Virtual Reality as a Communication Process: User Perceptions and Experiences

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Abstract
This thesis addresses the Virtual Reality (VR) as an efficient communication process, further emphasizes on the importance of Haptic Feedback in Virtual Reality applications. Haptic Feedback plays a pivotal role in Virtual Reality simulations by enhancing users’ interactivity and immersion. Considering the human perceptions and experiences in line with technology is extremely significant for an effective Virtual Reality. The aim of this research is to study the perceptions and experiences of human participants about Virtual Reality applications, importance of Haptic Feedback, and to explore the advantages and limitations of such applications. The need to integrate Haptic Feedback in today’s Virtual Reality applications, and its advantages were emphasized. In order to acquire in-depth understanding of user’s perceptions and experiences about Virtual Reality as a communication process, a qualitative case study was employed in this study with interpretive research approach and purposeful sampling. After interviewing the selective participants, the outcomes of the study would be to consider Virtual Reality as an effective communication medium and to propose improvement plans for IKEA VR Experience with Haptic Feedback. Based on the outcomes of this study, organizations can strive towards providing richer Virtual Reality experience to their customers in the years to come.

Keywords: information systems; Virtual Reality; Haptic Feedback; IKEA VR Experience; communication process; user perception and experience;
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List of abbreviations:
VR – Virtual Reality
VE – Virtual Reality Environment
ICT – Information and Communication System
HCI – Human-Computer Interaction
3D – Three-Dimensional Space
Chapter 1 Introduction

This chapter constitutes an introduction to the research study. Firstly, the research setting is presented. Followed by the purpose statement, the research questions and topic justifications. Later the limitations of the study are discussed. At last the chapter is concluded with thesis presentation.

1.1 Introduction and Research Setting

Information is a multifaceted entity which is foundational to any communication (Beynon-Davies, 2009). In the modern world, technology is becoming an integral component of human life. The growth of any business organization is primarily dependent on technological adaptations and providing its customers a unique experience every time (Beynon-Davies, 2013, p.45). The information can be mediated through various channels, the inclusion of technology to facilitate such communications paved way to some of the established technological advancements like telephone communication, emails, voice chats (Beynon-Davies, 2013, pp.140-141), etc. Having said that the conventional modes of communication is a key for any organization, the need to adapt to recent trends in communication technology is becoming essential for a growing business (Beynon-Davies, 2013, pp.130-138). The technology mediated communication is growing in a rapid pace, the influence of such communications over human societies have really enhanced the quality of living. Television, radio and telephone are some examples of communication media. Communication media provides stimuli for visual and aural sensory channels (Beynon-Davies, 2013, pp.141-143). Beynon-Davies (2009) states that the conventional technology mediated communications, for instance, telephone conversations, emailing, messaging, suffers from loss of information by ignoring the most important aspects of communication like face to face interactions, bodily gestures, emotions, etc. The intension to address such limitations would have driven the emergence and development of Virtual Reality (VR) for the purpose that people are not bound by the geographical borders and physical presence is not always necessary.

There is an increasing need to have a technology which matches the physical reality and the users tends to believe that they are in a different world. The technology calls for a complex computer-mediated communication, which is named as Virtual Reality. Burdea and Coiffet (2003) explain the technology of Virtual Reality is an immersive system with fully rich sensors that has ability to simulate a realistic world for its users.

In this digital era, VR has to be even more realistic than merely a representation of objects in three-dimensional space (3D), which calls for technology that acts as an extension of human senses and takes the user to the next level of Virtual Reality. Such technologies undeniably convinced humans to believe that one can travel anywhere in the world and can experience almost everything in the three-dimensional space. The emerging trend in VR is immersive Virtual Reality environments (VE) where all the attributes like VR interface, transmission channels and organizational infrastructure are considered and emphasizes is more on end user feedback to the stimuli.

The phrase, Virtual Reality, increasingly refers not to a piece of technology but to an emerging communication system (Biocca and Levy, 1995). The efficiency of VR depends on how well the user experiences and feedbacks are translated and transmitted in virtual world, the
importance of sensory stimuli to experience the objects in 3D space is crucial for any immersive Virtual Reality technology (Marini, 2012).

A virtual environment to be so realistic should simulate the sensation of surface textures by providing the information to the tactile sensors. The user should be able to feel and differentiate rough or smooth, hard or soft surfaces in virtual environments (Biocca and Levy, 1995). Systems that facilitate the user to experience the VR as real environments through tactile feedback or bodily sensations are sometimes called haptic interfaces and are of significant interest to VR researchers (Salisbury and Srinivasan, 1992; Shimoga, 1993a; 1993b cited in Biocca and Levy, 1995). The Haptic Feedback, as known as the Tactile Feedback, stands for the sense of touch (Steinbach et al., 2012). Which is considered as the key factor along with aural media in any effective VR communication system. As stated by Biocca and Levy (1995), haptic interfaces could enhance the users experience in virtual worlds to a great extent. Various studies show that Haptic Feedback in virtual environments can reduce the time taken for performing a task (Shimoga, 1993a; 1993b cited in Biocca and Levy, 1995).

There are several studies emphasizing on VR as a communication medium (Barricell and Marini, 2016; Marini 2012; Biocca and Levy, 1995) and inclusion of haptics to enhance Virtual Reality experience (Jones et al., 2016; Steinbach, et al., 2012; Salisbury and Srinivasan, 1992; Shimoga, 1993a, 1993b; Biocca and Levy, 1995). However, there is a limited research in the area of user experiences and perceptions in building an efficient and more realistic VR environment.

Human perceptions and experiences are considered as crucial elements in understanding and creating effective Virtual Reality environments. Hale and Stanney (1998) states that in order to develop effective virtual systems that praised by users, the human-factors research is the primary aspect need to be accomplished. The human experiences are to be considered in line with the technology to make the systems more usable and effective. The technology alone should not be perceived in isolation, rather it exists along with human factors. As per Hale and Stanney (1998), it is impossible to segregate human factors from the design of a potential VE technology and consider them in isolation. Hale and Stanney (1998) emphasized the importance of understanding human-factors, as it is essential for any VE research which aims at advancing the technology to better meet the needs of its users.

Some major areas of this study are studying VR as a communication process and investigating enhancements of user experience on VR application from user perspective. IKEA VR Experience, a VR application of an immersive kitchen experience, therefore was selected as case study in order to study human-technology interaction in immersive environment. Additionally, a mini game of NVIDIA VR Funhouse – Balloon Knight was experienced for the purpose of understanding the assumption of Haptic Feedback gives assistance for facilitating the experience of VR applications. Outcomes of this research claim the importance of Haptic Feedback in the development of VR applications and the necessity of improving user experience by presenting the sense of touch.

1.2 The Purpose Statement and Research questions
This research paper focuses on exploring user experiences and perceptions in a Virtual Reality environment, and to understand the importance of Haptic Feedback in enhancing the VR experience. In this context, the application of IKEA VR Experience is chosen to explore user
experiences and perceptions. The aim is to explore, understand the current features in IKEA VR Experience, and the user predispositions, experiences, thereby providing the improvements in general and specific to haptics in the current setup.

In order to understand the user perceptions and experiences in a better way, it became necessary to setup a VR environment with HTC Vive, IKEA VR Experience application and NVIDIA VR funhouse – Balloon Knight, a Haptic Feedback-based application at the Linnaeus University. Selective participants are required to be chosen for this study as it requires users with basic understanding of VR environments. As the study also focuses on importance of haptics, it is even more essential to do a comparative study on the VR experiences with and without haptics. In this context, an application with Haptic Feedback (NVIDIA VR funhouse – Balloon Knight application) is chosen to explore user experiences with Haptic Feedback. The research study is a qualitative case study with interpretive paradigm, as it intends to explore the user perceptions and experiences in VR environments described above. The following are two research questions that the thesis has answered:

1. How do the users perceive Virtual Reality as a communication process between human and technology and describe their requirements to enhance IKEA’s virtual experience?
2. How do the users describe the importance of Haptic Feedback in enhancing the communication process in the context of IKEA VR Experience?

1.3 Topic Justification
There are several studies emphasizing the importance of Virtual Reality as an effective communication process and role of haptics in immersive Virtual Reality, but very few studies explored the user experiences and perceptions in Virtual Reality environments (VE). As Marini et al. (2012) states,

“Virtual Reality is a communication process between humans, mediated by computer systems, which uses interaction, visualization and other sensory stimuli to convey information”.

In the comparative study on subjective responses to simulated and real environments, Bishop and Rohrmann (2003) highlights the importance of two factors which govern the environmental simulation i.e. considering the impacts of planning and designing a simulated environment which do not exist, and experimental study on perceptions and evaluations of environment change.

Majority of the studies in Virtual environment have restricted themselves to the design and planning of simulated environments and have not focused on the importance of environmental response (Bishop and Hull, 1991; Bishop and Rohrmann, 1995). Therefore, human-environment interactions play a vital role in the virtual environment design. The above studies give enough confidence to study and explore subjective responses in a Virtual environment.

The goal of any complex computer mediated communication like Virtual Reality is to provide an amazing user experience, where the user is totally isolated from the external factors and get immersed in virtual world. The experience is so realistic, that participants respond to the environment naturally and the sense of being in place facilitated by Virtual environments (North and North, 2016).
Recent studies on perceptions of presence in 3-D haptic-enabled VR environments have proven that user experiences are enriched by haptics, as it stands out to be more than essential feature in Virtual Reality (Jones et al., 2016). The quality of the virtual environment compared to the real world is determined by the sense of immersion (Steuer, 1992). The sense of immersion lies on sensory feedback and realistic features in Virtual environments. The user visualizes the virtual environment and its authenticity with sensory experience (Steuer, 1992). Slater and Steed (2000 cited in Steuer, 1992) state that, visual senses may strongly influence the VE experience, however haptic interactions are proven to increase the sense of presence by many folds. A combined experience of visual, auditory, motion and Haptic Feedback contributes to a more realistic virtual environment (Steuer, 1992). Haptic Feedback is considered as most crucial component of Virtual Reality simulations. However, the technology is not fully developed, not integrated with today’s Virtual Reality applications. In general, this area of research still needs to be explored. There is a great need to integrate haptics with VR applications to make it even more interactive to users.

Most of the research in Virtual Reality is technology centric, very few studies highlighted the importance of user perceptions and experiences in designing an effective Virtual Reality environment. The technology and human interaction in a VE cannot be isolated and considered as two different entities, both the entities have equal importance. It is extremely important to consider the human perceptions and experiences in line with technology for an effective Virtual Reality system. The importance of user experiences in VR environments is supported by the study on presence (Witmer and Singer, 1998), as the author states that the sense of presence is essentially the driving factor for designing realistic Virtual environments. “Presence is defined as the subjective experience of being in one place or environment, even when one is physically situated in another.” (Witmer and Singer, 1998).

Home furniture giants like IKEA pioneered the immersive kitchen concepts to the world. IKEA started expanding their online business by providing the state of art infrastructure to the online customers. IKEA VR Experience is one such technological innovation (IKEA, 2016; Åkesson, 2016). Considering the vast landscape of IKEA online business, today’s VR experience should be enhanced many folds to attract customers. VR experience should not only be limited to displaying objects in 3d space, changing colors of drawers, cabinets etc., but users should able to touch and feel the texture, dimensions etc. which is possible through the Haptic Feedback technology. Currently IKEA VR Experience lacks Haptic Feedback.

Therefore, evaluating user experiences and perceptions helps in understanding human-computer interaction in VR environment in a better way, helps organizations to adapt Virtual Reality as an efficient communication tool (Hale and Stanney, 1998; Takatalo et al, 2007; Kronqvist et al, 2016; Gaggioli, 2003). This study aids in understanding the requirements of consumers/users in a much broader spectrum, based on the users’ feedback, organizations can strive towards providing a rich VR experience to their customers in future.

1.4 Scope and Limitations

The research study involves selective participants who are knowledgeable in Virtual Reality environments. An assumption is made that all the participants have some predisposition about
VR environments and Haptic Feedback. The research study is conducted with HTC Vive, IKEA VR Experience application and NVIDIA VR funhouse – Balloon Knight on the campus of the Linnaeus University. The participants were invited to take part in the Virtual Reality session at the LNU based on agreed timelines. A room equipped with a TV screen, required cables and enough space was borrowed to hold the session. Because neither the researchers nor the university have HTC Vive devices, the researchers have rent the HTC Vive devices from a third-party provider. With the assurance that every selected participant had enough time to experience the two VR applications, the available time for renting the needed equipment was limited within 5 hours. Initially, a brief overview of the case study, objective was explained to participants, later subjecting them to IKEA VR Experience and a mini game of NVIDIA VR Funhouse - a Virtual Reality carnival game associated with physical simulations.

The research study is conducted in English, for the consideration of the participants that come from different countries and English is their common language to communicate. On completion of users’ VR experience, an interview is scheduled for each of the participants on agreed timelines. A detailed questionnaire is prepared to explore users’ perception and experiences in Virtual Reality sessions, the questionnaire is good enough to capture all the required details to understand the user requirements, expectations, and suggestions to improve IKEA VR Experience. The users’ feedback aids in providing recommendations for inclusion of Haptic Feedback in VR environments.

The research setting is based on users’ perceptions and experiences, a qualitative approach with interpretive paradigm which in turn may suffer from biased opinions and views. Some user responses would look like too early interpretations about the Virtual Reality technology. This research study is limited to IKEA VR Experience and may work as a benchmark for considering the human factors, importance of perceptions in building an effective VR. Nevertheless, a simulation program of IKEA VR Experience application with Haptic Feedback won’t be written during the processing of this master thesis. To build such an application requires both hardware aspect and software aspect, that is, components for constructing devices and programming for implementation. On the one hand, the process is time-consuming, on the other hand, it won’t be stay within the scope of informatics field.

1.5 Thesis Organization
This master thesis is conceptualized into six main chapters (Figure 1.1). The chapters 1 includes the introductory section narrowing down to research questions. Chapter 2 provides a literature review on the main framework of the Master thesis. Chapter 3 explains the methodology, which deals methodological tradition, the methodological approach discussed along with the methods for data collection and data analysis, and concluded the chapter 3 with reliability, validity and ethical considerations. Chapter 4 explains about the empirical findings. Chapter 5 discuss about the findings, additional outcomes and reflection. Chapter 6, concludes the thesis with an overview to future research. Thesis organization is explained in the following picture.
Figure 1.1 Thesis Organization
Chapter 2 Literature Review

This chapter focuses on the implementation of the Virtual Reality technology within organizations in connection to IKEA VR Experience, and the user experience enhancement with respect to Haptic Feedback. This section provides a better understanding on the research topic and an understandable contextual framework to the readers.

2.1 The Utilization of Technologies

2.1.1 Definition of Virtual Reality

The term Virtual Reality is coined by the founder of the VPL Research, Jaron Lanier. Whereas, William Gibson called it as “cyberspace” (Machover and Tice, 1994). The technology of VR is a three-dimensional multisensory experience that brings participants into a comprehensive immersive environment, as Gigante defined (1993, pp3-14).

Burdea and Coiffet (2003) describe the VR technology as a functional and real-time interactive simulation that utilized to create an immersive world but with realistic feeling. They also point out that the VR world is not haptic, nevertheless, it could give feedback instantaneously according to the user’s action and interaction. The key aspect of Virtual Reality is to provide a more intuitive experience for end-users than in any another platform, as such smartphones, tablets to have a realistic experience (Rosedale, 2017).

The development of VR technology could enhance the operation of a complicated system. Furthermore, the technology could provide end-user richer information and then developing the information into knowledge (Machover and Tice, 1994; Sutherland, 1965). Human interaction is emphasized during developing the following aspects, for instance, user interface design, visual simulation and telepresence technologies (Machover and Tice, 1994). The quality of VR experience therefore becomes significant.

2.1.2 The utilization of Information and Communication Technology

A comprehensive organization is supported by three essential elements, namely, activities systems, information systems and information and communication technology (ICT). ICT is utilized to collect information, process and distribute and use (Beynon-Davies, 2013). The implementation of ICT has been extensively accepted by individuals and organizations. Additionally, the technology has created positive influences. Hardware, software, data management technology and data communication technology construct an ICT system, which supports individual-organization-technology communication and interaction (Beynon-Davies, 2013). World wide web, intranet and data management systems are essential aspects of ICT infrastructure, as Beynon-Davies (2013) stated. The World-Wide-Web provides users a front-end ICT, which is a platform that could interact with the users, simultaneously, databases acts as back-end ICT and response to the users’ requirements. The intranet is a front-end access channel, transfers information for those people who are within the organization (Beynon-Davies, 2013).

With support from ICT and the internet, the current way of doing business has facilitated from the traditional method which requests face-to-face presence, to a more comprehensive method, which also accepts presenting information and interacting under the long-distance circumstance. The implementation of ICT has positively impacted on the communication and
cooperative relationships among individuals and organizations. Different types of information and communication technology, for instance, emails, video conferencing, telephone conferencing, are widely used in daily life. Goncalves et al. (2012) demonstrate that the information and communication technology has been utilized in the process of Virtual Reality development, likewise, Virtual Reality is implemented as a tool of ICT in order to increase organizations’ working performance (Woksepp, 2007).

From the aspect of IS/IT to view the Virtual Reality implementation, the VR is utilized by individuals within the organizations for the reason of decreasing spatial spaces, so that to obtain external information, exchange information in different organizations and communicate with others (Tampieri, 2012). VR applications run on electronic devices, for instance, computers and mobile phones. Associating with back-end databases, the individuals could interact with the Virtual Reality application. Beynon-Davies (2013) introduces that the physical aspects, such as, input devices and output devices are hardware of ICT system. The software of ICT system includes applications and programs that control the hardware. The data management technology of ICT system refers to hardware could store data. Finally, the data communication technology of ICT system stands for those components that transmit data, for instance, network, routers and software that used to understand and process communication protocols (Beynon-Davies, 2013). From the perspective of VR is a tool of ICT (Woksepp, 2007), the devices of VR count as hardware of ICT, they assist humans to communicate with ICT systems. VR applications are examples of software of ICT Systems, they manage the performance of hardware. The databases of VR applications are storage of user’s data, meanwhile, interact with the users’ requirements. The internet, VR Audio cables and the network of interactive devices are some components of communication technology.

According to the point of Woksepp’s view (2007), in daily work, implementing the ICT tool, VR, benefits the quality and efficiency of the organizational work from aspects of financial conditions and processes of development. Furthermore, McLay (2011) and Buhalis and O’Conner (2005) say that to take into consideration the implementation of ICT impacts on individuals’ and organizations’ competitiveness, the employees therefore are requested to have a good-understand of information technology and improve their level of utilizing software skills, in order to obtain benefits from the ICT. For instance, facilitate the working performance and obviated potential vulnerabilities.

2.2 User Experience in the Virtual Environment

Abbasi (2015) defines the human-computer interaction (HCI) as a study of interaction among humans and electrical machines, such as, personal computers, mobile telephone and tablet computers, etc. HCI and information systems commonly aim to design a remarkable system based on aspects of humans and technology so that the system could satisfy users’ requirements (Balbo, Bentley and Collings, 2006). In the field of information technology, the term of “interaction” defines as communication between human and system (Miyata, 2012).

Miyata (2012) points out that HCI is widely used in the development of Virtual Reality applications. Realism and immersion and interaction are Virtual Reality’s essential factors (Miyata, 2012, pp. 287-306; Luca et al., 2012, pp.153-178). The interaction factor provides users ability to communicate with computer-based simulations so that the users’ viewing VR experiences are easier to explore, whereby, the performances become more effective (Miyata, 2012, pp. 287-306). Wies et al. (2001) and Wall and Harwin (2001) illustrate that the
technology of Haptic Feedback is a new form of HCI, for example, associated with the HCI devices for instance the monitor and audio cues, Haptic Feedback provides users an interface that plays a role of information exchanging communication platform between human and technology. Collaborating with HCI, the Haptic Feedback increases the communication capabilities of blind people so that they could reduce the limitations of disability and obtain more tactile information (Wies et al., 2001).

According to the viewpoint of Miyata (2012), the quality of the user experience is one of essential considerations during the interactive system design. Experience is defined as the accumulation of knowledge or skill that results from direct participation in events or activities (Visual Thesaurus, 2017). Participation requires interaction between person and environment (Takatalo et al., 2007). The experience driven by interactions is often influenced by memory and previous experiences (Glenberg, 1997). The emotional and psychological factors influence a person-environment interaction and makes it a meaningful experience and adds value to that interaction (Takatalo et al., 2007).

To understand the importance of human experiences in Virtual Reality, studying usability it is essential to consider the “sense of presence” (Kronqvist et al., 2016). There are various definitions and conceptualizations available for the term “presence” (Hale and Stanney, 2014, p.858), such as, virtual presence, co-presence, subjective presence, etc. However, the most convenient definition of presence would be to consider it as “virtual presence” to represent the sense of being present in VE (Barfield et al., 1995). A virtual environment allows user to experience presence as if they are in a real physical environment (Ralph, 2008). To have an experience matching physical reality, user needs to feel the sense of presence i.e. experience “being there” or being immersed in the environment (Loomis et al., 1999). There are various constructs to explain the sense of presence in virtual environments. Firstly, presence requires involvement in VE’s, secondly, it is defined by subjective experiences, thirdly presence as a multi-dimensional construct (Gaggioli, 2003). Human performance in VE is greatly influenced by the degree of presence (Fontaine, 1992; Zeltzer, 1992). Majority of the research considers the VE systems with more realistic sense of presence is considered as an efficient environment when compared to the environments without human perceptions (Hale and Stanney, 1998). Most of the researchers point that presence is essential aspect of VE. Hence, the sense of presence is relevant for design and the evaluation of VR applications (Gaggioli, 2003).

The study on human factors in virtual environments emphasizes the importance of human factors in designing VE’s. Due to close interaction between technology and humans in a VE, it is difficult to segregate and explore them as two different entities. The effectiveness of virtual worlds is determined by user’s capabilities and limitations (Hale and Stanney, 1998). The future VE research efforts can be aimed at understanding human-factor issues in order to meet the user needs (Hale and Stanney, 1998).

2.3 Virtual Reality as a Communication Process

Beynon-Davies (2013) defines an organization as some groups of people collaborate with each other in order to reach a common goal. Activity systems, information systems and information and communication technology (ICT) systems become essential elements of organizations that assisting organizations’ performance through the way of facilitating efficacy, efficiency and effectiveness of internal and external communication, information interchange and data management. Information systems provide organizations a communication system so that
information is available to exchange. According to Beynon-Davies (2009), the term of information system is understood as a term encompasses the overlapping areas of information systems, information management and information technology.

The reason that an organization implements information systems is to reach the goal of controlling organizational activities and facilitating ways of doing things. With the assistance of information systems, organizations have capabilities to work more efficiently. Furthermore, the implementation of information systems could enhance employees’ working performance and guide the employees to work towards a better achievement. Simultaneously, information systems provide customers benefits, such as, a high quality of product and a comfort service.

Beynon-Davies (2013) states that an information system is known as a communication system. Communication and interpretation are significant methods for humans to get information. From the understanding’s point of view, individuals should establish a common sign-system which is known as an agreeable collection of signs and meanings, an activity system-related communication which is existed with specific purpose (Beynon-Davies, 2009). Beynon-Davies (2013, p.74) defines a sign as “a pattern of significance” and a kernel element that connects humans’ intentions and expressions, cooperation, information transmission and data collection together (Beynon-Davies, 2009).

Biocca and Levy (1995) introduce the communication system is constructed by “a communication interface, transmission channels and organizational infrastructures”. They explain that sensorimotor channels are significant element to build a communication interface. The transmission channels will be used when there is information need to be transferred. In the case of VR, VR’s communication interface is defined as physical media, code, and information along with sensorimotor channels. The aim of designing VR’s communication interface is tried to extend the sensorimotor channels. Transmission channels constitute the way the information is transported in cyberspace via digital media and the user experience/feedback to stimulus and finally the development of VR is managed by governments, such as, financial and support organizations, because governments and agencies have been aware of the capacity of this technology (Biocca and Levy, 1995).

Biocca and Levy (1995) point out that the process of communication is like a way that transport information. In the case of VR, after experiencing the immersive environment, the user obtains the senses of touching and all these experiences become information which is transferred through the transmission channels in order to communicate (Biocca and Levy, 1995). Therefore, VR is a communication system and by implementing the VR, the user could interpret senses of reality and give interaction in an immersive environment (Marini, 2012).

2.4 VR Enhances Human-Human and Human-Technology Communication
From the perception of individuals, a variety of communication systems meet different people’s need based on their individual preferences (Hammick and Lee, 2013). Previous studies pointed out that people who lack of communication skills or having difficulties to communicate because of their personal issues, prefer to communicate via technology devices rather than having communication in the form of face-to-face (Hertel et al., 2008; Hammick and Lee, 2013). Based on this communication problem, researchers have focused on Virtual Reality and have investigated factors that would influence on user’s communication experiences in the immersive environment (Suh and Lee, 2005; Hammick and Lee, 2013). According to Miyata’s
Interaction is a feature of communication process as well as an essential factor of Virtual Reality, therefore, Virtual Reality is a communication process that handles with communication between users and systems (Miyata, 2012, p.288). Associated with hand controllers and headset, users explore different application within an intuitive but immersive environment. Furthermore, it provides users a convenient way to access world widely (Rosedale, 2017).

Marini (2012) and Stamper (1973) illustrate that once meet a communication-related problem, there are three different abstraction levels in the term of “communication” need to be considered, following by the order from the lowest to the highest, they are, syntactic level, semantic level and pragmatic level. The level of syntactic deals with the structure, function and model of communication, meanwhile the level of pragmatic is not only making decision of the purpose of the communication, but also play as a role as a discipline that exploring the sign-meaning relationship (Marina, 2012). According to Sjöström and Goldkuhl (2003 cited in Barricelli et al., 2016, p.2), “in human-computer interaction (HCI), the relationship between humans and computers is based on the given interaction rules; therefore, we can consider that the rules of the human-machine dialogue are part of the pragmatic level”.

Marini (2012) argues that when implementing VR as a solution for communication problems, the developers of VR should realize to simulate the case by following specific structure, function and underlying process of the problem so that the participants could interact the case within a high visual realism.

Rosedale (2017) highlights that the affections Virtual Reality is going to bring to humans and society shouldn’t be neglected. Contemporary Virtual Reality is a communication medium bridges the gap which enhances a better technology-individual-organization relationship.

2.5 The Implementation and Experience of HTC Vive
The technology of Virtual Reality has been highly compelling nowadays because it revolutionarily places humans in an immersive world with a computer-generated device so that the users are able to explore different worlds and interact to a various of experiences (Egger et al., 2017). Industries are in developing competitions with each other and dedicate themselves to innovation for the purpose of leading in the technology of Virtual Reality exploitation (Ripton and Prasuethsut, 2015). Oculus Rift, PlayStation VR, HTC Vive and Samsung Gear VR are major computer-generated devices in the recent market and each of them has special superiorities. Nevertheless, the emphasis of this section is on the devices of HTC Vive and their influences on user experience, because HTC Vive is the specified Virtual Reality viewing product to launch the application of IKEA VR Experience.
On April 5\textsuperscript{th}, 2016, Taiwanese company HTC together with Valve Corporation released a Virtual Reality device, HTC Vive, as the Figure 2.1 shown above. The HTC Vive includes a headset, two trackpad controllers and two stationary reference units (Egger et al., 2017; Dempsey, 2016). In order to provide customers a high quality of immersive Virtual Reality experience, HTC Vive has strived to be consummate from aspects of hardware and software.

In consideration of optimizing user experience from aspect of hardware, with an adjustable strap, the HTC Vive attends to provide as much as comfortable headset solution to customers (Dempsey, 2016). Before getting start with explore the immersive HTC Vive world, the user should choose a play area which is larger than 1.5*2 meters so that the user has enough space to move around during the time of experiencing VR applications (Anon, 2016). To lock down the play area, the user need to place two base stations diagonally within the scope of 5 meters (Anon, 2016). The two base stations track the position of the headset’ and controllers’ sensors, so that the system recognizes user’s movement and sends out warning if the user is going to across the real physical boundaries (Dempsey, 2016; Vive, 2017; Anon, 2016). Noteworthily, any reflective surfaces, such as, windows and mirrors as well as direct sunlight should be excluded in the play environment so that the two Vive based stations could easily recognize the user’s movements without any unnecessary interrupts (Anon, 2016). The two wireless and trackpad controllers are handy. Each of the controllers has twenty-four (24) sensors and implements the functionality of Haptic Feedback in order to tract every single movement within the sense of immersion landscape and consequently brings the VR experience to a more practical level (Vive, 2017). The higher quality of display, the better immersive viewing experiences users will have. Combining with 2160*1200 display resolution and 90MHz refresh rate, the HTC Vive is designed to run with a high-end hardware, which lays the foundation for Vive to meet user’s requirements with high quality of display performance (Vive, 2017; Dempsey, 2016; Egger et al., 2017).

Nevertheless, each coin has two sides, according to Dempsey (2016), HTC Vive has two concerns need to be improved in order to enhance user experience in the future. The first issue is after viewing the VR applications in a short time, eyes sockets of the headset easily get sweaty. The second consideration is those multiple cables connect HTC Vive to the hardware are irritating and some related potential safety risks are existed. Therefore, the components and the materials of the HTC Vive could be fully tuned and optimized. Furthermore, wireless and portable devices will be implemented in the future in order to facilitate users’ viewing VR experiences (Dempsey, 2016).
2.6 User Experience of VR Applications Exploration
2.6.1 User Experience with the IKEA Virtual Realty Kitchen

Kleinermann et al. (2005) have looked to the future that the home furniture retails giant IKEA could be reconstructed associated with the technology of Virtual Reality with functions of, such as, walking around the immersive shop, purchasing furniture and searching rich information about every single product.

As one of few organizations adopted the technology of VR as a solution to meet the needs of potential customers (Åkesson, 2016), April 5, 2016, IKEA launched its first Virtual Reality related application, which is named as IKEA VR Kitchen Experience (IKEA, 2016). The test app was developed collaboratively with Allegorithmic. By downloading the app from the Valve’s game platform, Steam, and running it with HTC Vive, consumers can use the app to explore the IKEA kitchen in a virtual environment, as the Figure 2.2 (Steam, 2017) shown above.

Because of the room-scale motion tracking (Åkesson, 2016), the user can walk around and experience ideal kitchen through doing some easy tasks in the immersive environment. With a click, the user could effortlessly change the color of cabinets and drawers to black, white or burlywood (IKEA, 2016). The app has offered users a feature that observing the kitchen from three different perspectives, namely, from 100 cm, user’s height and 200cm (IKEA, 2016). Hence, the user could stand in kid’s shoe and consider whether the solution is appropriate. Those options therefore assist users to explore a better solution as well as enhance the Virtual Reality experience. Jesper Brodin, managing director at IKEA of Sweden and Range and Supply Manager at IKEA Group, points out that about five to ten years, the technology of Virtual Reality will be integrated as a part of human’s live. Moreover, he insists that VR will have irreplaceable positions in the near future (IKEA, 2016).
2.6.2 User Exploration of NVIDIA VR Funhouse – Balloon Knight
NVIDIA believes that the essential approach to enhance user’s experiences of VR is to simulate the sense of physics (Rege, 2016). Once the players get inside into the immersive environment, visual effects work collaboratively with physical effects for instance, Haptic Feedback, provide the players an interactive and realistic experience (Rege, 2016). NVIDIA has elaborately designed on VR Funhouse. The VR Funhouse consists of ten mini games, namely, Fun with Green Goo, Balloon Knights and Shoot Flaming Arrows (NVIDIA® VR Funhouse, 2017; Rege, 2016), etc. In consideration of simplicity and enjoyment, the game of Balloon Knights (Figure 2.3) was selected for the purpose of exploring the effects that haptics made.

![Figure 2.3 Balloon Knight, Garreffa, 2016](image)

The aforementioned game as show in the Figure 2.3 (Garreffa, 2016), the Balloon Knight, offers players an immersive experience that players could utilize two swords to hit the colorful balloons. The game is full of haptics effects and different effective levels of feedback were illustrated based on game player’ behaviors. The game players unhesitatingly utilized the Vive’s wireless motion controllers in their hand in order to control the swords in the game so that they could hit the confetti-filled balloons as many as they could. Simultaneously, the controllers simulated the effects of balloons’ explosion by vibrating thoroughly. Furthermore, when the game players put the swords together in order to run against each other, the vibration also facilitated the simulation of physical reflection so that provides the users a more authentic popping balloons experience.

2.7 Haptic Feedback Analysis in Virtual Environment
Haptic Feedback, the sense of touch, plays a vital role in humans’ cognitive ability to experience any physical environment. For instance, taking a pencil or pen from a bag doesn’t require any visual or auditory modalities. The sense of touch is equally important in virtual environments to enhance the users’ sense of immersion. Haptic Feedback is an important sensory technique in Virtual Reality interactions. According to Mazuryk and Gervautz (1996) and Burdea and Coiffet (2003), Ivan Sutherland was the first one who presented the idea of having “a kinesthetic display” in VR. Sutherland (1965) claims that in order to realize a kinesthetic display, computers should be able to produce meaningful sounds, simulate smells, control the force feedback, sense human’s muscles, interpret eye movement and react to semantic commands.
Stone (2001) illustrates that early Haptic Feedback systems’ developments aimed to help people with visual disabilities to explore unknown field through virtual environments. Recently, the focus of developments however is on 3D visual simulations, which is, VR. A common example of Haptic Feedback implementation is showed by Stone (2001), that is, two people play a furniture handling game and their task is moving a table in a crowded room. The application gives different reactions which is depended on the players’ performance. For instance, when players move the table in different directions, a feeling of the push and pull will be given to individuals, which means, players will feel the force of obstruction. In this case, Haptic Feedback is used as an interaction approach for users to communicate with machines as well as to communicate across distance in Virtual Reality environment. Communication that made through implementing Haptic Feedback, called haptic communication. Steinbach, et al. (2012) illustrate that interaction between human-human and human-machine facility by analyzing haptic communication. Implementing haptic communication on 3D visual simulations increases interactional communication between human actors and technology actors. In addition, it makes 3D simulation games cumulatively interesting. Therefore, haptic communication plays an informative role nowadays (Wang, Chellali and Cao, 2015).

Haptic Feedback groups the modalities of force feedback, tactile feedback, and the proprioceptive feedback (Burdea, 1996 cited in Burdea, 1999). Force feedback integrated in a VR simulation provides data on a virtual object hardness, weight, and inertia. Tactile feedback is used to give the user a feel of the virtual object surface contact geometry, smoothness, slippage, and temperature. Finally, proprioceptive feedback in the sensing of the user's body position, or posture.

Virtual Reality applications are now well established in Medical, Educational and Mechanical environments. The advantages of haptics in such environments are well proven and Xia et al. (2011, pp.382-383) state the advantages as the following:

“Integrating haptics into virtual assembly is a promising and valuable application for mechanical products, which can result in faster product development process, faster identification of assembly and design issues and an efficient and low-cost approach for assembly planning and training.”

There are various studies support the importance of haptics in the field of medicine, especially haptics is proven to enhance the user skills and aids in effective training for surgeries (Keus, et al., 2006 cited in Meijden and Schijven, 2009). Realistic procedural simulations with Haptic Feedback lead to better performances, faster performance curves and high transfer of operative skill.

2.8 Hypothetical Haptics Framework for IKEA VR Experience
According to Israr, et al. (2016), the Haptic Feedback is an indispensable part to be incorporated into the comprehensive sensory experiences. Usually, experiences of tactile feedback include, namely, shake, force feedback, sense of temperature, humidity and weak electric shocks (Israr et al., 2016). Along with user’s movement and activities, biofeedback and network messages, the Haptic Feedback will enhance the quality of VR viewing experience (Israr et al., 2016).

The IKEA VR Experience has been outstanding in the way it is dynamic, user friendly, the user can explore three different kitchen settings in an immersive environment. However, the aspect
of haptics is not being considered in IKEA’s virtual kitchen setup. The lack of haptics in the IKEA VR Experience is considered as a limitation from users’ perspective, where the users interaction with virtual objects is not so realistic. The sense of immersion would have been better with haptics (Penn et al., 2001). In order to improve the virtual circumstance and expand the potential market, especially through the way of enhancing user’s online experience, there is room for IKEA to continually innovate, improve and develop the IKEA VR Experience. Therefore, the IKEA VR experience may have to be upgraded to the next step, that is, the application would require more functionalities and users may be allowed to experience the sense of touch along with visual and auditory modalities. The inclusion of Haptic Feedback in the IKEA VR Experience would take its users to a different world by enhancing the users’ interactivity and immersion.

As illustrated in the above Figure 2.4 – hypothetical Haptics IKEA VR Experience Framework, associated with the customization, the IKEA VR Experience application runs the gaming engine on a high-end computer and consequently give output information to audiovisuals and haptic plugin. The customer has ability to customize the level of feedback from strong feeling to weak feeling based on personal preference. The application is collaboratively presented by two kinds of devices. One of them is the HTC Vive headset, aiming to present sound and vision. The other one is a pair of haptics gloves, aiming to empower the user to control the action in the application and feel the feedback.

In order to enhance the user experience of the IKEA VR Experience application with respect to the technology of Haptic Feedback, a pair of haptic gloves is needed. Utilizing haptic gloves will have the following advantages, for example, the user could effortlessly move kitchen items around, simultaneously, the user could feel the relative tactile feedback. After connecting the VR devices, which include HTC Vive headset and a pair of haptic gloves, with a high-end computer, the user runs the application of IKEA VR Experience and subsequently to interact with the application. With the help of Haptic Feedback, the application of IKEA VR Experience becomes a communication process not only receives the user’s actions, but also forwards the sense of touch to the user. The system will accordingly provide sound and vision based on the user’s action, activities and eye movement. Furthermore, tracking the user’s motion and biofeedback so that to activate the sensors to react. The goal of this function is to simulate the immersive kitchen with more physical senses, so that the experience of the application becomes increasingly authentic. The user is available to experience different feedbacks under specific situations, for instance, when the user open or close the drawer, the sense of pull or push force
feedback will be presented. Furthermore, while cooking meatballs, the user will be able to feel the temperature of the pan simultaneously becomes increasingly warmer. When the user changes their perspective to a kid’s height (100cm), the user will feel the need to push or pull harder in order to open or close the drawer.

2.9 Summarization of the Literature Review
This chapter was intended to probe how Virtual Reality acts as a bridge between humans and organizations. The chapter started with the definition of Virtual Reality and introduced the Virtual Reality technology utilization in the field of human-computer interaction and information systems. By exploring user experience in the Virtual Reality environment and communication process, the researchers understood that increasing sense of authentic feeling and touch would improve user experience in the immersive world, reduce potential risks of communication problems and enhance technology-individual-organization relationship. The need of Haptic Feedback therefore was highlighted. The application of IKEA VR Experience was introduced in the chapter as the case study. Furthermore, NVIDIA VR Funhouse-Balloon Knight application was presented, this is to point out that the implementation of Haptic Feedback in the immersive environment has benefits, for instance, enhancing the sense of immersion, improving communication and interaction. Hypothetical Haptics Framework for IKEA VR Experience aimed for promoting user experience was consequently developed. Afterwards, with the help of the knowledge gained from the Literature Review chapter, the researchers analyzed the data which is collected from the interview. The outcomes and conclusions were strongly motivated responding to the points that stated in the Literature Review chapter.

The chapter of Literature Review is summarized as the following table 2.1:

<table>
<thead>
<tr>
<th>Subtitle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utilization of Technologies</strong></td>
<td>• VR as a tool of information and communication technology</td>
</tr>
<tr>
<td></td>
<td>• Human-computer interaction</td>
</tr>
<tr>
<td><strong>Implementation and Experience of VR</strong></td>
<td>• A 3D multisensory experience that brings users into a comprehensive immersive environment with realistic feeling</td>
</tr>
<tr>
<td></td>
<td>• User experience of the HTC Vive</td>
</tr>
<tr>
<td><strong>User Experience in the Virtual Environment</strong></td>
<td>• Quality of user experience</td>
</tr>
<tr>
<td></td>
<td>• Sense of presence</td>
</tr>
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<td></td>
<td>• Human performance</td>
</tr>
<tr>
<td></td>
<td>• Understanding human-factor issues</td>
</tr>
<tr>
<td><strong>Virtual Reality as a Communication Process</strong></td>
<td>Elements of Organizations:</td>
</tr>
<tr>
<td></td>
<td>• Activity Systems</td>
</tr>
<tr>
<td></td>
<td>• Information Systems, as known as Communication Systems</td>
</tr>
<tr>
<td></td>
<td>• ICT Systems</td>
</tr>
<tr>
<td></td>
<td>VR as a Communication System:</td>
</tr>
<tr>
<td></td>
<td>• Communication Interface: Physical media, code and information with sensorimotor channels.</td>
</tr>
<tr>
<td></td>
<td>• Transmission Channels: Transport information and user experience via Digital Media.</td>
</tr>
</tbody>
</table>
- Organizational Infrastructures: Organizations, such as, financial, support, academic organizations, etc. The user interprets senses of reality and gives interactive feedback in an immersive environment.

| VR enhances Communications | • Strives to solve communication problems and improve communication skills.  
|                           | • Enhances technology-individual-organization relationship. |

| User Experience of VR Application Exploration | IKEA VR Experience  
|                                               | • Changing color of cabinets  
|                                               | • Walking around and observing the immersive kitchen from three different perspectives  
|                                               | • Experiencing kitchen activities, such as, cooking meatballs and baking cinnamon rolls  
| NVIDIA VR Funhouse-Balloon Knight          | • Using swords to pop balloons  
|                                               | • Provides users a chance to explore the effects of Haptic Feedback |

| Haptic Feedback Analysis in Virtual Environment | Haptic Feedback:  
|                                                | • The sense of touch enhances the sense of immersion  
|                                                | • An interaction approach for users to communicate |

| Hypothetical Haptics Framework for IKEA VR Experience | Haptic Feedback enhances the User Experience:  
|                                                      | • Provides comprehensive sensory experiences  
|                                                      | • Presents the feedbacks of force, temperature and humidity, etc.  
|                                                      | • Enhances the quality of VR viewing experience  
| Hypothetical Haptics Framework is designed for User Experience | Haptic Feedback enhances the User Experience:  
|                                                        | • Provides comprehensive sensory experiences  
|                                                        | • Presents the feedbacks of force, temperature and humidity, etc.  
|                                                        | • Enhances the quality of VR viewing experience  
|                                                        | The user customizes the level of feedbacks based on personal preference.  
|                                                        | IKEA VR Experience runs on a game service of a high-end computer associates with HTC Vive headset and a pair of haptics gloves so that to empower control ability of the user and increase the effortlessness of experience.  
|                                                        | The immersive experience becomes more authentic because the VR as a communication process forwards the sense of touch to users based on user’s action. |
Chapter 3 Methodology

This Chapter deals with Methodology. Methodology is the systematic, theoretical analysis of the methods applied to a field of study and in this chapter methodological tradition and methodological approach is discussed in appropriateness to the study. In addition, methods of data collection and data analysis are also discussed. This chapter concludes with the discussion of issues, such as, validity, reliability, and ethical concerns.

3.1 Methodology Tradition

Huang and Fang (2016) introduce that ontology, epistemology and methodology are three elements related to the research paradigms. Ontology concerns the nature of reality and methodology stands for the awareness of knowledge which is obtained through processing and instrument (Huang and Fang, 2016). Methodological tradition explains that epistemology refers to the relation between the reality and the research (Myers, 1997; Huang and Fang, 2016). Lee (2004, p6) argues that the term of “epistemology” is not only “the theory or science of knowledge”, instead, an epistemology is

“A broad and high-level outline of the reasoning process by which a school of thought performs its empirical and logical work”.

Orlikowski and Baroudi (1991) have classified three epistemologies paradigms within the field of information systems, namely, the positivist, the interpretive and the critical. The positivism attempts to develop new theories, test and refine the existed theories. Positive research considers realities are objectively given and could be measured independently by instruments (Myers, 1997). Schrag (1992) argues that the positivist paradigm is focused more on its consequential influences than its own value. Whereas, the focus of critical research is to change and improve systems (Myers, 1997). Orlikowski and Baroudi (1991) claim that the critical epistemology prefers to question and analysis social phenomenon which has been rooted in human perception from a dialectical perspective with collaboration of social systems, so that to pursue a further goal of disclosing the social practices from history, ideology and contradictory aspects.

This master thesis aims to explore user’s perceptions and experiences over the VR applications. During the investigation, the interpretivism was employed rather than positivism and critical for certain considerations. Myers (1997) and Goldkuhl (2012) demonstrate that the interpretive research aims to emerge context by interpreting human’s meaning through interacting with social constructions for instance languages, shared meanings and documents, humans obtain realistic knowledge (Klein and Myers, 1999). From the view of interpretivist paradigm, social realities are created when humans act and interact with others. There are few instruments to measure the social realities, nevertheless, the researchers could play a role as an instrument to interpret the participant’s meaning through social constructions in order to measure the realities. When the aim of researches is to understand the insights of human, the interpretive research is a good choice to process with, as stated by Klein and Myers (1999). In brief, applying interpretive approach to research could help the investigation stay in the scope of interpreting the respondents’ perceptions and experiences.
3.2 Methodological Approach

Qualitative research and quantitative research are common alternative methodological approaches for researchers to narrow down their investigations from a broad assumption to detailed methods of data collection, so that they could utilize those collected data for ulterior analysing (Creswell, 2014). Myers (1997) states that it doesn’t matter which research approach a research applies, all researches have a common, which is, all of them are founded on some underlying assumptions regarding to how to do a valid research in order to meet the research objectives and obtain knowledge.

According to Creswell (2014, p.4), the quantitative research aims to test influences of different variables on objective theories. To get results therefore statistical tools are implemented in order to analyse the numbered data. Meanwhile, the qualitative research approach is applied by investigators when they need to study the phenomenon of society and human beings (Creswell, 2014), because the qualitative researchers are interested in understanding and interpreting other’s experiences and their ideas of the experiences (Merriam and Tisdell, 2015). Merriam and Tisdell (2015) illustrate that designing of questions about understanding participants’ experiences is the process of a qualitative design. Researchers in the informatics field have increased interestingness of applying qualitative research in their studies. Qualitative research as known as qualitative inquiry could help with understanding the meaning of real-life with a contemporary phenomenon, representing human’s perceptions, producing new insights and explaining human behavior (Yin, 2015). From Merriam and Tisdell’s (2015) point of view, the aim of qualitative case study is to understand meanings of phenomenon. They added that the researchers play the role as instrument so that they could analyze the collected data. The results of analysis are described in-depth with rich information (Merriam and Tisdell, 2015).

In order to acquire in-depth understanding of user’s perceptions and experiences about VR implements as a communication process, qualitative research therefore is employed in this study. Comparing with quantitative methods, qualitative methods are more flexible. Instead of answering the research questions with yes or no, the participants could express themselves with their own words. Therefore, the participant’s answer could be complex (Mack, et al., 2005).

3.2.1 Research Strategy

Case study is the most common qualitative research method utilized in the field of information systems among another research methods, such as, action research, grounded theory and ethnography (Orlikowski and Baroudi, 1991; Myers, 1997; Myers, 1998). As an empirical inquiry, a case study is focused more on the interaction between individuals, organizations and technology than technical issues (Benbasat et al., 1987; Yin, 2014). Boddy (2016) and Merriam and Tisdell (2015) have recognized the importance of the quality of case, because a single case for instance a bounded system or a single entity could provide in-depth and meaningful understanding of phenomena. The purpose of this master thesis study was to explore and understand the perceptions and experiences of virtual reality for individuals. Therefore, the case study research method with a single focused case was appropriate for the study with benefits of facilitating interaction among the researchers, individuals, organizations and technology and helping the researchers understand the participants’ behaviors and meanings in-depth.

A qualitative case study of the IKEA VR Kitchen Experience application is processed at the Linnaeus University. Fifteen (15) participants were purposefully selected because they are interested in contemporary technology and online shopping so that to make sure that they are
able to express themselves in the relevant field and provide useful answers willingly and readily. The HTC Vive, IKEA VR Experience application and a Haptic Feedback-based application, NVIDIA VR Funhouse–Balloon Knight, were introduced to the participants. As a technique to collect data in the qualitative case study research, the participants were called for interview after experiencing the applications. More information was presented in the following sectors.

3.2.2 Sampling
Merriam and Tisdell (2015) illustrate that applying the purposive sampling method is aimed to discover, investigate and gain insight of a phenomenon among those samples could get the most information from. Patton (2015) demonstrates that qualitative purposeful sampling has the advantage of getting rich information within specific cases. In order to get the most information and investigate the human’s perceptions and experiences of Virtual Reality, the participants were therefore selected purposively in this thesis.

In order to make sure the participants would be willing to share their ideas and thoughts related to Virtual Reality, the focus of selection is limited to those who are fulfilled with the following two conditions:

1. People who are interested in contemporary technology, especially, the technology of Virtual Reality and Haptic Feedback.
2. People who think that to be able to view a product over great distance could be an advantage.

Burmeister and Aitken (2012) have pointed out that the size of sampling plays a significant role in the qualitative research because of the effects on the validity of research. Boddy (2016), Malterud, Siersma and Guassora (2016) and Merriam and Tisdell (2015) state that there isn’t any clear standard existed to evaluate whether the number of respondents is appropriate, however, they suggest researchers making a decision on the number of participants based on the types of paradigm, the aim of research and the analysis strategy. Bobby (2016), Merriam and Tisdell (2015) and Creswell (2014) introduce that taking in consideration gathering enough data in order to write the research findings validly, researchers could pay attention on the concept of data saturation. Data saturation refers to none new information, concepts, themes or insights could be obtained during interviews. Furthermore, Bobby (2016) illustrates that qualitative research prefers to study a phenomenon in-depth rather than breadth. Therefore, interviewing and investigating one single case or few participants would obtain valid data for the interpretivist and critical paradigm, as long as the single case could help with exploring a new area or finding (Malterud, Siersma and Guassora, 2016; Bobby, 2016). Nevertheless, the positivist paradigm requires the number of participant should accumulate to a certain quantity (Bobby, 2016).

Before inviting people to be the participants in this study, the researchers have evaluated those potential participants whether fit in this research based on the abovementioned two selective conditions. A brief introduction of this research and an invitation has sent to the selective potential participants before the VR experience started. The data analysis has started parallelly when the researchers collected data, so that they could evaluate whether the answers of respondents have been overlapped. The respondents have divided to three groups based on their background and VR experience. Consequently, the researchers have interviewed fifteen (15)
participants. Four of them work as university’s lectures, PhD or PhD candidates. Six of them are students from the University. The rest of five are from IKEA IT department. The participants in the first group know well about the contemporary technology and they were eager to share their perceptions of VR, describe their experiences of IKEA VR Experience and elaborate their expectation of future development. The participants of second group are interested in the technology of Virtual Reality and are aware of the impact VR will make in the near future. The participants in the third group are used to work with IKEA IT and they are familiar to IKEA VR Experience.

3.3 Methods for Data Collection and Analysis

3.3.1 Exploration of IKEA VR Experience and NVIDIA VR Funhouse
15 participants were made to experience two different Virtual Reality applications
- IKEA VR Experience
- NVIDIA VR Funhouse – Balloon Knight

IKEA VR Experience:
In order to guide the participants to explore the primary parts of IKEA VR Experience, two assignments were arranged for them to accomplish, they were, to cook meatballs and bake cinnamon rolls. For the purpose of finishing the first assignment, opening drawers to look for the frying pan, lifting up the pan and putting it on the stove were required. Subsequently, the participants placed the meatballs into the pan, turned on the heat and then held the pan in the hand in order to shock around the meatballs as how they did in the real life (Figure 3.1). To accomplish the second assignment, after opening the oven, the participants needed to carry the cinnamon rolls and put them into the oven.

![Figure 3.1 Exploring IKEA VR Experience](image)

After accomplishing the two assignments, the participants were suggested to explore the immersive kitchen. Some of them have changed the color of cabinets, read the IKEA’s catalogues and magazines, changed their perspectives of viewing to a kid’s height or walked around from a cat’s perspective, etc.
NVIDIA VR Funhouse – Balloon Knight:
After exploring IKEA VR Experience, the participants were led to play the mini game of NVIDIA VR Funhouse– Balloon Knight (Figure 3.2) so that they understood the Haptic Feedback and experienced the effects it made. Furthermore, the participants could assume the influence that Haptic Feedback would make on IKEA VR Experience and state their opinions during the interview session.

![Figure 3.2 exploring NVIDIA VR Funhouse – Balloon Knight](image)

The participants had 60 seconds to wield the swords which were controlled by the HTC Vive’s controllers in their hand in order to pop the balloons as many as them could. During the process of balloons puncturing, the participants could clearly feel simulations of balloons’ explosion, which were reflected by the controllers associated with the technology of Haptic Feedback. Furthermore, the controllers simulated the tactile impression when the two swords were clinched together. The colorful visual representation with the Haptic Feedback sensations brought the participants an impressive and immersive carnie experience. The aim of experiencing the Balloon Knight was the participants had an opportunity to explore the technology of Haptic Feedbacks afterwards they could share their ideas and thoughts during the interview session.

3.3.2 Data collection
Associated with qualitative research methods, the researchers are able to analyse qualitative data which is gathered from, for instance, participant’s observations, interviews and documents, in order to study and understand social and cultural phenomena (Myers, 1997). Walsham (1995) illustrates that in the interpretive case studies, the data collection method, interview, is the primary data source for the reason of the researchers could interpret insights of participants regarding to their actions. Furthermore, the qualitative interviews have the advantages of, for instance, respondents are available to provide researchers their historical information and the researchers could manage the order of questioning depends on situations (Creswell, 2014). Hence, interview method was selected for data collection in this thesis.

There are three kinds of interviews in qualitative data collection which are as follows, structured, unstructured and semi-structured interviews (Merriam, 2015). Two primary considerations were satisfied with semi structured interviews for the data collection, the first criteria, they are well suited for the exploration of the perceptions and opinions of respondents,
in relation to complex, sensitive issues and helps to get more information and clarification to answers. The second criteria, various background information of the sample group helps in precluding a schedule for the standardized interview (Barriball and While, 1994). Semi Structured interviews were conducted with the interview questions framed earlier (Appendix B). Though the researchers carry out interpretive case studies, interviews are still an important data source, as the interview helps the researchers to step back and to interpret some details of the participants (Walsham, 1995).

After the participants experienced the abovementioned Virtual Reality applications, the interview was conducted on the days followed according to the convenience of the participants. All the interviews were face to face and it approximately lasted for 20 to 30 minutes. The important aspects in interviewing particularly for an interpretive study is to record participant’s interpretations and at the same time normal social interchanges of the interview. For that, one of the best approach is to tape-record all research interviews and the advantage of tape recording is that the full description of the participants was obtained and notes taking can be done partially (Walsham, 1995). The interview of the respondents was audio recorded with their consent and certain answers have been written down as notes. As it was audio recorded it was useful to transcribe the data collected. The transcriptions of the interviews were documented as a report.

### 3.3.3 Data Analysis

The data collected from the interviews were analyzed from the transcription of the interviews and meaningful concepts were formulated. 3Cs analysis were done in order to translate the raw data to meaningful concepts. The three Cs of analysis (Lichtman, 2013) are codes, categories and concepts which is explained in the following Figure (Figure 3.3):

![Figure 3.3: Three Cs of data analysis: Codes, Categories, Concepts, Lichtman, 2013, P.26.](image)

The goal of qualitative analysis is to take a large amount of data that may be cumbersome and without any clear meaning and interact with it in such a manner that you can make sense of gathered data (Lichtman, 2013). This is how to move from raw data to meaningful concepts or themes. The three Cs of analysis: from coding to categorizing to concepts. Coding interview data, observational notes, and text into meaningful chunks is a challenging task. In this research study, the 3Cs data analysis of Lichtman (2013) is done to make the large data into meaningful concepts.
The data analysis was done according to the six steps (Lichtman, 2013) they were initial coding, revisiting initial coding, developing an initial list of categories, modifying initial list based on additional re-reading, revisiting the categories and subcategories and moving from categories to concepts.

The interview conducted by the researchers to the participants were transcribed into data. Initial coding of words and phrases from the data is done as suggested by Lichtman (2013). Substantial number of codes were made initially from the interview data, later the coding was checked for redundancy and the final set of codes were formulated. From the codes, a list of categories was developed. The categories were again revisited to make categories and subcategories. With additional rereading the categories and sub categories the final categories were framed. Later meaningful themes were developed from categories.

The researchers finalized nine different themes from the transcribed data, they are Users’ apprehension over Virtual Reality, Users’ Experience of IKEA VR Experience, Users’ Opinion about IKEA VR Experience, Communication Enhancement of IKEA VR Experience, Plan for Improvement of IKEA VR Experience with Haptic Feedback, User Experience Enhancement IKEA VR Experience with Haptic Feedback, General Suggestions over IKEA VR Experience with Haptic Feedback, Advantages of Future Innovation of VR which are explained in Chapter 4, Empirical findings.

![Figure 3.4 Relationship Between Questions, Data, and Meaning, Lichtman, 2013, p.27.](image)

Figure 3.4 Relationship Between Questions, Data, and Meaning, Lichtman, 2013, p.27.

The six steps in the movement from codes through categories to concepts is completed. Strengthening the process by adding texture and depth to the analysis, it is necessary to return to the documents to look for other things that will enhance the interpretation. One such area to explore is the use of metaphors (Lichtman, 2013). The language is rich with metaphorical allusions and they often reveal much about what others mean. Other kinds of things to look for in the data are the richness of detail, conflicting ideas from the same respondent, unusual or unique experiences, or ideas that contradict current thinking on the topic. Making meaning from qualitative data is a process that moves between questions, data, and meaning. This interpretive case study is motivated to select the framing of concepts with help of 3Cs analysis of Litchmen (2013), as the qualitative data is processed which moves between questions, data and meaning. So that the researchers can interpret the proper content meaning of the participants answered during interview. Figure 3.4 provides a summary of the data analysis process when looking for concepts. Key elements in the model are that it is iterative, circular, and can be entered at any point (Lichtman, 2013).
3.4 Reliability and Validity

Validity and reliability decide research quality. Patton (2002) mentions that validity in quantitative research depends on careful instrument construction to ensure that the instrument measures what is supposed to measure but on the other hand in qualitative research, the researcher is the instrument. In qualitative research, validity represents the appropriateness of a valid research question, the methodology to answer the research question, designing of the methodology, appropriate sampling and empirical analysis with a final output for the results and conclusions to validate the sample and context (Leung, 2015).

Lincoln and Guba (1985) illustrate four components that influence authenticity of qualitative research, namely, credibility, transferability, dependability and confirmability. Yin (2009), however, introduces another four alternatives for probing the quality of case studies in qualitative research, that is, internal validity, external validity, construct validity and reliability. According to Merriam and Tisdell (2015), internal validity supports investigators to determine whether the cases are related to reality. Meanwhile, Yin (2009) adds that internal validity explains causal relationships between two objects and helps with making inferences. The aim of the case study in this master thesis is studying users’ perceptions and experiences from the view of IKEA VR Experience and Haptic Feedback. There is not clear connection between the case study and the internal validity, the internal validity therefore won’t be considered in this research. Nevertheless, to answer the abovementioned research questions and contribute trustworthy results, external validity, construct validity and reliability are taking into consideration.

3.4.1 External Validity

Merriam and Tisdell (2015) and Yin (2009) describe external validity as how to generalize the results of findings in other cases. Continually, they suggest investigators to provide comprehensive details in their studies, which inquire description of study setting, selective samplings, participants and findings, so that on the one hand, enhancing the rigor of studies. On the other hand, readers may be able to match the cases in their situations. In this master thesis, two research questions have been stated with “how” and as Yin (2009) claims, external validity should be included in consideration while research questions start with “how” and “why”. In order to get validity results and achieve an analytic generalization, study setting and participant selection among population in the university were taken fully consideration. Whereas, statistical generalization wouldn’t be applied in this study because it doesn’t have much relevance to case study (Yin, 2009).

3.4.2 Construct Validity

As Yin (2009) declares, the following three components promote the construct validity, they are, multi-source evidence utilization, chains of evidence establishment and primary informants review. In qualitative research, triangulation is understood as one of tactics improves for research rigor and trustworthiness through collecting and analyzing perspectives from various circumstances, utilizing multiple data sources or data collection methods so that to achieve the goal of confirming generated findings (Patton, 2015; Merriam and Tisdell, 2015). Triangulation of qualitative sources, mixed qualitative-quantitative methods triangulation, analyst triangulation and theory triangulation are the four kinds of analytical triangulation defined by Patton (2015). In this study, the third triangulation, analyst triangulation, has been applied. As Patton (2015) introduces, analyst triangulation knows as investigator triangulation, which
analyzes data from the view of multiple perspectives. Usually, two or more researchers will interview participants together with same interview questions. After interpreting collected data independently, the interviewers will discuss their insights of findings so as to improve the rigorous of inquiries (Patton, 2015).

In this study, the two researchers interviewed the selective respondents together with the same interview questions. After interviewing, the researchers listened to the voice recordings independently and interpreting the collected data. During the process of interpretation, one of the researchers was aiming to cluster answers for the two research questions, meanwhile the other one had the mindset of listening to customers’ needs.

3.4.3 Reliability
Reliability explains the consistency and dependability of a measure. If this measure is reliable then the measures are consistent with each other. Reliability is challenging in qualitative research as it is with diverse paradigms. Hence, in qualitative research the essence of reliability lies with consistency (Leung, 2015). Qualitative analysis challenge is mainly on how to make sense from the massive data. There are no formulas for deriving the significance and perfectly replicate the researcher’s thought process. The researchers should represent and communicate the data with full intellect what the data reveal for study (Patton, 2002).

3.4.4 Validity and Reliability in the Case Study of IKEA VR Experience
Validity and reliability in qualitative research depends on the quality of the data collection and the respective analysis. This is a time for guaranteeing the quality of data. The below mentioned points ensured reliability and validity of the research findings especially aimed for the case study of IKEA VR Experience in this research:

- Two research questions were started with “how” so that to guide the exploration of Haptic Feedback enhanced user experience over Virtual Reality.
- Rich data was collected from the interviews which was conducted with 15 number of selective participants.
- Purposeful sampling was done to have a better insight and the data to be information rich.
- The participants were practically made to experience two different Virtual Reality applications, that is, IKEA VR Experience and NVIDIA VR Funhouse – Balloon Knight.
- Clarifications followed up with the participants were conducted to have a precise data.
- The two researchers have interpreted the interview recordings separately.
- The findings have been discussed.
- Data collected were transcribed with at most care into codes categories and themes. Presumptions were strictly not followed to have high accuracy.

3.5 Ethic Considerations
The credibility of a research, more specific, the trustworthiness of collected data and analyzed results, depended on the decisions which are made by investigators in order to deal with ethical related issues (Merriam and Tisdell, 2015). Gustafsson, Hermerén and Pettersson (2011) mention that ethical considerations are significant for a research because they help to find the balance between diversity of interests, one example of interests is requirement of new
knowledge, because it could benefit individuals and society. The other interest is keeping individuals away from any harm or risk of harm and protecting their privacy.

Merriam and Tisdell (2015) illustrate that the relationship between researchers and respondents are significant for the ethical dilemmas. They correspondingly explain that together with the purpose of study, investigator-respondent relationship impact on the process of data collection, which means, if the relationship between researcher and respondent is good, the respondent would share more information with the researcher so that enhance the situation of ethical issues (Merriam and Tisdell, 2015).

From the point of obtaining knowledge from the participants, the researchers in this research will acknowledge the respondents sincerely for their kindly help. The researchers remembered in mind that the purpose of interview wasn’t judge or a therapist (Patton, 2015; Merriam and Tisdell, 2015). Instead, the interviews were the process for the researchers to study and understand the respondents’ perceptions. Therefore, the researchers shown respect when interacted with the participants. Furthermore, the knowledge will be solely used for the purpose of the academic research with respect to master thesis. However, their identities and interview contexts won’t be revealed, since a promise of confidentiality has been given. Patton (2015) defines confidentiality as the researchers won’t share the known personal information and answers of questions to another in order to protect the respondents’ identities and privacy. From the point of protecting participant’s rights and privacy of view, the researchers have addressed some ethical issues and mentioned them in the written informed consent and sent to the participants of the master thesis research (Appendix A). The consent provides information which included a briefly introduction of study project, study motivation, permission of confidentiality, guidelines and explanation of data collecting methods. Before individual interviewing, the consent form has distributed to all participants and obtained their agreement.

3.6 Summarization of the Methodology
The methodology that utilized in this thesis has briefly summarized as the following Table 3.1:

<table>
<thead>
<tr>
<th>Description</th>
<th>Research Philosophy</th>
<th>Research Method</th>
<th>Research Design</th>
<th>Data Collection Method</th>
<th>Sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpretive</td>
<td>Interprets how users perceive VR as a communication process</td>
<td>Case Study</td>
<td>Interview</td>
<td>Purposive Sampling</td>
<td></td>
</tr>
<tr>
<td>Understands user perception and experience over VR applications</td>
<td>Understands in-depth user perception and experience over VR in respect with Haptic Feedback</td>
<td></td>
<td>15 human participants face-to-face interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with the help of hermeneutics</td>
<td>Investigates individuals’ interaction in the immersive environment of IKEA VR Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- People who are interested in contemporary technology, especially, the technology of Virtual Reality and Haptic Feedback.
- People who think that to be able to view a product over great distance could be an advantage.

<table>
<thead>
<tr>
<th>Data Analysis Technique</th>
<th>3CS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The data collected from the interviews were analyzed from the transcription of the interviews and meaningful concepts were formulated.</td>
</tr>
<tr>
<td></td>
<td>3Cs analysis were done in order to translate the raw data to meaningful concepts.</td>
</tr>
<tr>
<td></td>
<td>The three Cs of analysis are codes, categories and concepts</td>
</tr>
</tbody>
</table>
Chapter 4 Empirical Findings

In this chapter, the findings were presented based on the methodology and strategies used in the previous chapter. The results were based on two parts, the semi structured interview and data analysis. The summary of the findings, relied on the content of the interview questions which are transcribed, categorized into themes are presented below to give a good overview about the findings.

The themes that were used are listed which were based on transcribed interviews. The resulting data was analyzed. The transcribed interviews were coded according to the 3Cs concept of codes, categories, concept and guidelines of Lichtman (2013). According to the technique the researchers analyzed the interviews in this qualitative case study, there were six steps within three C strategy—coding, category and concept and all the six steps were well explained in the chapter 3 under the section data analysis. In the end, the relevant and appropriate categories in relation to the focus of our case study were kept. As a result, nine different themes have been identified.

There are nine different themes that were found through the thematic analysis of the transcriptions of the gathered data:

- Users’ Apprehension over Virtual Reality
- Users’ Experience on IKEA VR Experience
- Users’ Opinion about IKEA VR Experience
- Communication Enhancement of IKEA VR Experience
- Limitations and Drawbacks of IKEA VR Experience
- Plan for Improvement for IKEA VR Experience with Haptic Feedback
- User Experience Enhancement for IKEA VR Experience with Haptic Feedback
- General Suggestions over IKEA VR Experience with Haptic Feedback
- Advantages of Future Innovation in the IKEA VR

Interestingly, through these themes we found answers for the research questions. Through in-depth study and discussion, the researchers found the first research question can be answered by the first five themes and the second research question can be answered by the last four themes. In order to have a clear understanding, the following section is divided into two main parts to clearly demonstrate how these themes answered each research question, which are shown in the table 4.1 and 4.2.

Themes to RQ1

*RQ1*: How do the users perceive Virtual Reality as communication process between human and technology and describe their requirements to enhance IKEA’s Virtual Kitchen experience?
### Table 4.1 The Themes and Categories for RQ 1

<table>
<thead>
<tr>
<th>Themes</th>
<th>Categories</th>
</tr>
</thead>
</table>
| **Users’ Apprehension over Virtual Reality** | • Had no experience but the perception was good, positive and scary;  
• Previously had experience but it was not as good like this and this experience is more than expected;  
• Previously had experience but those were good. |
| **Users’ Experience on IKEA VR Kitchen** | • Felt very real and at the same time very unreal;  
• Authentic but limited;  
• Pleasure and interesting experience;  
• Very plain not very effective. |
| **Users’ Opinion about IKEA VR Kitchen** | • Very positive, amazed and excited;  
• Very good initiative;  
• Initial phase, very plain, should have simulations and haptics. |
| **Communication Enhancement on IKEA VR Kitchen** | • Effective communication between the organization and the users;  
• It depends on the situation. |
| **Limitations and Drawbacks on IKEA VR Kitchen** | • Using the controllers;  
• Familiarity with technology and technology development; Should be effective and interactive. |

The above table 4.1 describes the various categories and the related themes to the research question 1.

**Themes to RQ2**

*RQ2: How do the users describe the importance of Haptic Feedback in enhancing the communication process in the context of IKEA VR Experience?*

### Table 4.2 The Themes and Categories for the Research Question 2

<table>
<thead>
<tr>
<th>Themes</th>
<th>Categories</th>
</tr>
</thead>
</table>
| **Plan for Improvement of IKEA VR Experience with Haptic Feedback** | • More realistic, bigger connection between human and the application, the next phase of VR;  
• felt kind of weird. |
| **User Experience Enhancement of IKEA VR Experience** | • Enhance user experience;  
• More things to associate. |
| **General Suggestions over IKEA VR Experience** | • Check and feel the surfaces;  
• Changing the controllers to gloves instead;  
• Very nice if IKEA uses VR kitchen with haptics. |
| **Advantages of Future Innovation on Virtual Reality** | • Customized solutions and beneficial to disabled people;  
Organize and plan to build a new house. |
4.1 Empirical findings for RQ1

RQ 1. How do the users perceive virtual reality as a communication process between human and technology and describe their requirements to enhance IKEA’s Virtual Kitchen experience?

The main themes of the Research Question 1 are shown as below:

- Users’ Apprehension over Virtual Reality
- Users’ Experience on IKEA VR Experience
- Users’ Opinion about IKEA VR Experience
- Communication Enhancement of IKEA VR Experience
- Limitations and Drawbacks of IKEA VR Experience

Theme 1: Users’ Apprehension over Virtual Reality

The participants of this research had different apprehensions about the Virtual Reality environment, as the sampling was done by purposeful sampling technique all were aware about the ideology of Virtual Reality environment. Surprisingly the selective respondents had two different ends of apprehensions about Virtual Reality. The three distinct categories emerged out during the analysis of this theme were; Had no experience but the understanding was good, positive and scary; Previously had experience but it was not as good like this and this experience is more than expected; Previously had experience but those were good. The perception about the Virtual Reality environment among the participants were different.

Respondent 1 said: “I had a scary kind of perception”.

Respondent 5 said: “I only had small experiences with smart phone. But, because it’s an old phone, the experiences aren’t as high as I expected. I thought that the VR would be worse, because I didn’t have any experience with it.”

Respondent 7 said: “I never tried something like VR, as people played with it. Anyhow, I really liked it. I didn’t know what I expected. But the explanation the person gave me was really in detail. So, I just needed few minutes to adjust, to knew what was going on. It was easy and I would like to play with it longer time, maybe I would be better.”

Respondent 11 responded: “Yes, I have used HTC Vive and tested oculus drift. I have experience with VR.”

Respondent 12 said: “I had an experience with the Samsung Gear VR in MediaMarket, Växjö and it was awesome, when I experienced first time.”

Respondent 15 said: “No I don’t have an experience. But it was more than I expected.”

Theme 2: Users’ Experience on IKEA VR Experience

The participants were made to experience about IKEA VR Kitchen and their experiences were interviewed. When their experiences were analyzed these are the various four categories
evolved out; felt very real and at the same time very unreal; authentic but limited; pleasure and interesting experience; very plain not very effective.

Respondent 1 said: “I felt very real at the same time very fake / unreal. I had excitement and fear (particularly about girls) and not sure about the teleport. I couldn’t realize that certain things work. When I was into it, I was more convenient and realized it was good.”

Respondent 4 said: “I was impressed with the authenticity of it all. But I thought that I was a little limited. For example, I couldn't grab a spatula when I stirred the meatballs. I couldn't really place the cinnamon buns in the oven and so on. So, in a nutshell, authentic, but definitely room for improvement.”

Respondent 8 said: “It was an interesting experience. It made me think it was a real thing that was happening. My brain was telling me that I was really cooking and thinking what to do.”

Respondent 9 said: “The first thing was, it was really immersive, you got right into the environment and you felt like you were there. Virtually, very exciting. Having the tools in your hands that was one thing I reflected to, what role did the tools have, because it was not like been an environment that working with your fingers, your sensitivities, it was something between you and the environment, the tools you grasped in your hands. But very great environment, very lifelike, you almost forgot you were in the VR, and environment was your environment. But something like having the tools, how difficult it was to, since we had limited space to move. To move around the space, we had to teleport. But once you got used to it, it was ok. What I knew was, I was doing a lot with my right hand. I had a tool in my left hand, I wasn’t really using it for anything. When I was doing something, I had to move. And I used my left hand to teleport to another part of kitchen. So, that was strange feeling. I am mostly right handed, then what did I do with my left hand here with holding this thing here?”

Respondent 11 said: “It looks very plain and as a moving object and it’s not that effective, I don’t feel that much with IKEA VR kitchen. As 3Dkitchen it is good, but no simulations or haptics. After played VR games with Haptic Feedback I couldn’t find much in IKEA VR kitchen.”

Respondent 15 said: “I’ll say that, innovative design, customizes solution. Though we have this kind of VR in gaming no one is there in terms of home need solutions. If they improve they can be masters in kitchen solution. They’ll pioneer the kitchen solutions by VR in future.”

Theme 3: Users’ Opinion on IKEA VR Experience

Once the participants experienced, shared their experience about IKEA Virtual Kitchen, they were asked to share about their opinion about the kitchen. Their opinion was categorized under these three important categories; Very positive, amazed and excited; Very good initiative; Initial phase, very plain, should have simulations and haptics. Most of the participants had very positive opinion about the kitchen.

Respondent 1 said: “I have a very positive opinion in general and it is very thoughtful, even though it is not real it felt very real. I could see a kitchen very real. It was as if being in a real world without being real.”
Respondent 4 said: “To be more advanced, for instance, I can really do meatballs from scratch or do the bun from scratch, because in that case, I can picture myself in kitchen more authentically. What items I want in this place or that place, how big the cabinets and drawers. I would like to have more tools in the kitchen, in order to feel me in the kitchen. I can customize it from my own needs. I would like to do more stuffs to actually know about the kitchen.”

Respondent 5 said; “I would say that it was a nice and pleasant experience. It was something new for me and I would like to do it again if I have to. However, I don’t know whether this experience could be able to convince me if I want to buy a real kitchen. The experience wasn’t enough for me, because I am a person who like to touch and explore everything by myself. So, virtual experience was nice, it gave me an idea. But it was just an idea, I wanted something more. If I just wanted to have the experience, then it was great and enough.”

Respondent 9 said: “For laying out spaces, for organizing, for work area, for storage, those kind of things, I think VR is a great tool to develop with. How could we make a pleasant experience to be in the kitchen? How could we design this area? Is this the right height for me? Is that a right layout for me? Also, for those people who have disability and difficulties, we don’t need to access to a proper kitchen, instead of can get them to try it in this way.”

Respondent 11 said: “My opinion about the IKEA VR Experience it is very plain and it should be enhanced with simulations with the help of haptics. Without simulations, it doesn’t make the customers to feel the kitchen.”

Respondent 12 said: “I feel it is a kind of initial phase in the IKEA VR Experience by viewing it and comparing to my first experience, I feel the IKEA VR Experience as a graphical representation without a real kind of look and it looks kind of model. It could be enhanced with type of feel too.”

Respondent 14 said: “Excellent it was. As I’m experiencing it for the first time I feel it is excellent. But I feel something can be added more, better if I could have the feel of papers in the catalogue while touching it.”

Theme 4: Communication Enhancement of IKEA VR Experience
The participants were asked would VR act as an efficient communication process between the organization and users, and how far VR technology in home furniture’s would match physical shopping experience and how the technology improves the user experience in retailing. The participants expressed their views which can be mainly categorized into two main aspects. In The first category, participants unanimously accepted that VR would act us effective communication process between the organization and the users. In the second category, some of the participants added that it depends on the situation. Some of the factors which decide the situation is the cost, time and the type of products.

Respondent 2 said: “I feel that it is related to consumer behavior. I can see a profit to consumer as like us but not for business to business. It depends on the levels of use in customer needs. I don’t how it is economically beneficial to IKEA and when I think about without having the economic factors, I feel it is good. Everything depends upon the product.”
Respondent 3 said: “In this way, when I use this technology, the moment I was in the kitchen, I would like to make good connection with the IKEA through the APP, if I need to check any information, I could find a way and go to the destination as I did in a physical shop. The technology is good and could help me, but we should consider about the cost. Also, the factor of age is important, because some technology is confusing to use, even for me. For those who are older than me, the technology might be hard for them to implement. To customize the application for different users becomes significant. The technology shouldn’t be designed for specific group, it should focus on general, public using. The devices should be body friendly.”

Respondent 5 said: “For me, I am kind of person who don’t like to go to the store, because it’s too much people. I don’t like to ask a real person either. I will look for information about the product. In the VR, I will appreciate, if I don’t need to deal with other people, I could do it all by myself. Maybe it takes only 15 minutes to feel and look how the product is like. But in the physical shop, I don’t like all the people coming around and look at me. In this way, it might help the relationship with the company. But then, if I have any questions regarding to the product inside the VR, I don’t know if there is a call center to help me with it. Because I don’t like the idea of call center. If it’s possible to just authorize it, if I choose furniture and I would get all the information about it, that would help me much more. All the information could be inside the VR.”

Respondent 6 said: “Before making decision to buy an item, people would like to compare the product with different stores in order to find the best one. In the future, maybe I could compare and try products in the VR before shopping physically. If VR could give us the real sense of product, I could sit and experience it, it would help me a lot. The VR will benefit both customers and companies. For the companies, they could publish the information of their products and provide customers service. For example, if I didn’t know a product existed, I wouldn’t think of buying it. For the customers, they could get the first-hand information about the product. If customers could communicate with company directly while they have any questions and companies could give them responses, it will definitely enhance their relationship.”

Respondent 12 said: “Yes. But it doesn’t suit all the cases. VR kind of shopping for furniture is good but not for grocery kind of thing. Regarding the physical shopping with VR shopping, VR enhances shopping by more of suitable kind of shopping it helps to buy what kind of stuff I buy will match my house or kitchen. More kind of sensible shopping than physical shopping.”

Respondent 15 said: “Yes. It enhances communication process. In future 2D shopping will be replaced by VR. Nowadays the picture shown in online shopping is 3D picture to make even more interactive. It will be revolutionizing thing if 3D image is being replaced by VR.”

Theme 5: Limitations and Drawbacks of IKEA VR Experience

Regarding the experience of the participants in limitations and drawbacks of the VR applications and devices, the evolved categories were, Limitations in using the controllers; Familiarity the technology needed and technology development; Should be effective and interactive; To match the physical reality shopping. Most of the participants felt constraints in using the controllers.
Respondent 1 said: “I feel the wires and the cords are the drawback and holding the controllers. Danger of isolating a person from the community may be potential drawback. Technology but not natural.”

Respondent 2 said: “When I experience it, it was very positive, as I am entering into a new world. First few minutes it was very positive but when I started using technology, I felt the constraints with the controllers but otherwise limitations mostly to the programming side to make the experience real. But of course, the technology was amazing and if it continues to develop. But the current situation I felt constraints particularly with the kitchen and I’m not comfortable with the controllers. My conclusion in general it is positive, and it depends on the technology development.”

Respondent 7 said: “The level of familiarity with the technology or who hasn’t experience with it, maybe he or she needs more time to understand. We see what we feel. So, the familiarity is a factor. If a person is quite familiar with technology, I don’t think it will be a problem. However, I have this idea, we are in the department of informatics and we deal with technology every day, but, I would like to somehow keep our human side. I wouldn’t like everything to be placed by technology. I would like to have a good experience, If I don’t have the time or if I would like to be more organized with everything. But also, I would like to have the option to go to the physical shops, touch the furniture and see with my eyes. I want to keep the human side of me. I wouldn’t like to be completely replaced by technology. I don’t want IKEA to become a virtual store and give customers only this kind of experience. I would like to have both of them. To combine both of them because the technology is like a medium, like a channel to make our life easier and improve some parts of our life. Because after that, we won’t be a human, we will be robots.”

Respondent 13 said: “Using gloves will be easier than the controllers.”

Respondent 15 said: “I would say that, how interactive and effective the VR with the customers is the success factor of VR in future. It should be matching physical shopping by the way consumers feel effective in interacting with VR.”

4.2 Empirical findings for RQ2

RQ 2. How do the users describe the importance of Haptic Feedback in enhancing the communication process in the context of IKEA VR Experience?

This question will be answered by the following themes:

- Plan for Improvement for IKEA VR Experience with Haptic Feedback
- User Experience Enhancement for IKEA VR Experience with Haptic Feedback
- General Suggestions over IKEA VR Experience with Haptic Feedback
- Advantages of Future Innovation in the IKEA VR

Theme 6: Plan for Improvement for IKEA VR Experience with Haptic feedback

The participants were made to experience the technology of haptic feedback with NVIDIA VR funhouse – Balloon Knight and were asked to explain what is their view if IKEA VR Experience
has the function of haptic feedback, with certain examples (for examples refer appendix B) and had these categories;

Out of 15 participants 14 of them felt haptic feedback in the IKEA VR Experience would make the kitchen more real, and some of them added reality to VR would be in a much faster way; the learning curve of Virtual Reality applications and devices will be smaller; feeling something that doesn’t exist is awesome; and all the fourteen of them felt to have haptic feedback by wearing cloves will be better than doing with the controllers in hands.

Respondent 2 said: “I think it will be more realistic for sure, I feel it will be much better, I feel that the learning curve will be smaller.”

Respondent 3 said: “It could make much bigger connection between human and the application. With haptic feedback, the experience will be better.”

Respondent 7 said: “It would be great if I could feel the feedback. These things matter if you like to buy a kitchen. There are some materials make the cabinets smoothly. This feedback will make experience more real. The haptic feedback will make different for me. It will be really interesting.”

Respondent 9 said: “I think it would be nice. Because, like opening drawers and the oven, are part of experience in feeling the resistance. When you are working with the frying pan, how will you feel the surfaces and weight of the pan? How could you simulate the heat from the oven or from the stove? So, you know, this is dangerous and hot. It could be some kind of feelings. A lot of experiences have the feeling in your hands, such as, textures which has been missed a lot.”

Respondent 12 said: “From my opinion, it may be the next phase of VR. It is now looking at things and it is not about feeling so far, but the feeling sense gives an extra confidence of buying that. The haptics will enhance the buying as if going to a shop and buying.”

One out of the 15 respondents said: “Actually, I felt kind of weird. When I was at the kitchen, it was good, because I didn’t find any vibration so it didn’t disturb me. When I popped the balloon, I couldn’t enjoy it. It was irritating.”

So out of 15 participants 14 claimed that the IKEA VR Experience should be improved with the Plan of Haptic feedback to experience the kitchen real, to have bigger connection between human and the application and to have a better experience.

Theme 7: User Experience Enhancement for IKEA VR Experience with Haptic Feedback

The participants were asked to express their thoughts of whether haptic feedback in VR would enhance the users experience, and as it was related to the previous themes and the categories were:

One participant expressed that he couldn’t imagine how haptic feedback would help and he wanted more things to associate, as like, to hear and to feel the force; from sounds and vision. He said that Haptics would be good for reminding and to feel everything.
Respondent 5 said: “I couldn’t imagine how haptic feedback should help me. Usually, there are more things to associate, for example, opening the cabinets, I can hear it, I can feel the force, because it is not only about feedback from my hands, the feedback also from sounds, vision and other perceptions. I realize it when I was somewhere and trying something, I used all the sensors, mainly with eyes. Also, I am sensitive with ears, most people just don’t realize it. Maybe there is one area I will appreciate. When I was grabbing something, to keep holding it, I had to hold the button. Then I forgot about it, so I dropped it. Maybe if there is a haptic feedback all the time, just to remind me I am holding something, it will help me. From my thought, the haptics should be good for reminding. In VR, I need to look at it at first.”

14 participants felt that the haptic feedback will enhance user experience, to realize the Virtual Reality environment in a better way, to understand and help virtual experience closer to the real things.

Respondent 1 said: “Definitely, it will. Easier to get into it. Faster into the Virtual Reality.”

Respondent 7 said: “I think it will! If you are able to touch a surface and realize how it feels, if you would like a wooden surface. Of course, it will enhance the experience. Because now, you just realize the environment you are in, you can understand how long the table is, but as I said, you couldn’t completely feel it. It will help virtual experience closer to the real things.”

Respondent 10 said: “Yes! If somebody is going to build a house, there is nothing there and they would like to have something good. Then the VR helps. Not only IKEA, all other sectors will get benefits from it.”

Theme 8: General Suggestions over IKEA VR Experience with Haptic Feedback

When the participants were asked to share their General Suggestions over the IKEA VR Experience with respect to haptic feedback, the outcome was like the following categories which mostly relates to the previous two analyses.

Respondent 5 said: “The problem was so disturbing because I could feel it all the time. I could feel vibration during the whole game and it was uncomfortable. If they would do limitation among the haptic feedback, I will appreciate it. Because there were too strange inputs, you thought about haptic feedback a lot and didn’t use other senses.”

Respondent 7 said: “I would like to have the option to check and feel the surfaces regard to the kitchen. I also would like to check the cupboard, the drawers, that would be great for me. Also, I would like to open the tap, to check how the water runs, how it would look like in the sink. With the height, it’s very important to know.”

Respondent 10 said: “Changing the controllers to gloves instead.”

Respondent 11 said: “It will be very nice if IKEA uses VR kitchen with haptics. IKEA can provide its own VR solutions to the customers by customizing the VR equipment. As the world is more towards virtualization it is more needed at this point.”

Theme 9: Advantages of Future Innovation in VR
The participants were asked, what are the advantages it will bring when HTC Vive headset is utilized to view the IKEA kitchen units and even in future the whole home experience and the participants explained their views, which made to formulate these categories; Customized solutions and beneficial to disabled people; Organize and plan to build a new house: Livelier and appealing.

Soon, when VR devices become less expensive, handy and easily accessible, would you be interested to view the furniture at home via VR, was the question asked to the participants and following were the categories; Good interesting and time saving, physical sensations associate with shopping and the price factor.

Respondent 1 said: “It would be wonderful. Experience will be totally beneficial and a feel that I’m there. More of options and it will change the whole experience. Rearrangements can be much easier. Better sense. More beneficial for the disabled people.” And also, added that “Yes. I Feel good about it.”

Respondent 5 said: “As the first step, to see if furniture fits my room, or to see how new painting would look like, I will appreciate it. The second step, I will definitely need to visit the physical shop, for example about a bed, I would feel the product, to make sure there is not mistake. In the VR, I can’t be sure the product’s measurement.” And also, added that “Inside the VR, especially in the IKEA VR, I liked it but also, I was afraid about the real world surrounding. Because I moved a lot because I have long hands, I was not sure how they design, I was afraid if I would touch anything with my hand. About VR, I like the idea of it and I like to be inside, but I would like to see solutions about how to be safe during using it, such as, don’t crush anything. The cable was quite irritating, because you can’t see but only feel it. You got scared.”

Respondent 7 said: “Great! I like that. Somehow, you can organize it if you plan to build a new house. I think it will help you save time if you check the furniture you want before going to the physical shop. If there is an opportunity to do that, it will be great.” And also, added that “I don’t know whether I will buy it. It depends on the price. If it’s worth to spend so much money in something. If I was 60 years old and I have a home, I don’t need to buy anything like that. If I was a young people who has whole life in front of me and I planned to buy an apartment or built a house, it will worth to buy something like that. I think it depends on which stage of your life you are in.”

Respondent 8 said: “VR is a good advantage to see how technology can get things happen. But I don’t know whether everyone will use it, whether VR will be managed to everyone, it felt as a lab, you experience it and then that’s it. But the VR is open-minded, as a game, you get to create it and see the world.” And also, added that “Why not? It’s always a good thing that move from one step to another.”

Respondent 9 said: “From the design perspective, if I have some design ideas, it’s ok. For example, if I build a new house, I can look around and try different things. Good idea if I could see how it looks like before I get it. If I design a house or an apartment, how the layout is for the rooms. How it would look like if we have a window here. So, lot of architectures and design possibilities for laying out spaces and testing spaces to try out in everyday life.” And also, added that “I think it will be a lot to do with the physical feeling. You can get an idea of
something, but it won’t make me to buy. I want to go to feel the materials and feelings. For example, if a person would like to buy a car, how it will feel like when open or close a door, how it will sound like. Opening a battle and put it back down again and how it smells like. So many physical sensations they are associated with buying something expensive. Maybe for a cheaper thing, you can do it with VR. Big purchase we make, it depends on different aspects of experiences, which is difficult to get through from the VR. Maybe it will give me some ideas, but I don’t think I will purchase directly through the VR.”
Chapter 5 Discussion

This chapter constitutes a discussion about the core findings and their significance for the research study. The discussion of the results is divided into two sections. First, a discussion based on the empirical findings that are presented in this previous chapter. The discussion will be presented through the reflection and understanding of the findings, what the results mean for this research and in connection to the literature review and the theoretical framework presented in the chapter of Methodology. The second part deals with, overall reflections based on the findings and outcomes from the detail discussion.

5.1 Discussion on Findings
The aim of this case study is to explore Virtual Reality as an efficient communication process, further emphasizing more on the importance of haptic feedback in virtual reality applications from users’ perceptions and experiences. These topics are covered by RQ1 and RQ2 with corresponding themes. Discussion of findings, discussions of additional outcomes about the presented themes in the empirical findings in the previous chapter, will explain the meaning and connection between them.

5.1.1 Discussion of RQ1
RQ 1. How do the users perceive virtual reality as a communication process between human and technology and describe their requirements to enhance IKEA’s Virtual Kitchen experience?

The findings for the research question 1 was explained by the five different themes, Users’ apprehension over Virtual Reality, Users’ Experience, Users’ Opinion, Communication Enhancement, Limitations and Drawbacks.

Users’ Apprehension over Virtual Reality:
The participants had theoretical knowledge about virtual reality and its applications. Few of the participants had exposure towards virtual reality environments but some of them didn’t have any such prior exposure, so when they were asked about their apprehension over virtual reality and virtual reality applications, the respondents who don’t have a prior exposure had mixed understanding, ranging from scary to excited. According to Myers (2004) and Butler (1998), humans are influenced by prejudice and living experiences. Prejudice consists of understanding and misunderstanding. Out of 15 participants two of them had prior exposure to VR and its applications, one of the participant said that he had prior experience to VR with Samsung gear VR and he enjoyed the experience, the other one had tried HTC Vive.

Users’ Experience on IKEA VR Experience:
When the participants were made to experience two different Virtual Reality applications, IKEA VR Experience and NVIDIA VR Funhouse– Balloon Knight, a Haptic Feedback-based application, their experience revealed; the users had a good and defined experience, but the quality of the experience relied on their exposure and handling of the various tools and controllers of the Virtual Reality application. According to Overby (2008) in a physical process there is physical interaction between people or between people and objects but in a virtual process, physical interaction between people and objects are removed. Some of the participants were impressed with the authenticity of the kitchen. However, they’ve thought that it was quite
limited. One of our participants described the incapability to differentiate between the VR environment and the physical reality, its influence was overwhelming to make them believe that their experience is real. However, some of the participants felt few limitations. Some of them thought it was a real thing which was happening to them, further they added that the cooking experience is so realistic. According to Sjöström and Goldkuhl (2003 cited in Barricelli et al., 2016, p.2), “in human-computer interaction (HCI), the relationship between humans and computers is based on the given interaction rules; therefore, we can consider that the rules of the human-machine dialogue are part of the pragmatic level”. On the contrary, there was a participant who thinks the kitchen was very plain and as a moving object and it’s not that effective. The users’ experience was, as stated by Marini (2012), each person from their experience in a communication, has their own context, beliefs, knowledge, emotions and affections that can contribute to convey the characteristic of the communication act. In this case, the different capabilities of interacting within a virtual circumstance impact variously on user experience on IKEA VR Experience.

Users’ Opinion about IKEA VR Experience:
Most of the participants have positive/good opinion over the IKEA VR Experience, however the acceptance level was different with few respondents. By following the steps introduced in the section of Reliability and Validity, the researchers have discussed their findings after the semi structured interview and collected data interpreting. During the process of discussions and exchanging findings, both of the researchers have found out the participants were eager for user experience improvement. Though most of the opinions of the participants were on the positive side, one of them felt that the IKEA VR Experience is very plain, and it should be enhanced with simulations with the help of haptics and one more participant expressed his opinion as, the IKEA VR Experience is in its initial phase and comparing it to his first experience, he felt that the IKEA VR Experience as a graphical representation of objects in three-dimensional space without real feel.

Communication process Enhancement of IKEA VR Experience:
VR as an efficient communication process between the organization and users, the improvement in user experience in retailing with the aid of technology was dealt and the discussions were, Marini (2012) states that Virtual Reality is a communication process, where interaction and sensory stimuli are used to convey information to human through computers. Some of our participants said that VR acts as a communication process between the customers and the organization and it is related in the terms of consumers and consumer behavior. They added that it depends on the levels of use in customer needs and the type of product. The participants also felt that they could compare products from different manufacturers, and buy them in one go from the same place. They also felt that VR as communication process would be better for show casing products and designing suggestions. The researchers have focused on Virtual Reality and have investigated factors that would influence on user’s communication experiences in the immersive environment (SuhandLee, 2005; Hammick and Lee, 2013). Most of the participants expressed that VR enhances communication process and brings the customer closer to the organization and revolutionizing the communication process can be done by VR, but they emphasized it truly depends on the customer needs and type of products. Rosedale (2017) highlights that the affections Virtual Reality is going to bring to humans and society shouldn’t be neglected. Contemporary Virtual Reality acts as an efficient and interactive communication process bridging the gap between end users and organizations. It also enhances a better technology-individual-organization relationship.
Limitations and Drawbacks of IKEA VR Experience:
From the empirical findings, the limitations and drawbacks of Virtual Reality and its applications were, the participants felt hardship in using controllers and they felt if the controllers are replaced by gloves it would be easy and convenient to use. Biocca (1995) explains that if the goal is to create tactile illusions, then a good place to start is with that part of our body we use to explore the world of surfaces and textures, the skin and pressure sensing organs on our hand especially the fingertips. The fingers are only a small percentage of our skin surface, but a significant part of our brain is dedicated to them.

So, to successfully communicate information to the brain, we must find ways to stimulate the tactile receptors that lie just below the surface of the skin. In order to create a better interactive connection between humans and technology, a pair of haptic gloves were recommended to replace the controllers. Additionally, some of the participants felt that the cords and the wires were little disturbing while using the application. The head mount was found little difficult for some of the participants and few could really feel the difference in the environment while when they are in the Virtual Reality Environment and when they come back into the real world. Most of them said they couldn’t use the application and the devices properly when they started using it and they could feel comfortable after they are into it.

5.1.2 Discussion of RQ2.

RQ 2. How do the users describe the importance of haptic feedback in enhancing the communication process in the context of IKEA VR Experience?

The findings for the research question 2 explain, the Plan for improvement, User Experience Enhancement, General suggestions, Advantages of Future Innovation.

Plan for Improvement of IKEA VR Experience with Haptic Feedback:
The introduction of technology of Haptic Feedback in the IKEA VR Experience was the plan for improvement and the discussions were, most of the participants felt that it will be good to feel something, such as, materials and how heavy to drag the drawers. Haptics explains both force feedback like object hardness, weight, Inertia and tactile feedback which includes surface contact geometry, smoothness, slippage and temperature as stated by Burdea, (1999). Participants exclaimed that, haptics may be the next phase of VR, so far it is looking at things and it is not about feeling, but the feeling sense gives an extra confidence of buying that, and added haptics will enhance the buying as if going to a shop and buying. The sense of touch is equally important in virtual environments to enhance the users’ sense of immersion. Haptic Feedback is an important sensory technique in Virtual Reality interactions. One of our participants said that developing the IKEA VR Experience application with the technology of Haptic Feedback will help the application to act more naturally. It will add the experience in a much faster way and adds reality. One more participant expressed that learning curve will be lesser when you have realistic feeling to VR. Keus et al. (2006 cited in Meijden and Schijven, 2009) described that realistic procedural simulations with Haptic Feedback lead to better performances, faster performance curves and high transfer of operative skill. One of our participants had a view that, feeling something, which really doesn’t exist is awesome. Another participant added that it could make much bigger connection between human and the application. With Haptic Feedback, the experience will be better.
Users’ Experience Enhancement of IKEA VR Experience with Haptic Feedback:
Discussions of, haptic feedback in VR will enhance the users experience, the sense of touch plays a vital role in humans’ cognitive ability to experience any physical environment. The sense of touch is equally important as auditory and visual experiences in virtual environments to enhance the users’ sense of immersion. Haptic Feedback is an important sensory technique in Virtual Reality interactions. During the analysis of the empirical findings the participants explained that the learning curve is minimized and becomes smaller because of more realistic learning with the help of Haptic Feedback and added that Haptic Feedback enhances the user experience by touching and feeling.

General suggestions over IKEA VR Experience with Haptic Feedback:
Based on the discussions regarding general suggestions over the IKEA VR Experience with respect to Haptic Feedback, most of the participants felt that controllers should be replaced by a pair of haptic gloves. One of our participants expressed that more research and innovation is required in this area, it still calls for a special design to address the needs of people with disabilities, and it is indeed beneficial to have Haptic Feedback for differently abled people. Stone (2001) illustrates that early Haptic Feedback systems developments aimed to help people with visual disabilities to explore unknown field through virtual environments. The participant who had a very good exposure towards virtual reality environment said that, it will be very nice if IKEA improved the IKEA VR Experience with haptics and if IKEA can provide its own VR solutions to the customers by customizing the VR equipment. As the world is more towards virtualization it is more needed at this point.

Advantages of Future Innovation of Virtual Reality:
The discussion focuses more on two aspects, the first one “If VR devices become less expensive, handy and easily accessible, would the participants be interested to view the furniture at home via VR?”. In this context, three main factors to be discussed from the participants’ perspective was time, cost and infrastructure. Most of the participants felt they would go for these types of future innovations on two main reasons, when they should save time and if they are less expensive. The third crucial factor is how technology improves itself in the future to fulfill the future innovation. A process can be virtualized with or without the use of IT. As Overby (2008) states, virtual processes have proliferated recently as a result of improvements in the sophistication and accessibility of Information Technology.

The second aspect, the applications of HTC Vive headset to view IKEA kitchen units, in future the whole home experience was analyzed from the participants view. Most of the participants informed that it would be an amazing innovation to look forward in future and expressed their interest in using such applications. They felt that it would be brilliant for dynamic customizations, rearrangements, renovation, interior designing, building a virtual “model” house almost close to reality.

5.1.3 Additional Outcomes
In addition to the findings related to the research questions, some of the additional outcomes which are not related to the research questions were discussed here, some of the participants expressed that this type of Virtual Reality environment may isolate human from the society, the interactions between human will be reduced. The people who are disabled are benefitted with this type of communication. Studies pointed out that people who lack of communication skills
or having difficulties to communicate because of their personal issues, prefer to communicate via technology devices rather than having communication in the form of face-to-face (Hertel et al., 2008; Hammick and Lee, 2013). Participants also felt that, it is more beneficial to people who are far away from the stores. Some of the participants felt that there is no need to transport yourself and this type of innovation are environment friendly.

5.2 Reflections

The empirical findings of this research reveal that, Virtual Reality is going to be a better process for communication from user perception and experience. From the perception of individuals, a variety of communication systems meet different people’s need based on their individual preferences (Hammick and Lee, 2013). The participants feel that VR acts as a communication process between the customers and the organization and it is in the terms of consumers, consumer behavior and the types of products. The participants expressed that they are much interested to use especially, if we they could meet people in the virtual environment and also added VR is loaded with positive value, and it’s important whether people will accept it or not but it’s more important that the new phenomenon has positive value. Above all, it depends what it can lead to, and they strongly feel the people are optimistic over this approach. Participants strongly believe that VR enhances communication and brings the customer closer to the organization and soon VR can revolutionize the communication.

Furthermore, if the IKEA VR Experience is enhanced with Haptic Feedback, will make the customer to experience more real, help to act more naturally, and add the experience in a much faster way and adds reality to VR. Haptic Feedback could make much bigger connection between human and the application. The participants felt that IKEA really needs haptics particularly with the help of haptic gloves to make it more sensible and satisfactory to the consumers. In addition, to have a view that Haptic Feedback is the next phase of VR gives an extra confidence of buying by the feeling sense. So out of 15, the 14 participants felt having Haptic Feedback in the IKEA VR Experience application, will make the kitchen authentically good. However, one of our participant felt the kitchen with haptic feedback a kind of weird and disturbing.
Chapter 6 Conclusion

In this chapter, general conclusions are made about the research study. Further, about the researchers’ contribution is explained. The chapter concludes with suggestions for future research.

6.1 Conclusions

The research primarily focuses on Virtual Reality as an efficient communication process, its advantages, limitations, future innovations etc. The research explored how the IKEA VR Experience could be enhanced with Haptic Feedback to promote user experience. The adopted methodology was qualitative research with the interpretive paradigm and was based on the methods of semi-structured interview. In relation to the research work, the researchers intended to make the selective respondents to experience IKEA VR Experience and NVIDIA VR Funhouse – Balloon Knight, a haptic feedback-based application, to experience Haptic Feedback. Once the participants experienced the virtual reality applications, an individual interview was conducted with all the participants. All the interviews conducted were recorded with the consent of the participants and related notes were taken respectively during the interview. As introduced in the section of Reliability and Validity, there were more than one observer or using several interviewers helped to reduce the potential bias from single person doing all data collection and data analysis. Pertain to the analyst triangulation, the researchers independently analyzed the same qualitative data and compared their findings in this case study. Same set of questions were used by the researchers while interviewing the participants, the outcomes were further discussed by analyzing data, sharing their insights and different perspectives. Then the researchers transcribed the interview with the help of three Cs, analytical strategy as introduced in the methodology section.

There are five different themes formulated for the research question 1: How do the users perceive virtual reality as a communication process between human and technology and describe their requirements to enhance of IKEA VR Experience?

The themes are users’ apprehension on virtual reality, users’ experience in IKEA VR Experience, users’ opinion on IKEA VR Kitchen, Communication enhancement for IKEA VR Experience, Limitations and drawbacks of IKEA VR Experience.

There are four different themes for the research question 2: How do the users describe the importance of haptic feedback in enhancing the communication process in the context of IKEA VR Experience?

They are, Plan for improvement of the IKEA VR kitchen with respect to haptic feedback, Users’ Experience Enhancement with haptic feedback in IKEA VR Kitchen, General suggestions for IKEA VR Kitchen, Advantages of Future Innovation in Virtual Reality.

With the first five themes, the study has found responses for the first research question:

By detailed analysis of the empirical data the researchers could find the users’ perception over Virtual Reality as a communication process was welcoming and they really had a positive opinion. The participants had exclaimed the experience as a kind of real experience, being
authentic and immersive. Mostly the researchers felt that the participants had a positive opinion over IKEA VR Experience. The participants from their perceptions and experiences admitted that Virtual Reality will enhance the communication process and in later years it may revolutionize the communication world. However, there are some limitations in handling the appliances particularly with controllers and most of the participants felt that a pair of haptic gloves could be a better option to replace the controllers in the Virtual Reality applications.

The last four themes of the thesis provided valuable answers for the second research question:

From the empirical analysis, it is evident that the participants felt that the IKEA VR Experience application could be enhanced with Haptic Feedback, and they expressed that the learning curve is minimized and becomes smaller because of more realistic learning with the help of Haptic Feedback and added that Haptic Feedback enhances the user experience by touching and feeling. They also felt that the IKEA VR Experience enhanced with Haptic Feedback will make the customer act more naturally and makes much bigger and better connection between human and the application, furthermore, the organization. There was huge response for the future innovation and it mostly depends on the needs of the customers and the type of products.

As additional outcomes, the participants expressed that this type of communication may enhance the experience of the disabled people according to their need and use. The customers who are far away from the stores and who doesn’t have enough time to do physical shopping can also be benefitted and moreover it is environment friendly.

However, one of the participant out of fifteen felt the IKEA Virtual Reality Kitchen enriched with Haptics would be little uncomfortable and some of them were afraid that this kind of communication may separate the individual from the society and there will not be human-human interaction in future.

6.2 Research Contribution

This research keenly focuses on the field of information systems development, with respect to users’ perception and experience. In addition, the research clearly explored that the virtual reality as an efficient communication process, further emphasized more on the importance of haptic feedback in virtual reality applications, by enhancing users’ interactivity and immersion. Considering the human perceptions and experiences in line with technology is extremely significant for an effective VR. Based on the outcomes of this study, organizations can strive towards providing a richer VR experience to their customers.

There are two authors in this thesis work. The knowledge and researches for the thesis were equally contributed and all studies and work for the thesis were evenly divided between the researchers. One of the authors concentrated on writing the introductory section, while the other one contributed to the chapter of Literature Review. Apart from that there was not a clear boundary between the two authors for different chapters of entire thesis since the two researchers closely worked together and are responsible for all parts of the thesis. The data collection was done by the researchers together, and both the researchers were part of every initiated interview. All the data collection and results were discussed between the researchers and both contributed equally to build the remaining chapters of the thesis.
6.3 Future Research
The importance of perceptions and experiences in Virtual Reality should be researched in greater detail to understand the expectations and demands from users’ perspective. Such studies will provide a clear landscape for an efficient virtual environment design. It is expected from organizations to upgrade their ICT Infrastructures to meet user needs in a better way. The IKEA VR Experience can be enhanced to a more realistic virtual environment by considering the inclusion of Haptic Feedback. Several proven research studies emphasized the importance of Haptic Feedback in making a VE more immersive. The sense of immersion in virtual environments is enhanced by many folds with haptic interfaces. This research study stands as a start point for proposing enhancements to IKEA VR Experience from users’ perspective, thereby proposing recommendations for inclusion of haptic interfaces in IKEA VR Experience. Most of the participants in this research study expressed their willingness to experience IKEA VR Experience with Haptic Feedback in future.

Furthermore, the methodologies and empirical findings described in this research can be further extended to study other Virtual Reality applications. In general, Haptic Feedback should be considered as an essential functionality in designing virtual environments. Organizations can develop Virtual Reality applications with Haptic Feedback to benefit people with disabilities (Etchemendy, et al., 2011; Hammick and Lee 2014; Lahav, 2014; Kang, Kang and Kim, 2014). For instance, utilizing VR in collaboration with Haptic Feedback to positively influence on interaction and communication experiences for those people who has difficulty in communication, as Hammick and Lee (2014) illustrated. How amazing it would be to provide an enriched virtual reality experience with haptics to the people with visual disabilities to explore the world, academics, interacting with the peers and so on. This area of research still needs to be explored in greater detail to provide better service to the people with disabilities.

The development of Virtual Reality applications in retail industry is still in its nascent stage. There is a great scope for the organizations to invest on such advanced technologies to have a competitive edge in modern business. It might not be practically possible to imagine and appreciate the future benefits of VR applications, but soon it is expected that conventional communication systems will be replaced by interactive Virtual Reality applications in the near future.
7 References


**Bibliography**


Appendices

Appendix A Informed Consent Form for Master Thesis

Virtual Reality as a Communication Process: Users perceptions and experiences

Researchers: Kasthuri Brindha K and Hanyu Yan

We would like to thank you for accepting our invitation and participating in our study. We are master students from the University specializing Information Systems. You are invited to participate in our master thesis project, which is related to user perceptions and experiences about the Virtual Reality (VR). In this project, approximately 15 people will be asked to participate in the interview and experience the IKEA VR Experience application and Nvidia VR funhouse – Balloon Knight application. We have arranged VR setup at the University, where the participants will be allowed to experience VR for a brief period of 15 minutes on Monday, March 27th. Afterwards, we will schedule an interview session with the participants from March 28th to April 2nd that will take 30 minutes to complete.

Virtual Reality is a computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as, a helmet with a screen inside or gloves fitted with sensors. Haptic feedback recreates the sense of touch by applying forces, vibrations, or motions to the user. Haptic feedback is considered as most crucial component of VR simulations. There is a great need to integrate haptics with VR applications to make it even more interactive to users.

Virtual Reality as a Communication Process: User Perceptions and Experiences is the main topic of this study. We aim to explore the IKEA VR Experience in order to study the current trends and the user’s thoughts. The IKEA VR Experience is an IKEA VR application, which was developed collaboratively with Allegorithmic. Associated with HTC Vive headset, the user can explore one of three differently-styled kitchen’s settings through the app. Moreover, the user can change the color of cabinets and drawers with a click. Furthermore, the app has offered users a feature that observes the kitchen from different perspectives while the user can adjust the height accordingly and view the kitchen from their normal perspective or from two other options. With the results, a better solution will be obtained with the integration of haptic feedback in a virtual reality environment. The information you share therefore would facilitate the future development of VR applications and the relationship between humans and technology.

The data gathered from the interview and meeting will be solely used for the purpose of the academic research with respect to master thesis. Your views and opinions will only be shared with us, our supervisor, examiners and IKEA. Your full name won’t be disclosed during and after the research and a written permission of recording the conversation of the meeting is requested.

As one of the research participants, you are selected because you have technology-based background and you have experiences with modern technological products. We believe that your knowledge and experience will be a useful contribution in our research.
Please do not forget to sign the consent form below before going through our work.

Guidelines

Please follow the guidelines shown as below:

1. The participant will be allowed to experience the applications at the University, Room B3037V for a brief period of 15 minutes.
2. The interview will be recorded by mobile phone and the answers are written down as notes.
3. Please read the short introduction about the study before attending the interview.
4. The interview will take 30 minutes and it is scheduled for a different date. We will send you a detailed schedule soon.
5. Your participation in this study is completely voluntary and you are allowed to drop the interview anytime.
6. You are allowed to decline to answer any questions.
7. Inform the researchers if you have any privacy requirements.
8. We won’t use your family name.
9. The data after transcription and interpretation will be shown to you.
10. The results will be shown with you.

If you have any questions or clarifications, please notify the researchers prior to the schedule of the interview. Again, thank you so much for your participation.

__________________________________________________________
Signature                                          Date

__________________________________________________________
Signature of the Investigator
Appendix B Questions for Interview

Questions after VR (IKEA VR Experience) experience and Nvidia VR funhouse – Balloon Knight application, to the participants after they experience the VR on March 27th:

What perception did you have over VR before you came and viewed the VR applications?
Could you explain the experience you had in viewing the IKEA VR Kitchen?
What’s your opinion about the IKEA VR Experience?
What advantages it will bring when we utilize the HTC Vive headset to view the IKEA Kitchen units and even in future the whole home experience?
You have experienced the technology of haptic feedback when you tried the Sword Knight application. What do you think if IKEA VR Experience has the function of haptic feedback, as like the following examples?
Example 1: The user can cook the meatballs when they experience the IKEA VR Experience. What do you think if you could feel whether the meatballs are cold or warm, hard or soft?
Example 2: When you change the color of the table as well as change the location of the table, you will feel the force of pull. Do you think this function will make customers more interested in the application?
Example 3: When you are able to feel the texture of the surface of cabinets, whether it is rough or smooth, soft or hard.
Example 4: As you can shrink yourself at the size of a 3.3-foot-tall child or stretch yourself at the size of a 6.4-foot-tall adult, will it be good to experience the push and pull force feedback in different level when you open or close the drawers?
Will haptic feedback in VR enhance the users experience?
Do you have any other general suggestion over IKEA VR Experience with respect to haptic feedback?
In the near future, when VR devices become less expensive, handy and easily accessible, would you be interested to shop from home via VR? How do you feel about it?
Will VR act as an efficient communication medium between the organization and users? What is your opinion? Do you think that VR technology in home furniture’s would match physical shopping experience to some extent? In future, do you think that this technology improves the user experience in retailing.
Do you find any limitations or drawbacks in VR applications and devices?