentioned in Section 3.1 of Chapter 3, one of the first decisions in any social science research is the unit of analysis of a scientific study. The units of analysis refer to the person, collective or object that is the target of the investigation. Typical unit of analysis include individuals, groups, organizations, countries, technologies and objects (Bhattacherjee, 2012). In this study, the result from the empirical data analysis was aggregated to several units of analysis using NVivo based on why they were formed, the communication structure and process, experience with technology and knowledge sharing in a VCoP. The research also conceived some concepts which were based on common themes that emerged from the literature reviews, research questions and interviews conducted among innovation professional at the FEI in high technology industries which includes Innovation, Ideas, New Products, Virtual Community, collaboration, organisation data and interviewee personal data. These main themes were further divided into subcategories for more detailed analysis. Please see Table 4 below.

The initial analysis was focused on the main themes and concepts related to the research questions and then further examined using related variables for richer observation. It is important at this junction to restate the research questions and theoretical framework of this thesis to remind the researcher of the main themes to focus on for the units of analysis.

In the first phase of analysis the researcher applied the Content Analysis technique in coding the data. Because of the considerable amount of text data which was gathered, the researcher began by sampling a selected set of texts for analysis. This process was not random. Rather, texts that had more pertinent content were chosen selectively. The main text search criteria selected from the sample population were; 'Innovation', 'Ideas', 'Collaboration', 'Virtual Community' and 'Communication Process'. Secondly, the researcher identified and applied rules to divide each text into segments or 'chunks' that can be treated as separate units of analysis. The rule for segmentation of data is based on the actions and definitions of the context as shown in Table 3 below. In this case only relevant concepts were examined. Finally, the researcher constructed and applied one or more concepts to each unitized text segment in a process called coding as will be shown

below and in subsequent sections of this chapter. For coding purposes, a coding scheme, which will be elaborated upon later in this chapter, was used based on the main themes and constructs that uncover coded data as the researcher classifies the text further.

In addition to the Content Analysis approach, which was used to critically interpret the data following the coding process, the researcher has applied Thematic Narrative Analysis (TNA) to examine the data from the storytelling part of the empirical research. According to Riessman (2005), in social sciences, the investigation of a set of closely-related groups, approached with varied type of texts that can be identified under a common attribute of a storied form, is termed as Narrative Analysis. The varied texts are implied as 'narratives' due to the classification and meanings they illuminate, such as why particular stories are preferred and how they are formulated, associated and assessed as relevant to a target group under research. Storytellers portray the world and actions around it by discovering and revealing the other hidden side of the narrative - depicting the reality of the world from their subjective tales. Narratives are a storytelling method for understanding and connecting our experiences (Hinchman & Hinchman, 1997). In order to answer the research questions this thesis will therefore focus primarily on the oral narratives of personal experiences that emerged in the interviews.

Two approaches are possible when analysing theory driven research. The first is deductive grounded theory and the second is Content Analysis. Due to the nature of the research, deductive grounded theory was not adopted because initially the investigation led the researcher to understand that using a deductive approach to generate substantive codes from the data is mostly attributable to a descriptive approach grounded in a set of propositions.

Instead, a method which came to prominence in the 1960s, called Directed Content Analysis (DCA) evolved from the grounded theory approach, which the researcher finds more suitable for the analysis of this study. The reason for this, as discussed by Krippendorff (2004, pp. 5-16), is that Content Analysis is a research method used for creating interpretations that might be constructed in several dispositions, i.e. from data to

meaningful context. It's main aim is to disseminate know-how, factual interpretations, original vision and a pragmatic approach to the process.

This theoretical foundation will be used to examine the findings and analysis of the empirical data which is based on a deductive methodology. The researcher now examines Content and Narrative Analysis in more detail and explain how they can be related to the empirical research.

4.2 Qualitative Content Analysis (QCA)

Content Analysis is considered by several researchers as a flexible technique for analysing text data (Cavanagh, 1997). It consists of a range of analytical tools which range from 'impressionistic, intuitive, interpretive analyses to systematic, strict textual analyses' (Rosengren, 1981, pp.9-19). The specific type of Content Analysis approach chosen by a researcher varies with the theoretical and substantive interests of the researcher and the problem being studied (Weber, 1990). Although this flexibility has made Content Analysis useful for a variety of researchers, the lack of a firm definition and procedures has led to numerous applications in research analysis (Tesch, 1990). Tesch (ibid) further describes Content Analysis as an approach that gives a methodical and dispassionate measure to construct and assess an experience. As such, it is lays much more emphasis on connotations, objectives, ramifications and conditions than merely counting events or episodes within the text itself.

Content Analysis has a great history in academic research and dates back to the 18th century in Scandinavia (Rosengren, 1981). In the United States, Content Analysis was first used as an analytic technique at the beginning of the 20th century (Barcus, 1959). Initially, researchers used Content Analysis as either a qualitative or quantitative method in their studies (Berelson, 1952). Later, Content Analysis was used primarily as a quantitative research method, with text data coded into explicit categories and then described using statistics. This approach is sometimes referred to as quantitative analysis of qualitative data (Morgan, 1993). However, it is not the primary methodology the

researcher has used because, firstly, the quantification of qualitative data is ambiguous, and secondly, it is contrary to the philosophical, epistemological and methodological decisions taken in this research.

During the last 20 years, the potential of Content Analysis as a method of qualitative analysis for social science researchers has been recognised. This has led to its increased application and popularity (Nandy & Sarvela, 1997). Qualitative Content Analysis (QCA) is one of numerous research methods used to analyse text data such as interview data or editorial reviews. Research using QCA focuses on the characteristics of language as a method communication with attention placed on the content or contextual meaning of the text (Budd et al., 1967; Lindkvist, 1981; McTavish & Pirro, 1990; Tesch, 1990).

Text data might be in verbal, print, or electronic form and might have been obtained from narrative responses, open-ended survey questions, interviews, focus groups, observations or print media such as articles, books or manuals (Kondracki & Wellman, 2002). QCA goes beyond merely counting words to examining language for the purpose of classifying large amounts of text into discrete categories that represent similar meanings (Weber, 1990). These categories can represent either explicit communication or inferred communication. The goal of Content Analysis is "to provide knowledge and understanding of the phenomenon under study" (Downe-Wamboldt, 1992, p. 314). In this research, qualitative content analysis is used because of its ability to efficiently filter the subjective interpretation of text data through the systematic classification process of coding and identifying themes or patterns.

According to Hsieh & Shannon (2005), there are three ways of applying content analysis: conventional, directed and summative. All three methods are used to decipher text data in an objective, unsentimental, manner. For the purpose of this research, the researcher will focus on DCA. This is because, as illustrated in Table 4 below, DCA is best suited to building on the use of empirical research data when applying SLT to the VCoP contexts under scrutiny.

Table 6: Major Coding Differences among Three Approaches to Content Analysis

Type of Content Analysis	Study Starts with	Timing of Defining Codes or Keywords	Source of codes or keywords
Conventional content Analysis	Observation	Codes are defined during data analysis	Codes are derived from Data
Directed content Analysis	Theory	Codes are defined before and during data analysis	Codes are derived from theory or relevant research findings
Summative content Analysis	Keywords	Keywords are identified before and during data analysis	Keywords are derived from interest of researchers or review of literature

According to Krippendorff (1980, p.76) & Krippendorff (2004, pp 127 - 135),

According to Krippendorff (1980, p.76) & Krippendorff (2004, pp 127 - 135), six questions must be addressed in every content analysis:
1.   Which data has been analysed by the content analysis?

2.   How is the data defined?

3.   What is the population from which the data is drawn?

4.   What is the context relative to how the data are analysed?

5.   What are the parameters or boundaries of the analysis?

6.   What is the target of the inferences?

4.3 Directed Content Analysis

To further justify using DCA as the main tool for analysing the text data the researcher will now elaborate further on the method itself. According to Hsieh & Shannon (2005), DCA is applied in research when a theoretical framework is used as a theoretical basis for research based on a deficient paradox or if the research will benefit from further exploration of an existing inquiry. This is evident in the researcher's application of SLT in CoP contexts. Furthermore, Potter & Levine-Donnerstein (1999) also classify this as a deductive adoption of theory placed on their view the role of theory. A similar direction was also validated by Hsieh & Shannon (2005) which claims that the main aim of a DCA approach is to justify or expand a theoretical framework or theory.

Content analysis using a directed approach is governed by a more analytical measure than in a traditional method which is not based strict principles of analysis (Hickey & Kipping, 1996). Using existing theory or prior research, researchers begin by identifying key concepts or variables and codify them into initial categories (Potter & Levine-Donnerstein, 1999). Theory is then used to resolve any questions over the practical interpretation of the data (Hsieh & Shannon, 2005). Therefore, existing theory or research may be used to guide the research question to the right target. It can also lead the research to useful indicators about the variables or about relationships between variables, thus helping to determine the basic coding pattern or relationships between codes (Hsieh & Shannon, 2005). Mayring (2000) describes this as deductive group utilization.

4.3.1 Analysing Research Through Direct Content Analysis

Firstly, because there was a considerable amount of text to analyse, the researcher began by sampling a set of texts for analysis starting with the frequency of selected words as a basis for identifying some recurrent themes. He then and aligned them with the key concepts and themes defined in the interview questions guide. The choice of words for this initial exploration of the data was based on their relevance to the overall research questions. The researcher then identified and applied rules to divide each text into segments that were treated as separate units of analysis based on the key defined nodes (used as variables, concepts and constructs) in Nvivo10. These included;

'Communication process', 'New Product Development', 'Knowledge Sharing process', 'Virtual Community of Practice (VCoP)', 'Innovation', 'Collaboration Process', 'New Idea Generation' and 'Interviewee personal data'. This process is called unitizing. Thus, assumptions, effects, enablers and barriers in texts may constitute such units (Bhattacherjee, 2012). Finally, the utilisation process was intuitively aggregated and examined further to extract the findings themselves.

The researcher constructed and applied one or more concept to each unitized text segment in a process called coding. For coding purposes, a coding scheme was used based on the themes the researcher was searching. These were mostly concepts and constructs within the framework of the FEI premise. Finally, the coded data was analysed, often both quantitatively and qualitatively, to determine which themes occur most frequently, in what contexts and it what ways they are related to each other. The following section will turn to the other methodology used, the Narrative Analysis.

4.4 Analysing Storytelling Data Using Narrative Analysis

This section will outline why TNA in storytelling was used as the second methodological tool for the research. Here, it is important to begin by recognising that one of the main challenges of knowledge management (KM) is to capture tacit knowledge (Linde, 2001). As a significant part of the research would be the extraction of tacit knowledge among teams in VCoPs at the FEI, the storytelling method was used as part of the data collection method because, according to Gabriel (2000), one of the ways to capture and communicate tacit knowledge is storytelling.

Stories are therefore seen to provide a bridge between the tacit and explicit knowledge. Storytelling is defined as orally communicating ideas, beliefs, personal experience and lessons learned (Groce, 2004). Storytelling is also a powerful means to share knowledge (Denning, 2000). These attributes are argued to overcome acknowledged challenges such as lack of understanding of what a story is, how it can be used in the organisation (Iofredda & Angelo, 2008) and instances where more experienced colleagues might have

difficulties in transferring their tacit knowledge to less experienced ones (Brown et al., 2009)

Because of the exploratory nature of the research, the researcher used Narrative Analysis for the purpose of understanding stories related by the respondents. This involved the researcher integrating storytelling at each stage of the process through the use of questions which were designed to allow the interviewee space to construct and relate their own narratives. According to Hyvärinen, (2008, pp. pp. 447-461), "Narrative inquiry has established itself as a broad and polymorphous research orientation within the social sciences." "From a hermeneutic point of view," Widdershoven maintains, "human life is a process of narrative interpretation," quite independently and before any Narrative Analysis (Widdershoven 1993, p. 2).

4.5 Narrative Analysis in Storytelling Method

In this section the researcher will describe the connection between Narrative Analysis and the storytelling method. In addition, this section will justify the use of individual stories and subjective experiences in establishing the true meaning of narratives and contextual environments related by participants. The allegorical perception of our experience through narrative means may be observed in concepts described by McAdams (1993) as 'exquisite comprehensibility' and the 'encircling true life story'. These concepts, when applied among professionals working at the FEI who are seeking to extract tacit knowledge, may well aid the researcher in drawing logical conclusions with regard to the challenges faced at this stage. However, researchers in different disciplines have often harmonised a mix amount of definition to particular narratives. For example, in social history and anthropology, the story of an experience which has been extracted from multiple interviews, observations and documents can be referred to as a complete narrative (Riessman, 2005).

This suggests that the application of narratives in storytelling varies between disciplines. This is also seen to hold true even when they are applied to the same context. The researcher will examine this premise through the lens of sociological and psychological

research, both of which are closely related to social science and the approach taken in this study. Although Riessman (2005) stated that in sociolinguistics and other disciplines narratives are perceived as very limiting, their ability to expose concise and defined meanings even though they may be embedded in stories formulated between various characters, settings and plots was a principal reason they were utilised and applied in this research[3].

Even though the application of narratives in psychology and sociology can consist of extended sessions of discussions which relate to accounts of individual experiences related in multiple interviews over a period of time (Riessman, 2005), this does not discount the viability of the single interview approach used here. Nevertheless, using Riessman's analogue, the researcher's interpretations of narratives leading to a varied approach to the investigative processes in research requires them to formulate text during analysis of empirical data. For example, to select themes for units of analysis, structure, coordinate documents, build field notes and code interview transcripts for further scrutiny. In social science research, narratives still require significant amount of manual effort from the researcher to translate and explain data during the process of analysis (ibid). Although some researchers will agree that narratives are a key analytical method for extracting meaning from a personal life story the general notion and concept of narrative as a method is held with a different view among modern scholars (ibid).

In recent times, the structure and theme of Narrative Analysis is developing expeditiously. 'Textual' and 'Structuralist' models of analysis are generally being replaced with contextual approaches that are centred on narrative practices and storytelling (Hyvärinen, 2008). Semantic theories and cognitive narratology present new means of associating the terminologies of operation and narrative in a more effective approach (ibid). From an expansive definition, story investigation endeavours to

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[3] One of the main popular etymological study of verbal narrative is that of Labov, in which he suggested a narrative composition, established in a series of reviews (Labov & Waletzky 1967; Labov 1972; Labov & Fanshel (1977). The foremost presentation of this in Labov & Waletzky (1967) involved scrutinising stories of individual events accumulated through the process of sociolinguistic Interview into the succeeding components: Abstract, Inclination, Complex action, Assessment, Outcome, Conclusion. All in answer to a single interview question through the Labovian narratives.

effectively engage with the narrative tool being utilised for the purpose of comprehending specific sorts of novel encounters.

Here, story investigators can either put more weight on examining the implications or extrapolate and better comprehend specific encounters. The use of narrative tools for the construction of meaning, which can range from highly subjective, life situations to retrospective evaluations of life courses is open to both quantitative and qualitative analytic procedures (ibid). However, the researcher will concentrate on the use of Narrative Analysis as a qualitative research method in this thesis.

Narrative Analysis as a research technique infers a general approach that gives the perspectives of a person in the context of their social surroundings importance with regard to questions regarding the wider world, including both their own experience of it and their understanding of how others interpret it. Although some challenges in Narrative Analysis have been pointed out with some issues with regard to Narrative Analysis as a method due to misinterpretation and misrepresentation because of the limitations in human knowledge and experience in the area. The bias created by our own life history becomes a hitch for the investigator analysing the stories of the interviewees (Bamberg, 2012).

However, the manner in which the research is operationalised, i.e. through interviews and surveys is fundamentally subjective and interpretive. Besides, in Narrative Analyses the story is raised into the essential frame by which human experience is made important (Polkinghorne & Donald, 1988). In addition, it is important to point out that the stories we tell are a reflection of the mirror of who we are (McAdams, 1993; Randall, 1995).

Data for Narrative Analysis can be extracted through any approach that involves capturing the event of a story such as through video, interview and participant observation, although none of these techniques are mutually exclusive. It is also worth noting that there is some disagreement among researchers who conduct Narrative Analysis about whether the product of Narrative Analysis should also be narrative

(Bamberg, 2012). This relates to how stories are not only narrated by the interviewees but also by and of the researchers themselves. The extent to which these stories are organised is regularly debated so as to reach the intended research audience (Clandinin & Connelly, 2000). The thematic approach was used in this research because, according to Reissman (2008), all narrative inquiry is concerned with content; '*what*?' is said, written or visually displayed. However, in Thematic Analysis, content is the exclusive focus in the applied setting. This thematic analytic orientation will be based on context and themes of the text transcribed from the audio data and the structured sequence of transformational elements, actions and characters of the stories in relation to innovation at the FFE.

Thematic Analysis: Here, emphasis was placed on the substance of a text. The "'what'" is taken as more important than "'how'" it is said; the "'told'" instead of the "'telling'". It is a misunderstood approach of dialect that supports the methodology: dialect is an immediate and unambiguous course to the interpretation of a story. For example, the thematic is a typology of stories constructed by analysing case studies or vignettes, and arranging them by topic is the standard way of presenting emergent data/themes (Riessman, 2005). In contrast, structural analysis focuses on the originality, structure and tone of the oral story with emphasis placed on the language used (ibid).

Other types of Narrative Analysis are interactional analysis and performance analysis. In interactional analysis the focus is placed more on the conversation between the interviewer and the story teller. In this approach the thematic values and the narrative framework are taken into consideration. Here, more emphasis is placed on the narrative as a co-construction process where the storyteller and the interviewee try to jointly establish the context under investigation. With this approach it becomes important to analyse the transcript of all participants in the communication. Finally, performative analysis takes a dramatic approach which tends to present the story in the form of a stage simulation through gestures and art of body language (Riessman, 2005).

Due to the exploratory nature of this thesis, and the research questions posed, structural, performance and interactional analysis are deemed to be unsuitable. Therefore, a

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Thematic Analysis approach was chosen to be most appropriate methodology for the research.

5. CHAPTER V: RESEARCH FINDINGS

5.1 Introduction

The process of Content and Narrative Analysis was lengthy and required the researcher to go over the data repeatedly to ensure the analysis was thorough and objective. The researcher classified the object of analysis into certain themes and variables in order to make sense of the data. The analysis is based on about 45 interviews conducted among high technology companies across the globe. These included industries operating in the following areas; Automotive, Aviation and Aerospace, Telecommunication, Chemical, Service Engineering, Building and Construction, Energy and Power, Information Technology, Research and Development and Service Innovation Consultancy firms. Please see Table 3 below for more details.

VCoP is an Internet mediated CoP that emerged due to online based communication. However, in order for a VCoP to be applicable as an extension of CoP it has to meet all the conditions of CoP as defined by Lave and Wenger (2009). For example, a combination of experts in the specific domain of interest and an informal social structure developed within the community to encourage knowledge sharing and creativity (Murillo 2008; Rogers 2000; Thomas 2005). In order to utilise the VCoP formula to analyse the data some of the specific conditions in a VCoP that will be examined are revolved around people's professional or vocational needs for 'connections', 'information', 'identity' and 'sense of belonging'. CoPs are about what people do for a living (Brown and Duguid, 1991).

After further aggregation of the themes and concepts from the empirical data which emerged from key exploratory issues such as why they were formed? the nature of the communication structure and process, how experience with technology and knowledge is shared in a VCoP, seven key units of analysis emerged. There are summarised below. A more detailed illustration is provided in Table 7.

- Processing Innovation at FEI

- Communication of New Ideas

- Extraction and Creation of knowledge in a VCoP.

- Knowledge Sharing in a VCoP

- Challenges of Communication in a VCoP

- Communication tools in a VCoP

- Challenges in Innovating

Building a structure for the communities requires an understanding of what a successful CoP does that Internet communication technology can help or hinder. Wenger (2001) provides a framework for looking at elements of a successful CoP, this framework informed Table 7 below which matches those elements with communication technologies and key concepts and themes that emerged from the empirical data.

Table 7: Analysis of Case Data

Key Concepts from this research	Evidence from the Empirical Data of this research	Interpretation Analysis as related to this research	Associated with elements of CoP and VCoP
Processing Innovation at FEI	This remains fuzzy as many firms interviewed for this research do not have any innovation process in place. These firms also do not dedicate enough time for the process nor communicate effectively at the FEI.	This discourages investments and investors' confidence at the FEI	Applicable to VCoP in terms of time and space the presence and visibility of VCoP is lacking.
Communication of New Ideas	The communication methods remain diverse due to the dispersed locations of most organisations. The intention would be to add more creative processing and influence on the business model, sales and distribution. Because it is easy to have ideas, it is also easy to fall for good ideas, but on the other hand the idea gets high precedence if it is a good revenue contributor and if it is easy to sell on all the business target markets.	Proper leadership and management was lacking to drive this forward and because of the uncertainties most firms apply a lot of caution in making any decision towards this end. As a result, creativity at the FEI is discouraged. This encourages both online Internet tools and face-to-face methods for communication.	This validates the current trend in VCoP as an extension of CoP which is made up of groups of selected members who share information, insight, experiences and tools about an area of common professionalism, expertise and a chosen subject area (McDermott, 2000; Wenger, 1998). According to Wenger (2001) in terms of participation, the rhythm and efficiency of involvement that may lead to a variety of interaction is lacking.

Extraction and Creation of knowledge in a VCoP	Technology scanning in the market place for needs and future trends in a systematic process still dominated this inquisition. Idea management tools and techniques were set in place in most firms. Informal and online communications were applicable. Again, online tools for microblogging and all kinds of online applications were in place.	The need for informal communication to extract knowledge at the FEI created a barrier on VCoP due to the online nature of the communication. Where VCoP functions in dispersed collaboration it also has limitations to fostering the face-to-face informal and formal communication required to facilitate knowledge creation.	In terms of value creation (Wenger, 2001), short-term value for each interaction and long-term value and commitment. As Bertels et al. (2011) stated in their research CoP help to yield creativity and innovativeness among members through active interaction and the sharing of knowledge when focused or dealing with a particular challenge brought before the community.

Knowledge Sharing in a VCoP	Being flexible at the FEI is key to improving the innovation process of the organisation. Most innovation leaders also suggested open innovation and collaboration with other businesses, institutions and organisation external to their respective companies.	The implication of this result lies on the ability of a firm to foster a grass roots innovation culture that builds trust and supports a flexible innovation process. The quest for Intellectual Property rights and political struggle in the organisation discourages this notion. In terms of community membership (Wenger, 2001) the belonging, fostering relationships at multiple levels and types of participation remain a challenge.	This concept is not aligned with CoP or VCoP. According to Wenger & Snyder (2000), the main objective of these groups within the realms of a CoP is to exchange and spread knowledge within an organisation through the construction of participation, identity and practice networks. Nevertheless, Contu & Willmott (2003) argue that some of these critical constructs have been suppressed by Lave & Wenger's (2001) original theory, in particular the role of power relations which are essential to the management of a CoP. Still, Contu & Willmott (2003) go on to state that it is noticeably arduous, perhaps futile, to attain a practice and therein join a CoP as a recognised participant expecting affability and adequate cooperation if power relations block or disallow admittance to the group's more proficient advocates. Of course, to a certain degree, the matter in contention is the dynamics of power with and within the group (Huzzard, 2004).

Challenges of Communication in a VCoP	Having a face-to-face meeting first or having a co-located team decide a project definitely. It is in an increased range of communication as the project progresses, sharing of knowledge is much more implicit trust within the key members after the face-to-face workshop or the co-location team at first. The face-to-face meeting becomes essential.	This presents some limitations to virtual Internet communication tools, although arguably, Internet video communication tools bridge some of the gaps.	This is applicable to CoP STL as opposed to VCoP in the extraction of knowledge at the FEI. In terms of connections and identity a connection to the world, personal identity and communal identity (Wenger, 2001).
Communication tools in a VCoP	Microblogs, SharePoint, Wiki's, Business model canvass, KANO software, Video sharing sessions such as Lync, Skype, etc.	This has become a standard for communication within a VCoP and most organisations are adapting and experimenting with new tools.	In terms of connections A connection to the World (Wenger, 2001). By using these enabling virtual tools the VCoP model can provide a structure for communalising which can function equal to a co-located community (Murillo, 2008).
Challenges in Innovating	Lack of dedicated teams, management support and funding for groups or individuals working at the FEI. Estimating the proper timeframe for execution. This is sometimes due to the large amount of teams involved in the process. Therefore, it becomes somewhat of a challenge to triangulate the estimated timeframe and accurate estimation, prioritisation and integrity of the project are compromised.	Top management focus too much on the existing product line in order to reach profit margin and operational expenditure sees investment in huge disruptive innovation as a risk due to the uncertainties. This has resulted in a decrease of funding and lack of investment in dedicated teams working at the FEI.	Situated Learning is defined as an active dynamic social interaction between individuals within a practicing community that results in the shaping of new knowledge (Lave & Wenger, 1991). The question of power control within CoP has been a further issue among critiques in validating the effectiveness of a CoP in organisational settings (Huzzard, 2004).

Figure 10 below shows the main themes and node of the empirical analysis from NVivo user interface before further ramifications.

Name	Sources	References	Created On	Created By	Modified On	Modified By
Rules for Commercialiazation of ideas	10	15	11/03/2015 16:24	LCR	14/03/2015 21:24	LCR
Spoting a good idea	17	32	11/03/2015 01:08	LCR	14/03/2015 23:09	LCR
Innovation	2	2	10/03/2015 14:23	LCR	14/03/2015 14:07	LCR
Challenges in Innovating	15	32	10/03/2015 14:24	LCR	14/03/2015 23:11	LCR
Difficult innovation Skills	8	8	14/03/2015 14:26	LCR	14/03/2015 23:06	LCR
Diffusion of Innovation	7	10	10/03/2015 14:23	LCR	14/03/2015 23:08	LCR
Employees views of Innovation	11	11	11/03/2015 11:40	LCR	14/03/2015 23:13	LCR
Fuzzy Front End of Innovation	10	19	10/03/2015 14:23	LCR	14/03/2015 20:27	LCR
Improving innovation process	16	28	10/03/2015 14:23	LCR	14/03/2015 23:12	LCR
Innovation Efficiency	7	10	10/03/2015 14:24	LCR	14/03/2015 21:57	LCR
Innovation experts	14	22	10/03/2015 14:24	LCR	14/03/2015 21:54	LCR
Innovation Methods and Tool	12	23	11/03/2015 01:13	LCR	14/03/2015 23:02	LCR
Innovation skills	18	37	10/03/2015 14:24	LCR	14/03/2015 23:03	LCR
Innovation Strategies	16	39	10/03/2015 14:24	LCR	14/03/2015 23:03	LCR
Innovativenes in relations to other competitors	16	30	10/03/2015 14:24	LCR	14/03/2015 23:09	LCR
Management of FEI	9	23	10/03/2015 14:25	LCR	14/03/2015 22:58	LCR
Managing Innovation skills	7	18	10/03/2015 14:25	LCR	14/03/2015 23:08	LCR
Mitigating the risk of loosing an expert	9	14	11/03/2015 11:03	LCR	14/03/2015 23:06	LCR
Interviewee Personal Data	1	1	10/03/2015 14:11	LCR	14/03/2015 14:07	LCR
Knowledge sharing	8	11	11/03/2015 14:07	LCR	14/03/2015 23:02	LCR
Challenges in Knowledge Sharing	9	11	11/03/2015 16:41	LCR	14/03/2015 23:10	LCR
Knowledge Sharing Strategies	8	11	14/03/2015 15:40	LCR	14/03/2015 23:10	LCR
Knowledge Sharing tools	8	13	11/03/2015 14:07	LCR	14/03/2015 23:10	LCR
New Product Developement	3	3	10/03/2015 14:26	LCR	14/03/2015 14:07	LCR
Challenges in NPD	8	18	10/03/2015 14:27	LCR	14/03/2015 17:29	LCR
Management of New Product Development	12	26	10/03/2015 14:26	LCR	14/03/2015 19:33	LCR
Measurement of Project results	15	24	10/03/2015 22:42	LCR	14/03/2015 23:11	LCR
NPD Process through Story Telling	11	11	10/03/2015 14:27	LCR	14/03/2015 19:51	LCR
Virtual Community of Practice	17	25	10/03/2015 14:27	LCR	14/03/2015 23:00	LCR
Challenges communication in a virtual community	9	18	10/03/2015 14:28	LCR	14/03/2015 21:57	LCR
communication tools in a virtual community	14	31	10/03/2015 14:29	LCR	14/03/2015 23:02	LCR
Creating knowlege in a virtual community	14	20	10/03/2015 14:28	LCR	14/03/2015 23:02	LCR
Extraction of knowledge in a virtual community	11	16	10/03/2015 14:28	LCR	14/03/2015 21:52	LCR
Extration of tacit knowledge in a virtual community	9	16	10/03/2015 14:29	LCR	14/03/2015 23:05	LCR
Knowledge sharing in a virtual community	15	53	10/03/2015 14:28	LCR	14/03/2015 23:02	LCR
Learning in a virtual community	13	24	10/03/2015 14:28	LCR	14/03/2015 23:02	LCR
The essence of communication in a Virtual community	6	10	10/03/2015 14:28	LCR	14/03/2015 23:10	LCR

Figure 10: Output of empirical data analysis from Nvivo interface.

5.2 The Empirical Journey

This research project was designed to look at how a virtual team might be organised to contribute to the sharing of knowledge at the FFEI as well as to try to establish if a virtual team can generate learning advantages meaningful to improve the FFEI and if so, how? In order to achieve this aim, the researcher submerged the seven empirical themes from Table 7 into two underlying structures; Communication Structure in VCoP and Knowledge Sharing in VCoP.

This section of the chapter will first present the findings in summarised form and then elaborate on them further in the discussion chapter. Aggregating the analysis based on two categories will help put the research in context and to help tell the story. In addition, this will help set the stage for other results. The researcher has combined all empirical data sources using the key concepts highlighted in Table 7 above and started off by establishing the structures of the themes. It was important for the researcher to properly examine themes and concepts within the idea creation stages of the FEI because, according to Cooper & Kleinschmidt (1990), two factors were determined as major contributors to the success of new products: the quality of executing the FFEI activities and a well-defined product and project at the ideation stages. Also, in their research, Koen et al. (2002) identified the FEI as the fundamental contributing element for a large amount of radical innovations commercialised yearly.

Figure 11 below illustrates the pattern of empirical data analysis. The red objects are the key areas examined in the empirical data. The green ones highlight the main themes, while those in blue signify the main units of analysis from the empirical data.

The Red Objects are the key areas
Examined in the empirical data

| Interviewee Personal Data | Organisation Data | Collaboration | Virtual Community | Ideas | New Products | Innovation |

The green objects highlights the Main
themes selected from the empirical data

Blue Objects highlights the Main Units
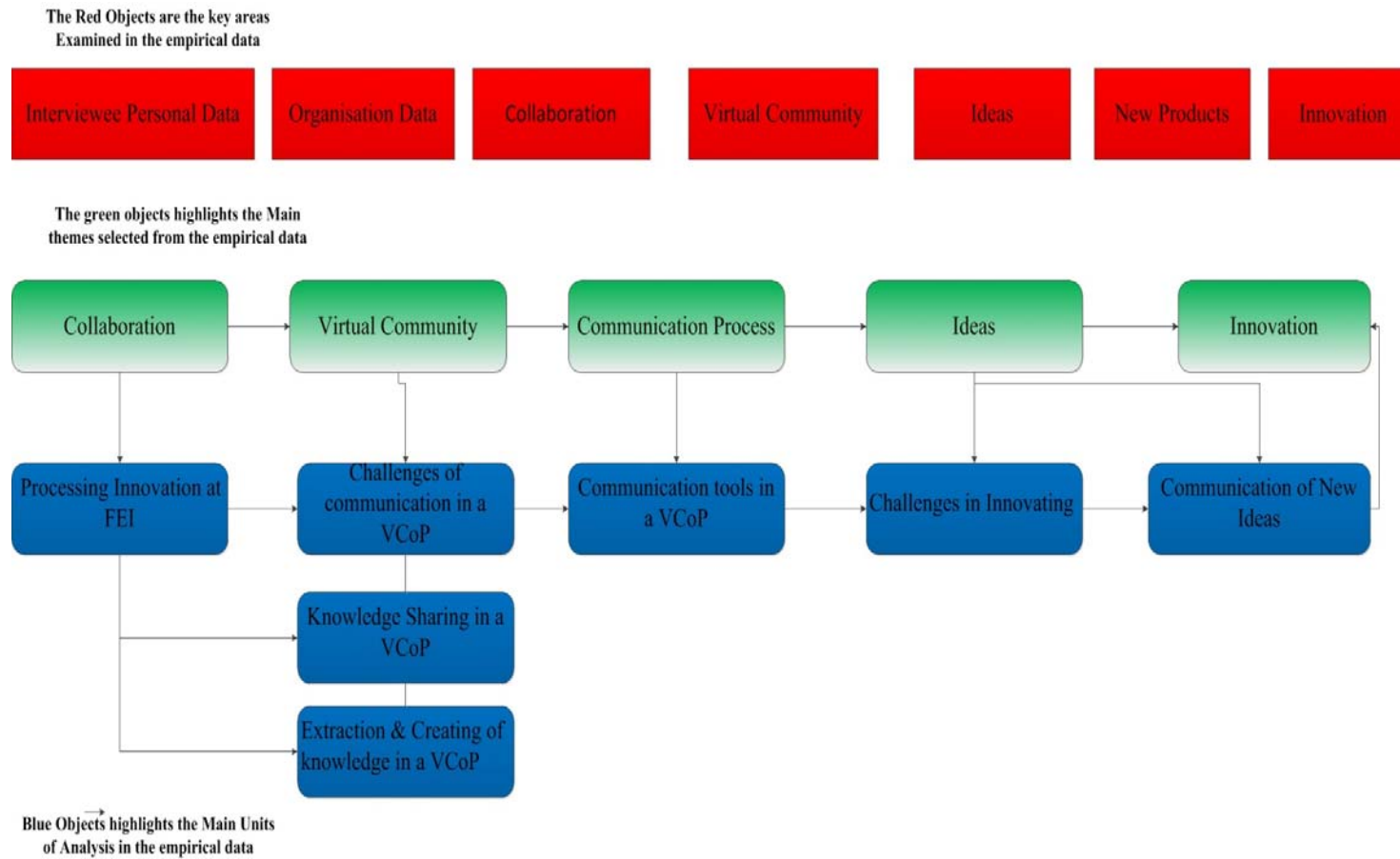of Analysis in the empirical data

Figure 11: The pattern of empirical data analysis.

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Figure 11 above illustrates the data analysis process; coding and themes and more evidence is provided in an example of an analysis transcript attached in the Appendix D of this thesis.

The research started off with the aid of Nvivo Software to extrapolate the frequency of words within the entire set of data which aided the researcher to manually and intuitively capture key themes which revolve around the research question of the thesis. Based on the interview transcript and as is shown by the red boxes in Figure 11 above, the researcher initially focused on extracting these key themes;

Interviewee Personal Data – This theme was used to filter the quality of the data as well as to ascertain the relevance of the interviewees' position in the innovation management discipline.

Organisation Data – The type of organisation where the empirical data emerged was also key factor in determining the quality of the data collected because this research focus is on high technology innovative companies around the world. Understanding the industrial position of each business where data was collected is a key factor to ensure the quality of the data.

Collaboration – This word was about the key themes that emerged from the data analysis as well as other key themes such as; Virtual Community, Ideas, New Products and Innovation. These key themes are also aligned specifically due to the nature of the research question which drives the solution this research seeks.

After filtering the quality of the research data, the researcher re-evaluated the coded data, and further down the analysis, 5 main themes emerged from the empirical data. These are again driven by the research questions and organised around their importance to the research following the literature reviews and theoretical framework of the research.

The main themes show in Figure 11 above in the green boxes are described as follows:

- **Collaboration** – This theme was driven by the collaborative nature of a VCoP

- **Virtual Community** – This theme was driven by the virtual nature of the VCoP

- **Communication Process** – This theme was driven by the need of the research to establish the communication process in a VCoP

- **Ideas** – This was driven around the need for the research to establish how knew knowledge is extracted within a VCoP

- **Innovation** – The word 'Innovation' was the most aggregated in the empirical data and with the highest frequency. Since Innovation remains a key theme in the entire research data is only reasonable to carry it along. However, it is also important to note that Innovating around VCoP remains a central theme of this research.

After further aggregation and analysis of the main themes and concepts from the empirical data which emerged from key exploratory issues such as why they were formed? the nature of the communication structure and process and how experience with technology and knowledge is shared in a VCoP, seven key units of analysis emerged. How these units of analysis were extrapolated and aggregated is shown in more detail in Table 7 as well as in the blue boxes in Figure 11 above. The units of analysis are;

- Processing Innovation at FEI

- Communication of New Ideas

- Extraction and Creation of knowledge in a VCoP.

- Knowledge Sharing in a VCoP

- Challenges of Communication in a VCoP

- Communication tools in a VCoP

- Challenges in Innovating

Finally, in order to achieve the aim of this research objectives, the researcher submerged the seven empirical themes from Table 7 into two underlying structures; Communication

Structure in VCoP and Knowledge Sharing in VCoP. These will be further elaborated upon in sections that follow.

5.2.1 Communication Structure in VCoP

In this section, the researcher extracted data from interviews by focusing most closely on those answers that addressed issues relevant to the communication process and the communication structure at the FEI of high technology companies. For reasons of clarity this section is divided into two parts: Innovation Process at FEI and Communication of New Ideas.

5.2.1.1 Innovation Process at FEI

Managers have described the FEI as the greatest weakness in product innovation (Khurana and Rosenthal 1997). The innovation process at the FEI, as told by some interviewees, is very focused on having some idea as to where the future is heading. For example, current technological innovations and trends that will have an impact on relevant industries' uncertainty, as well as understanding those reoccurring trends and why they are of high importance. This information is analysed in order to add value into the creative process at the FEI where firms seek opportunities to generate new ideas. According to some respondents, the proposed ideas are sometimes often rated and the best are clustered into a group of smaller ideas. In this scenario. the best ideas are often used for conceptualisation for a second level of analysis leading to the bigger ideas. In a way this can be considered as a somewhat structured approach even though there were no proper systems in place to do so. For example, one respondent had this to say:

Interview 9:

"Our innovation is mostly based on a knowledge of consumer's and the client's and kind of the context for which we are designing certain products or creating the design. Therefore, I think it is key to understanding what the customers and the consumers want, but then it is overall to innovate on top of those user requirements and needs. Because I

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know that kind of random people from the street, they can point out the problems but they will not give you the kind of the new innovative concepts or product ideas."

"So I think firstly we formulate kind of the sandbox that "okay, this is the area where we should innovate, that we focus on". Mostly we do it, then we try to get the best ideas. I think just like getting enough people with different backgrounds together, so we have the people like graphic designers, user interface designers, user researchers, software developers, all kinds of consultants here. When you combine all those guys, then you might come up with something totally different."

As stated earlier, some participant companies use some sort of structure for extracting innovation even if does not match Wenger's CoP model exactly. However, other organisations claimed that no such structure exists at their various FEI processes. Most respondents interviewed agreed that there is a well-structured Stage-Gate process available at the back end of the innovation process but the front end remains fuzzy. Most companies treat innovation as a single entity and fail to use the cross-functional approach to innovation culture which should be applied to all facets of the organisation alongside cross-functional collaboration as outlined in the Wenger's CoP theory (Wenger, 2008). It was evident from the research that this was lacking in some organisations. A reference to such structure and process can be seen from the answers from interview 38.

Interview 38 Question: Can you describe the innovation process of your organisation?

"Sure. It is in broad terms not too distinct from what most people would know as a Stage-Gate related process. We began with cultivating new ideas that can be documented based upon the information at hand around what will be the potential market feasibility and technical feasibility and the description of the idea. We have a multi-functional team that co-ordinate the rating and we have a rating scale or ways to put how well that idea fits to

our current business focus and strategy so, as that idea is approved or, we never technically kill an idea we put them in a parking lot, kind of on hold for things that may change overtime or more information may come to bear but the ones that get promoted, we enter into the second phase that we would call concept development and it is typically a limited period of time of about anywhere from one to not more than six months and that is where if we can answer some of the questions that surfaced within the first review of the idea, then we can make a better decision on whether to continue to promote the idea into what we would call an act of project execution phase and resource it for a longer term work or whether we learn something that could be a piece of information, something that says this doesn't make sense for us and therefore we put that idea on hold and if it does pass the screening with the additional work that is done and as we talked about with the first phase review, there is a second level review that combines the technical leadership and the specific business area of leadership of the idea pertains to, if it does get approved at that level, then the project enters into an act of project execution phase and can vary anywhere from usually about six months to up to two years but we are trying to bring the project to a point where we either make a conscious decision to again place that idea on hold if something we learn doesn't make sense then we put that idea back on hold or we decide to go to the final phase before full commercialization and we call that market launch, so, once it moves to a market launch phase, then we really believe we have adequately defined the value or position of that product and that idea".

"We have done some limited work with customers many times under confidentiality to validate what we believe the value proposition is, we have a good sense for products performance of what the pricing that it can justify in a market and then we can do that profitably so when it goes to market launch, now we are really opening that up to broader markets where we now take into the full market, multiple customers trying to see how well the market launch penetrates the broader market and that phase can usually take about a year and at the end of that period of time, we would be either validated, value proposition to where now that product is embedded in existing business line within our carbon technologies group or we learn something's that suggest the opportunity is far too limited and will at least to the minimum, stop actively working on developing that

product concept. There are some that we literally do just kind of release to on-going sales
with a very limited customer base, if it is not a burden in terms of our production
capabilities, but that will be the final commercialization decision where it is no longer at
that point managed within our innovation process."

Another important finding was that innovation at the FFE is collaborative process
between analytical and creative thinkers which is characterised by terminological
complexity. Unravelling this interaction thus became a key goal of this research itself.
One major issue is the problem of defining a problem in the first instance. As one
respondent said "A problem well stated is a problem half-solved". This may indeed hold
currency because a lot of companies misconstrue the challenges associated with NPD or
are missing something within the marketing strategy which may allow them to define
activities at the FEI. This particular discussion can be reference to an excerpt from
interview 12 below:

Interview 12 Question: Please can you describe in as much detail as possible what the
Front End of Innovation means for your company and for you and ow do you get new
ideas?

Respondent answer to interview 12:
"So the fuzzy front end is you know a big term and I would say that what we do is, we
help. Our major push is always problem definition. It's patrol of covering quote a
problem well stated is a problem have sorted. This is so true. Because of lot of lot
companies misattribute the issues they are having in product development or they are
missing something within the marketing strategy. And so we can define what they are
trying to do and this is the part of our immersive innovation process. We help them to
define what their problem is. That is one of the biggest things that you can do, is to help
define the problem accurately. So that when you are doing the research, you are going
through the process, you have it stated properly. I think to be honest, most people would
agree with that. When you could define your problem accurately. And that is one of the
hardest things to do, because so many people have their sort of... when you are in a

company or within the organization, where you are focused on one thing and one thing only, let's say food and beverage. Within those companies, potato chips they are focused on potato chips. They have such linear focus and it is not their issue, it is not really their fault that there are so focused, but they have a hard time looking beyond. And what we deal with every day is people say "Oh, we have this issue" and I say "Well that is not really that issue. I mean you should have look at it from an even higher level. Your issue really is this." and it is sort of an aha moment, when they can understand where you are coming from. And they sort of take a step back and they say, "Wow, haven't thought about it like that."

According to Thomke and Fujimoto (2000), a major breakthrough in the study of the FFEI would be the ability to define the problems and complexities accurately. This would help researchers and professionals at the FEI to properly align the process as well as understand how to properly structure the FEI. The pattern of 'fuzziness' which has characterised the FEI over the past decade is therefore likely to continue unless innovators are able to identify the problems and challenges at FEI, and Martinsuo & Poskela (2011) agree on the effectiveness of using evaluation criteria and innovation performance in the FEI.

Respondent 15 relates an FFE activity that applies evaluation criteria and innovation performance at the FEI:

Interview 15 Question: *Please can you describe the innovation process of your organisation?*
Answer: "Well, I wouldn't call it a formal process because I think innovation innovative is a cultural way that people work. But in terms of how we innovate. We innovate across a couple of different spectrums, we have a specific problem that we want to innovate around, we pose the theme, we bring a multi-functional team into our room we talk a little bit about the need, problem to be solved. I always bring in industrial designers and people that are very good at sketching so they can quickly bring the ideas to life in front of the team".

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"We get quite a few people that are outstanding artists, either at the white board or a piece of paper and as the group articulates their ideas these folks start to bring them to life with cover around what the concept of the person if they're not a good sketcher. And then that usually leads to some of ideas most of the group, and then we generally try to go for as many potential innovative ideas either solve that problem or address that costumer need or gap in the product line. And then we would typically publish the results in rough form, just photos of the sketches or photos of the white board and distribute that to the next level to get people thinking about things. And once we kind of get those the universe of our ideas bracketed we try to down-select it to two or three, if it is a product I would call them architectures".

"Those architectures will then be developed in a little more detail so people can get a better sense around the advantages and disadvantages of each architecture. Then I typically use a weighted decision matrix exercise with the team to define what the key user needs kind of we met by these architectures. What the underneath, and then we kind of go through a qualitative exercise where we rank the key features of each architecture against each other and come up with some type of a quantitative guide that would help in forming the decision. It does not define the decision because it is a very soft tool. But it is helpful, especially in a technical environment where people like numbers and have something that they can help quantify their thinking around".

It is fair to comment that most businesses interviewed for this research have what seems to be an identifiable innovation process in place. The processes are far more apparent in some of the organisations with a tailored product line while organisations that are very dynamic about productisation often have to be flexible with the ideation process. The second and even more important issue concerns the appropriate management of the ideation stage that we term the FFE. For good reasons, the early phase of innovation, in which ideas are born, is often considered the 'fuzzy stage'. The front-end process is indeed highly informal, knowledge-intensive and erratic (Frishammar et al, 2011; Lingo & O'Mahony, 2010). A typical example is from Respondent 6 below. When asked, in

case you want to introduce something new – for example, a new service or product - how do you get new ideas?

Interview6

"I wish I could, it's quite fuzzy well to start with, we have the Stage-Gate innovation process, that's fairly new to us and in being pared as company X we are trying to get a joint unified Stage-Gate innovation process in some business units we have had it for many years but in most business units we have not had it. In my own business unit, we have started with it a year ago and that is one of my main responsibility to be the process owner for the Stage-Gate innovation, that is just the process, probably you know very much about the Stage-Gate process and I can tell you that one revolution for us was that we really started to use cross-functional, we did not do that early we will claim that we worked cross-functional but honestly we did not."

"If we go back 5, 10 years ago, back to the 90s one R&D project was born in the R&D department and conducted solely in the R&D department and then when we had found that answer and had a final solution, we so to say and then we hand it over to the marketing and the supply chain, that was really not good. Now we have the fully closed functional process so already what you call the fuzzy front end, we try to involve people from integrated supply chain all production and marketing and sales and legal and financial and all kind of functions, so that is the big revolution so to say".

An important theme that often emerged from the empirical data was the application of innovation across the entire cross function of the organisation, where innovation activities are not only isolated within the R&D or the Innovation Department. Again, just as was found in the literature review, the Stage-Gate process is often applied at the FFI of most organisations while the challenges remain at the initial stages of the FEI.

5.2.1.2 Communication of New Ideas at the Front End of Innovation (FEI)

This section describes how organisations communicate new ideas at the FEI based on the empirical data collected for this thesis. In the sections that follow the researcher will bring link the themes which emerged to the research questions themselves.

In addition to the stage-gate process, several attempts have been made to structure the FFEI (Murphy & Kumar, 1997). However, the FFEI remains fuzzy. This is reflected in Khurana & Rosenthal's (1998) multi-faceted definition of the FFEI which included; 'product strategy formulation and communication', 'opportunity identification and assessment', 'idea generation', 'product definition', 'project planning and executive reviews'. Nonetheless, these elements have been useful in assisting the researcher in aligning the importance of communication with the FEI process and frame the opening to the discussion in this section.

In many large organisations, the researcher found that there was no single method of communication but rather multiple channels of sources and ideas that are generated in different areas and are managed in different ways. For example, some organisations use an idea box for companywide contributions. The suggestions are then screened and filtered to small amounts which might eventually make it to the prototype phases. Some ideas might even make their way to the company long term product development strategic planning. In these instances, they may end up being processed by different entities depending on the nature of the idea in the first place.

An NPD group who are determined to yield a great innovative result will often juggle around different problems, ideas and conceptualisations during the FFE activities in a dynamic and flexible way, fine-tuning the outputs until perfected (Griffin et al., 2012; Reid & de Brentani, 2004). The use of VCoP which depends largely on textual communication to provide understanding to the virtual innovation team at the FEI could assist teams dispersed nationally or globally within or external to the organisation for exchange and sharing of professional ideas (Boland, 1991). Again, the usage of VCoP by virtual teams working at the FEI creates a bond of togetherness for mutual benefit service

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(Schultze & Orlikowski, 2001). This, in turn, leads to better communication pathways for sharing of new ideas (ibid).

Interview15 Question How did you communicate new ideas or changes in your organisation, which were derived from a recent management decision or stakeholder's relationship?

Answer: *"I have team meetings frequently with my team and I just like to keep everybody up to speed certainly for both that are remote you know in China email or Hong Kong. But I think pretty standard stuff".*

Question: Do you think that these methods have been fruitful and what do you think needs to be done to improve the processes and what are you doing about it?

Answer: *"I think it works fine. I mean I have always felt that real time communication with team meetings lets people do an emails unit direction on it sometimes misinterpreted. So one of our possible if there are new ideas or changes I find that our team meeting in real time is the best method."*

Ideas are crucial for innovation to happen. Hence large multinational corporations such as Allianz, Ericsson, DHL, GE and Shell use knowledge management activities to pollinate, extract, establish, assess and facilitate ideas within the organisation and to introduce innovation (Fairbank & Williams, 2001; Frese et al., 1999; Dijk & Van Den Ende, 2002). Some of the interview participants mentioned that it is important to recognise that organisations should be built around the fact that people make things happen. People create and build new products and not companies and therefore it is important to value the employees within the business as well as making efforts to keep them together. Also, it is very important to maintain the essence of conversation among these people, either through face-to-face or online collaboration. Having the right set of people in this communication process is essential and face-to-face communication is deemed important

even though most organisations today rely heavily on email or other virtual communication tools.

As outlined in CoP learning theory, in order to drive a new idea, product or process it is also necessary to have core teams and clients from diverse disciplines work and communicate with each other on a daily basis using the same workspace. However, most organisations are dispersed nationally or internationally and cannot afford the luxury of such co-location of teams but rather have to rely on online virtual communication tools. Although 'Situatedness' in Rogers' (2000) CoP theory. does not necessarily translate into physically being in the same location in all cases but rather situated in the same discipline or industry.

Interview 11 Question: Do you think that these methods have been fruitful and what do you think needs to be done to improve the processes and what are you doing about it?

"On a continuous basis we are tracking the most relevant trends that impact our industry. And we do that by ways that several colleagues have their own areas where they are capturing and sharing exciting trends and examples of change.

Then we have an automatic trend spotting service, we set up specific words that look for news in relevant news articles. So that is like a news site crawler that looks for interesting trends, activities and events within our industry, and capture that. So we run like a trend analysis and business intelligence analysis on a running basis. Then on frequent occasions, we have idea jam where employees are invited to participate in sharing their ideas, idea suggestions. Then that is so like a company public space where everyone can see different suggestions, everyone can comment and vote on the suggestions they like. And then some of the suggestions are grouped or merged into a bigger concept, and that is outlined and described and analysed for that to set some specific criteria's."

Transparency of communication was identified as a major challenge in knowledge sharing but the use of publications within the organisation itself has ameliorated this problem in some companies. Some corporations practice the use of frequent workshops to promote this endeavour. In this regard, some individuals from diverse teams and projects are invited to participate in the event. Other respondents suggested having an 'innovation or research day' to showcase innovative project prototypes. They believed this approach encouraged innovation, and found that displaying the results of innovative outcomes, and providing feedback during the event also fostered a creative environment. For example, when the researcher asked what, if anything, would you change about your organisations' innovation process if you could? Respondent 30 replied:

"Well, what I think everyone in the company needs a basic training in innovation, in innovation perspective right from idea generation, portfolio management, commercialisation and learn something about the various tools that are available in order to generate new ideas. I think in that sense, everyone in an organisation need to understand that they are a part of an innovative process and they have a task to challenge, to contribute to the organisation by being more innovative and that could be, I mean innovation in itself is a rather broad context. I think it is everything that makes the work you do tomorrow, it makes it more focused, it makes it better, it makes it more creative than you did it today and it could be reducing lead times, it could be taking new opportunities, you could find a new application for the things you are doing, you could find a new way of doing things, you can find more uses of something that is already out there. So, I think it is from the sector to the top because how often do actually managers question themselves and the way that they rule and the way that they support their organisation or govern their organisation so I think it is as much for mangers to continually improve the way that they manage."

Most of the answers received from respondents highlight nearly the same facts as above apart from virtual collaborations where time differences between countries exist such as the time zones between Europe and Far East Asia. Emails therefore became handy as

well the use of virtual real time meetings to communicate new ideas and share information. It is very interesting to note the many different tools for communicating new ideas. For example, some organisations have used TV Shows, newsletters and some sort of Twitter type of application to share events.

It is worth mentioning that the documentation process is a major part of communicating and disseminating information and new ideas within an organisation. For example, shared storages of information and document repository. These documentation processes are all used for validating and sharing digital, virtual and physical communication among teams at the FEI. It is also very important to communicate new ideas as early as possible to the project teams, and people should feel involved as active participant in the process from the beginning. This is particularly important in relation to their engagement with the complexities of an idea, and also to immerse them in the process. This particular theme emerged in several interviews.

When knowledge becomes individual specific, and certain individuals become a repository of that knowledge, the organisation ends up having to coerce that information from them over a period of time. This process is sometimes referred to as tacit knowledge. It is recommended that the organisation put a career plan in place for these more experienced employees who have accumulated this knowledge to make them see the bigger broader strategic goals. For example, these more experienced employees should be convinced that not sharing this information will not be of any particular advantage to them. Some organisations had to give their experts incentives for doing so and this can vary from person to person. These incentives may come in the form of an excellence award or some kind of recognition for them before they really become collaborative rather than exclusive in terms of knowledge sharing.

Sometimes languages and culture, national laws and times zones were found to act as barriers in dispersed collaboration. For example, an organisation conducting an online virtual meeting consisting of teams dispersed transnationally over multiple jurisdictions often experiences challenges in integrating and managing the different variables.

However, this can be mitigated after a period of time through the increased familiarity with accents and the development of common understandings. Once they reach a level of common understanding with these issues the collaboration will feel borderless, it is seamless. In some cases, however, knowledge sharing takes longer than usual in dispersed collaboration due to these cultural and language differences and sometimes even creates an unwillingness to share information.

Interview 15 Question: Please can you describe in as much detail as possible what the Front End of Innovation means for your company and for you, and how your organisation is driving this forward? For example, any particular activities in places?

Interview 15 Respondent Answer: *"We have an R&D group that is in charge of finding fuzzy concept and feasibility around some key areas that we are actively engaged and developing. And they are involved in the brainstorming along with product development team. We typically develop concepts new technology brainstorm around the potential product need that could be tied to a roadmap and could also be tied to an intended launch date. So we have backed all that up, if we say we want a ground breaking new upright vacuum cleaner that will be released for the holiday selling season in 2016 which means that in September it is going to be shipping to stores from distribution, which means that in July it is going to be falling on a ladder out of the factory that we going to pick to make it in China. And 9 months before that we already have to solidify the concept. So if I want to make something innovative for that product kind of like what the automotive companies are doing, you have a road map that ties the key launches and some of them are new platforms, some of them have what we hope would be very innovative features, we start doing that work 12 to 18 months in advance before the intended launch date. So we kind of bookend our innovation time in our ability to incubate significantly new ideas around where we want the product to end up. Because in the retailer business our launch is tied to retailers' shop resets. And those happen a couple of times a year. They happen in the spring and happen in the fall. And if you don't hit it on one of those, you not necessary get a scheme (12:50) on shelf. "*

"We have a process by which we develop products that is first teams all understand the framework. And we have informal processes for daily communication, so that we can leverage with our large team in China that picks up a lot of the work that we leave when we go home. They pick it up and they work during their day which is our night. So we effectively get solved the solid engineering and product development by the way we cooperate and communicate with our team in China since they are 12 hours off set. Q: What communication methods do you apply within your Company's R&D and or New Product Development team dispersed geographically either nationally or internationally? When we are iterating a design we exchange cad and MCAD and ICAD files on a daily basis through an FTP site. So when work done we load it they grab it, when they are done they load it we grab it, and we do that every day. And in addition to dropping the CAD we generally put together a fairly rich Power Point presentation that includes screen shots of what we changed, questions that we have for the team to work on during our evening, and generally direction that we would like our team in Chine to have and then they do the same for us in terms of we can learn in the morning as a response theirs to what they did what they question are. So we have this kind of informal back and forth collaboration in words and pictures, because it is very importation to communicate with our team in China very clearly. And we found over time that screen-shots with pictures simple bold questions are more effective than trying to have early morning or late evening conference calls."

"I have team meetings frequently with my team and I just like to keep everybody up to speed certainly for both that are remote you know in China email or Hong Kong. But I think pretty standard stuff. I think it works fine. So one of our possible if there are new ideas or changes I find that our team meeting in real time is the best method. Our ideas come from many different sources, I mean I think you can't limit your ideas. We are probably one of the most costumer centric company that exists, which is I think why we have experienced such good growth. So our ideas come from consumers we do a lot of research, we use a lot of tools. I don't know if you are familiar with Kano analysis, but I find the Kano analysis gives ideas for existing products that can be breakthrough from costumers if you can draw that information out. We get breakthrough ideas from our

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retail customers. You know we sell to consumers directly we also sell to consumers through retailers. Retailers have the advantage of talking with all of the companies that they also hear directly from their customers what they like about products and what they don't like. So we get very good ideas from our retailers. And every one of our employees is a consumer. So we get outstanding ideas from our employees as well."

5.2.2 Knowledge Sharing in VCoP

Irrespective of being based in different locations or organisations there are many horizontal activities that bring individuals of common interest together to share their ideas (Murillo 2008; Rogers 2000; Thomas 2005). Most companies interviewed for this research used tools for micro-blogging and all kinds of online applications. Furthermore, they have well-established practices in place in the fabric of these firms in respect of these activities. Respondents described the challenges faced in an environment where the absence of face-to-face communication due to the dispersed nature of most organisations resulted in the need for the use of Internet communication technologies and platforms as a means of online collaboration. However, while virtual communication sometimes works well for most organisations, it's success or failure could boil down to an individual's personality and character. For example, how engaging and charismatic the virtual teams' members are.

Mostly, the ideas generated are good but, at the end of the day, it is a game of practice that can proportionately determine the market potential of an idea or product. Following Schultze and Orlikowski (2001), the use of VCoP could provide a common practice or means of solving common problems associated with virtual team collaboration when seeking to share knowledge. Indeed, it could also help them construct a common knowledge repository to improve the various tasks they perform at the FEI. An important component of VCoP is textual communication (Boland 1991), and therefore a knowledge repository based on textual communication would provide an ideal framework for analysing and understanding of activities of participating VCoP teams. This was said to be in place by most firms who participated in the research.

Interview 2 Question:

Question: "How do, how did you communicate new ideas or changes in your organisation which was driven, which was derived from maybe recent collaboration from some of your stake holder, the universities and all the partners you work with and then finally you find a new idea, how would you communicate this idea within your organisation and this changes?"

Interview 2 Answer:

Within the project it's, I would say sharing text knowledge and during the experiment and research we have the papers, the patterns, the technical reports, the result from that experiment and so on. Then we have some internship, for example, some people exchange, and people from universities that goes to our R&D Lab and we have some visitors from within our business to the universities as well. Yes, and within corporate research they spread the knowledge from the project, the main result from the project".

Twoof the major hurdles in online virtual communication within an organisation are the engagement process, and the ability to be able to constantly follow-up interaction with communities. Often, innovation teams are involved in different projects simultaneously and face the challenge of logging activities online. Keeping track of virtual communities thus becomes an issue due to the authentication process required for some online communication tools. Some interview participants suggested that perhaps having some constant reminders through the use of email and automated systems might ease this problem as well as foster a conscious motivation for the effort.

Another challenge can be seen in the manner in which the poor interface associated with SharePoint, which was designed for more general use rather than customised for one particular firm environment, causes difficulties. In SharePoint software, one has to actively seek out information as there are no functions to automatically keep the user on track. Face-to-face communication is appreciated in this case and can make a difference

when it is possible to have a quick chat with a colleague sitting in the next office space or on the other floor.

Even though blogs and wikis are meant to supplement some of the face–to-face activities lacking in a virtual communication, the power of face-to-face conversation with a colleague or colleagues sitting nearby should never be underestimated because it gives the individual a chance to have quick, direct, feedback and respond immediately. However, this can also be achieved through video communication. This validates Meyer & Marion's (2013) claim that certain challenges exist within the area of VCoP due to the loss of tacit knowledge, which currently requires face-to-face time in order for a CoP to flourish.

One instance of this can be observed when the researcher posed the following question from interview 16: Can you describe any particular difficulties or challenges experienced by your company in relation to innovating? This particular question was meant to capture the challenges of a VCoP within the FEI.

Interview16 Answer: *"I would say we are getting better since we have created the R&D team. But prior to bringing in a team dedicated to work in the fuzzy front end or the front end of innovation, we were always hostage to the latest project that needed to be accelerated or kept on schedule. We were pulling people away from that kind of innovative front end because there is always time to do that after we solved the current crisis. So I would say the biggest challenge is keeping the core set of people focused on innovation and outside of the execution of existing projects.*

Some interview participants agreed that getting people from different background into the same space and page is a good way for knowledge sharing but comes with some challenges such as; handling the iterations from different individuals from different background with different ways of thinking."

5.2.2.1 Virtual Communication versus Face-to-Face at FEI

Some respondents claimed that having a face-to-face meeting at the early stages of a project in a co-located setting facilitates the pace of project discussion as well as puts a face to colleagues' names and encourages team spirit and identity. It also adds an increased range of communication as the project progresses. Therefore, sharing of knowledge becomes more of an implicit trust within the key members after the face-to-face workshop or the co-location team meeting. After the innovation team at the FEI returns to their virtual settings having physically met new colleagues, they are more likely to place more trust in new collaborators and less inhibited when it comes to future knowledge sharing. Therefore, a face-to-face meeting is seen as essential at the FEI for better and faster results. For example, please see excerpts from Interview 1 answer from the empirical data below:

Interview 1 Answer:

"Yeah, we have like two major teams that are in the United States, and each one of them represents one of the businesses horizontally but they are international. My team has been involved in a little bit resource teams but not so much but mainly, its project based so, if you have a project that you run with them or they run a project and they hear that we have done something similar already or looked into the same area then, you organise a sharing session. We try to use blogs where everyone can participate and know what is going on. I always find it really difficult but if you work on a project together, you have one space where you share and update documents that might be relevant and having regular updates as regards something that may be happening which you can put out there.

we have regular touch points, some face to face time like in a workshop or a couple of days, message board, when you bring the team together. That is more in the beginning. Yes. It is considered important for collaboration.

I think we have like a combination of skills especially in the area that we are developing things for you. You do need a designer, developer and marketing specialists and the earlier you involve these people, they kick off the project the better.

I think with the blog; my biggest problem is SharePoint. You have to actively look up stuff all the time and there is nothing that makes you go back or keep you on track automatically. I think the biggest difference in having someone sit next to you or on a floor below you that you have a quick chat. I think the idea is that the blog should replace them but if the person crosses my path like twice a day, I naturally talk with the person about it. If I have to go to a blog for a project, then I don't have to keep track with them and I never saw it really working. It is always like one person who is very active and who is maintaining it but it never replaces things like a quick chat.

With the workshop, you have to get the people into the same place, then you have to get everyone on the same page, you have different backgrounds and that is a nice thing but that is also difficult like taking everyone up from where they come from and communicating what is the next step, what are we trying to achieve and that is like handling alterations from different people that have different background and different way of thinking."

If the face to face meeting has already taken place some individuals appreciate further face-to-face interaction due to the one dimensional nature of communication using virtual knowledge sharing tools. For example, emails are easy to use across geographies and cultures, telephones and video conferencing helps brings the individual closer to a face-to-face interaction but still there remains some gap. Respondents prefer a co-located meeting, seminar or workshop at the outset of a project which they believe are immensely helpful in terms of knowledge sharing across VCoP as well as building the life cycle of the project in question.

Such early stage, face-to-face, interaction was particularly recommended during innovation ideation processes, implementation processes or even general discussion. As

organising these events on a regular basis can be very costly and time constraining, online VCoPs supported by Internet technologies can be a viable alternative to live conversation and knowledge sharing (Dubé et al. 2005). This view is supported by Murillo (2008), who proposes that VCoPs can facilitate the sharing of real tacit experience by enabling virtual teams at the FEI with common interests and objectives to engage in discussion, debate and reflection.

An alternative can be seen in how some organisations use an 'idea management' website as a platform for capturing ideas. Here, 'idea challenges' among company employees are organised roughly four to six times in a year on a specific topic. These are complimented by face-to-face workshops, with groups recruited from throughout the organisation. Depending on the type of product and business structure, some interview participants claimed that ideas are sometimes generated by customers, and therefore they are often invited to join the workshop and even the innovation process at the FEI. Additional participation may take the form of separate workshops specially designed for customers.

Some respondents also claimed that, depending on the type of business, service or technology, harnessing a new idea from the market may be achieved by analysing customer feedback on factors influencing demand for the product or service in question. In some cases, however, customer insight might be problematic especially in a break through innovation such as the Apple iPhone where the customer vision for the future might be short-sighted. In these instances, it becomes important to go beyond what people say and try to understand the basic future market needs or trends. These contacts with the market are considered sometimes a key to innovation but are often insufficient in themselves and can only complement existing processes.

The findings also suggested the importance of idea ownership and collaborative, needs-based, decision making processes in finding and selecting new ideas within virtual teams. However, this process may require a considerable period of time to come to fruition and may only be achievable if firms can avoid the temptation of killing off ideas in early stages of the decision making process. The ideas should be analysed and deliberated upon

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by the team during the period under review until the basic needs they satisfy are understood and developed.

To encourage innovative ideas being generated within the business, businesses engage in incentive schemes (Alexy et al., 2009) such as awarding prizes through miniature compensations, property rights and financial rewards. Nevertheless, very little is known or understood about how these rewards influence motivation, member's contributions or output. Literature in the area of creativity suggests that rewards only serve as a short-term measure that regulate individual conduct, and will eventually have a negative impact on motivation and innovation as well as minimise innovation output itself (George, 2007; Hennessey & Teresa, 2010). However, other school of thoughts argue that rewards would instead help the team to place creativity as their primary objective as well as encourage individuals to work harder towards high performance as well as focus on innovation in order to enhance their creativity (Eisenberger & Armeli, 1997).

One interview participant stated this below when asked about some of the challenges he and his company faced in knowledge sharing at the FEI:

Interview 30 Answer: *"Knowledge sharing is a difficult process because at most times knowledge sharing revolves around successes and not about failures. It is somewhat easy for people to share knowledge about success but it is not very easy for people to share information about failures and this is where the fundamental question of leadership comes into play. It is important for an organisation to have leaders who are capable of acknowledging their own mistakes and are open with them as well in order to make it possible for people down in the organisation to follow this example".*

The respondent further elaborated on the answer with an example and real life scenario as stated below:

Interview 30 Answer: *"…because if you just play the big master and the one who knows it all and never do anything wrong, people will never dare to admit that they did*

something wrong but one of the strongest leaders in Sweden actually was that because what that leads to is low level of risk taking but he used to see and make friends of the one who started Company A and other companies in Sweden and the head of the Company B Group, the guy who died back in 10 years ago now. He was very different, he asked people in his staff and his leader, how many mistakes or failures have you made this month? The people asked said, well I haven't done any failures but then he said, "Then you haven't tried harder". I think that the different way of challenging people to take more risk but to not only play things safe."

This particular answer was very important because it emerged several times in the interview discussions regarding the role of a bottom up approach to innovation. Some participants, however, claimed that most decisions are made at the top of the organisational hierarchy making some contributions made by those at the lower end of the chain irrelevant. In their paper, Salter et al. (2015) highlight an evolving topic in FEI community management, which implies that the interest from the higher strata in the firm is significant for the value of the ideas created within the organisation. However, there are other essential parts of idea creation which are not applicable to this assertion, for example, those mentioned in this research not related to compensation. Globocnik & Salomo (2015) and Kock et al. (2015) encourage further research in the area of how managerial interest functions in terms of boosting the quality of ideas of the innovation team or company personnel in general.

5.2.2.2 Measuring Knowledge Sharing and Impact Assessment at the Front End of Innovation.

Measuring the impact of knowledge sharing is one of the factors in understanding if a virtual team can generate meaningful learning advantages to improve productivity at the FFEI. The important thing is to measure the impact of sharing rather than just having means or methods to actually store knowledge (Murillo, 2008). A number of factors are critical here. For example, the amount of knowledge shared in different types of projects, whether it is internal or external expertise, an open innovation environment or a closed

one, the number of personnel involved and the diversity of the team itself. It is therefore important to include the diverse amount of knowledge contributed by each stakeholder in the process, and also measure knowledge in terms of the diverse inputs that go into the innovation process at the FFEI among VCoPs. VCoPs are informal, self-organising, networks of people dedicated to sharing knowledge. VCoPs evolve over time and can become dynamic and create the flexibility that enables them to discover objectives and re-invent themselves where necessary (Wenger et al., 2002).

Research by Van Den Ende et al (2015) argues that there are two outstanding problems to consider with regard to the management of ideas for new products and services in an organisation. Firstly, the need to emphasise the importance of development methodologies, i.e. the means and procedures that will enable a larger amount of innovative and diverse concepts to be created and, secondly, isolating the best ideas from the rest. Nevertheless, with the growing number of specialists with technical and scientific understanding, coupled with the influence of information communication technology integrated tools, the amount of ideas created and assimilated through the firms internal and external collaboration activities could become overwhelming to manage within the organisations themselves.

Most organisations interviewed for this research do not measure knowledge in their respective organisations. Instead, they evaluate the performance of the innovation team and, where there is no evaluation procedure in place, conduct weekly meetings or biweekly reviews with senior management to help achieve this aim. In some firms even the CEO and top level executives are involved with the innovation and product development process at the FFEI with meetings or workshops held on a weekly base to discuss and align the competence levels and knowledge sharing required for the innovation process to succeed.

Some companies that do make provision for measuring knowledge do so partly by recording the number of employees that read online project reports, newsletters and other central document repositories, which are available for sharing knowledge using online

Internet statistical tools. In addition, knowledge sharing in some organisations is measured on a yearly basis via feedback questionnaires investigating issues such as employees' satisfaction with company policy and how they feel about getting involved in knowledge sharing and project collaboration. However, in most cases, businesses use customer feedback and sales figures to validate a project's success. An uninterrupted influx of useful ideas and using an efficient means to validate and manage these ideas is very significant in moving the process through the NPD stages. Nevertheless, ideas remain the principal initial point where innovation begins (Van Den Ende et al., 2015).

5.3 Empirical Analysis through the Lens of Narratives and Storytelling

As part of the research methodology applied in this study, this section will analyse the empirical data from the stories told by the interviewees through the lens of the Thematic Narrative method (Reissman, 2008). The researcher will also try to link these stories with particular concepts and constructs adapted to virtual teams working at the FFE where appropriate, and as they emerge from the narratives. Through the review of related literature, the researcher identified that the use of storytelling to narrate the activities at the FFE may lead to further insights into the activities and actions that transpired at the FFE. In addition, this method may also illuminate some of the challenges which are faced at this critical point in the innovation process. As mentioned earlier (please refer to Section 4.3) one of the main challenges for innovation at the FFE would be how to capture tacit knowledge within a virtual team (Linde, 2001). Although it can be argued that tacit knowledge cannot be measured in its implicit sense, it can be captured through storytelling because narration provides a bridge between tacit and explicit knowledge (Gabriel, 2000).

The focal point of Narrative Analysis is the approach whereby stories can be created and used to explain the world and are structured in a distinct way which portrays the cause and effect dependencies associated with actions that occur over a peculiar period of time among the selected characters under study. Although other elements can be used to

investigate the narrative characteristics of a message (Avraamidou & Osborne, 2009) the researcher will try to capture themes and conceptual structures from the narratives.

Because they portray a special action rather than the legitimacy of the story narratives are inherently powerful. In narrative, there is no need to rationalise the veracity of the assertions within the narration; the story itself establishes the validity of the case. Furthermore, the framework of narrative connects the story into a cause and effect association, leading the outcome of the narrative to seem predictable where many possible outcomes could have emerged (Curtis, 1994).

This predictability, coupled with the lack of a desire for rationalisation, substantiates the numerous normative components within a narrative - what is acceptable, what is unacceptable - without the need for further elucidation (Graesser & Ottati, 1995). Because narratives have the capability to add new standards to real-world phenomena without objection, it is somewhat difficult to contradict their case (Bamberg, 2012) and this feeds into this research due to its exploratory nature.

The use of narrative as a primary human technique to interpret events is much more than understanding how to comprehend meaning in the format of a story. The phrase 'narrative as a scientific method' entails a generic approach that captures different characters in their social environments vigorously attributing different interpretations and explanations to real life phenomena. This includes others as well as our individual selves. The process of collecting these stories either through interviews or surveys is fundamentally subjective and interpretive (Bamberg, 2012). If narrative is elevated into 'the primary form by which human experience is made meaningful' (Polkinghorne & Donald, 1988, p. 1) then it becomes reasonable to suggest that the narratives we share are what they are as a reflection of *who* we are (McAdams, 1993; Randall, 1995).

In order to extract meaningful data from the stories, the narratives are clustered around accounts which contain an element of transformation, i.e. change over time involving some kind of action and characters. These stories are then brought together in a plot line.

For the purpose of this study, emphases will be placed on the transformational elements, actions and characters of the stories in relation to the exploitation of innovation at the FFE.

Currently, a number of in-depth qualitative interview methods have been modelled specifically to evoke narrative accounts. Among others these include open-ended and unstructured formats, semi-structured and guided methods, for example, the free association narrative interview method developed by Hollway & Jefferson (2008), the biographic-narrative interpretive model which looks at individual actions, past conditions and life-stories (Wengraf, 2006) and narrative attributed investigation (Hiles & Cermák, 2008).

The researcher used semi-structured and open ended questions, and in order to compress the story into the duration of the interviews, the researcher tactfully asked the following question which led the respondent to narratives at the FEI; 'Could you please narrate a story about the occurrence and process of a particular commercialisation of a product in your organisation beginning from the idea creation to the product launch?' Stories then emerged of actual activities at the FFE which were carefully examined through the narrative lens. These are summarised in the conclusion to this chapter.

One of the characteristics of the Narrative Method that distinguishes it from other methods is the contrast between structure and performance (Bamberg, 1997). Gubrium & Holstein (2009) suggest a binary view of narratives, one which is a bisect of demarcation, one that sees narratives as texts and one which conceptualises them as a system or rule. The study of the textual elements of narrative is commonly attributed with textual anatomical qualities as well as with content in terms of themes and the characters that are disclosed in the story during the timeframe.

The essence of Narrative System analysis 'takes us outside such accounts and their transcripts to varied storytelling occasions' (Gubrium & Holstein, 2009, p. 210). According to Reissman (2008), there are four distinct analytic approaches; Thematic

Analysis, structural analysis, dialogic/performance analysis and visual analysis. Thematic Analysis relies on classifying narratives or actions in the narratives in the story. Structural analysis is used to investigate the different approaches in which the narratives can be structured and what the expression in the narratives does both on textual as well as cultural issues. Dialogic/performance analysis focuses on the obstacles in evaluating narratives of events that are co-constructed and, finally, visual analysis focuses on the analysis of all visual media including video and digital media(ibid).

5.3.1. Thematic Narrative Analysis

TNA is a classification blueprint for qualitative data. Researchers analyse their empirical data, take notes and begin to classify themes into groups. Patterned as a form of data analysis approach, it aids investigators to extend their inquiry from a complex spectrum of codes towards logical patterns and themes (Braun & Clarke, 2006). While researchers argue if Thematic Analysis is an exhaustive 'method' per se, it is a technique that can be applied to different types of qualitative data, and with multiple objectives. Based on this deduction, Thematic Analysis is often implicitly and explicitly a part of other types of data analysis including discourse analysis, grounded theory and case study (Braun & Clarke, 2006).

According to Boyatzis (1998) Thematic Analysis is the practice of 'encoding qualitative information' (1998). Thus the researcher establishes codes, words or phrases that are used to isolate patterns in segments of data. These codes are determined by the methodology being used and research questions posed, and can be presented in dissimilar layouts and size. Referring to a set of codes, Boyatzis elucidates, this could be a list of themes, a complicated pattern with themes, pointers, and criterions that are causally related; or somewhat in between these two types (ibid).

Thematic Analysis is flexible and what researchers do with the themes once they uncover them can differ depending on the objectives of the study and the units of analysis. Some researchers use Thematic Analysis as a method to get deeper and richer insight into their code as well as comprehending the complexities of the data content (Braun & Clarke,

2006). Researchers interested in seeking wider patterns in order to then further refine the analysis often use Thematic Analysis as a basic step at the early stages of their research. Thematic Analysis is not bound to any particular epistemology or practice (Braun & Clarke, 2006).

All narrative inquiry is, of course, concerned with content – '*what?*' is said, written or visually shown - but in Thematic Analysis, content is the exclusive focus in the applied setting. There are no particular rules in analysing data thematically because candidates' exemplars can vary widely. For example, in terms of the type of data under analysis, theoretical perspective, epistemological position, research questions or in regard to the very definition of narrative itself (Riessman, 2008). Instead, my objective was to focus on '*what?*' is said rather than 'how?', 'to whom?' or 'for what purposes?'. My exemplars are diverse due to the number of high technology industries involved in this study. The researcher aimed to use this method of analysis in order to ascertain to what extent it can be used to substantiate the research data by analysing the stories that were told by the interviewees which are recorded as part of the empirical data for this thesis. The table below gives a summary of Thematic Analysis; definition of narrative, how data was represented, the focus of the units of analysis, as well as the contexts of attention which made up part of the lens in the analysis of the stories extracted from this research data.

Table 8. Summary of Thematic Analysis

Author	Definition of Narrative	How represented: Attention to form and language	Unit of Analysis focus	Attention to contexts
Williams (1984)	Extended account of a speaker; story of the illness	Lengthy interview excerpts; cleaned up speech; some attention to metaphors	A narrator's understanding of genesis of his/her illness	Local: minimal Societal: considerable
Ewick & Silbey (2003)	Bounded segment of interview text about an incident	Brief interview excerpt; cleaned up speech	Acts of resistance reported in Personal narratives	Local: minimal Societal: considerable
Tamboukou (2003)	Bounded segment of a document about space (implicit)	Segment of document as written	Subjectivities of women teachers as they reflect on meanings of space and place	Local: minimal Societal: considerable

Cain (1991)	Life story of speaker or writer about drinking	As written (documents); Reconstructed from memory (observations); Summaries of Interviews (from tapes)	The narrative primarily (recurrent episodes across narratives); the narrator secondarily	Local: minimal Societal: considerable

5.3.2. What Counts as a Theme?

A theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set. Some important questions to address in terms of coding are what counts as a pattern/theme? or what 'size' does a theme need to be? This is a question of how frequently both in terms of occurrence within each data item, and prevalence across the entire data set (Braun & Clarke, 2006). Ideally, there will be a number of instances of the theme across the data set. However, frequent instances do not necessarily mean the theme itself is more crucial. As this is qualitative analysis; there is no hard-and-fast answer to the question of what proportion of your data set needs to display evidence of the theme for it to be considered a theme (Braun & Clarke, 2006).

It is not the case that if it was present in 50% of one's data items it would be a theme, but if it was present only in 47%, then it would not be. Nor is it the case that a theme is only something that many data items give considerable attention to rather than a sentence or two. A theme might be given considerable weight in some data items and little or none in others or it might appear in relatively little of the data set. Therefore, judgements made by the researcher are necessary to determine what a theme is. Furthermore, the 'keyness' of a theme is not necessarily dependent on quantifiable measures but in terms of whether it captures something important in relation to the overall research question (Riessman, 2008).

5.3.3. Inductive vs Theoretical Thematic Analysis

In order to understand the right approach to extracting interview data, the researcher needs to identify patterns within the data using one of the two primary methods in Thematic Analysis as defined by Frith & Gleeson (2004); an inductive or 'bottom up' method or via a theoretical or deductive or 'top down' approach. Due to the deductive nature of this research a theoretical Thematic Analysis methodology which will be linked to SLT of CoP has been utilised. An inductive approach means the themes identified are

strongly linked to the data themselves (Patton, 1990). In this approach, if the data have been collected specifically for the research, for example, via an interview or focus group, the themes identified may bear little relationship to the specific question that were asked of the participants. They would also not be driven by the researcher's theoretical interest in the area or topic (Boyatzis, 1998: Hayes, 1997). Inductive analysis is therefore a process of coding the data without trying to fit it into a pre-existing coding frame, or the researcher's analytic preconceptions. In this sense, this form of Thematic Analysis is data-driven. However, it is important to note that researchers cannot free themselves of their theoretical and epistemological commitments, and data are not coded in an epistemological vacuum (Braun & Clarke, 2006).

In contrast, a 'theoretical' Thematic Analysis would tend to be driven by the researcher's theoretical or analytic interest in the area, and is thus more explicitly analyst-driven. This form of Thematic Analysis tends to provide a less rich description of the data overall, and more a detailed analysis of some aspects of the data. The choice between inductive and theoretical maps into how and why you are coding the data (Braun & Clarke, 2006), supports the researchers approach to code mostly for the specific research questions posed for this study and tried to map them onto the SLT of CoP - the theoretical lens of this study. It was also taken into consideration that other questions might emerge through the coding process.

5.3.4. Stories Drawn from the Empirical Data of this Study

To analyse the stories that emerged from the data, the researcher selected key narratives merged into five stories based on the position of the narrators who worked in VCoP FEI environments in high technology companies. It is important to make this distinction in order to filter the quality of data and streamline the Thematic Analysis for a more substantive result. This is also because according to Gibbs (2007), thematic coding is a form of qualitative analysis which involves recording or identifying passages of text or images that are linked by a common theme or idea allowing you to index the text into categories and therefore establish the basis of thematic concepts around this (ibid). It is

therefore essential to view the text in a theoretical or analytical way rather than merely approaching it using a descriptive focus.

Charmaz suggests some basic questions to ask as you undertake this intensive reading that will help you get started:

- What is going on?
- What are people doing? What is the person saying?
- What do these actions and statements take for granted?
- How do structure and context serve to support, maintain, impede or change these actions and statements?" (Charmaz, 2003, pp. 94 - 95: Gibbs, 2007, p. 42)

Before introducing and analysing the stories told by the respondents, it is important to briefly detail the focus of the narratives in order to provide the reader with the basic premise of the enquiry. The stories narrated by the interviewees are focused on the activities at the FEI of the respective companies involved with this empirical research. The researcher has asked the respondents to tell a story from start to finish of a particular innovation activity within respective companies. Their stories focused on the NPD journey of a particular product and included the ideation process at the FEI all the way to commercialisation. The knowledge extracted from the stories will give the researcher an insight into how a particular product was idealised to market launch within the virtual community of the respondents' innovation departments.

STORY 1:

These stories are about the successful commercialisation of electronic products in VCoP's of high technology engineering industries as narrated by Senior Directors of Engineering at their respective Product Development and Innovation Departments.

STORY 1.1

'It is pretty straightforward as it is the fact that it goes very rapidly because we do push the envelope on schedule. We have an ideation period when we work with R&D and new technology and we arrive at call it fruitful concept. Once we have fruitful concept, we start the concept design around that theme, maybe one or two concepts, possibly three could go to concept review phase. And we down-select it to one, which is usually a combination of the concepts that have been bought forward. While we are doing this, we are in parallel working the industrial design and the user touch points the work profile the ergonomics, the appearance, and so the engineering functionality and the industrial design are kind of come together as a concept."

"Once everybody agrees that we have a concept that meets the key user needs that we feel we can deliver at the cost target needed, we will complete the design and quickly do what we call P1 or first prototype. And that first prototype will generally be a CNC ABS made over in China because we can do it there quickly and a fairly low cost. We will often times buy three to five of these there are not that expensive, and we will immediately begin exposing consumers and employees to the product and the concepts to refine the user touch points we get real time feedback on usability functionality. We will complete design reviews and trade-offs of this prototype so that we can iterate the design. Depending upon the complexity and newness of the product, we may do two maybe three more prototypes of this variety and soon we will drive to what we call tooling release. And when something goes in the tooling release we have done the RLI we have done the internal motivational studies with costumers, we validated that we have a product that will sell on the price plane that will delight users."

"We have done the return of investment, we picked the factory we get the cost of building, we get a quote that how much tooling will cost, we have all the elements to look at the RLI and so that tooling release gate is a big one. For it's because we may be authorising, you know, a million dollar spend. And then after the tooling release we will do some

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number of engineering builds. And those engineering builds are also predefined at each iteration. Again, depending upon the newness and complexity of the product we can do anywhere from one to three engineering builds where we refine tools, change tools, throw away tools, test with consumers. We go from observational studies to use test where we just basically send products to consumers around the world to use in their homes in exchange for survey data, to validate the consumer need. At that time, we also start aggressive verification validation testing. We have full set of consumer test labs in Suzhou China and so currently we are testing with consumers we are doing perhaps with the live test we are measuring all the key parameters that the product was designed around and specialised around."

"All in all it accommodates a stabilised design, the consumers are delighted by the needs across target the needs the performance calls. And we move it to a pilot run, and the pilot run is designed to prove out the manufacturing process so design changes are locked down, they are complete. The pilot run looks at how the product is built in the cells, there are the moving belts, is it all the manufacturing instructions solid, you know when we are doing the right number of test and prices to make sure that we get products in the end of the production line, there will be packaging test, drop test. And then, if we have a successful pilot run, we authorise mass production."

STORY 1.2:

Another story from the same industry was considered to reveal certain themes in the empirical research. The following narrative was therefore merged with this story to validate the analysis and results.

'Basically, because we are a strategy innovation firm so this is what we do for the organisation so in other words, we use a front end innovation. We have an anthropologist that goes on the field. We have a mandate to understand the use of theory about a problem. It goes really through to the narrative that I told you before. So, we reach out to Rexony to get a sense of what kind of services can be developed for users with chronic

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hepatitis, so what we have done is we set up a team, the team starts to get on with the key stakeholders of the clients. We interview them to understand their expectations. From that we started to craft a more robust statement of work then we started really to engage in the exact process of innovation so we went into the field, select and identify the people that we will recruit in to be using context lab and so on. So we went into the field and did the research after that we put all together the research into kind of a narrative which is identifiable with our partner, with our clients to get a sense of what was going on, what was going on in their minds. Out of that we then very quickly identify some of the major things of interest for innovation, what could be of value to new products, new services in that domain and from that we scan through paper research and kind of research on some at most times at the front industries are on different teams which is kind of Crank Man at month, Gaming, the mitigations and obvious different elements to develop some cards that have been used during the workshop so this workshop was an event where not only would you share the opportunity for innovation but we also started to build and deduct the development of ideas in the mind of the company so to co-create the ideas and the concept that would be selected for the next gate."

"Once identified, we prioritise that all together very quickly, it is kind of a quick prioritisation scheme with no interest, no aim to make it robust as a finished product. After that we then move to, so we proffer a solution for the client, develop the business cases and more exactly we develop three business cases highlighting the pros and cons of each of them and enter the full work to be delivered and presented to the higher executive management and this is where our project is ending and at that cross level, it is then the responsibility for the company to go to the implementation phase where innovation pays."

Thematic Analysis of Story 1:

Firstly, in order to understand the context and be able to properly reveal the themes and structure it is important to summarise the story before decoding. For the same reason a brief summary of Story 2 follows.

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Summary of Story 1.1:

The narrator of Story 1.1 talks about collaboration within the R&D team during an ideation period of an NPD process established to work on the design and conceptual aspects of a new technology. Three concepts were reviewed and put forward for prototyping using low cost manufacturing in China. All three concepts were merged as one in the final product. The NPD team drives the collaboration and agrees if the selected concepts meet the customer needs at the target cost.

The design is then completed and the final prototype is put forward. The prototypes are refined using user's experiences obtained via real time feedback on usability functionalities, after which designs are reviewed and iterated with trade-offs to validate the final product to the end users. The tooling and tuning is conducted before the release gate, with the number of engineering builds being predefined and estimated at each iteration. Depending upon the newness and complexity of the product they can do anywhere from one to three engineering builds where change and throw away tools are refined as well as final testing with the customer.

Products are distributed to consumers around the world for use in their homes as part of a usage test in exchange for survey data to validate the consumer needs. The verification and validation testing is conducted simultaneously. Alongside this, a live test to measure the key parameters that the product was designed and specialised around is conducted. In addition, the product is stabilised using performances calls before a pilot run is rolled out to prove the manufacturing process before the design is locked down for production. Other tests, such as a packaging and drop test, are also conducted during the manufacturing phases. Then, if they have a successful pilot run, the product will be authorised for mass production.

Summary of Story 1.2:

Data is collected from the field at the FEI, and a mandate is set to understand the theory of the problem. An NPD team is created to manage the FEI and works with the key stakeholders involved in the project. These key stakeholders are then interviewed to understand the problem and expectations of the clients. Again, the NPD team return to the field to recruit participants for data collection and create the context labs. After data are collected from the field, the NPD team put the content of the data into a constructive narrative that makes meaningful sense to the expectations of the project goal. This information is then related back to the clients for validation and re-evaluation. The NPD team develops an ideation and innovation workshop to co-create the ideas and concepts for a solution. Furthermore, three business cases are developed highlighting the pros and cons of the end solution and presented to higher executive management.

Analysis of Story 1:

There is an evidence of global collaboration in the NPD process. For example, the NPD team worked alongside their counterparts in China and even had a testing lab in the region. Although the narrator did not mention what specific tools were used in such global collaboration at the NPD, the researcher was told in other interviews with the respondent, that virtual communication tools such as emails, video conferencing etc. have been in place within the said company. In addition, the narrator works for a USA based multinational company with branches in China and other parts of the globe and collaborated virtually with all other NPD team members in China and around the world.

Several themes emerged from the stories such as; *collaboration, idea management, decision making, conceptualisation, and consumer needs and cost.* This demonstrates the importance and ability of managing these themes at the FEI in a VCoP. According to Henard & Szymanski (2001), a number of factors such as the target market, the corporate strategies deployed, the product in question and the features of the NPD process all influence the success of a new products' commercialisation. A lot of failures have also been attributed to the lack of front end management and technology, and therefore the

FFE stage is considered a very important component for potentially successful innovations (Coates, 2009). Furthermore, it is important to recognise the influential elements that propel consumers to collaborate with firms in co-creation exercises which empower companies to design blue prints for conducting their co-creation relationships and innovation processes (Roberts et al., 2014).

The narrator repeatedly mentioned a fine line of cooperation between the internal FEI team and the end users through the use of virtual communication tools which can be identified in the narration as a key indicator of the successful outcome of a project; thus highlighting the collaboration themes that emerged from the stories. As Meyer & Marion (2013) stated the use of content management systems for innovation that preceded the traditional IT solutions proffered in NPD, can be used as a measure to address the disparity found within their article. Although their report was focused on R&D within globally dispersed corporations, the researcher perceives a clear link between their narratives and his current review relating to the justification for developing innovation at the FFE and knowledge transfer and management in VCoP.

Although the idea management theme was not clearly highlighted in the story, the researcher has tacitly construed this theme from the interview based on the specificity of the cognitive interpretation that can be constructed from knowledge definition of idea management settings found in the narrative. Conceptualisation, consumer needs and cost were much linked themes in the stories that were repeatedly aggregated as part of the narrative leading to the successful outcome of the product.

For example, according to the narrator; "*Once we have fruitful concept, we start the concept design around that theme, maybe one or two concepts, possibly three could go to concept review phase. And we down-select it to one, which is usually a combination of the concepts that have been bought forward*". This can somewhat be aligned with Cooper (2008) and Rothwell (1994) who proposed that product innovation is typically a conceptualised practice which revolves around several phases within a time frame.

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The decision making structure of an organisation remains an often repeated theme and emerged in several stories. Even though the narrators related successful innovation outcomes, research by Bertels et al. (2011) recognised some of the challenges relating to power and political structure in many high technology organisations where a CoP is customary for knowledge transfer. It is important to note that the organisation and its FEI process appears more structured due to the several defined stages of NPD ideation process which it utilises. What is not clear from the story is the actual brainstorming sessions at the ideation stage of how creativity is triggered at the FFEI. For example, how was the idea generated at the FEI?

However, how the idea was communicated at the FEI and how the virtual team was organised in the sharing of knowledge remain crucial parts of the successful outcome of the innovation. This story can still infer some presence of structure, organisation and VCoP at the FEI. It is also interesting to note that end users also played a vital role at the FEI where online surveys and tools are also used to retrieve consumer real time feedback during the validation phases of the NPD process. This premise further validates Fixson & Marion (2012) statement that the success of R&D and product innovation is highly dependent on a variety of factors such as markets and technologies, techniques and tools, organisational structures, processes and decision mechanisms in NPD.

Although the presence of a VCoP was not directly mentioned in this narrative, the respondent mentioned the use of an NPD team at the FEI to collect meaningful data and manage the stakeholder's relationship at the FEI. This has been taken by the researcher as implying a VCoP. This points to the importance of CoP in the NPD process, and also highlights the fact that a VCoP can facilitate the sharing of knowledge and can generate learning advantages meaningful to improve the FFE by developing a structured and consistent framework.

STORY 2:

This story focuses on how VCoP was used at the FFI to generate new ideas and knowledge sharing in order to create meaningful outcomes in an innovation process as told by an innovation manager in the aerospace industry.

"I would try and tell two stories. One of them is an area that we launched an innovation project on about a year and half ago and it was in an area which is about 80 percent of our business already. We already considered one of the world leaders in that area but we felt in order to remain ahead we should be putting some effort into innovating in this area so we got some of our global experts together, organised a workshop to identify what we thought were the key customer needs and then we took that and expressed it as a question to the organisation, how can we achieve those customer needs? and we ran an online idea challenge. We gathered around about 40 ideas against that challenge and then they were accessed by experts around company X some of which were the same people involved in the original workshop and out of those 40 or so ideas, we chose about 15 to progress or at least to investigate further.

One of those in particular was considered a highly disruptive idea, highly desirable to the customer if we could make it work but with quite a few developing challenges. So that is actually the type of ideas that we like to try and go after because it is considered to be highly desirable and disruptive then this is something which is perhaps revolutionary and one of the few developing challenges was in an area of engineering where we don't really have any internal expertise so we went on to find a supply organisation, an expert organisation who were able to do some developing analysis that proved that the thing we wanted to create was possible and might be possible within the core circuit that we were heading for and that was about 9 months ago.

Then sometimes we had gone out and made agreements with further partners, we can provide different parts of the overall solution and sometimes we had been in the process of combining us together with internal expertise to create a new solution and at the

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moment, that one is roughly halfway through the overall process and if it continues to go to plan perhaps we will have something ready for the market by the end of this year.

The second example is a little bit similar but in quite a different area. So we decided we needed to do some innovation in customer service able to identify a key topic. When we reviewed it at our internal sales conference that was about 2 years ago again we ran an idea challenge online, we gathered in that case about 90 ideas and decided to take about 20 of them forward which we grouped into about 5 teams and then we had a big delay while we had to recruit the teams and the resource who were actually going to do those projects and we delayed for over a year, and maybe close to a year and half.

In our rules, people are all applied to the project and projects are progressing through the innovation process and same with the situation of the last story, they are about half-way through the process and should result in new services for the market by the end of this year. Purpose of telling you two different stories, whilst one was a product technical challenge where we had to go out and get external expertise so to form an open innovation, and the other one was one where we had organisational barriers where we needed to recruit in order to make it happen. So I gave two stories to illustrate where you can have barriers and different ways to overcome them."

Thematic Analysis of Story 2:

Firstly, a community was created among global experts in the field. These groups co-created a workshop to improve the quality of an existing product. This group were able to identify key customer needs and provide their findings to higher management within the organisation. In order to achieve those customer needs an online ideation challenge was conducted which generated over 40 ideas. These ideas were subsequently evaluated by these groups of experts who later narrowed down and streamlined these ideas to about 15 for further investigation and deliberation. One of those in particular was considered a highly disruptive idea in the sense that, though highly desirable for the customer if feasible, it posed substantial development challenges. This validates the work of Öberg,

(2010) who proposed that VCoPs are determined as an essential element that instigates positive innovation outcomes, and an avenue for adopting customer perception into the innovation process (Schröder & Hölzle, 2010)

The company was unable to overcome the development challenges internally due to lack of engineering, and the problem which was eventually outsourced to a third party business to bridge the gap. Several themes emerged from this story such as; *VCoP, collaboration, customer needs, idea generation, conceptualisation of idea and virtual communication*. Again, the role and needs of a CoP were clearly important at the FEI of the global organisation in question, and the presence of VCoP was clearly mentioned by the narrator as part of the innovation process of the business.

In one story the interviewee mentioned the use of outsourcing at the FEI. Here, the power of open collaboration, which was implied by the interviewee as open innovation, was successfully harnessed at the FEI. That said, open innovation critiques may argue that this sort of structure may impede the innovation outcome (West & Gallagher, 2006). However, some organisations, who are clearly motivated for success in highly competitive global innovative environments, have put in place measures to curb these exigencies such as an open climate favouring risk taking, trust and open interaction in order to succeed in FEI activities (Bertels et al., 2011).

An important aspect of this story is the process of idea creation which was extracted through online polls and ideation boxes among internal employees as wells as consumers. These ideas were subsequently conceptualised and hence the emergence of the theme in Story 2. In this particular narrative, conceptualisation was applied mainly to the number of ideas generated instead of the technology as earlier told in Story 1. However, further down the line, the narrator also found and demonstrated further evidence of conceptualisation of technology and process within the innovation process. According to Bertels et al. (2011), business units which display a more accomplished CoP and show a

greater interest in the community have a greater influence on the FFE than organisations which do not support the formation of communities.

It is also important to note that the executive management boards make the final decision call in most innovation process at the FEI. How this has affected the efficiency and performance of an NPD process at the FEI is yet to be seen, even though the innovation had a successful outcome. However, this is always correlated with the recommendations of the working committee at the FEI, described as group of CoP experts, and counters some earlier findings in a paper published by Ekvall (1987) which states that one of the major challenges for a CoP in the current global corporate climate remains with geographically dispersed corporations, where business units are spread across different countries and regions, while maintaining the same legal structures and common mission statements and visions within diverse cultural and ethnic affiliations (ibid, 1987). The narrator also mentioned the use of online tools and other methods of virtual communication.

Indeed, and in some part of the story even where it was not directly mentioned, the open and global nature of the collaboration also infers the use of virtual communication tools in harnessing and communicating ideas within the company; further evidence of the virtual communication theme which emerged from this story. These ideas were further managed by the expert group who were brought together in a CoP. Most of the innovation activities and collaboration happened in face-to-face workshops in several sessions but, as a global effort, virtual collaboration tools such as emails, SharePoint, phone call, video conferencing and instant messaging were also used as part of the VCoP. Here we see the use of online tools to facilitate and manage NPD processes at the FEI which further validates the fact that a VCoP tool can be used to improve and facilitate knowledge sharing at the FEI.

STORY 3:

Director of Business Development and Innovation, Director of Product development and innovation at a Chemical Company as well as the CEO of a Health and beauty organisation. Two themes emerged from this story, customer input and decision-making in an organisation**.**

STORY 3.1:

'I will keep it very generic. There was a particular market application for a product that we had that was first handled into the market place almost ten years ago and it has taken a variety of people resources, capital investment, various things to pursue this particular market application. Once we got the rigorous process in place, more and more questions were coming up as often happens around what is the real market opportunity and once that market opportunity was more rigorous we realised that it was too small to warrant the work that we have been doing for the past ten years and so the initiative ended. We are simply maintaining the little bit of customer base that was cultured during that time with existing product capabilities but had those questions been asked ten years ago, it would have saved a lot of cost that has been put into that particular area.'

STORY 3.2:

"Certainly I do my best. If was actually my all-time favourite innovation project. As I mentioned we were working on ergonomic products for the office. And a trend that we recognized was that people don't work in their offices at desktop computers as we used to. People are working in coffee shops and trains and planes with their laptops. Laptops you know they are notoriously getting very hot and could cause lot of discomfort on the leg. So we were working on a portable laptop riser that would put the computer in a position that would easier on the wrists to prevent carpal tunnel syndrome and also keep the leg cool but at the same time it had to be very lightweight, portable and easy to store. So it was a major challenge. And we came up with a variety of methods. It started up with using like inflatable air sacks and we were creating all sorts of wicked ideas on how to solve this problem. And one day the head engineer on this project and I sat at my office

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and we just draw concepts on my whiteboard until we figured out something that was very intriguing. He went out on that afternoon to a Home Depot, bought a bunch of plywood and door hedges and crazy things and spent the next day in his house building a prototype.

He came in and showed it to me on the next day based on what we have drawn. It was absolutely ugly, it was too big, it was heavy it did not work very well, but it demonstrated to me the concept and I got very excited. So I made a huge mistake from a process standpoint at that time to show some of my cross-functional colleges and leaders this prototype and say this is what we want to work on. Because it was so ugly and heavy and it was left out. And it was absolutely not, my general manager specifically said, do not invest anything in developing that, we are to move on. My engineer and I were convinced that this had merit if we could make it smaller, lighter, more portable, using regular parts. I pulled him secretly off of one of the projects to which he was assigned and put him on developing this exclusively."

"We made a very cheap quick plastic prototype, but it got the idea across. And it was thinner than a pencil, weight less than a pound and it was basically functional. Still not quite pretty but basically functional. And then we re-demonstrated it to my general manager and the rest of the team and then they were excited about it. They did not, that was what we were conceiving. Once they got behind it, we got organisational resources to fully develop it and we launched it. And it really helped to us to get in to a new market space because it was only in one of our catalogues, but we got it in to one of the retail outlets. And it was probably the most exciting thing that I worked on because it was so creative and because so many people said it can't be done and we did it. And actually we did get reprimanded though for kind of not listening to my general manager so it was not the best thing I ever did for my career but I'm certainly very proud of the accomplishment that we had."

STORY 3.3:

"Okay. So Dairy Queen is a simple one to talk about. There is a thing that is currently called MO Latté. So however many years ago we were looking at our product sales, sales numbers started to take ahead between basically 2:30 the afternoon and 6 o clock. Which to that day part was starting to struggle? And we did not understand why and we were talking to people and the problem was that at the Dairy Queen there happened to be across from a school. Lot of Diary Queens are rurally based and they are close to... there are you know in rural communities, and very often they are destinations of schools. So it happened to be at the Dairy Queen we were all talking about this and we kind of observed similar things that being that these Diary Queens that were across from schools, the kids the local kids were starting to go to the local coffee shop instead of coming to Dairy Queen. Because it was the beginning of the trend of fluffy coffees, so fancy coffees like mochas at Starbucks and that sort of things.

So granted Dairy Queen had never had a coffee line at all, it would be a different kind of packaging, it would be a different kind of straw, certainly a different behaviour from the consumer, there was everything about it. But long story short, that was where the indicator was, so we started to explore the idea of MoLatte. Ended up.... you know, we originally started with some regular kind of coffees and that would be more direct competitor. Then we decided to leverage the brand equity. And it was that complexity and to launch that product was not only bringing in almost all except one new ingredient, so entirely new ingredients, you are bringing in also a different process, a different machine, a different package, and even a different straw. So it is incredibly complicated for something that was not target market at the actual franchisee. Most of the franchisees are get better audience, it is mostly female but most of the franchisees are actually men and this is not at all something they would drink or eat. We got through that all and ended up bringing in the first year 13 million dollars in business."

STORY 3.4:

"Honestly, I am not really well based to tell you this kind of story. What I can tell you is the story of a general product launch for the company. What I can tell you is about an entrepreneurial project becoming a true reality in the end. One of the good examples that we had is a marketing guy who was discussing with the customers on a broad idea just to associate a wireless base station with alternative energy production means and through an entrepreneurial programme we gave him some kind of visibility, the opportunity to sample, not to disappoint the routine around this idea, developing a business plan and presenting in front of some executives and we have just been convinced and he asked for some budget to platform just to fine tune his product and he managed to get the budget to fine tune the solution. When we started, there were just five people for that, after two years there were 15 people and the top line that generated was €20 million."

Thematic Analysis of Story 3:

This narrative highlights the importance of good and thorough market research during NPD stages of the FEI. The FEI might take a substantial amount of time to actualise in most product development phases. Therefore, the need to constantly evaluate the market, while simultaneously working at the FEI process should never be underestimated. Otherwise it can have a negative financial impact on the organisation should FEI fail.

Two themes emerged from this story; customer input and decision-making in an organisation. According to literature reviewed for this research, the limitation of participation and consideration by top management (where strategic, structural and resource planning occurs), could hinder the innovation process or outcome (Burgelman & Sayles, 1986; Khurana & Rosenthal, 1997). Knowledge sharing at a firm level remains a crucial element for harnessing collective intuition (Eisenhardt, 1999), and this is why it is very relevant to validate the information sharing structures and process within an innovation space (Davenport, 1993). In addition, this will determine the best practices to help manage knowledge sharing at the early stages of the NPD at FFE.

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These stories emphasise the importance of packaging to attract consumer needs and increase market sales, a missing component might have a negative reflection on sales output. It goes to show that the FEI is perhaps a continuous process throughout the product or service lifecycle. In addition to earlier themes mentioned, other concepts that emerged from this stories are; informal discussion, trust, persistence and the power of prototyping at the FEI. Also, the importance of management control or decision making in an organisation at the FEI can never be underestimated as shown in these stories.

One narrator tells of the importance of customer innovation and entrepreneurial programmes within an organisation which provides ideas for product lines and information for expert groups to nurture and grow. How this was communicated at the FEI was not specifically stated in the story, but rather demonstrates the importance of customer inputs in co-creating innovative ideas. This is because communication within the firm through the means of a VCoP implies the importance of aligning and integrating the diversity of organisational cultures, knowledge management methods and targets in order to achieve results from the interaction (Dahlander et al., 2008; Michaelides & Morton, 2008). The important theme here is open stakeholder collaboration to achieve an innovative outcome at the FEI and constantly monitoring new and future market trends to achieve radical innovation.

STORY 4:

The main focus of this story is to validate the functions of VCoP in an engineering design environment at the FFE as told by a Fellow of Engineering Design. 3 themes emerged from this story; Decision-making, prototyping and the innovation environment.

'First of all let me thank you for the interview, I have really enjoyed it. This last comment about narrative, narrative is incredibly important. Because storytelling is how you get people to remember things. We have been doing this for thousands of years. And it is as applicable today as it was 2000 years ago. So being able to turn what you are doing into

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a story means that people will remember it. And I'm an enormous advocate of using narrative when I teach.

Okay you want a quick story. So and again I won't name the product, but I will tell you a little bit about it. So I first met a senior academic here, who had a good idea about something he wanted to do. I mean again in very broadly it was sort of manner, technology space. And I think it was still some good research, but it was research, it was not applicable if you like to the marketplace. Now he was interacting with me, and this is where we come back to this interaction between if you like a bright young academic and somebody who spent 40 years in the industry. I could say to him, okay I can see some good ideas here and what you are doing in some of the research. But actually there are a couple of things here which given a bit more development really could have an impact on the marketplace. He liked that as feedback. This happened about three years ago we had the first conversation. So I meet with him again, probably 6 months later and to be fair to him, a bright guy, he continued the research he was doing generally, but the piece I said to him "okay that could have an impact", he has spent some special time, he put some PhD students on it he put a postdoc on it, and they really developed this forward. So now he had a prototype. "

"So again coming back to prototyping. And he said to me, come down to the lab, have a look at this, tell me what you think. So I went to the lab, had a look at it, it was essentially a new product. And I looked to this and said 'Yeah, wow, this is interesting.' It is not ready for the marketplace yet, but this is not an idea anymore, I can feel this, I can touch this, this is solid. And it is not quite ready, not quite is the market ready, it was not ready from a capability. It was getting very close but it wasn't quite best of what was already out there. Because that was the other thing, it was in a space where there was already an existing product, but potentially this product could be a lot better. But when I looked at it, it was not. So I said 'Okay. Again, I can tell you from my experience, that if you go to market with this, it is got to be better. It must be better than what is out there. Otherwise

why on earth would you buy it? You know, it is an existing product it has been around for a long time and it is fine, why on earth would you by a new product?'

So he said okay, all right. So another 6 months or so went by and he did a lot more refinement on the product, then I went back to the lab again. And we did some small measurements, and the product now was about the same as the existing product. However, it was much cheaper to produce, and a much better in a whole number of other ways. Its parameters if you like were now better than the existing products. It was cheaper, it was easier to produce. And not only that he was using a wise product but nobody else wanted to produce it, he was using a wise product, which is quite nice. So I said, that is brilliant, but you still got to have impact. "

"So I still want to see this product actually being better than what is out there. Because that what is going to turn people's heads. It's a bit cheaper, well yeah, but I have been using the existing product for years I'm happy with. If it is a bit cheaper, you not going to move the marketplace. If it is actually better, then you start to have an impact. So again, another 6 months has very well passed, he spent also time in the lab, have got some PhD student on it, couple of post docs. I met him again, and this time it is better. No only it actually performed better than the existing product, but it is still cheaper so it is less so expensive, I can produce it in very large volumes, so if somebody wants to buy it I can sell them a lot earlier. I have corrected the production problem, I can produce it consistently, and that was another problem it had to be consistent. And where is it today? They are putting a factory together in Cambridge, and they going to do to a large amount production. So it was a long process, it was 3 or 4 years, just refining it, getting the product better. So that he could go to industry with this prototype and say 'Look, there it is. And it is cheaper, and it is better, and I can produce as much of it as you want.' And then of course industry says 'Wow.' And that is what you are looking for. It is the senior people, getting the access to the senior people not easy obviously, but if you can get it in front of the central board of the company, I would always say, what you are looking for is the wow factor. They go wow that is good.'

FOLLOW UP QUESTION: That is interesting, but you do not worry about the timeline? 3 to 4 years speed to market is very important. Nokia was doing the same research for touchscreen form when iPad came first before them, and they lost the whole market. Are you not worried about this?

ANSWER: *"Absolutely. So, if we have meeting ahead with this guy, I said who else is doing this, and where are they? And we always managed to maintain a lead of about 6 months. If it is that lead seemed to erode, and it could have gone. I mean we only need somebody to make a breakthrough, and then there are some big labs in other parts of the world that were doing exactly the same thing. But we managed to maintain that lead of about 6 months, and again in high tech 6 months, this is everything. As you said the touchscreens. So if that lead eroded during that period we would have just cancelled it and not moved forward. Yes, we got to be realistic about it."*

FOLLOW UP QUESTION: And then you lose all the money you have invested in it.
ANSWER: *"That is the risk. So as I as well love your description the fuzzy front end, it is risky. It is not particularly tangible. You can't put your hands on it. And it does come back to having teams that have good people with lots of experience. With people who don't have intellectual boundaries, so generally younger people because they are the ones that don't have intellectual boundaries. If you can get those teams and mature people who worked in the marketplace they worked in the domain for long time, with bright young people, who don't have the constraints, and you get it to work, you will get fantastic outcomes."*

Analysis of Story 4:

The main themes extracted from this story are speed to market and decision making in innovation processes. In addition, the story also highlights the importance of prototyping and the innovation environment at the FFE. Three themes emerged from this story; decision-making, prototyping and innovation environment. In the NPD process, the FFE can take time to realise, and it is therefore important to be realistic with the timeline and changes in the market in actualisation of innovation at the FEI. Working around new products requires constant feedback and re-evaluation of product life line in the market place to achieve a successful launch. In the end, it becomes unrealistic to place a particular timeline on the NPD process as this makes the process more vulnerable to competitors.

Khurana & Rosenthal (1997), Moenaert et al. (1995) and Reinertsen (1992) have established some of the foundational framework that gives better insight into the theoretical lens of the FFE by investigating vital elements of the FFE and their distinct impact on NPD success. Numerous researchers have contributing evidence linking innovation performance and the time required to complete the NPD backend activities (Cooper et al., 2011; Kuczmarski & Associates., 1994; Urban & Hauser, 1993). Therefore, the inquest into improving the processes at the FEI still remains a crucial objective in the inquisition to help organisations realise maximum success at their NPD processes.

Khurana & Rosenthal's (1997) research was explicitly centred on the relevance of applying a well-structured approach for managing innovation process at the FFE. Moeneart et al. (1995) examined the relevance of communication at the R&D/marketing interface for establishing exceptional development conception at the FFE. Reinertsen (1999) investigated the relevance of advancing the FFE process by speeding up decision-making and screening; all with a view to reducing the risk of failure. The underlying structure of path-dependent processes is based on network effects. Network effects, in the innovation domain, could be translated as decision-makers' response to the choices of

other decision-makers as they affect the chances that the earlier decisions made within the network will not turn out to be disadvantageous (Öberg, 2010).

The benefit of embracing an innovation differs directly with the amount of organisations adopting the new technology (Hunt & Morgan, 1996; Katz & Shapiro, 1985). In order to have a clearer perception of the FFE, based on this context, the innovation environment is pivotal in initial choices adopted by teams working at the very early stages of the FEI. This is also applicable to NPD teams seeking to use the environment to gain new knowledge and information as well as generate new insight about an innovation. Maintaining a constant insight into the innovation environment also helps the innovation team to see the ongoing generic pattern for new technology adoption before initiating the conversation within the organisation (Reid & de Brentani, 2004).

5.3.5 Reflections from Thematic Analysis of All Stories

Even though a significant amount of research in the field of virtual community and maintenance and user innovations in offline communities exists (Laine, 2009; Luthje, 2004; Luthje, 2004; Fuller et al, 2007), there is not enough empirical research to validate a successful application and communication between organisations and VCoPs at the innovation space (Laine, 2006; Füller et al., 2007). It is still uncertain what the level of interaction and approach companies could apply for successful outcome of this relationship at the FEI (Dahlander & Magnusson, 2008). Academia and industry are still struggling with to comprehend the challenge of its intricacies and subsequently to develop a better framework and rules of engagement for a sustainable virtual communication (Stürmer, 2009). To this end, current empirical research in the advancement of virtual communities remains unclear and uncertain due to the high level of complexity that revolves around the high interdependency among the various stakeholders to be accounted for in the process. This has also created a barrier that hinders the possibility to thoroughly investigate the treatise (Leimeister et al, 2011).

There is evidence of virtual collaboration in the NPD process, as evidenced by the 4 stories above. This was evident in the empirical data from interviewees. The narrators mentioned the presence of dispersed collaboration either locally, nationally or globally which implies the use of virtual tools for collaboration at the NPD. Before the stories narrated to the researcher, the respondent in the interviews had already mentioned the use of virtual communication tools such as emails, online repository, virtual work space, video conferencing etc. This is further supported by the fact that the narrators work for dispersed collaborative teams in the respective innovative platforms of the respondents' companies, and it would have been almost an impossible fit to achieve successful innovative outcomes with frequent travel to all NPD team members at all times at stakeholder locations.

Going by the several phases of ideation defined in their processes it is important to note that some organisations perhaps seem to be more structured at the FEI than others. What is not clear from the stories is the actual brainstorming stages at the ideation stage. For example, how was the idea generated and communicated at the FEI in the first place, and how the virtual team is organised in the sharing of tacit knowledge. However, these stories still infer some presence of structure, organisation and VCoP at the FEI. It is also interesting to note that customers/consumers played a role at the FEI where online surveys and tools are used to retrieve consumer real time feedback during the validation phases of the NPD process.

Data are collected from the field at the FEI and a mandate is set to understand the theory of the problem as one narrator told the researcher. An NPD team is usually created to manage the FEI and works with the key stakeholders involved in the project. These key stakeholders are interviewed to understand the problem and expectations of the clients. Again, the NPD team often return to the field to recruit participants for data collection and the innovation process. After data are collected from the field, the NPD team put the content of the data into a constructive narrative which makes meaningful sense to the

expectations of the project goal and relates back to the clients for validation and re-evaluation.

The NPD team develops an ideation and innovation workshop to co-create the ideas and concepts for a solution. Furthermore, three business cases are developed highlighting the pros and cons of the end solution and are then presented to the higher executive management. Although no specific mention of a VCoP team existed in some narratives, most narrators mentioned the use of an NPD team collaborating virtually at the FEI to collect meaningful data and manage the stakeholder's relationship at the FEI. This can be also be referred to as a VCoP. This emphasises the importance of CoP in NPD processes.

A community of global experts confined within a working committee was created to function as a virtual NPD team in workshops within the organisation. As told by one narrator, these global groups co-created a workshop to improve the quality of an existing product to meet the challenges of that company. This group also were able to identify key customer needs and present their findings to higher management within the organisation. In order to achieve those customer needs, most organisations have a practice of an online ideation challenge conducted to generate new ideas. These ideas were subsequently evaluated by these groups of experts who later narrowed and streamlined the volume of these ideas for further investigation and deliberation. This process has been proven to generate highly disruptive ideas which may be highly desirable to the customer if they can be commercialised but with quite a few development challenges.

Some companies were unable to overcome some development challenges internally due to lack of expertise and the complexities of the new idea. Those that emerged successfully did so by outsourcing the area were internal competence was lacking. For example, one service company in the aerospace sector faced an engineering problem which was outsourced to a third party business to resolve. Again, based on the story told by that particular narrator, the role and need of a CoP was clearly important at the FEI of a global organisation, and was also mentioned by the interviewee. Therefore, the

researcher concluded that some sort of VCoP might have taken place within the innovation process. The narrator mentioned the use of outsourcing at the FEI where, in this case, open collaboration is not in particular associated with the same connotation as the concept of open innovation. It is also important to note that the executive management boards make the final decision call in most innovation process at the FEI. How this is connected to the efficiency and performance of an NPD process at the FEI is yet to be seen. However, this is always corroborated with the recommendations of the working committee at the FEI described as a group of CoP experts.

Some narrators also mentioned the use of online tools in harnessing and communicating ideas within the company. These ideas were further managed by the expert group. Here we see the use of online tools to facilitate and manage NPD processes at the FEI. The narrators tell of the importance of customer innovation and entrepreneurial programmes within an organisation, providing ideas for product lines which are then presented to expert groups to nurture and grow. How this was communicated at the FEI was not specifically stated in the stories but rather demonstrates the importance of customer inputs in co-creating innovative ideas. This goes to show that the importance of stakeholder collaboration can never be underestimated at the FEI, and constantly monitoring new and future market trends to achieve radical innovation outcomes remains an important theme to achieve an innovative outcome at the FEI.

Story 2, 3 and 4 highlighted the importance of thorough market research during NPD stages of the FEI as well as continual market research updates throughout the ideation process. As the FEI might take so much time to actualise in most product development phases, the need to constantly evaluate the market simultaneously while working at the FEI process should never be underestimated. Otherwise, it can have a negative financial impact on the organisation should FEI fails.

The narrator of Story 4 emphasises the importance of packaging to attract consumer needs and increase market sales as a missing component might have a negative reflection

on sales output. This substantiates the fact that FEI is perhaps is a continuous process throughout the product or service lifecycle. Some themes emerged from these stories such as informal discussion, trust, persistence and the power of prototyping at the FEI. Also the importance of management control at the FEI can never be underestimated as shown in most of the stories.

The essence of speed to market in innovation was another important theme and, again, the importance of prototyping. In NPD processes, the FFE can take time to realise and it is important to be realistic and objective with the NPD process timeline as well as constant follow up with regard to changes in the market in actualisation of innovation at the FEI. Working around new products requires constant feedback and re-evaluation of product life line in the market place to achieve a successful launch. In the end, it becomes unrealistic to place a particular timeline on the NPD processes because this makes the process more vulnerable to competitors.

In light of the empirical data analysed throughout this research. It is clear that high technology multinational companies indeed do have some challenges at their various FEI. This may be becausethe nature of the industry and the type of product and services might have had a considerable impact on these challenges. The researcher would, however, conclude that in The researcher will agree with what the existing literature suggests about the FEI within a VCoP. The FEI remains an important part of the innovation process of an organisation. The findings from this research can concludes that the FEI probably does not need to be structured but can be managed based on the nature of the business and product or services.

It is also important to note that some variants of a CoP can also be attributed to a VCoP regardless of its virtual nature. Although the best outcome at the FEI can always be achieved by a combination of applying both the CoP and VCoP. Perhaps the fuzziness at the FEI might not be a deterrent to any successful outcome, though some challenges emerges in VCoPs within the FEI such as the complexity of the Internet technologies and

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the suitability of the tools used within the VCoP at the FEI according to the findings from this research. The researcher is confident to conclude that VCoPs cannot be organised to contribute to the sharing of tacit knowledge at the FFE, butcan generate learning advantages meaningful to improve the FFE within a VCoP.

6. CHAPTER VI: DISCUSSION AND IMPLICATIONS

This chapter is a reflection on the main findings of the research in terms of its contribution to the key topics of the thesis, the research questions raised in the literature review, the methodology employed the empirical research itself and how the findings link the challenges faced by VCoP to these issues and literature on the subject. Finally, this chapter will state the contribution to knowledge obtained as a result of extending the CoP framework to a VCoP context.

6.1 Overview of the study

This section discusses and reviews the objectives of this research, what and how it was conducted and the process and methods of exploration used to serve as a brief reflection of the entire study before the actual discussion that follows.

The thesis has explored the current difficulties faced by businesses, specifically when extracting and sharing knowledge through VCoP at the FFE of the innovation process, particularly in relation to more tacit forms of knowledge within high technology organisations. The researcher began by examining academic literature which focused on the FFEI and VCoP. This revealed a dearth of research on the global corporate innovation space. The researcher at first broadly considered reviews on major aspects of innovation treatise such as; FFEI, CoP, collaboration methods, knowledge management theories and literature reviews, the Stage-Gate model, sense of community and their intra-extra relationship to FFI and VCoP.

This led the researcher to narrow down the review of the literature and focus more specifically on the SLT of CoP and VCoP. The researcher also considered the orthogonality of their relationship and the manner in which VCoP might function in order to diagnose the challenges encountered at the FFE of innovation. The use of virtual

communication as a means for collaboration has become inevitable for many businesses in the 21st century (Baltes et al., 2002; Bergiel et al., 2008; Hertel et al., 2005). The evolution of technology and Internet mediated communication technology has broken the barriers for long distance communication giving organisations access to experts across the global innovation space. It is therefore no surprise that many professionals will be involved in one form of virtual communication or another within any firm project space (Dewar, 2006). Virtual communication is not without issues, but it has been an effective means for collaboration within organisations. Some of the challenges encountered in this means of communication are due to too much focus on the technology rather than understanding the user requirements as well as mitigating circumstances in intra- and extra-organisation virtual collaboration space (ibid).

Due to the nature of the inquiry, the researcher had to generate data from fieldwork through scheduling interviews with the relevant stakeholders within the high technology industries who were interested in finding a resolution to the current problems associated with their virtual teams at the FFEI. Most of the interviewees who participated in the empirical data collection of this study worked in different sectors of the pre-selected organisations and high technology innovative industries such as; telecommunications, health care, chemical, aerospace, mechanical and robotics as well as automotive industries. The pre-selection of the individuals from these organisations was based on their position in relation to the innovative activities of the high technology company, for example, most of them are managers and leaders of innovation at their respective organisations.

Furthermore, the researcher endeavoured to better understand the subject under investigation through the use of a qualitative research approach. The reason for choosing qualitative research as the methodology for this research was based on the reasoning that to precisely understand the complexities of the social interactions involved in a virtual team within a high technology organisation, the researcher had to be involved and have close interactions with practitioners in the subject area. This was achieved through the

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use of open-ended semi-structured and unstructured questions, face-to-face interviews and virtual meetings through video conferencing. Such a variety of methods was required because of the trans-national locations of the respondents and this led to a reasonable result for the empirical study of this research.

This thesis was analysed from a social constructionism view of the world. Under this philosophical position, while an objective social world might exist, people's views, knowledge and interpretation of the world is judged to be socially mediated by their experiences and the actions of others. Thus, knowledge is seen as subjective as was discussed in the methods and methodology chapters respectively. Given the use of Content and Narrative Analysis as research methods for examining and extracting those world views in the subject under investigation. This approach is not particularly theory-oriented; the focus is rather on the 'disclosure' of how social phenomena are socially constructed around virtual communities working at the FEI.

Qualitative research interviews and storytelling through interviews were the main research methodologies applied for this research. This is because interviews seek to construe the connotations of central themes in the life world of the subjects. The main objective of the interviews was to interpret the context of the interviewees' story and journey (Kvale, 1996). A qualitative research interview seeks to capture both an accurate and a contextual level, even though interviews pose more challenges on a meaning level (ibid). These interviews were particularly useful for getting the story behind an interviewee's journey and assisted the researcher in pursuing in-depth knowledge of the topic. The interview questions revolved around a methodological approach in constructing the story. Interview sessions were transcribed and analysed hermeneutically based on the Content and Narrative Analysis method. Nvivo10 was used in organising and analysing the data. This leaves the research to obtain the answers to the research questions of this study from the empirical data which will be discussed in the coming sections.

The researcher will use the subsequent sections to analyse the implications of the research questions and the empirical results, linking them together for the purposes of connecting the implications and contributions of the research to knowledge as well as describe any congruencies and surprises observed in the literature.

6.2 Contributions to theory

This section discusses and reaffirms the objectives of this research; what and how it was conducted and the process and methods of exploration to serve as a brief reflection of the entire study before the actual discussion that follows.

The research findings have several implications for both theory and practice. Looking firstly at the theoretical implications, the research questions section discusses an overview of existing knowledge literature and has attempted to capture what this research has added to the existing theory. In addition, it gives recommendations which are relevant to the theory that have been organised around the research questions and the theoretical framework of this study. These are revisited principally in section 6.2.1, though there is a degree of inevitable intersections elsewhere within this chapter. The implications of this research to business and practice is discussed in section 7.2 of Chapter 7.

6.2.1 Theoretical Implications - The Research Questions

This section addresses the implications of this research for knowledge and existing literature and how it has addressed the research questions of this study. It is therefore important at this stage to revisit the research questions again below:

Research Question 1 (RQ1): How might a VCoP be organised to contribute to the sharing of knowledge at the FFE*?*

Research Question 2 (RQ2): Does a VCoP generate learning advantages meaningful to improve the FFE and if so, how?

The standardisation of NPD has evolved since the early 1990s and several high technology industries have already adopted a Stage-Gate model as part of standard NPD methodology (Cooper et al., 2002, 2005). Although the NPD process and standards differ depending on the type of industry or business in question, one aspect considered in this research is the notion of a 'formal' NPD process, which some research considered to be at a mature stage within the high technology industry in commercialisation of NPD ventures.

It is important to reiterate again at this stage that the amalgamation of several of the early stages of business activities are combined to make up the FFE (Khurana & Rosenthal, 1998). A number of examples of this were found to be in areas such as: market requirement analysis, the choice of technology and other NPD decisions proposed, considered and evaluated at this stage (Coates, 2009). Unlike the formal NPD process, the literature reviewed for this study claims that the FFE lacks any proper standardised acceptable universal model and as a consequence the inception of the term 'fuzzy' emerged and remains an appropriate descriptor of the nature of the front end aspects of innovating (ibid). Even though, the empirical analysis of this research found this claim to be partly true, results also suggests the importance of achieving a balance on the level of standardisation required at the FFE because as it seems the FEI within a VCoP perhaps do not need to be structured to be effective. Thus, its fuzziness may not have a negative impact on the activities at the FEI because in order for creativity and innovation to flourish at the FEI the innovation process needs to be able to accommodate the diversity of people and resources required for a successful outcome.

According to findings from the empirical research, despite the fact that the businesses who participated have a structured and systematic process of managing the FEI, they do not follow any particular standard - this clears part of the doubt on RQ1. The FFI within

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a VCoP is organised according to the type of project in question, the resources and designations of the organisation and also varies from one company to other. The use of virtual tools for communications at CoP adds a complexity to the VCoP due the virtual nature of the interaction, for example, the effort required to understand and access the tool as well as the differences in geographical time zones. After all, according to Birkinshaw & Gibson (2004), in general, innovation management is a balancing act between creating a supporting and stimulating context on the one hand, and setting direction and focus on the other. The findings also highlight the importance of the VCoP structure when generating and sharing new ideas at the FEI within a VCoP. Indeed, the nature of the structure, if it can be adaptable to different FEI parlance rather than standardised or controlled, can also facilitate collaboration and discovery of new ideas.

The research results also tell of the importance of customer innovation and entrepreneurial programmes within an organisation, generating ideas for product lines which are then often dedicated to expert groups to nurture and grow. How these ideas were triggered at the FEI was not specifically stated in the stories told but rather highlights the importance of customer inputs in co-creating innovative ideas, and this remains an area for future studies. In addition, this also adds some clarity to the importance of stakeholder collaboration at the FEI, and represents an important tool for achieving innovative outcomes at the FEI by constantly monitoring new and future market trends to achieve radical innovation outcomes.

Just as several studies have emphasised the importance of the FFE, the success of the FFE is still highly dependent on a number of factors such as; the technology at play, the type of innovation, industry, speed to market and amount of R&D effort and resources invested in the process at the FEI (Bertels et al., 2011). Although the level of stakeholder's involvement was limited to particular organisations and projects, their participation at the FEI was critical to complimenting and supplementing the required expertise and resources in an organisation during FEI activities. It is also interesting to note that the customers/consumers played a crucial role at the FEI where online surveys

and tools where part of the process used to retrieve consumer real time feedback during the validation phases of the NPD process.

Some organisations interviewed for this research use some sort of structure for extracting innovation but not explicitly as defined by Lave & Wenger's (1991) CoP theoretical framework. However, other organisations claimed no structure exists at their various FEI process especially within their VCoP. Most respondents agreed that there is a well-structured Stage-Gate process available at the back end of the innovation process but the front end remains fuzzy. Some companies treat innovation as a single entity and fail to use the cross-functional approach. However, innovation culture should be applied in all facets of the organisation and cross-functional collaboration as described in Lave & Wenger's (1991) CoP theory, and this was found to be lacking in some organisations. Finally, evidence from the empirical research leads the researcher to believe that activities at the FFEI should not be structured but can be better managed in order to absorb the diversities required for creativity at the FFEI.

Even though a significant amount of research in the field of virtual community and maintenance and user innovations in offline communities exists (Laine, 2009: Luthje, 2004: Fuller et al., 2007), the level of interaction and approach that companies could apply for producing successful outcomes at the FEI remains uncertain (Dahlander & Magnusson, 2008). Furthermore, recent studies of the FEI still suggest that there is no evidence of what exact, successful, criteria lead to the successful commercialisation of new products (Kock et al., 2015). In addition, even though Lave & Wenger (1991) SLT in CoP states that knowledge and creativity can be extracted through CoP, and potentially VCoPs, there are very few studies into VCoP. However, the problem is that CoPs benefit from face-to-face formal and informal interactions but VCoPs require some facsimile of this because of the inability to use physical meetings. To date then, it has not been at all clear to what extent SLT can be applied to a VCoP and particularly to innovation activities at the FFEI (where we anticipate the major benefits of this activity can be seen).

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My research investigated the implications of SLT of CoP among VCoPs and concluded that knowledge can still be extracted among VCoP's using online or virtual communication tools as a means for communication. In addition, VCoP do not necessarily have to be managed nor conform to CoP characteristics in order to achieve successful knowledge sharing outcomes. These insights demonstrate different mechanisms such as; adaptable communication technology, informal discussion, trust, persistence and the power of prototyping, flexibility and theoretical expectations about VCoP in the innovation process and asserts their value over and above CoP. The major benefit of VCoP to an organisation is that it can capitalise on communities of common interest across the organisation as a whole, regardless of its boundaries and borders, and therefore increases the potential for new CoPs (in virtual form) to emerge - opportunities far greater than if the firm relied solely on physical CoPs.

6.2.1.1 Research Question 1: How might a virtual team be organised to contribute to the sharing of knowledge at the FFEI?

In order to identify the problem areas at the FFEI, the researcher uncovered recurring themes and concepts in the knowledge management literature reviewed for this research, and observed a purported positive connection between tacit knowledge, knowledge transfer and SLT of CoP at the FEI within high technology organisations (Wenger et al., 2005). This is supported by empirical evidence, which states that individuals or groups with more social connections are more likely to be innovative, creative and share knowledge than isolated people or groups (Bjork & Magnusson, 2009). This, in turn, points positively to the knowledge transmission benefits of a CoP, particularly in relation to the transfer of tacit knowledge at the FEI. However, the researcher's theoretical understanding based on the results of the empirical research of this thesis has given some credence of how different expert knowledge is managed at a CoP.

This research demonstrates that it is not necessary to have a rigid managerial structure at the FEI in order to achieve success in NPD. In some organisations, the FEI remains a flat structure with the Head of Innovation serving as the custodian leader driving the project.

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During the inquisition a typical scenario was one of the stories related by an NPD team which depended heavily on sourcing new information through fieldwork by engaging with clients and customers during FEI activities. This was achieved through direct interaction with clients or potential customers through a VCoP. The data which were collected were further analysed and refined in several stages using a selected NPD team dispersed physically across various locations and communicated through virtual Internet technology.

Additionally, the innovation process was facilitated through continuous virtual collaboration with other stakeholders. In order to refine the problems to meet the expectations of the clients, the key stakeholders where repeatedly interviewed over the phone, via video communication while a few took place in person. After initial assessment of the first stage of data processing, the NPD team made further assessments through customer and clients in order to validate the choices made throughout the innovation process. This sort of validation is often repeated several times in different phases based on the intuitive accuracy of the journey. Finally, a decision was made to select a particular idea to move on to the next gate. The NPD team put the content of the data into a constructive narrative that makes meaningful sense to the expectations of the project goal and related this information back to the clients during the repeated validation and re-evaluation process.

In addition to the above scenario, some NPD teams often develop an ideation and innovation workshop to co-create the ideas and concepts for a solution. These forums eventually led to the creation of several business cases which were developed and adopted to highlight the pros and cons of the end solution and finally presented to the higher executive management for final decision making and ratification. In view of the example presented in this and previous paragraphs, the researcher concluded that managing a virtual team at the FFEI should be the key focus rather than structuring and how they should be organised. That said, the researcher sensed some form of systematisation required for this process where the final decisions are ratified by the

higher executive management of the organisation. Developing a standard process for communication, instead of focusing on the structure of the VCoP team at the FFEI, is perhaps the key for better organising contributions to the sharing of knowledge at the FEI. According to Wenger et al. (2002), a CoP exhibits certain characteristics such as: 1. A 'domain' which defines the identity of the community, 2. The 'community' which defines the group of individuals who makes up the domain area to exchange knowledge in order to solve a problem or support each other and 3., 'practice'; a set of rules or methods applied during information sharing. This research found that even though the 'community' and 'domain' remains applicable for VCoP framework, the 'practice' in VCoP do not apply the same as in CoP. This research has shown that 'practice' in VCoP is relatively flexible due to the virtual nature of the communication.

Staying with linking the results to RQ1, some companies created and used a community of global experts organised into a working committee which functioned as part of a virtual NPD team participating in workshops within the organisations. These global groups of VCoP co-created a workshop either to create a radical innovation or improve the quality of an existing product to meet the challenges of the company in question. In contrast, it is also noted that this can be achieved through nurturing a suitable environment for increased information dissemination within the context of a CoP (Bertels et al., 2011). However, this research found that part of this was achieved by identifying key customer needs through these groups of VCoP collaboration and reporting the essential findings to higher executive management within the organisation.

In order to understand and deliver those customer needs, most organisations have a practice of an online ideation challenge conducted to generate new ideas. These ideas were subsequently evaluated by a group of experts within the organisation who later narrowed and streamlined the volume of these ideas for further investigation and deliberation. This research also suggests that this process has been proven to generate highly disruptive ideas, which may be very desirable to customers, especially where they can be commercialised with minimal development challenges such as; difficulties with

virtual communication (lack of face-to-face), cultural differences, time zone divides and even, in some cases, lack of internal expertise in the domain areas. In this example, a VCoP was managed through an expert group which was incorporated into a horizontal hierarchical CoP structure using online communication tools to drive a successful innovation outcome. Organisations which encourage Situated Learning within the empathetic social environment characterised by an informal free flow of communication and trust within their organisational climate tend to narrow the gap and limitations created by dispersed collaborations by increasing the generation of tacit knowledge at the FEI.

Dahlander & Piezunka (2014) and Iriberri & Leroy (2009) stated in their research that VCoPs with external links are not sustainable due to the lack of motivation and interest over a prolonged period of time even where incentives are sometimes involved. This study finds that in order to enhance the chances of success at the FEI, some businesses were unable to overcome FEI development challenges internally due to lack of expertise coupled with the complexities and technical challenges associated with a new idea. Those organisations which emerged successfully from these difficulties did so by outsourcing the areas where internal competence was lacking.

For example, one service company in the aerospace sector faced engineering problems which were later outsourced to a third party business to resolve. This again emphasises the important role and need for a CoP at the FEI. These external entities of the VCoP can often become more productive and resourceful than the internal personnel of the organisation at the FEI (Poetz & Schreier, 2012). However, according to this study, the use of outsourcing at the FEI by some organisations to achieve a successful innovation outcome (which the researcher terms the externalisation of innovation resources popularly known as outsourcing) and open collaboration is not tied in particular in the sense of an Open Innovation framework where various stakeholders might have a shared IP rights. Nevertheless, this remains the case in several scenarios of an outsourced collaboration at the FEI especially through the use of VCoP for knowledge sharing.

The drawback with outsourcing is, again, the difficulties it creates in retaining knowledge in-house as well as working across different organisational cultures, processes, Service Level Agreements (SLA), Non-Disclosure Agreements (NDA), conflicting functional organisational strategies across different organisations and shared access with VCoP tools between internal and external employees. As the researcher has observed, it is also important to mention the superior role played by the executive management boards of the project initiator as well as IP owners as the final decision makers in most of the innovation processes at the FEI. This is unlike in open innovation where shared resources could also mean shared ownerships, management and IP. How this is connected to the efficiency and performance of an NPD process at the FEI is yet to be seen. Moreover, the outcomes of the product or service from this collaborative effort are always corroborated with the recommendations of the working committee at the FEI, described as group of CoP experts. As earlier stated, how a VCoP is managed and organised at the FEI depends on the structure of the organisation, the project outlined given in this scenario, the level of expertise available within and outside the organisation and the overall resources available to execute the project at all NPD stages. The complexity of the challenges of organising a VCoP varies from businesses and technologies.

In studies conducted by Meyer & Marion (2013), empirical data were collected from 146 companies using some of the technologically advanced IT tools. Their results indicated that certain challenges do exist within the area of VCoP due to the loss of tacit knowledge which currently requires face-to-face time in order for a CoP to flourish (Wenger 2002). Although Meyer & Marion (2013) did not specifically use the term 'VCoP', the concept was implied in their work and is proportionally related. This bolsters the reasoning that a VCoP can be, in part at least, applied to CoP in knowledge transfer but its effectiveness in comparison is seemingly weaker or undermined. This raises the question of how a VCoP might be organised in order to increase knowledge sharing and transfer potential, particularly in relation to more tacit forms of knowledge (established earlier as seemingly more beneficial for innovation activity than explicit knowledge). Irrespective of the

propagation of VCoPs within corporations across the globe, there is not enough knowledge on the circumstances influencing the successful implementation of a VCoP. However, members' motivation to be a part of these online groups remains one of the significant elements governing the success of a virtual community in knowledge sharing sessions (Ardichvili, 2008).

VCoPs perform key functions in the knowledge management stratagems of several global businesses including Caterpillar (Powers, 2004), Chevron, Ford, Xerox, Raytheon, IBM (Ellis, 2001) and Shell (Haimila, 2001). Moreover, knowledge management experts also contend that sharing information through virtual communication means is considered as an essential method of communal learning (Rosenberg, 2005). This is because inexperienced members may have to adapt to new methods and processes of sharing information and communicating with group members through the use of virtual communication tools to develop social conditions that might be easily achievable through a CoP such as building social ties and skills (Bourhis & Dubé, 2010).

In addition, as this research has found, sometimes languages and culture, national laws and times zones are found to act as a barrier in dispersed collaboration. For example, an organisation with an online virtual meeting among teams dispersed across multi-geographical, multi-jurisdictional borders often experiences challenges in integrating and managing the many different variables involved. However, this can be mitigated after a period of time through familiarity of accents and common understanding. Once the protagonists reach a level of common understanding with these issues the collaboration will feel borderless and would be easier to manage. There are a lot of horizontal activities that bring individuals of common interest to share their ideas irrespective of the fact that they are based in different organisations or locations to become part of the parent organisation (Murillo 2008: Rogers 2000: Thomas 2005)

Globalisation is a new trend in the new world order and can sometimes be considered unavoidable as most companies who stay local might eventually find themselves isolated

and unable to compete in the global market (Townsend et al., 1998). Hence, firms face an increased need to resolve the challenges within the expanse of fostering innovation and knowledge management in high technology organisations through VCoPs. The propensity of individuals working at the FEI to share tacit knowledge among each other can grow in an organisation by facilitating and encouraging the functions and activities that encourages the dissemination and sharing of tacit knowledge as wellas through establishing suitable environments and groups that drive the overall knowledge sharing constructs whether in CoP or VCoP (Bertels et al., 2011).

Meyer & Marion (2013) mentioned in their report that the use of content management systems for innovation that preceded the traditional IT solutions proffered in NPD can be used as a measure to address the challenges found within their article. Although their report was focused on R&D within globally dispersed corporations, the researcher perceives a clear link between their narratives and his current findings relating to the justification for developing innovation at the FFE and knowledge transfer and management in VCoP.

According to the results of this research, alongside the lessons of prototyping, the centrality of speed to market in innovation was another important theme which emerged. Proof of concepts and prototypes are seen as a very efficient method for communicating and illustrating new ideas at the FFI and even from back end to front end. However, building prototypes are very resource draining and this might not be a feasible alternative for most small and underfunded projects. However, it partly depends on the type of project. For example, some prototypes can be built online and shared feedbacks and inputs may be communicated through VCoP.

The research findings also encourage the use of cross-functional interaction via a workshop instead of the generic cross interaction among teams from different departments and divisions within the organisation which can be very daunting and sometime ineffective in NPD processes. The FFE can often take considerable time to

materialise and it is important to be realistic and objective with the NPD process timeline as well as constantly follow up changes in the market space in the actualisation of innovation at the FEI. The success of R&D and product innovation is highly dependent on a variety of factors such as; markets and technologies, techniques and tools, organisational structures, processes and decision mechanisms in NPD (Fixson & Marion, 2012). Working around new products requires constant feedback and re-evaluation of product lifeline in the market place to achieve a successful launch and avoid killing off possibly good products and services before they reach the next gate. In the end, it becomes unrealistic to place a particular timeline on the NPD process regardless of how it is communicated either through CoP or VCoP as this makes the process more vulnerable to competitors.

The research findings encourage the development of a combination of skill sets at the FEI in order to produce successful innovation outcomes. For example, in a particular development effort in NPD, a skills set combining designers, engineers, developers and marketing specialists wasrequired and should be involved as early as possible during the project kick off phase. However, the inclusion of domain experts is sometimes necessary at the FEI process to bring the domain knowledge to the team in order to facilitate the FEI process. As stated earlier, this is why the Front Ends might need to be fuzzy in order to accommodate the diversity of resources employed no matter what communication means are being utilised, be they a face-to-face CoP or through VCoP.

One of the most difficult challenges at the FFE is the lack of a proper framework for managing idea generation at the FEI. Even though this early stage of the innovation process is considered fuzzy the FEI method is extremely informal, inconsistent and knowledge consuming (Frishammar et al., 2011; Lingo & O'Mahony, 2010). These traits suggest that the results of the idea-generation practice are highly ambiguous. Therefore, dealing with this stage of FEI is delicate and can turn out to be disadvantageous to businesses' processes and performance unless they are tactically managed (Van Den Ende et al., 2015).

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Due to the amount of diversity required at the FEI this research finding identifies the essence of cross-functional communication and collaboration capability through VCoP in NPD as; cross-interaction with different product teams in different disciplines as well as the possibility of involving all stakeholders and departments within the company from marketing, sales, development, production teams, services and designers. This cross-functional interaction in VCoP can be organised in the form of workshops that give the project team a platform where all stakeholders can provide input in a single forum to streamline the ideas into a single and narrow funnel as well as provide a regular checkpoint for the Stage-Gate process. This form or structure sometimes presents organisational challenges due to the disperse nature of the interaction through virtual communication tools and the level and number of people involved which can also create chaos in organisations with large VCoP teams.

This research results also suggest that some of the challenges in a corporate entity are partly due to the difficulties in bridging the gap between innovation and implementation and communicating with other internal and external divisions of the organisation as well as how the communication and collaboration process has to be managed for actual product implementation. This also remains one of the major challenges in a VCoP with most organisations applying an overarching business strategy driven at a very high level at the FFE. In idea generation processes some organisations rely on the initiation of a very broad topic at the FFI stages with focus on the detailed exploration of the main task which is driven by the corporate strategy. The new product is adapted to fit into corporate strategies and is then subjected to further scrutiny which takes into account design and conceptualisation issues. This empirical finding also emphasises the importance of packaging to attract consumer needs and increase market sales because a missing component might have a negative reflection on sales output. This goes to show that the FEI is perhaps a continuous process throughout the product or service lifecycle.

It is important to note that some organisations seem to be more structured at the FEI going by the several phases of ideation and the Stage-Gate model defined in their early stage business processes. What is not clear from the stories is the model used for the triggering ideas during brainstorming sessions at the ideation stage even among VCoPs. For example, how the idea was generated from the individual tacit process at the FEI. How the virtual team is organised in the sharing of tacit knowledge perhaps can be attributed to the structure and management of VCoP in the company and the overall innovation strategy of the organisation. However, the stories extracted from the empirical journey of this study implied some presence of structure, organisation and VCoP at the FEI.

In broad terms, innovation management is a harmonising action that aspires to generate a supportive and inspiring environment which, at the same time, seeks to balance this with empowering the project with the right leadership and effort required to succeed (Birkinshaw & Gibson, 2004). In NPD phases, there is no more important place where balance and empathy is required than the FEI. Generating a supportive and inspiring environment is equally crucial in developing the ethos of creativeness that FEI team members require as the necessary tools and measures to create, validate and perfect new ideas (Van Den Ende et al., 2015). Linking back to RQ1, and earlier discussions from the findings of this research, due to the successful outcomes of most stories told at the FEI in VCoP at multinational high technology organisations, the researcher is confident to conclude that VCoP do not necessarily have to be organised at the FEI to contribute to the sharing of tacit knowledge at the FFE but do generate learning advantages meaningful to innovation outcome.

In conclusion, the virtual team were managed by structure but also engaged with teams in and across different departments and stakeholders within the same or different disciplines across the organisation. Even though online tools were observed to have their disadvantages, this research found that any drawbacks were outweighed by the importance of ensuring at least a face-to-face workshop at the earlier stages of the

innovation process to put a face on the individuals and team members with occasional use of video conference also very helpful in the sharing of knowledge at the VCoP. Putting a face on the individual project team members at the early stages of the innovation process also helps to shape the bond and sense of community that is required to foster the VCoP Front End activities.

This can be visible in the virtual tools used for communication. However, overall, a virtual team need not be organised to contribute to the sharing of knowledge at the FFEI. Businesses should not treat innovation as a single entity and should also use the cross-functional approach. Innovation culture should be applied in all facets of the organisation and cross-functional collaboration as linked in Wenger's (2008 CoP theory. Moreover, developing a standard process for communication, instead of focusing on the structure and organisation of the VCoP team at the FFEI, is perhaps the key for better organisation which will enhance the sharing of knowledge at the FEI.

6.2.1.2. Research Question 2: Does a virtual team generate learning advantages meaningful to improve the FFEI and, if so, how?

The main theoretical lens used in this research is SLT as applied to a CoP. This investigation has focused on invoking tacit knowledge from within high technology organisations dispersed across the globe, referred to as VCoP. This, alongside a CoP, also considered as a core concept within SLT (Hof, 2004). A VCoP can also be referred to as a CoP but as one which operates across a virtual network. The use of Internet and computer mediated communication tools for CoP, can to some degree at least, create more challenges as well as hamper some of the benefits that face-to-face meetings can produce. Indeed, this is an issue is also problematic at the FFE during NDP.

Due to the issues surrounding VCoP such as the acquisition and transfer of tacit knowledge in organisations remains a highly significant area in the process of extracting knowledge for innovation. The methods by which organisations meet these challenges remains a vital gap, and several concepts related to SLT have been debated throughout

the course of this thesis. As was found in most of the literature, the effectiveness of VCoP as a mechanism for generating knowledge at the FEI remains a vital issue and led to the second research question of this study. The researcher observed some interesting connections between tacit knowledge and SLT in VCoP and this remains the main driver for the research themes.

Academia and the industry still struggle to comprehend the challenge of its intricacies and subsequently to develop a better framework and rules of engagement for a sustainable virtual communication within the FEI space (Stürmer, 2009). Furthermore, current empirical research in the advancement of virtual community remains unclear and uncertain due to the high level of complexity that revolves around the high interdependency among the various stakeholders to be accounted for in the process. This has also created a barrier that hinders the possibility of thoroughly investigating the treatise (Leimeister et al., 2011).

In order to ascertain the potential for a successful learning outcome through a VCoP, it is important to understand how new knowledge is measured in an organisation (because of the interconnection between the two variables, such as measuring and sharing knowledge). For example, it is through measuring the impact of knowledge shared that the success rate can be realised. Most organisations interviewed for this research do not measure knowledge directly in their respective organisations but rather are continually evaluating the proper alignment of the innovation team and the volume of penetration of VCoP communication tools. Where there is no proper measure in place, some organisations conduct weekly meetings or, sometimes, biweekly reviews with the leadership of the company and innovation teams through virtual communication tools to help achieve this aim. In some firms, the CEO and top-level executives are involved with the innovation and product development. This is achieved through individual testimonies provided during each meeting at the FFEI development process.

Sometimes, meetings or workshops are held on a weekly basis to discuss and align the required competence. Knowledge sharing and innovation processes are examined as part of the evaluation of the efficacy of the diffusion and success of knowledge sharing among VCoP teams within the organisation. Some companies that made provision for measuring knowledge do so by partly accounting for the amount of employees who read online project reports, newsletters and other central document repositories available for sharing knowledge using online Internet statistical tools. In addition, knowledge sharing in some organisations is measured on yearly bases through feedback questionnaires with inquiries. These cover issues such as; employees' satisfaction with taking company actions and as well as objectively comprehending the complexities of getting involved in knowledge sharing and project collaboration. However, in some cases, businesses interviewed for this research use customers' feedback and sales figures to validate the project's success.

Although Henard & Szymanski (2001) claimed that a number of factors such as the target market, the corporate strategies deployed, the product in question and the features of the NPD process all influence the success of a new product's commercialisation, and crucially, this all is dependent upon the activities at the earlier stages of the FFEI. One of the major hurdles in online virtual communication within an organisation is the engagement process and the ability to be able to constantly follow-up with communities. Therefore, and measuring the impact of knowledge sharing requires dedicated attention within the business in order to achieve a measurable outcome of a VCoP as this research analysis has shown.

VCoP team members are sometimes simultaneously involved in cross-functional collaboration projects and face the hurdle of logging activities online to keep track of VCoP projects and member's activities. In this virtual space it becomes a challenge to measure the impact of these activities due to the numerous authentication processes required for most online communication tools. This is most especially the case in an uncontrolled system or environment and the findings of this research would suggest that

some organisations pay closer attention to the impact of VCoP and resolve to find meaningful ways to measure the outcome of VCoP interaction in order for them to be able to tailor their VCoP activities toward their business needs.

Perhaps using email and automated systems as a means for constant reminders might ease some the challenges presented by several online authentication mechanisms required to interact with VCoP teams. It may also be possible to increase conscious motivations for the effort if some of these portals are customised with centralised authentication processes to avoid multiple authentication schemes being applied to different portals or links during cross-functional collaboration. For example, SharePoint poses some issues due to the poor interface that was designed for general users rather than customised for one particular firm environment. In SharePoint software the users have to actively look up information each time they are logged into the interface and in most cases find it time consuming if the required information cannot be easily retrieved. In addition, this software also lacks the functions to automatically keep the user on track.

Face-to-face communication is often appreciated in these cases and can sometimes make a difference when it is possible to have a quick chat with a colleague sitting in the next office space or on another floor. Even though blogs and wikis are meant to supplement some of the face-to-face activities lacking in a virtual communication, the power of face-to-face conversation within a CoP team situated in the same location also had a significant and positive impact on knowledge sharing because it gives the individual a chance to receive quick feedback and respond immediately. That said, it is acknowledged that this can also be achieved through video communication.

Again, this substantiates Meyer & Marion's (2013) claim that certain challenges exist within the area of VCoP due to the loss of tacit knowledge which currently requires face-to-face time in order for a CoP to flourish. Even though video communication can almost achieve the same impact as a face-to-face meeting in sharing knowledge some organisations who participated in the research did not pay particular attention to

measuring the activities at the VCoP. Online communication tools remain a means of communication and as long as everyone is happy, it is business as usual. The use of virtual communication facilities that support visual presentations tools as well as audio or video capacity in VCoP activity improved the possibility of knowledge sharing. In particular, it is also important for organisations to pay a great deal of attention to the quality of the virtual communication tools, for example, with regard to bandwidth and access. In one particular case a VCoP in an R&D centre of an automation and robotic VCoP knowledge sharing activity, was negatively impacted due to the effects of poor quality in virtual communication tools.

In other businesses with tailored VCoP Internet applications for knowledge sharing, the stories from the findings are much more optimistic. These businesses create an information-sharing portal that allows VCoP team members to find subject area experts, post questions to particular specialists or to the community at large, post data themselves, find knowledge data, participate in virtual communication through messaging and asynchronous threaded discussions of queries and problem solving sessions and link up to other VCoP project groups. It is worth mentioning that most of the online tools have built in auditing and logging tools which are also used to measure the rate and impact of the knowledge shared in the medium.

Most of the VCoP project groups where created by the initiative of the employees, and not because of interventions planned by the management group or the top executive team. VCoPs tend to form around specific subject matter expertise or professional activity areas but are open to all interested employees. A typical community includes; a community manager, one or more delegate, a number of experts and subscribers. Managers are typically elected by the team and are often senior, experienced members who have earned the team's respect through a strong history of contributions to the company. This can also be linked to Murillo (2008) who states that these software and communication systems are used in the service of a CoP (which can also be termed a VCoP due to the implied nature of the community) with and the fundamental difference being the virtual setting of

this communication. By using these enabling virtual tools, the VCoP model can provide a structure for co-operative working which can function along the same lines as a co-located community (ibid). However, it remains the function of the organisation to understand the importance of customising every VCoP communication tool and tailor it to different projects for better results.

Accordingly, FFE innovation processes require a great deal of flexibility to be applied during product conceptualisation, definition and planning stage and must contain an adaptability that leaves room to address any future possibilities for improvement, enhancement or modification at each stage of the innovation process (Vojak et al., 2012). Making the right choices in the early stages of the business development of the FEI is crucial to the subsequent stages of the NPD process and the eventual commercialisation of the product (Cohen & Levinthal, 1990). Flexibility in VCoP does not apply to the online communication tools but has more relevant consequence for the VCoP team. Online communication tools used in VCoP should be properly managed and configured to meet the specific team and project needs.

When knowledge becomes individual specific and certain individuals become a repository of that knowledge, the organisation ends up having to coerce that information from them over a period of time. This makes it even more challenging to measure knowledge sharing and its impact assessment since some organisations tend to lean too much on subject matter experts when dealing with specialised areas of knowledge. Although the use of expert knowledge at the FEI within a VCoP could be a measure of time and cost saving at the innovation process. It does not often lead to creativity nor does it drive knowledge sharing. Instead, it can become a deterrent for encouraging sharing and measuring knowledge at the FEI among VCoPs. Even though this is often discouraging, this research finds that some organisations have a career plan for these more experienced employees who have accumulated extensive know-how which may enable to look beyond the horizon of their personal ambition. For example, experts and older members of CoP need to be made to understand that their unwillingness to share

information is detrimental to the successful outcome of knowledge transfer within the organisation and perhaps might not give them any meaningful advantage at the FEI. A few organisations go to an extent of creating a reward system in the organisation by using incentives to encourage these experts to share knowledge both at CoP and VCoP. However, the impact of such a strategy can vary from person to person and may additionally depend on whether it is presented in the form of an excellence award or other kind of recognition, which may be financial, before they really become collaborative rather than exclusive in terms of knowledge sharing.

The findings also suggested the importance of idea ownership and the decision making process in selecting and finding new ideas among virtual teams, which should be collaborative and decisive based on needs, but can require a considerable period of time to achieve, and may depend on firms resisting the temptation to kill off ideas in the early stages of the decision making process. The ideas could be analysed and deliberated upon by the team during the innovation phase until the basic need they can satisfy are understood and developed in the other Stage-Gate NPD steps. Although, the researcher has partly addressed some of the issues regarding the impact of virtual teams in achieving a favourable learning outcome, the subsequent paragraphs will continue to focus on addressing the second research question of this study - *Does a virtual team generate learning advantages meaningful to improve the FFEI and if so, how?*

Even though a significant amount of research in the field of virtual community, maintenance and user innovations in offline communities exists (Laine, 2009: Füller et al., 2007) it is still uncertain as to the level of interaction and approach that companies could apply for successful outcome of this relationship at the FEI (Dahlander &Magnusson, 2008). To this end, current empirical research in the advancement of virtual communities remains unclear and uncertain due to the high level of complexity that revolves around the high interdependency among the various stakeholders to be accounted for in the process.

This has also created a barrier that hinders the possibility to thoroughly investigate the treatise (Leimeister et al., 2011). This research finds conflicting ideologies between reality and theory with most organisations involved in this research that focused on building and developing effective virtual communication tools, rather than finding methods to structure VCoP teams, able to overcome the underlying challenges in VCoP communication structure. In addition, these were more effective in the use of virtual communication tool at the FEI interaction. The use of virtual communication tools such as emails, online repository, virtual work space and video conferencing for VCoP activities has become so common and taken for granted in many businesses and, as already stated, it is now standard practice for most organisations.

In high technology organisations, dispersed either locally or globally, most talented VCoP team members are also often scattered geographically. This is most regularly the case in organisations which focus heavily on R&D. The research findings highlighted the importance of thorough market research during NPD stages of the FEI as well as continual market research update throughout the ideation process. However, the FEI might require a prolonged period of time to actualise in most NPD phases, and the need to constantly evaluate market conditions while simultaneously working at the FEI remains an important factor in achieving successful outcomes. This illustrates that virtual teams have been the driving factors for generating learning advantages meaningful to improve the FFEI by making it possible for organisations to utilise their human resources effectively regardless of the VCoP team member's geographic location. Otherwise, utilising only local resources or talent for innovation or encouraging the physical movement of CoP dispersed geographically in an organisation can have a negative impact on innovation and creativity within the business.

Regardless of the tools applied at the FEI to generate new ideas, VCoP teams need to have the appropriate know-how and intellectual acumen to make the right judgment and select the ideas which are most appealing in relation to innovative as well as compatible with the strategic needs of the organisation (Kester et al., 2011). This study found that in

some high technology companies VCoPs are organised around workshops of design sessions with members from cross-functional disciplines across various departments within the organisation.

These forums are often used as a means to share individual projects or assignments and challenge other members of the working group. An agenda is drawn up for each session and at least one member of the VCoP will make a presentation on an ongoing project, its progress and the challenges faced. In addition, the forum is used as an opportunity for receiving feedback and for interacting with the other members of the VCoP.

The VCoPs concerned often have designated leadership structures where some members are assigned as portfolio reviewers and moderators. These reviewers dedicate more time to each portfolio presented to the forums in order to present a detailed analysis of each project to the working group. For example, what is happening everywhere, what the problems are, what the obstacles are, what is needed and a more in-depth analytical congress where reviewers review different projects collectively. This can address any stage of the innovation process as well as identify key points that can help the Lead to identify innovative projects with realistic potential for implementation.

The findings of the VCoP working group are often communicated to the group and designated personnel in leadership and management within the organisation through word of mouth, weekly reports and other online document sharing repositories such as SharePoint and Salesforce. In addition, knowledge sharing sessions are arranged on weekly and monthly basis.

The narratives discussed in this paragraph partly describe how some effective organisations organise VCoPs to generate positive learning outcomes. From a conventional innovation viewpoint, the knowledge literature on the FEI shares common ground with how new ideas are processed into a typical pipeline of funnel during NPD processes, for services and product innovation, new design concepts or FEI strategic

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reorganisation (Axtell et al., 2000; Brentani & Reid, 2012; Frese et al., 1999; Khurana & Rosenthal, 1998; Kim & Wilemon, 2002).

In order to determine if VCoPs generate learning advantages meaningful to improve the FFEI, this research has taken into consideration all the challenges and positive outcomes derived from the knowledge stories to suggest that VCoP is capable of facilitating the extraction of knowledge and creativity at the FEI. Furthermore, this can be achieved through a sustainable, flexible and adaptable innovation process, which can be understood as creating an environment for the innovation process which is filtered through several gates where all experiences and innovation journeys are properly scrutinised as well as used for mitigating risk. (Eventually all processed and filtered into a pipeline of tunnels of communication process and tools.) This highlights the importance of focusing on defining tailored tools suitable for different projects and teams at the FEI.

7. CHAPTER VII CONCLUSION

This chapter provides a general overview of the study and outlines the implications of the research for practice and industry. It ends with concluding remarks pertaining to the thesis as a whole.

7.1 Research Overview & Summary of Findings

This thesis has journeyed into the world of innovation and VCoP for the purpose of examining the challenges of how to create and manage knowledge at the front-end stages of innovation. Specifically, the researcher has aimed to develop new knowledge to understand how the formation of VCoP informs the front end of NPD and the use of uncodified knowledge to achieve FFE innovation outcomes therein. The 'fuzziness' therefore comes from the fact that this cannot be codified and is therefore unpredictable. According to Coates (2009), this is relevant because many new product failures have been attributed to the lack of management at the FFEI and the technologies at play at this stage. It is for these reasons that the FFEI continues to be a very important component for potentially successful innovations (ibid), and the research gap of this study has been centred around the challenges at the FFEI which led the research into the twin activities of knowledge sharing and creation in VCoP at the FFE.

The empirical data for this research were collected from professionals working at the FFI in 46 high technology industries from around the world. The interview respondents were primarily either the head of an innovation department or innovation leaders in their respective organisations working to facilitate innovation and NDP. The researcher submerged the interview data and categorised the empirical themes into two underlying structures; Communication Structure in VCoP and Knowledge Sharing in VCoP and further sought to elaborate the story using the theoretical lens chosen for this study; SLT of VCoP. The implementation of a VCoP will facilitate the sharing of tacit experience by enabling virtual teams working at the FEI with common interests and objectives to engage in discussions, debate and reflection on their professional practices through the

Internet (Murillo, 2008: Rogers, 2000). As covered in the discussion chapter this was substantiated by the contribution of this research to knowledge. In the section that follows the researcher will discuss the implications of this research for practice.

The implication of this research for the literature is that the FEI continues to be a fuzzy place. Creativity and innovation remain one of the most complex aspects of humanity and cannot be easily manipulated but rather different people with diverse skills, character, disciplines, personality and culture cannot be simply managed in certain ways. Adapting this diversity of people into innovation teams in different industries should be flexible and adaptable to the specific business and place. The approach to innovation at the FFEI will depend on the nature of the organisation, the structure and type of industry and the product or service in question.

Innovation should always follow a holistic approach, and businesses need to build enabling environments to sustain the FFEI. In addition, innovation at the front or back end should not be left to itself either, it has to be managed or governed in some way with dedicated budgets and resources made available which are capable of influencing and fostering an innovation culture across every unit in the organisation. Understanding the need for a vision as well as the need to invest in innovation should be a starting point for breeding innovation in a company. Focusing too much on implementation, product rollout and company growth may be problematic as it is apparent that implementation and production roll out is not an effective way of beating the competition.

In managing a VCoP team using computer mediated Internet communication tools, businesses should focus on the quality of the communication medium as well as building online applications or tools tailored to provide a better user experience for the innovation team in question. In order to achieve better innovative outcomes, organisations should avoid, if at all possible, the temptation to deploy complex and complicated tools in their VCoP communication processes.

It is hoped that the theoretical implication of this research will drive future literature to challenge new communication concepts in VCoPs, and will encourage future examination of the social dimensions of utilising VCoPs for innovation instead of too much focus on how it should be managed. The next sections will discuss the implications of this research for practice, the limitations of the study and finally closing with a conclusion.

7.2 The Implications of this Research for Practice

This section discusses the implications of this research for practice, the global state of innovation in the past and at present, the implications of innovation for industry and offers more specific recommendations for overall practice based on the findings of this research.

This study is important because it provides new insights into the activities at the FEI. Innovation is a broad discipline and can be defined in various ways depending on the occupation or trade. It is often used in many different contexts (Ahmed & Shepherd, 2010). Innovation has a variety of definitions for different people depending on their disciplines, trade and occupational levels in society and in the human ecosystem. Therefore, it can be interpreted in many contrasting ways by various people. Also, in high technology industries, innovation can mean creating new values and improvements for our businesses, services, technologies, working tools and environment in order to guarantee survival and maintain a competitive advantage in the marketplace (Ahmed & Shepherd, 2010). Innovation remains a very holistic subject that has defined human heritage and defies most conventional wisdom and best practice. The technology transition of a discontinuous innovation within a corporate setting will require new skill sets and competences for a proper diffusion within the business and consumer sectors respectively (Reid & de Brentani, 2004).

The notion of innovation has never been taken more seriously than in the 21st century, which is seen as the information age where markets are saturated with over rated

technologies and products. This, coupled with high levels of competitiveness in current business environments due to globalisation and a fast-paced business arena, contributes to the driving forces behind innovation.

During the last global financial crisis, the world economy experienced a decline in the manufacturing sectors of the most advanced countries, and at the same time a shift in manufacturing industries to low cost labour economies in the developing world (Goldstein & Overstron-Coleman, 2012). A big question therefore arises for the future of global production industries and technologies as they eventually become saturated and clustered. The researcher would therefore argue that it has become inevitable that any way forward for global economic recovery may well rely on the intense innovation of global macro and micro economies and high technology industries.

In reference to the above discussion, the disciplines of innovation and new technology research on technology adoption and technology diffusion have gained more attention than the innovation process. Numerous studies on innovation, ideation and venture creation have been centred on empirical research related to creativity and learning. There has been compelling research in recent times that has already explored and answered questions as to why, where and whom using different conditions of innovation (Bjork & Magnusson, 2009).

Innovation is such a complex and diverse subject; it can be applied to any discipline and could play a significant role in human development and global economic recovery in the 21st century. For this reason, the study of innovation has become particularly important at this juncture. Although the jargon used in innovation has changed over the course of human history, it is worth mentioning that innovation in the mainstream is still classified into these main technological categories: (1) revolutionary, discontinuous, breakthrough, radical, emergent or step-function technologies and, (2) evolutionary, continuous, incremental or 'nuts and bolts' technologies (Florida & Kenney 1990; Morone 1993; Utterback 1994).

During the literature review, the researcher concentrated on the CoP theory which was used as the main theoretical lens into this empirical research. Prior perceptions of SLT have often disregarded the ramifications of wider social and power affiliations. In spite of these claims, most recent literature, including studies conducted by Bertels et al. (2011), suggest that organisations which encourage Situated Learning within an empathetic social context, characterised by an informal free flow of communication and trust within their organisational climate, tends to narrow the gap and address limitations created by dispersed collaborations by increasing the generation of tacit knowledge at the FEI. This is achieved through nurturing a suitable environment for increased information dissemination within the context of a CoP (Bertels et al., 2011).

The question of power control within CoP has been a further issue among critiques seeking to validate the effectiveness of a CoP in organisational settings (Huzzard, 2004). Yet, this CoP power structures have sometimes been misunderstood and mixed up with the traditional power and political structure of a traditional organisation which Situated Learning in a CoP does not represent. According to Lave & Wenger (1991) when knowledge, labour and social interactions within a CoP are placed in a formal context or where they are financially institutionalised, the potential for achieving the optimum from the community is diminished because this can hinder the free flow information sharing and knowledge transfer.

Nonetheless, Lave & Wenger (1991) did not rule out the possibility of extracting knowledge in such conditions. Research by Bertels et al. (2011) recognises some of these challenges relating to power and political structure in many high technology organisations where a CoP is customary for knowledge transfer. These organisations, which are clearly motivated for success in highly competitive global innovative environments, have put in place measures to address these challenges such as a transparent environment favouring risk taking, trust and open interaction in order to succeed in FEI activities (Bertels et al., 2011).

Although some organisation use innovation as buzz word as part of their corporate slogan in the empirical finding but they fail to invest in innovation. Innovation should not be a function of a unit or department in an organisation but vertically instituted across the horizons of a business. Understanding that the need for a vision as well as the need to invest in innovation should be a starting point for breading innovation in a company, instead of focusing too much on implementation and product rollout into the market and the more a company grows, it becomes more apparent that implementation and production roll out is not an effective effort to beat the competition.

According to this research finding some form of community supports the drive towards and sustains innovation effort at the FFI, and contributes to defining and shaping the challenges at the FFEI, which is also part of an immersive innovation process. According to Thomke & Fujimoto (2000), a major breakthrough in the study of the FFEI would be the possibility of defining the problems and complexities accurately. This will help researchers and professionals at the FEI to properly align the process as well as understand how to properly structure and align the FEI. Until innovators are able to align the problems and challenges at FEI that have already proven difficult during the last decade, the pattern of the fuzziness at the FFEI will continue. This research finding also suggests that defining the problems and complexity is not the major challenge for most organisations at the FFEI but rather finding methods to trigger creativity and innovative ideas among virtual team members is the key challenge.

Studies on FEI have become very significant in recent times. This is because of their strategic place at the early stages of the NPD as well as their importance to the success of product or business service commercialisation (Bacon et al., 1994). The fuzziness and intangible nature of this phase of NPD further creates and adds to the complexities and challenges experienced in the management of these activities at this stage. Accordingly, FFI requires a great deal of flexibility to be applied during product conceptualisation, definition and planning stages, and always leaves a gap to address any future possibilities

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for improvement, enhancement or modification at every stage of the innovation process (Bacon et al., 1994). Making the right choices in the early stages of the business development of the FEI is crucial to the rest of the NPD process and the eventual commercialisation of the product (Cohen & Levintal, 1990). The findings from the research suggests that, in the practical implementation of everyday practice, some high technology industries are already applying structured methods and systems for processing and managing information at the other stages of the NPD process which follow on from the FFE.

This research has examined the importance of the FEI in high technology companies and the challenges of how to create and manage knowledge at the FEI stages of innovation. The research on FEI is critical to the progress of innovation management discipline (Bertels, et al., 2011), and in order to generate new ideas at the FEI many organisations have different ways of looking into the market space. These include; opportunities, tag areas, market atmosphere and investigation of the topic. At the early stages, what is encouraged is a general research and from the research, the VCoP team at the FEI go on to identify and define focus areas. This should lead to a form of model or framework developed around the focus area such as; the opportunity areas for analysing and synthesising ideas at the FEI and thereafter proceeds into the ideation phase and this is the basis of the foundational structure for new ideas for some companies.

Even though some ideas can be generated during the synthetisation of an NPD process, some of these ideas can initially be used as backups in the categorisation of importance. These new ideas could later be refined in subsequent VCoP workshops designated as bigger and more multi-scale or to smaller multi design oriented workshops. Even cross-collaboration with people of varying disciplines is encouraged at the FEI. In addition, it is equally important to align people with the same mind-set, often in smaller units of VCoP, and the rest would be a matter of how the creativity of each individual team member can trigger ideas during the workshop sessions. Indeed, it is also noted, that it can sometimes take quite a push by management to really trigger the FEI team through their leadership.

The findings from the research suggests that in the practical implementation of everyday practice some high technology industries are already applying structured methods and systems for processing and managing information at the other stages of the NPD process which follow on from the FFE.

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Even though some ideas can be generated during the synthetisation of an NPD process, some of these ideas can initially be used as backups in the categorisation of importance. These new ideas could later be refined in subsequent VCoP workshops designated as bigger and more multi-scale or to smaller multi-design oriented workshops. Even though cross-collaboration with people of various disciplines is encouraged at the FEI, it is equally important to bring together people with the same mind set as is often seen in smaller units of VCoP.

According to the findings of this research, with regard to knowledge sharing most organisations apply the following strategy; documentation and standard reporting systems, written reports for every project and meeting, presentations which may include oral presentations during phone, video conferencing or face-to-face meetings and the

practice of internship within the organisation. For example, this may occur when a person from a team working on a particular project in cross-functional activity with another FEI project (which may be in another department) is transferred to another project for a couple of months. This internship activity across several FEI projects tends to be a very effective way to achieve knowledge sharing and technology transfer. Some organisations also use weekly and monthly publications from different projects to share knowledge in a deliberate attempt to facilitate the transfer of tacit knowledge and technology know-how within the company. Organisations who pay close attention to finding better ways on how these tools can be standardised or tailored specifically to each VCoP project will perhaps more likely to achieve good results.

Findings from the research would perhaps suggest that the FEI should not be structured, Businesses need to build an enabling environment to sustain the FFEI. . Innovation on the front or back end should not be left to itself either; it has to be managed or governed in some way. In order to develop and manage a VCoP at the FFI this research recommends a sustainable, flexible and adaptable innovation process. This can be translated as creating a moderation for the innovation process filtered through several gates where all experiences and the innovation journey is properly scrutinised and can be used for mitigating risk. Finally, the use of virtual communication tools such as emails, online repository and virtual work space, video conferencing etc. has become so common and taken for granted in many businesses and it is business-as-usual for some companies. Organisations who pay close attention to finding better ways on how these tools can be standardized or tailored specifically to each VCoP activity will perhaps more likely to achieve better results.

In conclusion, general evidence from this research supports existing literature on knowledge transfer, and the evidence also supports the implications of this research for practice. The findings from this research are important because they are consistent across both practice and theory.

7.3 The Limitations to the Study and Implications for Future Studies

There are several limitations to this research. Future studies should consider the use of ethnography and multiple case studies to investigate the research questions. The initial aim of the research was also to apply participant observation in ethnography and multiple case studies as part of the research methodology. However, due to high level of ownership, confidentiality and trust required from a researcher to observe activities at the FEI, the researcher found it difficult to gain access to the FEI activities of any high technology company. In addition, the researcher had limited time or the networks required to gain employee status at the FEI in one of the high technology companies who participated. High level of IP ownership at the FEI also contributed to the challenge of gaining access to these companies' FFI activities as a participant observer. The researcher believes that these methods might help give a better insight into the activities at the FFI in future research.

Another factor that might be worth considering is the extended use of storytelling instead of a combination of both interviews and storytelling. In order to increase the amount of data collected during a one-hour interview session, the researcher combined storytelling and interviews methods. The interviews themselves were restricted to one hour sessions due to fear of losing the interest of the interviewee if the interview time become too long. Future research could focus on splitting the interview participants into two groups, with interview data collected from one group and storytelling from the other. However, the danger of applying this technique could result in loosing quality data from some participants, and it might jeopardise the quality of data collected from interview participants.

There is a substantial amount of research on Virtual Communities and Internet mediated communication. However, not many studies are focused on CoP. Future studies should

leverage on this work and others to strengthen the literature reviews of future studies on VCoP. The term VCoP computer or Internet mediated communication are not the same. VCoP was coined from CoP and should have similar characteristics to CoP except that the members of the VCoP are dispersed and therefore the use Internet mediated communication tools for knowledge sharing and collaboration instead of face-to-face. Virtual or online communities can range from Internet forums to social media groups etc. which are not affiliated or employed by the same organisation but exchange information online due to social interest.

The researcher extended SLT in CoP into VCoP through the use of interviews and storytelling in a qualitative social context. The researcher encourages future research to build on Situated Learning in VCoP instead of CoP within selected high technology organisations for the purpose of understanding how this group might be managed and or structured for sharing and extracting knowledge using other research methodologies.

Even though a significant number of research in the field of virtual community, maintenance and User innovations in offline communities do exists (Laine, 2009; Füller et al., 2007), there is not enough empirical research to validate a successful application and communication between organisations and VCoPat the innovation space (Laine, 2006; Füller et al., 2007). It is still uncertain as to the level of interaction and approach that companies could apply for successful outcome of this relationship at the FEI (Dahlander & Magnusson, 2008). Academia and the industry are still struggling to comprehend the challenge and its intricacies, and subsequently to develop a better framework and rules of engagement for a sustainable virtual communication (Stürmer, 2009).

Another limitation to this study is that most of the companies selected for this research are innovative high technology companies based on studies by Boston Consulting Group (2012) on high technology innovation companies. The researcher believes that this could be a limitation in regards to the industry-specific variables that were chosen. For any

industrial grouping, there could be a myriad of variables that measure long-term firm innovation performance. The variables used in this study where in part selected for ease of data gathering even though they are related to high technology innovative companies.

In the literature reviewed for this research covering open innovation, the researcher found several challenges to open innovation, which made it inconclusively unjustifiable as an approach for this research journey due to the length of time required for the investigation. Although an open source collaboration can be an opening for generating tacit knowledge through transparent interaction from both within and outside the organisation, it also has limitations created by lack of trust, the battle for IP ownership and the competitive wrangling for market share. For these reasons, the openness required for a CoP to thrive in an open innovation environment will most likely be counteractive to effective free flow of knowledge and creativity. The researcher encourages future research in this area to investigate the connection between open innovation within intra and extra organisational functions and how companies can capitalise on the knowledge of open innovation to create new ideas and knowledge sharing. It should also look at how open innovation can be properly managed to generate new knowledge within and outside the organisation.

Finally, the concept of exaptation is one of the least researched areas in innovation studies. Future research should endeavour to look into how exaptation can be applied to complexity theory, C-K theory (Hatchuel, et al., 2004: Hatchuel, et al., 2009) and other innovation concepts in fostering front end of innovation activities.

7.4 Conclusion

When we say the Front End is fuzzy, many have tried to structure the FEI and have even built concepts to streamline it. However, findings from the research would suggest that it does not need to be structured and, indeed, cannot be structured. Instead, every organisation needs to build enabling environments to sustain the FFEI. Innovation on the

front or back end cannot be left to itself either; it has to be managed or governed in some way. What I mean by building enabling environments is the ability of an organisation to establish the right set of teams/people, collaboration and communication process that will eventually lead to innovation, this is key. The FEI cannot be as structured as much as the back-end but needs to be encouraged and embedded as a grassroots culture in any high technology organisation that drives or wishes to drive innovation activities.

Finally, the use of virtual communication tools such as emails, online repository, virtual workspace and video conferencing for VCoP activities has become commonplace and taken for granted in many businesses. In short, as previously stated, it is business as usual for some companies. Organisations who pay close attention to finding better ways for how these tools can be standardised or tailored specifically to each VCoP project will more likely achieve good results.

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APPENDIX A

Letter Soliciting for Permission to Conduct a PhD Research

Permission to Conduct PhD Research Study at Blizzard Entertainment

<u>PhD research Interest: Fuzzy Front End Technological Innovation Process Management in high-tech companies: A theoretical framework and empirical study in the Software industry.</u>

My name is Leonard Raphael and I am a second year PhD student in Business Studies at Durham University in the UK. I am conducting research for my Doctoral thesis which involves how new knowledge is created and managed at the front end stages of innovation. My research also aims to develop new knowledge in order to understand how the formation of dispersed collaboration within a Community of Practice informs the front end of the New Product Development process and how dispersed collaboration within a Community of Practice might be used as an iterative tacit process which makes use of uncodified knowledge to achieve Fuzzy Front End innovation outcomes. This study has been approved by Durham University Business School and the project will be supervised by my PhD supervisors Dr. Christos Tsinopoulos (Email at chris.tsinopoulos@durham.ac.uk) and Dr. Mathew Hughes (Email at mat.hughes@durham.ac.uk).

As most Software companies are dispersed geographically it is becoming increasingly important to work within virtual teams spread across different locations using virtual communication tools as a means of sharing and transferring knowledge. My research is focused on the current issues surrounding the creation of new knowledge and innovation within virtual communities of practice and has identified the transfer of tacit knowledge to be most problematic at the Fuzzy Front End stage of New Product Development. The methods by which your organisation can meet these current challenges remains a vital

gap within the industry and could be addressed by my research in order for your Company to be able to design some attractive new market propositions for innovation.

As my research could be mutually beneficial I am asking for your approval to conduct qualitative research using ethnography participant observations and interviews among members of a virtual Community of Practice at Blizzard Entertainment. The observations and interviews will require me to be collocated within the dispersed collaborators of the Community of Practice of Blizzard Entertainment. All participants and the name of your organisation will remain anonymous in the final report and data analysis. The observations and interviews will take approximately 3 months to complete and will require me to observe the virtual tools used in dispersed collaborations among Blizzard Entertainment. Community of Practice as well as monitoring the participation within these groups. I will be very grateful if I could be given access to become part of these groups within Blizzard Entertainment in order to maximize the results of my research.

In addition to the group observations and participation I would also like to conduct physical interviews with a select group of your employees such as; junior and senior engineers, specialist, product managers, business and product development managers, scientist, senior managers, section heads and if possible your CEO. I would also like to include product specialist and corporate strategist who have formed a Virtual Community of Practice in their respective fields as part of my analysis. Most of these people will presumably work in different sectors of Blizzard Entertainment and I will therefore focus on those who work or deal directly with the products and services found at the Front End of your business technological innovation management process.

Finally, please let me assure you that there is no identified risk to your organisation from participating in this project as the results of the research will only be reported in aggregated form to protect the identity of your Company and the respondents. Neither the University nor myself have a conflict of interest with the results. Upon completion of the study I will undertake to provide Blizzard Entertainment with a copy of the full research

report which I believe will be very useful to your organisation. If you require any further information, please do not hesitate to contact me on my mobile +447424724121 and/or email address l.c.raphael@durham.ac.uk.Your approval to conduct this study within Blizzard Entertainment will be greatly appreciated. Thank you for your time and consideration in this matter.

Yours Faithfully,
Leonard Raphael
PhD Candidate Business Studies

NOTE: "Blizzard Entertainment" used in this correspondence was substituted for other companies contacted for similar purpose.

APPENDIX B

PhD Research Interview Questions Guide

PhD RESEARCH ON FRONT END OF INNOVATION

INTERVIEW QUESTIONS GUIDE

Durham University Business School

Leonard Raphael

2014

Research Objectives:

My name is Leonard Raphael and I am a second year PhD student in Business Studies at Durham University in the UK. I am conducting research for my Doctoral thesis which involves how new knowledge is created and managed at the front end stages of innovation. This study has been approved by Durham University Business School.

Interview date:

Objectives of the interviews:

- To gather information and obtain your personal views of:

  ➢ Your experience and perception of exploring the options and processes used at your company for new product development.

  ➢ Methods and tools used for communication, knowledge sharing, creation and collaboration at the Front End of your company's business innovation.

  ➢ How useful the methods and tools were, whether it met your needs and expectations, and how positive or negative the experience was.

Confidentiality:

The feedback, which you provide during this interview, is confidential and will not be attributed.

Time of contact:

The interview is designed to last around 30-60 minutes.

Note taking and questions:

- Although I am using a list of questions to enable me to draw out common themes, please feel free to input as appropriate.

- I would like to record the interview to ensure accurate data collection but only with your permission. I would really appreciate it if you can give me your permission to record the interview.

- Are there any points you would like me to clarify before we proceed further?

Name (optional)	
Age	
Number of years' experience in the industry?	
Number of years at the firm? Tenure?	
Qualifications/Education	
Position & Department	
Background	
Size of the Department & Organization	
Organization Age	
Nature of role (in terms of organizational innovation activity)? Impressions	

Identifying Knowledge Sharing:

#	Main Questions	Additional Questions
1.	Can you tell me about innovation in your organization?	
2.	Can you describe in as much detail as possible what Front End of Innovation means for your company and for you and how your organization is driving this forward?	How much are you involved with these activities within your organization?
3.	How do you see your company today in terms of innovation compared to your main competitors, the current times and were you were, for example, say 2 years ago?	
4.	Do you have an organization that is dispersed across geographical zones? Do you have a set of formal and informal processes for communication for dispersed collaboration within your organization and what those processes consist of?	
5.	What communication methods do you apply within your Company's R&D and or New Product Development team dispersed geographically either nationally or internationally	
6.	What knowledge and skills are essential for your innovation project or activity to operate successfully?	Are any of the knowledge and skills at risk of being lost if key personnel stop performing the activity? For example, if they leave the company and If so, how would you prioritize these knowledge and skills?
7.	Do you have special experts who know how conduct and drive your innovation activity better than other employees?	Would you ideally like to clone some employees in this area of expertise? Who needs to know how to do this activity?

	Main Questions	Additional Questions
8.	Are there skills unique to the function of innovation and creativity that are difficult, or rarely, attained?	Need also to get a sense of the mix of who they collaborate with and how – but collaborate is a loaded term implying working together,

		you might also want to explore communication and serendipitous communication (e.g., across function, in communities of interest and/or practice).
9.	How did you communicate new ideas or changes in your organization, which was derived from a recent stakeholder's relationship?	Who do you have to talk to in order to complete the task/activity?
10.	Who is responsible for continuing processes, e.g. decision or implementation of a new idea?	What are the steps that you go through to complete your task/activity? Why does each step matter?
11.	Do you think that these methods have been fruitful and what do you think needs to be done to improve the processes and what are you doing about it?	How much reliance does your position or function place on management experience or knowledge?

Capturing Knowledge Transfer

	Main Questions	**Additional Questions**
12.	In case you want to introduce something new – e.g. a new service or product - how do you get new ideas?	How do you know when to ask for help? What's the appropriate way to ask for help? What are the rules and which ones can you ignore?
13.	Why are you better and more innovative than other organizations?	How do you know when you're over your head?
14.	Can you describe any particular difficulties or challenges your team experiences using the methods of collaboration you mentioned earlier?	What type of strategies do you apply in knowledge sharing during collaboration and Knowledge Transfer sessions?

	Main Questions	**Additional Questions**
15	What does Innovation mean to your company? Are you currently involved in an ongoing innovative Project? And what methods of collaboration and knowledge sharing methods do you apply?	How do you know if the task/activity is completed and if it has been completed satisfactorily?
16	Can you describe any particularly difficulties or challenges experienced by your company in relation to innovating?	
17	How do you ensure that knowledge is shared in	

	your organization among your teams dispersed geographically and how do you measure knowledge sharing in your organization?	
18	To what extent do you consider your company active in both the innovation world and the virtual knowledge sharing within your organization?	
19	What, if anything, would you change about your organizations innovation process if you could?	

	Main Questions	**Additional Questions**
20	How do your employees or colleagues view innovation in your organization?	
21	Are there any questions I have not asked that you feel would be interesting to be considered?	
22	Thank you very much for your time and for participating in this interview. I would be very grateful if I may approach you again if I require further information.	
23	Would you like a copy of the report?	

Research Questions

From the above review, the following research questions areas are drawn:

1. How might a VCoP be organised to contribute to the sharing of knowledge at the FFE?

2. Does a VCoP generate learning advantages meaningful to improve the FFE and if so, how?

APPENDIX C

21 months PhD review poster

APPENDIX D

Some of the PhD research empirical data analysis and transcripts are embedded below –
The permission to view the interviews scripts are subject to Non-Disclosure Agreement
(NDA) and should not be included in the published thesis nor copied.

Copy of
PhD_DataAnalysis_L