AN APPROACH TO CREATE A VIRTUAL NETWORK FOR CO-DESIGN PROCESSES

Master’s (one year) thesis in Informatics (15 credits)
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Abstract

With the increasing popularity of information technologies, many companies try to set up a virtual network in order to share their business information. The purpose of creating such a virtual network is to create a new knowledge base on the combination of the existing knowledge. Collaboration is very necessary in such a virtual network as cross-unit collaboration takes place when people from different units work together in cross-unit teams on a common task or provide significant help to each other. Recently, co-design is an emerging technology in the field of informatics. It is considered as the development of system thinking, and it is a collaborative designing process which recruits designers, researchers, stakeholders and others together. The purpose of this collaborative activity is to solve designing problems. Therefore, if we want to increase collaboration in a co-design process, we need to look at ways of increasing the efficiency of collaboration. The rapid development of accessible, reliable, and user-friendly information technology offers improvements to traditional collaboration, and makes new approaches possible. Many platforms for the exchange of information such as the Internet, email, and video-conferencing are well-established aids to collaborative activities. Therefore, my research investigates to create an efficient virtual network for a co-design process. In this research, I will try to investigate that what is the need of a virtual network for co-design process and what are those virtual network soft-ware which can help us in a co-design process. My research discussion is related to the theory of CSCW (Computer Supported cooperative work).

Keywords: Virtual network, information sharing, collaboration, co-design process, system thinking, CSCW.
Preface

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1. Introduction

1.1 Background

A philosopher, C. West Churchman has given a concept of cooperative work, technologies network, co-design and group works in his unique sentence, "begins when first you view the world through the eyes of another’’(Churchman, 1968).

Many companies try to set up a virtual network in order to share their business information. The purpose of establishing such a virtual network is to create a new knowledge base on the combination of the existing knowledge. From the sociological aspect, I can say that co-operative people can develop their society more efficiently than a non co-operative society. The people in a co-operative society shared their problems and knowledge, and competent to find a better solution for their problems.

Computers network provide a co-operative environment facility to an organization as all employees can share their information with each other. Organizations having computers network facility can manage their assets more efficiently because it provides express communication amongst employees while on the other hand if an organization has no computers network facility, may face many problems due to the lake of fast communication and data managements (Setthagen&Dahlqvist, 2004).

The development of a country is impossible without the co-operation of government organizations. It has been observed that government organizations have fewer problems because they are connected with each others through a proper channel, and can share their information (Rowe, 2004).

There are a lot of success stories of collaborative work in various business organizations since co-design is another emerging technology in the field of informatics, in which different organization’s experienced peoples, comes together, to solve their designing problems. In a co-design process, inexperienced persons gain knowledge from experienced persons (Lind, 2005). When two experienced people come together, and share their information, often a new knowledge may be created which might be result in the form of a new product.
A debate in a co-design process is similar to a group discussion. In universities and colleges, students do their assignment and thesis in group shape. The purpose of making group is to produce efficient data (Sondra & Commile, 1999).

Therefore the mean of a co-design process is to make a well-organized data because different diversity of alternatives may develop in such a process. The most important advantage of such process is to minimize risk because of sharing responsibility.

Recently, a co-design is very famous for urban relocation and mobile development (hardware/software co-design). As the designing of earth quake and tsunami recovery was a great challenge for designers. An office was organized for this purpose, and it was discovered that it is uneasy to recover urban in the old place because of earth quake. Therefore, they decided to build the city in a new place, but it was not possible without the co-operation of stockholders. So in the city of Llico, a number of stockholders; business men, citizen, restaurant owners, fishermen came together, and design a new urban area in a new location, which base on previous urban area (Jonathan, 2010). The words of Immanuel Kant may be reminded in such a situation, as he had given a concept that “every person has some information and knowledge”. He called it a priori knowledge and this knowledge is very useful for a designer (Jelsoft Enterprises, 2010).

Virtual networking is a powerful invention of information technology which is increasingly becoming common. Many companies (like computer software/hardware, mobiles, designing and others) desire to come together to create a common virtual network, in which they can easily share their knowledge with each other. Companies outside of this common network will be suffered in great problems. There are different types of virtual networks, used for different purposes. Some of them are used for a social relation, some for real time communication, some for business modeling and some for mobile application. There are also some business activities which is not possible without virtual networking. E.g. Mobile communication, the use of ‘Access card’ technology, checking of tickets in transport system etc, but nowadays there is an extensive
need of virtual network for a co-design process as the investigation of my research. My research thesis will provide a solution for creating a virtual community for a co-design process.

A co–design virtual network is an extensive need of the modern world, because people have no enough time to participate physically in a co-design process. There are so many companies having their franchises (business partners) in all over the world, and they are facing with a large problem of communication. Many universities, colleges and companies exporters want to share their knowledge, but could not find a proper way to share their knowledge. Therefore, a virtual network that would be created for a co-design process may be capable to solve many of these problems.

1.2 Statement of Problem

As it is stated above that co-operation is very essential in many businesses in various cases. Proper communication is the key concept for the development of a business. There are also some business organizations and companies that cannot be operated without a proper positive communication. E.g. In a co-design process, many designers along with stockholders comes together, to design a system. The success of a co-design process is only dependent on the co-operation of stakeholders, but it is very difficult to collect the entire stakeholders in a single platform. For this purpose information technology maintenances tries to create a virtual network. Due to which the stakeholders could easily participate in the design process, and communicate with the designers.

There are a lot of virtual network computing application use for different purposes. E.g. Skype which is very famous in net meeting, Secure shell (SSH) is very useful for remote file management, Real VNC which is famous for desktop sharing. Similarly, to fulfill the requirement of a co-design process, there is a need of virtual network due to which designers and stakeholders easily contribute in a co-design process, and this is the aim of my thesis investigation.

1.3 Purpose of the study

The virtual network is becoming more and more common, and many companies try to create a powerful efficient virtual network. Some of these virtual networks are very successful while others have efficiency problems. The purpose of studying different virtual network is to produce
knowledge which will be helpful in the creating of virtual network for a co-design process. There may be some virtual networks available for a co-designing process, but my purpose of study these networks is to give a clear cut knowledge for the creation of an efficient virtual network (for a co-design process).

### 1.4 Research Question

My research investigation emphasize on the question:

- **What aspects should be considered to create an efficient virtual network for a co-design process?**

The question can be illuminated by study the following sub question:

- Why do we need a Virtual network for a co-design process?
- What types of famous Virtual networks are available now?
- How are the famous type virtual networks working?
- Can the available networks be modified for co-design processes?

### 1.5 Target group

The research will create some knowledge for the creation of virtual network for a co-design process. The target group is researchers in the field of informatics. They can use this thesis as a contribution for further research in the creation of a virtual network for a co-design process.

This thesis may also be helpful for those people that are interesting in the creation of knowledge about virtual network.

The thesis may also give a good explanation of a co-design process. So those who are interesting in gaining knowledge about a co-design process can also use this thesis.

Software designer can use this thesis for the designing of virtual network software, for a co-design process.

### 1.6 Expected Result

A co-design concept is a broad phenomenon. It is a development of system thinking in which the designers need the priori knowledge of multiple stakeholders. Virtual network community is a
best way to collect this priori knowledge of the stakeholders. The thesis result will create some knowledge in the field of informatics which will be helpful in the creation of a virtual network for a co-design process.

1.7 Delimitation

Different areas of study can give valuable contribution to my research. E.g. How to increase the interest of stakeholders to use a virtual network, and help the designer in a co-design process? Stakeholder interest is very important, but the thesis does not explain any method of motivation of stakeholder’s interest.

1.8 Author’s background

My knowledge background in this research is limited to the use of some virtual network community. My interest in this field was developed at the time when I was using virtual network computing (VNC) for Linux desktop sharing. In Pakistan our Linux teacher was working on VNC viewer when he taught practical work to us. We have also sometime use Skype for net meeting. I have also some experience of group community while working on our course assignments, and co-design is such like an activity of designer.


2. Research Design

2.1 Research Perspectives

The characteristics of the knowledge that will be created through this research may be of different kinds. The result could be normative. A normative claim concerns evaluation: not things how are, but how they should be. It says that something is good or bad, right or wrong, desirable or undesirable, just or unjust and so on (Andrew & Edward 2010). (Goldkuhl, 1998) stated that, with a result of the latter kind it may be difficult to justify the choice of actions. My research aim is to create virtual community for a co-design process, relevant to interpersonal relationships in the virtual communities. The knowledge characteristics may primarily be described as aim towards comprehension. Knowledge of that kinds try to answer questions about what something is instead of explaining why something is the way it is, which is the aim of explanatory knowledge (Lind, 2005). Comprehension knowledge can form a basis for decision making about the knowledge strategies in the virtual communities. The Research which creates comprehension knowledge will reveal the characteristics of the specific concept, and will illuminate as well as attach meanings (Lind, 2005).

The words communication technologies are used for transferring information and knowledge. Anderson defines knowledge as structurally order information. As a useful analogy, information is like a set of variables while knowledge is like a set of equations define the relation between the variables. Because it is more complex, knowledge is more difficult to transfer than information. (William, 2006) Knowledge can also be define as a set of organized statements of facts or ideas, presenting a reasoned judgment or an experimental result, which is transmitted to other through some communication medium in some systematic form (Daniel, 1999). It is necessary for researchers to state his view in knowledge that should be created through research, since my study purpose is to investigate proper information or a set of variables, and the way of relation among these variables which may be raised in the form of a new knowledge, and this will be possible through epistemological and empirical study. The knowledge that will be received through research investigation will be used for creating a virtual community, and in this virtual community, everyone will participate individually which will form a virtual co-design process.

The two main scientific research perspectives, hermeneutic and positivistic are used in research methodology. A researcher may either select a hermeneutic or positivistic perspective, defends on the nature of the research knowledge strategy. The aim of my research is to produce comprehensive knowledge through interpretation; hermeneutics is the most relevant approach because it aims at interpreting and explaining meaningful concepts (Gilje & Grimen, 1992). According to hermeneutics perspective; Text, language and artifacts can be seen as containing collective experiences and expectations. Our knowledge of the world is also mediated through
language that is we construct a certain understanding of the world with the use of language (Lind, 2005).

That the individual constructs his own world has a great impact on the hermeneutic perspective. It implies that it is unfeasible to create a common picture of our surrounding world. The pre-knowledge we have, is our own, and it is unique, and since it is part of the research process, the process as well as the research results will be individual that is they contain a subjective component. It is therefore no such thing as a handbook of hermeneutic method. Every situation must be solved from its own conditions. It is therefore not possible to learn a general pattern for hermeneutics but the researcher must learn through experience. (Benediktsson, 1989)

Ricoeur (1974 cited Lind 2005) means that also actions can be interpreted as texts (Ödman, 1994) and that these like texts should be regarded as autonomous. He thinks that the hermeneutic process not in the first place aims at insight in the mental world of the creator, since the text exceeds the intentions and horizon of the author. It is thus the text in itself that should be interpreted.

Different writers use different perspectives for interpreting the knowledge, but I will include Ricoeur’s perspectives in my research. In my case the factor and models that I will use in the theatrical study must need to be interpreted. The interpretation may be done through provide empirical materials. The material must be related to my research knowledge. The notion of the hermeneutics remains extraordinarily pervasive in qualitative research, often been used interchangeably with that of interpretation (Pushkala, 2005).

For achieving the goal of a research, one may use either a quantitative or qualitative research method. Qualitative methods involve a researcher in describing the kinds and characteristics of people and events, without comparing events in terms of measurements or amounts. Quantitative methods, on the other hand, focus attention on measurements and amounts (more and less, large and smaller, often and seldom, similar and different) of the characteristic displayed by the people and events that the research studies (Thomas, 2003)

The aim of qualitative research methods is in-depth understanding of the human behaviors, and the reason which govern on these behaviors. Qualitative research methods focused on the question of what, when, where, how, and why. Qualitative research methods create knowledge in a specific case study, and the other more general conclusions are only a hypothesis. Therefore, as a hermeneutic perspective, I will select qualitative methods for my research investigation. The key difference between qualitative and quantitative research method is its flexibility. A qualitative research method is slightly more flexible than quantitative. It allows greater
spontaneity and adaptively in the interaction between participants and researcher. For example it mostly asks “open-ended” question in which the participant is free to answer in their own words.

The main strengthen and advantage of the use of qualitative methods is its ability to provide a complex textual description of the give research issue. Qualitative research provides information about the human side of the research issue. E.g. it gives information about the human beliefs, emotions, opinions and relationship of the individual. Data achieve through qualitative research is usually extended to people as their characteristic.

### 2.2 Research Strategy

Different research methods are useful for different purposes, and it is important to establish the purpose of the research and the method of the research study since this will influence the research strategy.

As a hermeneutic perspective, the characteristics of my study is explorative because my research investigates such knowledge which base on a new interest, and the subject area “co-design” is itself a new technology of the informatics. In my research, the reasoning goes from specific to general which adopt inductive mode of thinking.

In order to clarify the research strategy, it is important that the researcher states the role of the theoretical and the empirical study. As an inductive mode of thinking, I will collect specific data through theoretical and empirical study, and then try to generalize the data. Theoretical study generally use for research findings from existing works to develop new ideas through analyze the existing theories and explanations. Empirical research, on the other hand, supports the development of new ideas. It is use for verify the theoretical research (Chris &Ian, 2010). Thus as a researcher, I will study different books and academic websites for the reason to find something from existing theories. I will try to develop new ideas through analyze the existing theory and explanation, and this will be the result of my theoretical study. After completion of this step, I will start empirical research to test my ideas and explanation.

### 2.3 Data collection procedure

This section describes the data collection procedures of my research. No research would be undertaken without data collection. All scientific researchers look for data which help them in answering the research question and achieving their research goals. There are several data collection’s methods, but a method can be selected due to the nature of the question (Herbert &Elana, 1989). The quality of any research study depends largely on the quality of the collected data, and the quality is directly related to the data collection procedures. Thus, well thought-out
data collection procedures will generally elicit high quality data, leads to valid research finding and conclusions, while unstructured procedures may often lead to invalid conclusions.

As it is stated above that I am using qualitative research method, and there are several data collection methods in qualitative research method, but mainly it can be divide into two categories that is the theoretical data collection (The theoretical research) and Empirical data collection methods (The empirical research).

### 2.3.1 Theoretical data

For collecting theoretical data, I will use **Text analysis** method. To perform a text analysis means reading written material, and then analyzing it (Repstad 1999). Text analysis summaries the opinions of many authors in order to reach a standard point that are relevant to the research. Different texts may be invented in this method which will create a scientific problem area of my research. Due to this method, I will search available virtual network software (Virtual network community software), and their characteristics. Therefore, I will include this method in my research. I have also sent mails to some organizations (companies) performing the co-design processes, Companies like ‘think public’ ([www.thinkpublic.com](http://www.thinkpublic.com)), ‘co-design workshop’ ([www.designworkshop.com](http://www.designworkshop.com)). I have told him to send me some success stories of the co-design process as they have been performed. In theoretical research, I will study subject related to the co-design process, like human behavior and system thinking. I will also search different virtual network software, installing that software, and try to compare it to the co-design process that will help me in providing a solution for creating virtual network software for a co-design process. As my research investigates proper virtual community software for a co-design process, therefore, I shall also study subjects like the community, the virtual community and the human community system.

### 2.3.2 Empirical data

The theoretical data will be tested through the empirical research. For collecting empirical data, I will perform an observation and the interviews

An **observation** is a method of gaining knowledge through the eyes or observes attentively. An observation can be either active or passive (Repstad 1999). Through observation, I should
observe the interaction of the members in the co-design workshop. In fact, it is useful for me, to join a co-design workshop as an observer, but unfortunately, here in Boras there is no co-design workshop, and I have very limited time for this research. Therefore I have collected a lot of videos related to the co-design process or workshop. URL of some of these videos is given in the references section of the thesis. My cognitive power will also be used in this method to find answers to my research questions. I know that if I shall use this method, I must perform a greater number of observations. In fact an observation is an approach to get deeper, more solid contacts with people and situations (Kathleen & Dillie, 2002). The observation is a backdrop to other research methods. It allows for greater rapport, better access to informants and activities, and enhances understanding of the phenomena. In my research I shall do video base observations. The major advantage of video-tapping is that particular sequences can be replayed again and again so that fine behavioral details and subtitle can be noted and interpreted (Guy, 2005). Video observation has two principal advantages over other observational techniques. It records more information than could otherwise be captured [i.e. density of information], and it allows retention of that information [i.e. permanence] (Grimshaw 1982). Videotaping allows reviewing of the interaction at a number of sequential levels; the whole event, major constituents and then particular aspects of organization within the event (Erickson 1982).

These elements of video make it particularly useful for a hermeneutic interpretation of emotional nuances, embodied perceptions, spatial influences, relational understandings, situational factors and temporal manifestations (Raingruber 2003).

Due to video observation, I shall be able to measure the actual skill of the co-design process, and also the interests of the participant in the process.

An Interview is a conversation between one or more people where questions are asked from the interviewee by the interviewer to obtain information from the interviewee. The aim of qualitative interviews (deep interviews) is to find out that how the participants are thinking and believing on a co-design process and a co-design virtual network. Here it is possible to find answers to several interesting questions, such as what aspect should be considered for the creation of an efficient virtual network for a co-design process. An important advantage of interview is that it is possible to go deeper into specific cognitive and affective aspects of the respondents’ view of the problem area. I will therefore perform interviews. A disadvantage with this method is that it takes time, and it may be difficult to reach the most appropriate respondents. This problem can be reduced by preparations well ahead of the occasion. I will also use web media for interviews. I shall use this method to collect empirical data for my research.

2.4 Data Analysis procedure
Data analysis is the most difficult work in qualitative research (Backman 1998 cited in Lind, 2005). Therefore it is important to have a strategy for the procedure. It is much difficult to define the research problems, develop and implement a sampling plan, conceptualize measure and develop a design structure. If a researcher done this work well, the analysis of the data is usually a fairly straightforward affair (William & Trochim, 2010). One of the importances of the analysis is to create a deeper meaning from the collected data. As it is stated that my first step will be theoretical research, the empirical research will be done for verify the result came from theoretical data. In the analysis phase, I will take a sub question of the research, and then compare the answer of that question, that will be found in theoretical study with the answer that will be found in empirical study. After this comparison, a new knowledge will be created which will be the answer of the research’s main question.

2.5 Strategies for validating findings

Data gathering is the base of the research findings. Such collected data must be valid and reliable. Their validity and reliability depends so much on the quality of the research instruments. A research instrument must also be valid and reliable.

A research instrument is valid when it measures what it intends to measure. The data collected through the instrument must serve the purpose for which the data are collected. (Ariola, 2006)

There are many types of validity but the three most common types are content validity, criterion validity and construct validity.

a. **Content validity.** It is referred to as face validity, logical validity or sampling validity by other authors. An instrument is valid in its content as well as in its format if the instrument is appropriately and comprehensively enough to cover the topics and variable intended to be studied and the item adequately represent the subject to be assessed. (Ariola, 2006)

b. **Criterion validity.** It is referred to as a predictive validity and concurrent validity by other authors. The validity of an instrument can be established if the score obtain by an individual using a particular instrument in significantly associated with the score the individual obtain in another instrument but of the same kind ad purpose known as the criterion. For example if the researcher wants to measure the academic subject and compare the students general average in the all academic subjects and compare it to his college admission test (CAT) core -the criterion variable. (Ariola, 2006)
c. **Constructive validity.** It is referred to as multitrait-multimethod and factorial validity by other authors. Construct validity refers to the specific construct, characteristics, or traits being measured by an instrument and how well the constructive given on the second test administration but an alternative form of the same test in administered. These two forms of test are intended to measure what it intends to measure and the reliability coefficient is obtained by correlating the two forms of test. It weakness’ is that it is difficult to construct a test with alternate form that are parallel. (Ariola, 2006)

Categories of validity (for example, concurrent validity, predictive validity, convergent validity, criterion-relative validity, internal/external validity) are based on positivistic assumptions that underlie quantitative and experimental research design. Qualitative researchers have generally responded either by denying the relevance of the quantitative or scientific paradigm for what they do or by arguing that qualitative research has its own procedures for attaining validity that are simply different from those of quantitative research (Huberman, Matthew, 2002).

The validity concept is described by a wide range of terms in qualitative studies. This concept is not a single, fixed or universal concept, but “rather a contingent construct, inescapably grounded in the processes and intentions of particular research methodologies and projects” (Winter, 2000). Although some qualitative researchers have argued that the term validity is not applicable to qualitative research, but at the same time, they have realized the need for some kind of qualifying check or measure for their research. For example, (Creswell & Miller, 2000) suggest that the validity is affected by the researcher’s perception of validity in the study and his/her choice of paradigm assumption. As a result, many researchers have developed their own concepts of validity and have often generated or adopted what they consider to be more appropriate terms, such as, quality, rigor and trustworthiness (Davies & Dodd, 2002; Lincoln & Guba, 1985; Mishler, 2000; Seale, 1999; Stenbacka, 2001). (Nahid, 2003)

Hence, as a qualitative researcher, I am free to define my own research validity. For theoretical data collection, I will predict the subject area and study the subject for the sense to find some arguments for the approval of the result. Any argument in the research study will be based on the predefine text of the other authors. The result will be compare to the fact describe previously by the other authors. I will also define sampling method for collect empirical data. Empirical research will be done for the verification of theoretical data.

### 2.6 Result presentation method and referencing technique
The result of my research study will be presented in written form. To facilitate understanding, and to make the presentation easy to grip for the reader, sometimes, I also use figures, but in this presentation, may be, I will also present some videos for understanding the problem area of the research.

In the thesis I am using the Harvard system for references. It means that I indicate author’s surname and publication year within brackets when referring to a source in the text. The reference is placed before the period in a sentence, if it concerns just this specific sentence, and after the period if the reference concerns more sentences or a whole section. When the reference is placed in the middle of a sentence, it concerns only the beginning of the sentence.
3. Theoretical study

3.1 Key concepts

The key concepts of my research are collaborations, co-designing, virtual community, system thinking, information system and computer supported cooperative work (CSCW).

**Collaboration:** Collaboration is a process, in which two or more than two folk work together to solve a problem. Cross-unit collaboration takes place when people from different units work together in cross-unit teams on a common task or provide significant help to each other (Morten, 2009).

**Co-designing:** Recently, co-design is an up-and-coming area in the field of informatics, and it is a collaborative designing process which recruits designers, researchers, stakeholders and others together. The purpose of this collaboration is to solve designing problems. If we want to increase collaboration in a co-design process, we need to look at ways of increasing the efficiency of collaboration and also the means of enhancing enthusiasm for this activity.

**Virtual community:** It is a community where their members meet online through a virtual network while virtual network is the interconnections of many computers, through which people are capable of, exchange their information. The rapid development of accessible, reliable, and user-friendly information technology offers improvements to traditional collaboration, and makes new approaches possible. Many platforms for the exchange of information such as the Internet, email, and video-conferencing are well established aids to collaboration (Audrey, 2003). Therefore, I can say that collaboration in a co-design process will be increased through a virtual community as well as the information interchange will be increase.

**System thinking:** The process of understanding that how things are influences on one another within a whole system is called system thinking and co-design process is a tool use for developing system thinking.

**Information system:** A computer system capable of exchange information is called information system. My thesis will give an idea of creating an information system, in the form of virtual network software, through which all designers, researchers, stakeholders and IT expert can easily exchange information. For this purpose I will search different relevant virtual network soft-wares available in the market, and studying their characteristic to find a best solution for creating an efficient virtual network for a co-design process.
Computer supported cooperative working (CSCW): It evaluates that "how collaborative activities and their coordination can be supported by means of computer systems", as related to my research which investigate that co-design process can be supported by means of a computer system.

3.2 Subject areas relevant for the research

The following list of subject areas will be discussed in my thesis for the purpose of finding answers to my research questions.

1) Co-Design process
   a) Human behavior
   b) System thinking

2) Virtual network community
   a) Community
   b) Virtual community
   c) Human activity system
   d) Virtual network soft-wares
      i) VNC.
      ii) Team viewer.
      iii) Radmin remote access.
      iv) WallColler.
In the above figure 3.1, subjects’ areas are given in square boxes, and related questions numbers are given in ‘Q symbol’, which are attached with their respective subjects’ areas. The study of these subject areas will help me in finding relevant answers for my research questions.
Additional subject areas will be used for argumentation. The research consists of two main subjects are:

- Co-design process
- And Virtual network community

Before starting debate on creating a virtual network for a co-design process, it is necessary to provide some basic knowledge of a co-design process for build the understanding of readers.

To find relevant answers for the first question of my research, I must study the human behavior because the problem in a co-design process is arising due to the change of human behavior. A co-design is a development of system thinking. Therefore, system thinking will be included in the subject areas. System thinking study will give support in finding the answer of sub question 1 (Why do we need a Virtual network for a co-design process?).

The study of virtual network community will help me in finding the answer of remaining questions (What types of famous Virtual network are available now? How are the famous type virtual networks working? Can the available networks be modified for co-design processes?)

The investigation of different virtual network community soft-wares will be included in my research study because I want to find those aspects which are considered to be relevant for creating a virtual community for a co-design process. A virtual network community is a human activity system. Therefore, I shall also study human activity system.

### 3.3 Relevant literature resources

Different literature reviewed contributed in my research investigation are given below.

CSCW is a generic term, which combines the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques. Therefore, I have done a review of the book titled “Computer supported cooperative work” (CSCW) written by Paul Wilson. This literature is very closely related to my research investigation. It was published in Great Britain in 1991 by intellect books and then by Kluwer Academic publishers.

Group support systems (GSS) extended the concept of decision support system in form of a group shape, which is also related to my research investigation. There for I have taken a review of the book titled by “emerging information technologies” the book is about improving decision, cooperation, and infrastructure. It is written by Kenneth E. Kendall, and published by SAGE in 1999.
I have also done a review of the paper titled “Dialog-Labs: Creative dialog in co-design session”, written by Andrés Lucero and Kirsikka Vaajakallio. The paper is published in October 2009 on Ieeexplore.ieee.com. This paper introduces the dialogue-labs method, which allows researchers and designers to actively involve various people to test and generate ideas in the middle stages of the design process.

Collaborative Virtual Environment (CVE) is a multiuser virtual environment that supports distributed collaboration. CVE is also related to my research investigation therefore, I have also done a review of the paper written on this issue. The paper title is “QoS-based adoptive access control in collaborative virtual environment”, written by Jiming Chen in School of computer science and telecom engineering Jianhsu University Cnina. The paper was published by Ieeexplore.iee in 2008.

I have also found some material relevant for our research on the internet using search engine of Google and Yahoo. Examples of some praises that we have uses are; Co-design process, Virtual network community, Collaboration, System development, CSCW, Human behavior, Virtual network soft-wares, Group supported system (GSS), cooperative working, technology base group etc.

I have used book.google.com for finding relevant definition, and references of these books are given in the references section of the thesis.

### 3.4 Previous research

Various researches on human behavior, system thinking and the effect of virtual community over society or people, can give an important contribution to the theoretical study of my research. The central scientific area of study is facilitating a co-design process through virtual network. (Lind, 2005) has stated that C Wes Churchman was one of the first thinkers that recognized the importance of co-design. He developed a knowledge philosophy (systems thinking or the systems approach). The basis for his philosophy is that we can look at the world or reality in a number of different ways and that the views can differ depending on the level of detail. It is important to notice that it is the viewers who design the views, and the individual is thus active in the process. It is important to notice that since co-design actually is a perspective, it cannot be described as the truth. Instead we can look at it as “one possible design”. Further Lind stated that the artifacts can be used to express the perspectives. In a virtual community the computer can be
seen as an artifact that mediates and communicates the different perspectives of individual members. In relation to the perspectives expressed by Arvola it can be argued that autonomy of the computer may change existing perspectives and contribute to the new activities (Lind, 2005). In this thesis my perspective is to create a virtual community for co-design process which integrates many subject areas like virtual community, virtual network soft-wares, human behavior and system thinking.

(Hui & Lei, 2008) have stated in their survey that pure physical utilities from virtual activities is much higher that from the real world, and virtual world is more attractive, and can meet the demand of all kinds of people. As co-design is relatively a new subject area in the field of informatics, but it has been developing very fast in many businesses and system development process for the past few years ago. Until the co-design process has been done in the real world, but it may possible to take advantage of co-design process, if it is implemented through a virtual network.

(Wright, 2006) stated that collaboration was an effective strategy in finding unique solutions to complex problems. (Carlile, 2002) argued that productivity increased when two different set of knowledge collide. This could be interpreted as showing that problem restructuring activities can also be supported through user designer collaboration. These authors indicated that user-designer collaboration can be implemented more effectively if the mechanisms of user-designer collaboration are better understood.

Here the problem is that most designers are aware of the importance of the co-design process, and have implemented co-design process as a way to access users’ latent needs during the early stage of the product development process. However, they have not developed strategic views of how a co-design process could be implemented as a design method. Therefore, identifying the co-design mechanism between the users and the designers during the early stage of the product development process was needed, and my research investigation (An approach to create a virtual network for co-design process) is bestowed for designer, as they can take advantage of it. (Ker & Buur, 2002) pointed out that in traditional user-centered design approaches, the researchers were kept at a distance in order for them not to engage in interaction with the users. Passive objectivity, therefore, has been widely accepted among user-centered design practitioners. However, (Buur & Bagger, 1999) argued that a passive attitude toward direct dialog with users sometimes impedes better understanding of the users’ context. Therefore passive objectivity should be understood as a strategy for encouraging the users’ active participation in the generation of design context.
3.5 Virtual network Software for a co-design process

3.5.1 The Co-design process

A co-design process is an inclusive, co-operative, encompassing collaboration and community design among others (Taylor & Francis, 2010).

In a co-design, there is an understanding that all human artifacts are designed for a purpose. But in a co-design, one tries to include those perspectives that are related to design in the process. It is generally recognized that the quality of design increases, if the stakeholder’s interests are considered in the design process. (Albinsson & Lind, 2007)

Defining the concept of a co-design in a few words is very dificult. therefore, I am write down a story of co-design for the beter understanding of readers. The story has been taken from youtube video, shared by www.thinkpublic.com .The diagrams used in the story, are the screen shots taken from the video.

The story of co-designing

Welcome to the PANDA Island, It is a peaceful Island the sun shine on one side, but there is one smooth problem, the people living in north side and the people living in south side can not visit each others because it is a long distance and easy to get lost.

Figure 3.2 (Thinkpublic, 2009)
For removing this problem, a meeting was fixed, who decide to establish a bus service from north to south.
The bus was designed on the demand of stakeholders (the people who are using the bus service). The bus was design according to the need of stakeholders.
The bus service was established according to the tough time table of the stakeholders because there were different stakeholders that using the bus service according to their employment scheduling.

But now, 10 years has passed, new stakeholders has joined the bus services, and the bus service did not fulfill the requirement of the new stakeholders.
Now it is the time to change the bus service to carry out the demand of all stakeholders.

So they decide that there is no need of management consultancy. The designing of new bus needs experience people, and experience people are the stakeholders that using the bus for 10 years, and they better know what is need to be change in the bus service.
Co-design is about capturing a lot of different perspective inside experiences, and it is a best solution of using innovative and creative techniques. So they organize an environment that a lot of people (Those who want to use the bus, those who are currently using the bus and those who are earning from the bus) comes together to express their opinions, and the bus design will be taken. (Thinkpublic, 2009)

![Figure 3.6](image)

The above people are the participator of this co-design workshop, and their participation had added some value to the bus designing process.

1) Marry living in south, but she wants to go to north for play card, because the club is situated in the north. She is using her wheel chair, and there is a problem for him to travel in the bus, because there is no place for arrange the wheel chair in the bus.

2) There are many school children living in north, but their school is in the south, and they always reach late to their school, because of weak services of the bus.

3) Peter goes to Sunday market to bring goods, but there is a problem for him to bring these merchandises as there is no proper place for keep the merchandises in the bus.

4) Darkey is a professor of Panda University, and he has 10 year experience of using this bus, and better knows what must need to be change in the bus services.
5) The driver driving the bus for 10 years and he has a lot of experience.

Hence, a lot of perspectives are collected from different participators, and bus designing has been taken on the expectations of the stakeholders.

Figure 3.7 (Thinkpublic, 2009)

But when they talked about Mary wheel chair, they design to fit a ramp in the bus that she can easy enter it into the bus.

Figure 3.8 (Thinkpublic, 2009)

When they talk about Peter, they put a rake on the roof of the bus that he can easily place their merchandises on it.

Figure 3.9 (Thinkpublic, 2009)
When they talk about school children, they decide a different path for bus services to make the delivery of students possible at the exact time.

Figure 3.10 (Thinkpublic, 2009)

Hence, a bus service was design on the demand of all stakeholders. All people are very happy and enjoying the bus service with a great pleasure, and this is the definition and advantages of co-design process which makes the problem easy to handle it.

Figure 3.11 (Thinkpublic, 2009)
Co-design involves a high degree of collective thinking where every participant has his or her own mental model as a background for the ideas that come into mind. If the numbers of participators are greater, more ideas will be integrated. As the activity goes on, the mental models of the participants will change and improve the development, and in some degree adapt each other. Most of the time, the participants are not aware of the shared patterns of thinking or the role that thinking will have on the creating of the design they are about to achieve. Co-design is very rapidly going to implement in many business areas like mobile hardware software co-designing. Recently co-designing is very famous for urban relocation. One idea behind co-design is that different perspectives should be present and, thus enrich the view on the problem area.

A co-design workshop is also called dialogue-lab. A co-design dialog-lab consists of various types of experienced participators. According to (Andrés & Kirsikka, 2009) each dialogue-labs session involves researchers who act in a double role of facilitator/designer plus end-users. The end-user participants are experts in the specific domain that is being studied and have ideally participated at previous stages in the research, thus providing the knowledge of the current situation and the future possibilities. Although dialogue-labs were initially conceived to involve end users who were also designers, we have also explored expanding the method to involve everyday people and other stakeholders in the design process (i.e. research and industry partners).

### 3.5.2 System thinking

Co-design is a development of system thinking while system thinking is the process of understanding that how things are influences on one another within a whole. C. West Churchman has added a sentence in the development of system thinking that "begins when first you view the world through the eyes of another" (Churchman, 1968).

An ecosystem is a natural system consists of various things such as water, air, animals and plants. These things work together to survive or perish. In an organization a system consists of people, structure and process that work together to make an organization strong and healthy or unhealthy. System thinking is an approach to problems solving, by viewing problems as part of an overall system. System thinking is not only a single thing, but a set of complex framework of habits or practices that is based on the belief that the component parts of a system can best be understood in the context of relationships with each other, and with other system, rather than in isolation. (Minneapolis, 2010)

A system having specific boundaries which are decides by their perspectives. The world is a collection of systems which are interrelated with each other through some extent. If a system has subsystem then it may be also a child system of another super system.
Each system having different nature, purpose and levels, and their components are decided due to their purpose. Energy, material and information flow among the different elements composed the system. The output of one system may be the input of another system. A system is a community situated within an environment.

Co-design is a set of theories, practices and studies that actively engage the end users or stakeholders in the design process to help ensure that the product meets their needs. It has been used in urban design, architecture, landscape architecture and planning as a way to create environments that are more responsive and appropriate to their inhabitants and users’ cultural, emotional, spiritual and practical needs (Sanoff, 2007). Recently the resulting knowledge and philosophy have been transferred into the fields of industrial system design and information technology. Early co-design literature emphasize on the development of tools and methods of participation; workshops, games and prototypes. Co-design has branched into diverse trajectories, influenced by political, socio-economic and cultural factors. Europe (especially Scandinavia) and the US (Puri, 2004) have developed quite different participatory design approaches. Based on (Asaro, 2000), the participatory tradition in Europe, especially in Scandinavia, was developed with a strong emphasis on democratization of the workplace. While the other trajectory of co-design approach, which was developed mostly in the United States and the United Kingdom, focused on users’ knowledge of work processes to improve the usability of end products.

The universe is a collection of systems which are connected with each other and each system having a specific perspective. Hundred and thousand of researcher tries to create new systems for the development of human life. As a researcher, I try to develop a system in the form of a virtual environment, in which designer and stakeholders share their knowledge with each other, but co-design process is not an ordinary system. In a co-design process, we combine the ideas of different people who provide a way of thinking for the development of a new system.

3.5.3 The Human behavior
There are many kinds of systems around humans that have been rapidly sophisticated by remarkable advances in information technology such as a computer, Internet technology, software and so on. This progress of information technology not only makes advanced and complicated tasks possible for a human, but also improves the quality of our daily life. However, humans need to acquire enormous knowledge and skills to operate the systems effectively in order to receive their benefits. Due to this reason, humans need to understand their characteristics and adapt to them. Moreover, the systems perform only schedule processes, thus, they cannot satisfy a person's requests adequately because personal characteristics such as his intention, habit and preference are not considered in the systems. Therefore, systems which give suitable support to a person have been desired in recent year, which means the systems adjust their behavior to the characteristics of the person.
There is no doubt that the Internet is a wondrous creation in recent world. The entire world is rapidly becoming fanatical with it. Whenever you look, you're bound to see something related to the Internet. Many business organizations take full advantage of the internet such as online banking, job seeker, ticket seller, movies sellers and others. Due to the increasing advantages of internet and virtual networks, the human behavior has also been changed. The main purpose of the internet is to provide communication. Internet has reduced the communication difficulties, and the whole world acts like a global village, we can communicate in fraction of a second with a person sitting in the other part of the world. Due to Email facility, we can chat for hours with our loved person. According to Charles H. Zastrow and Karen K. Kirst-Ashman, if a sales person knows that how to motivate people to buy a certain product, he or she can then structure the sales pitch around this focus. If a social worker knows why a father is abusing his child, the social worker then knows that has to be changed to stop the abuse. If a mother knows what discipline techniques will be effective for her children, she is then better prepared to curb unwanted behavior in her children (Charles & Karen, 2008). The primary framework of the human behavior and social environment text is to provide theoretical background for the understanding of readers. Hence if a person can say that what is the need of virtual network for a co-design process then I can say that the environment has been changed due to wonderful innovation of informatics. Therefore, a change has also been seen in the human behavior. In a co-design process, a designer need the priori knowledge of stakeholder, and it is seem feasible for stakeholders to use a virtual network instead of physically participate in a co-design workshop, and it is the nature of human to adopt those methods which are easy for him.

There are numerous types of human information behavior, but in my research I will deal with “information use behavior”, consists of the physical, and mental acts involved in incorporating the information found in the person's existing knowledge base. Therefore, it may involve physical acts such as marking sections in a text to note down their importance or significance, as well as mental acts that involve, for example, comparison of new information with existing knowledge.

### 3.5.4 Virtual Network

A virtual network is an interconnected group of networks (an internet) that appears as one large network to the user. Banyan Systems, creator of VINES, which stands for VirtualNetworking System, defined virtual networking as "the ability for users to transparently communicate locally and remotely across similar and dissimilar networks through a simple and consistent user interface." (Ziff, 2010)
A virtual network is a collection of interconnected networks (internet) that appears as a single network to the user. A virtual network provides facility for a user to communicate locally or remotely across similar and dissimilar networks. A virtual network provides a simple and consistent user interface. A Banyan system was founded in 1993 by David C. Mahoney. Banyan system creates VINES (Virtual integrated network service) for the first time. A VINE was a computer network operating system that sets protocols for network.

A virtual network is a computer network that uses a public telecommunication infrastructure such as the internet to provide remote individual users or offices with secure access to their organization’s network. The purpose of virtual network is to avoid an expensive system of owned line that can be used by only one organization. Following is a simple diagram of virtual network which shows that virtual network consists of a head-office in which we install and configure virtual network server software which might be provided by different software industries like Microsoft, VMware and others. The client system must install the virtual network server-access-software.

![A virtual Network structure](Ludovic, 2010)

A short description of virtual network was given for reader understanding, since my aim is, that how a virtual network can facilitate a co-design process. A virtual network forms a virtual community for a co-design process which might also be called a virtual co-design process community. Hence for understanding virtual community it is better to know that what a community is.
3.5.5 The Community

The concept of community has been analyzed in the sociological tradition, and its origins can be traced to Hobbes, which meant that social relations are developed as a mean to avoid chaos and to establish order. A model for this was the contract which legitimated the social relations. The concept of contract was later replaced by “community” (Skirbekk&Gilje, 2001).

Community use to characterize many different groups. (Hamman, 1999) The group could be seen as a place for people to share their thoughts and experiences. In our daily life the term community is used in a number of contexts and each has an explicit meaning of the word. The community is for example used to illustrate cities and buildings, but also a feeling of that a group of individuals have something in common. The use of the term in our everyday language is thus one source of the ambiguity. Another trouble is the fact that the phenomenon or social construct that the word refers to be dynamic and changes over time. The sense of the word community depends on the context, such as for example who the sender is, and what the specific purpose of the action or message.

Durkheim has observed some changes in communities during the transition from rural agricultural societies to urban industrial societies. In the first type of society the meaning of community is connected to kinship relations and geographical closeness whereas in the second type of society, the base consists of a common interest as well as geographical closeness. For Marx the basis for a community is dominated by economic relations and is formed according to class. Later in the second half of the 20th century, the word community would stand for a group of people interested in a specific cause. (Hamman, 1999)

Hamman (1999) concludes that the allusion of this is that the word community must be defined in every document that describes the phenomenon. Otherwise the term will be useless (and non-scientific).

Hamman (1999) suggests that a community includes four parts:
"(1) a group of people (2) who share social interaction (3) and some common ties between themselves and other members of the group (4) and who share an area for at least some of the time."

A number of questions arise in this definition such as for example how long a member must share an area in the group, and how frequent and deep the interaction must be, but the definition still seems vigorous for the communities that are significant for this study.

Hamman (1999) also states that recent communities are more privatized than previous, which mean that communities take the form of networks. Network communities are often based upon individuals.
A community is thus developed through the forming and maintaining of interpersonal relationships between the individual members, but what is it that initiates the process? Clark (1999) means that the individuals must be convinced by someone or in another way discover the added value that can be created if the individual is part of the human activity system, the community. This can be done by previous members or by an establishment (Authoritative) imposing demands that must be met.

### 3.5.6 The Virtual community

A community where their members meet personally in the real world and other communities are organized to allow their members to meet in cyberspace. This kind of community is called a virtual community. When we are talking about virtual community, it means that we are focusing on electronic communication.

The concept virtual community may be defined as a social cluster of interconnected computer networks where a sufficient number of people can publicly exchange ideas long enough and with a sufficient level of human emotions involved to allow personal relationships to emerge in cyberspace (Rheingold, 1998). The definition thus stresses on both cognitive and affective components. The definition is ambiguous about “sufficient number of people” and “long enough” with “sufficient level of human emotions”. These levels may however be related to the transformation that should be sufficient for an added value to be created. For the purpose of this study, I will regard a virtual community as an organized social group of people or organizations where interactions between the members are performed through a computer network. The purpose of the interaction among members is to exchange ideas and share solutions.

An important difference between virtual and physical communities is related to communication. Goffman (1963) stated that normally communication boundaries exist around communicating group of people. It is easy to recognize such boundaries in a physical environment where for example a few people are engaged in a discussion. But there are no such boundaries to regulate communication in virtual communities.

A great advantage with a virtual community is the interaction between participants with a common interest will contribute to an environment where creativity and innovation flourish (Blunt, 2003). An important reason to shape a virtual community is thus to exchange and take advantage of each others’ knowledge. But there could also be other reasons such as for example to prevent the unsuccessfully that occurs when many people work with the same inventions. Sometimes it is also important to guarantee that information is distributed to the right recipients. This will also at the same time keep hold of the information within the community even if one participant decides to leave it.
When the content in the community is created by the members, some additional advantages will arise, for example

- It attracts new members
- It will create loyalty among the members through the efforts put in by the members
- Customization will discourage members from moving to another virtual community

There are of course many factors that influence the success of a virtual community. First it is important that the participants have a common goal. This will ensure that the members work in the same direction. In a virtual community it is also important that the individual members experience an added value from their participation in activities, and interaction with the other members. They must, thus be encouraged and realize the benefits for themselves as well as for the community as a whole. (Rowe, 2004)

The interaction in the virtual community must also be organized in an effective way and the members must therefore accept at least some degree of management of their ideas and thinking. There are two possibilities to organize the activities in the community. On the top-down approach a center is first established which will influence the information sharing in the community. At the bottom up approach individual collaboration between different members are supported to form a knowledge sharing virtual community (Forsgren, 2004).

Some important skills are required to organize a virtual community. It is necessary for the organizer to possess ability to aggregate members, retain them in the community over time as well as to encourage them to interact with other members in the community. (Hagel & Armstrong, 1997)

### 3.5.6.1 Solutions Sharing Network

One platform for virtual communities is Microsoft’s Solutions Sharing Network (SSN). The network has been created to allow public-sector customers to share knowledge during the entire system development life cycle from project inception to the evaluation of a finished project. At the same time SSN will encourage increased collaboration among government organizations and other actors such as academic institutions. (Microsoft, 2005)

The SSN consists of (Microsoft, 2005):

- A web-based platform allowing secure access to hosted data and solutions. A community and collaborative environment facilitating the sharing and enhancement of government solutions. A mechanism for searching, rating, and cataloguing solutions and projects.
- An open forum for partners to contribute and showcase their solutions and capabilities.
SSN has so far been successfully used by numerous different organizations from the public sector such as for example national, regional and local authorities along with universities. The SSN platform provides a possibility to store easy accessible knowledge that can be used, and developed by the different members of the community. Knowledge sharing is thus facilitated, and time and costs are reduced. It is also possible for universities, and other research organizations to use SSN for research about the development of open applications.

In a SSN there is a need to create trustworthiness, and therefore, it is necessary to promote good solutions. At the same time the community must also encourage diversity for alternative solutions and innovations to occur. Once a solution is found the work should always continue trying to find a better solution or improvements. (Rowe, 2004)

3.5.7 Virtual network soft-wares

a. VNC (Virtual Network Community)

VNC is a remote control software which allows users to view, and fully interact with one computer desktop (the "VNC server") using a simple program (the "VNC viewer") on another computer desktop, anywhere on the Internet. The two computers don't even have to be the same type, so for example you can use VNC to view a Windows Vista desktop at the office on a Linux or Mac computer at home. For ultimate simplicity, there is even a Java viewer, so that any desktop can be controlled remotely from within a browser without having to install software (Real VNC, 2010). VNC is in widespread active use by many millions throughout industry, academia and privately. There are several versions to choose from; including a free version and some substantially enhanced commercial versions.

VNC is remote desktop sharing software which can be used to establish a virtual network, by install VNC server on a server computer in a centralized area, and VNC viewer on any client computer. It doesn’t matter; the server computer has one operating system, and the client computers have another operating system. VNC is free source software; you can see a Windows desktop on a Linux, UNIX and Mac operating system and vice versa. VNC also have a Java viewer, it means that you can access VNC server desktop through a simple web browser without install any VNC viewer software.
For the individual user, one common scenario is using VNC to help troubleshoot the computer of a distant less-technically-savvy relative. In other words, sitting at your desk in Baltimore, you could use VNC to take control of your relative's PC in California and show them how to install and use some new software package by actually doing it yourself. (Real VNC, 2010)

A person setting on one place and can remotely see the desktop of another person can help him a lot in his work and this is the main finding of my research. If a person doing designing on his computer and other person or stakeholders can see their work then he/she can give him ideas very easily.

A very common business application of VNC is remote system administration, where it is used to allow administrators to take control of employee machines to diagnose and fix problems, or to access and administer server machines without making a trip to the console. VNC can also be used to provide a flexible hot-disking and road-warrior environment by allowing employees to access their office desktop and server machines from any machine in the company's offices or from other remote sites, regardless of the type of computers involved at either end (Real VNC, 2010).

If a VNC has a business application of remote system administration then it can also helps us in a co-design process. In co-design process a number of stakeholder are involve in writing stories, making flow charts and other designing related things. So an administrator as a designer's tutor or guider can easily access their client’s computers, and can help him in their designing projects.
VNC Viewer enables you to take remote control of a computer from your iPhone, iPad or iPod touch. View the desktop, run applications, change settings, and access data exactly as you would be permitted to do were you sitting in front of the computer, and using its keyboard and mouse. (VNC Viewer for iPhone, iPod and iPad, 2010)

![Image of VNC viewers on iPhone, iPad, iPod](image.png)

**Figure 3.14 VNC viewers for iPhone, iPad, iPod (Real VNC, 2010)**

If a VNC viewer having application for iPhone, iPad and iPod, it will be easier for the designer to view their desktop, run application, change the setting and edit their design project from anywhere as he got an idea from the stakeholder.

VNC is widely used in educational contexts, for example to allow a distributed group of students simultaneously to view a computer screen being manipulated by an instructor, or to allow the instructor to take control of the students' computers to provide assistance (Real VNC, 2010). As I have already mentioned in the author experience section in chapter 1 that when we were taking the training of Linux network administration in Pakistan our Linux tutor will use a VNC server and we all students connect with him through a VNC viewer.

If we add an extra feature of text, video and audio with VNC software then a virtual community for a co-design process is possible.

b. **Team viewer**

Team Viewer is an excellent screen-sharing and file-transfer application that can be used to facilitate business collaborations, remotely access a second computer, or helps distraught relatives diagnose and cure computer problems. Along with being free for non corporate use, it gives users precisely the tools they need to share screens securely, send files with a minimum of hassle, control access rights, and even flip which the user has control. (Seth, 2010)

A Team viewer is desktop sharing software used for facilitating business collaborations. Both users must install the team viewer software, and both will have equal access control because
there is no concept of server and client, and free for non corporate use. I think this software cannot facilitate a co-design process well because it gives equally facility to each user while in co-design process; there are different levels of users. The designer and stakeholders are not equal participate in the designing process.

c. WallCooler VPN

Vedivi makes remote working for individuals easier than ever: access remote files, applications, or network resources from anywhere. All Windows based applications are supported no need to use special applications or synchronize files. MS Outlook, Remote printing, Windows File-Sharing, Windows Remote Desktop, or Remote assistance are only few of the applications you can use locally. Vedivi is also ideal for SMBs. Users can remote access an organization's databases, e-mails, remote desktops, product catalog from anywhere. No need for complicated Internet security infrastructure. Vedivi sets on your local company network, uses your existing Internet connection and automatically manages incoming connections via relay servers. (Vedivi, 2010)

Wheelchair can remotely access other's computers. There is no need to install a special application for access windows applicants. It is a Virtual private network and use in a single organization. User can access the organization's database, e-mails, remote desktops product catalog from anywhere. The network works very efficient for a business organization, but the software cannot be used efficiently for designing purpose. As co-design process is a broad phenomenon, is a development of system thinking, which needs the participation of many stakeholder. So it seems difficult that this virtual community software will work better for a co-design process. Another drawback of WallCooler is that it only works on windows platform.

d. Radmin Remote Access

Radmin (Remote Administrator) is fast and secure remote PC access software that enables you to work on a remote computer as if you were sitting right in front of it and access it from multiple places. Radmin includes full support for Windows 7 (32-bit and 64-bit), file transfer, multi-user text and voice chats, Windows security, and Kerberos authentication, 256-bit AES encryption for all data streams, telnet access, multiple monitors support and unique Direct Screen Transfer™ technology. Radmin utilizes the ever-present TCP/IP protocol - the most widespread protocol used in LANs, WANs and the Internet. This means you can access remote PC from anywhere in the world (Famatech, 2010).
Redmin remote control software includes many features like highest security level, the highest speed of work, and Hardware remote control with Intel AMT support. Full compatibility with windows 7, provide text, audio and video chat, Easy to use, Secure “Drag and drop” file transfer with “Delta copy” feature, Multiple connection support and free technical support. It utilized the most widespread TCP/IP protocol used in the Internet. One feature of Radmin which is very necessary for a virtual co design process is text, audio and video chat.

As long as you have a microphone and speakers or a headset, you can use your computer for personal and conference calls via Radmin Communication Server Voice Chat. Just like Text Chat mode, Voice Chat provides a common General channel and multiple user-created channels. Once connected, a user can immediately start speaking and be heard by all who are joined to the General channel (Famatech, 2010).

In a virtual co-design process, it is needed that when one user start speaking the other connected persons must heard it because it will generate new ideas in the mind of hearing persons, and that is the characteristic of a co-design process. But the drawback of Radmin system is that it works on a unique platform. There is no Radmin viewer for iPhone mobile and iPod or iPad users. Radmin only works on windows operation system and in the case of a co-design process, it may possible that the stakeholders are using a different operating system like UNIX, Linux, Mac and others.

3.5.8 A virtual community as a human activity system
A virtual community can thus be regarded as a human activity system. Checkland (1999) presented a theory to explain a human activity system which can be summarized by the acronym CATWOE.

Checkland’s CATWOE model

- **C** = Customer, who is the person or the organization that will benefit from the activity
- **A** = Actors, who are the individuals involved in the activity.
- **T** = Transformation, which defines input, output and main processes necessary to describe the system
- **W** = Weltanschauung (= world perception, the perception of critical concepts related to the activity)
- **O** = Ownership, that is the organizational body that has the ultimate power and ambition to continue the activity
- **E** = Environment, the factors in the surrounding world (context) that could influence the activity.
The computer system is an important part of the human activity system in the context of knowledge creation for designing a system in virtual communities. We can get the following result if we take Checkland’s CATWOE model as a base for analyzing a virtual community.

**Customer:** The customers in a virtual community are the designer (In my case Co-design process) that can take benefit from the activity.

**Actors:** The actors in a virtual community are those who are involved with the transformation process, in my case the creation of knowledge for system thinking. Therefore the actors are also individual members. The actor can be a researcher, a designer or a stakeholder.

**Transformation:** Transformation is a question of input, output and the processes that transforms the input to output. In my case input is the priori knowledge of stakeholders, output is the new created knowledge and the processes are related to the social interaction between the members in the community. It is the transformation that creates the added value in the system. The processes taking part in the activity depend on the different roles that the participants will possess.

**Weltanschauung** (world perception): This aspect relates to how the individual members in the community perceive critical concepts related to system thinking. Such aspects could for example be the nature of the system.

**Ownership:** those who has control of the processes in a virtual community, and has the ultimate power to continue the activities since the community is formed and controlled by its members, or at least a group among the members, they are also the owners.

**Environment:** Environmental factors are related to the perception of the concept context. One important aspect of the environment is that the interaction takes place in a virtual world. The specific environment of a virtual community is created through social interaction where a computer system is used to link the members together. There are thus, specific properties of that system to consider. There are also environmental factors that include the relationship between the virtual community and the outside world. The community has a need to establish trust and credibility in its relation to other parties.

In virtual communities the owners, actors and the customers are thus at least partially the same group of people. It is possible that this can have an influence on the motivation of the individual members of the virtual community.

### 3.6 Summary of the theoretical study
Through theoretical research, it may be summarized for the answer of research sub question (1) that passive communication is more understandable than active. Passive objectivity should be understood as a strategy for encouraging the user active participation in the generation of designing context, and the Internet is the best example of implementing passive communication. It has been stated that environment changing has a greater effect on human behavior, and there is no doubt that the Internet is a wondrous creation in recent would. Therefore the need of virtual network for a co-design process might also be seen. Co-design is a collaborative activity, and the efficiency of collaboration has great effect on the efficiency of co-design, and it has been discussed that collaborative efficiency increase with virtual communication. Co-design is a development of system thinking which needs high degree of thinking. System thinking needs large numbers of perspective which is possible through a virtual network. Following are some common advantages of virtual network for a co-design process.

- It is easy to exchange and take advantages of other’s knowledge
- It can attract new members very easily.
- Remove distance problems, as the international members can also participate very easily.
- It reduces risk, as the risk divide among all members.

To find relevant answers for research sub question two (2), I have sought different virtual network softwares in order to find such virtual network software which will appropriated for a co-design process. Through theoretical research, I have found four relevant virtual network softwares which is list bellow.

- Real VNC
- Team viewer
- Radmin Remote access
- Wallcoller

For finding the answer of research sub question three (3), I have deeply studied the above virtual network soft-wares. I have found that Real VNC is used in classes for teachers and student cooperative work. All students in a class send a request to their tutor to share the screen. The tutor accepts their request. At the result, such an environment is created, in which all students are feeling that they are working on same computer. Team viewer is mostly used for personal home computer screen sharing. Radmin remote access software is used for network administrating purposes. Similarly wallcoller is also a screen sharing software used in various organizations for virtual group meeting.

To seek relevant answer of research sub question four (4), I have studied the characteristic (feature or aspect) of the above chosen virtual networks. While study their characteristics, I come to the point that two virtual network soft-wares (Real VNC and Radmin) are appropriated for a co-design process, if we combine the characteristics of Real VNC and Radmin in a single virtual
network software, because both having some powerful feature which is related to the activities which always happen in a co-design workshop. Virtual network software provides a virtual community, and virtual community is a human activity system. Checkland’s CATWOE model for human activity system could be used as a base for analyzing a virtual community system.

3.7 Arguments for an empirical study

The purpose of the empirical study is to search evidence for the answers of the research questions that has been found in theoretical research. Due to theoretical research, I come to know that what types of questions, I will use in the interviews, and what pattern, I should use for observation. I also come to the point that what sampling pattern, I will use during interviews. My research investigates virtual network software for a co-design process. Therefore, I will use such sampling for my empirical survey that will be affected by a co-design process, and also having some knowledge about virtual networks.
4. Empirical survey

4.1 Purpose of empirical survey

There are various types of researches, some base only on theoretical sources while other base on both theoretical and empirical sources, as my research base on theoretical research as well as on empirical research. Therefore the data, that I have been collected through the theoretical research must be approved through empirical research. The word empirical denotes information gained by means of observation, experience, or experiment (Houghton Mifflin, 2000). The term empirical survey refers to the method of working that is testable using observation, interview or experiment. (Thomas Kuhn, 1970) has promoted the concept that these methods are influenced by prior beliefs and experiences. So it cannot be expected that the two scientists carry the observation or experience of the same event will make the same theory.

As the answers of the research questions were found through theoretical study, but due to empirical research I will verify these answers. Here it may possible that my mode of thinking for creating a virtual network for co-design process might not be similar to other person mode of thinking. I am expecting that I should receive many different ideas from various people and these ideas would help me in analysis.

4.2 Sampling

Sampling is an act or a process of selection of population or a group of population, from which we collect empirical data. If researchers select a sample for collect empirical data then he/she can gather needed information more rapidly. E.g. suppose you are a Doctor and a disease has broken out in a village within your district, the disease is contagious, and it is killing within hours, nobody knows what the disease is. You are required to conduct quick tests to help save the situation. If you are trying to do a survey of those affected, there may be long dead when you arrived with your results. In such a case just a few of those already infected could be used to obtain the required information. It has been discussed in chapter two (2) that I am using qualitative method in my research investigation which base on hermeneutic perspectives and it has been also argued in chapter two that qualitative researchers define their own validity for research finding.

My research investigation is about creating virtual network for a co-design process which depends on such sampling plan that criticized because of difficulties to evaluate the precision of judgment and how does a person determine that the element was good or bad, effective or ineffective. I will use this sampling method for achieving empirical data. My research
investigation is about a new phenomenon which gives value to an existing technology. I shall use two methods for collecting empirical data that is the interviews and the observation.

4.3 The Interviews

Interview is a method of empirical research in which one person (interviewer) ask question from other person (interviewee). The interviewer meets with different peoples for taking their interview. Therefore it is necessary to do a proper preparation for it. The interviewer must plain their meeting style, communication style and must set a goal. In this purpose, first of all I made questions that I shall ask from interviewees. The questions are made on the bases of research question and purpose. Then I took printsof that question on papers. Then I decide the interviewee sample. I decided that I will ask these questions from those persons having knowledge of co-design process and virtual networks or at least one of these two.

Mostly, I took interviews of students because of more easily accessible to me. I start the interview in my own university (Hogskoln I Borås). I took a notebook with me to note the interviewee comments. Whenever I met to a student or a group of students, first I introduce myself, and then ask for his/their introduction. During the introduction, I come to know that he could or could not give me any information on my research investigation. If I knew that he is my desire interviewee then I give him an introduction of my research investigation, and ask for his cooperation (Participation). In many cases, I received very good response from the participators.

As my research is about co-design and many participants were not having clear information about co-design process. In such a situation, I encouraged him (that basically it is a new idea of designing), and explain a clear cut purpose of the co-design process. For develop the interest of interviewee, I was telling him some success story of co-design process. Later than so much interest of interviewee has been seen in the discussion. During interviews, new questions came in my mind which was asking from the interviewee. Before starting another interview, I try to make documents of the previous interview. I was kept the result of each interview in my diary because during the analysis I will need these interviews results.

Before starting my first interview, I felt hesitation because there was a lot of explanation in interview questions. But after doing a couple of interviews, I become daring as the interviewee took interest..

4.4 The First Interview

An interview was taken from a group of students. All were informatics students and having knowledge about co-design process. As they told me that they had not personally participate in
any co-design process, but have knowledge about co-design process through internet media. They told me that co-design process workshop has always arranged for a particular project, and the participants often take interest for their own purpose. The participants were mostly affected by that project through some extent. Therefore, there are so many people that are affected by that project, but cannot attain the co-design workshop.

People cannot participate in the co-design process having different reason behind it. Many people were busy in their jobs, and the co-design process time did not match with their free time. Some are out of the country or there are some transportation difficulties. The interviewees told me that the best solution for removing such difficulties is to create a virtual network for a co-design process. Due to which these people can easily participant in the process.

They suggested me to use a virtual network like “Radmin Remote Administrator” or “team viewer”, but they emphasize on “Radmin Remote Administrator” instead of team viewer because it can connect many people at the same time, and will work very efficient for a co-design process. It is very excellent in audio, video and text chat. If we modified it further for different platforms users then it will be more efficient for a co-design process because it may possible that the participant have using different operating system.

4.5 The Second Interview

Another interesting interview was taken from another informatics student. He told me that he knows about co-design process through internet media. He described that co-design process is a very interesting subject. People want to participate in it for their own purposes. As in a co-design process, the designer need the priori knowledge of each stakeholder therefore they want more participants while on the other hand there are some stakeholders how want to gain some knowledge from exporters. A Co-design process have a lot of advantages, it usually provides a new result. There are different companies making a product with same designing and same functionality. So, if there is a co-design workshop between these companies, and all the exporters of these companies participant in it, and discuss their ideas about the product, it may possible that the product adopt a new structure with a new functionality.

He told me that it is very difficult to arrange all the stakeholders in a single place because recently every company is in competition with another company. No business man has enough time to participate in such like activities. Therefore if a virtual network is created for them, it will be easy for him to participant in the process. There are many virtual networks in the market but
he preferred VNC because of different platform viewers. He suggests that if we add the functionality of audio, video and text chat then it may be possible for a co-design process.

4.6 The Observation

Observation has a different role in my study. During the whole research I was engaged with observation. I have also done an observation before starting the theoretical study which helped me in the selection of subject area. Then in Empirical study I did the observation with more attentively to find the answer to my research question.

It is necessary for observation that I must join a co-design workshop, but it was not possible here in Borås or in the nearest city. So for this purpose I collect some videos of a co-design workshop through the internet. I watched each video more than 3 or 4 times. In these videos, each co-design workshop was arranged for the designing of specific system thinking. There were some workshops whose participants were school children, and the purpose of such workshop was to discover a system for facilitating children life. Some workshops were arranged for rebuild the old system and the participant of such workshops were those people who had experience of that system for many years, but the main observation had done over two videos which are discussed below.

In May 2007, a co-design workshop has been arranged for the redesign of ‘Pacific Rim national park’ of Canada as a tourist place. As I have read the text on his website that they need the contribution of local and international people for structuring the park. The text is taken from the website: [http://www.pc.gc.ca/pn-np/bc/pacificrim/natcul/natcul9.aspx](http://www.pc.gc.ca/pn-np/bc/pacificrim/natcul/natcul9.aspx) *(Each individual of the local, national and international community has the ability to contribute the ecological integrity of Pacific Rim National Park Reserve of Canada. Parks Canada and the Nuu-chah-nulth First Nations are working together to achieve this goal and we need your help)*

I saw the video of this co-design workshop in which I observed that the participants were taken very interest in the designing process. Every onewants to express their ideas and opinions, and the designer wrote their ideas on the boards for the purpose that each participant clearly seen and aware about other participant's ideas and opinions. One other thing that observed in observation is that most of the participants were looking more than 50 year old. May be they are retire or jobless persons that having so much times for participate in such like activities. It was told by many participants in the workshop that so many times different and new thought of structuring
were comes in their mind when they visit the ‘Pacific Rim Park’ and they wanted to express their thought but couldn’t find such a proper place or situation (PointlessHysteria, 2007). So I came to the conclusion that there may be so many people working in offices and may be want to participant in such like activities, and want to express their ideas but don’t have enough time to participate in the workshop. As in the above text taken from his website they mentioned that the designers need the help of local and international people. But according to my opinions and observations if the local people do not have enough time to participant in the workshop, how the international people will participate in the process. So the best solution for this problem is to create virtual network. That the people can easily express and convey their ideas to the designer. In this video, I have also observed that designing material is very necessary in co-design process so, when we will modify an existing virtual network, must also add a feature of toolbox consists of designing material. I have also observed the importance of grouping (of predictors), therefore, we should also add the feature of grouping in the virtual network software. Following is the link of this video.

In another video, a co-design workshop has been established for the improvement of this Pacific Rim national park of Canada, and the participators of this workshop were nursery school children. From this video, I observed a new factor that the occupation of a beautiful views place is also valuable for a co-design workshop because it will stimulate the participators in the process, but the addition of such feature look slightly difficult in a virtual network. The video can be found here.

http://www.youtube.com/watch?v=EarqY99NqJ0&feature=related

My observation is limited to sub question 1 and 4.

4.7 Empirical research result

The answer of the research sub question 1 (Why do we need a Virtual network for a co-design process?) was found in interviews and observation.

It stated in the interviews that people want to participate in a co-design workshop for their own purpose, and there are many people want to participate, but can not participate due to the fallowing reason.

- Many people are busy in their jobs, and the time of co-design workshop does not match with their personal timetable.
- Some people are out of the country.
- Sometime international people also want to participate in the co-design workshop, but can not participate due to travel expense and long distance.
It is also observed from observation that people are want to express and explain their mental images, but could not find a proper place and situation. It is observed that the participators were aged, and look like retired or jobless person, and there are a lot experience employees working in various organization want to participant in a co-design workshop.

Hence, it is concluded that if there were a virtual network for a co-design process then the above problems can be solve through some extent.

The answer of the second sub question 2 (What types of famous Virtual network are available now?) was also verified. Through interviews, many participants told me that there are a lot of virtual networks available such as VNC, Team viewer, SSH, Radmin, WallCoolleretc. and people use it for different purposes. A very few interviewee also suggest that a co-design process is also possible through a dynamic website on which designer puts their ideas, sketches and videos. Participant will give comments on it and the process will be going on. It is stated in the first interview that Radmin is suitable, but in the second interview it is that stated that Radmin is suitable for maintaining a co-design workshop. I found nothing for this question in the observation because my observation has taken place in such a co-design workshop where there is no virtual network used.

The answer of third sub question 3 (How are the famous type virtual networks working?) was also verified through interview. As the pre mentioned virtual networks are used nowadays for different purposes. When two persons collaborate with each other on personal interest they often use team viewer, VNC is mostly use in classrooms for teaching purposes. Radmin is use for remote administration. SSH is also use for remote administration and for configure trouble shooting remotely. Like the previous question, I also found nothing for this question in the observation because my observation has taken place in such a co-design workshop where there is no virtual network used.

The answer of the fourth sub question 4 (Can the available networks be modified for co-design processes?) was also verified through interviews and observation. Some interviewee told me that virtual community for a co-design process will be possible if we modify Real VNC or Radmin Remote Access. Some interviewee told me that along with virtual network software, we also need to use a web page because there are so many people that may not be able to participate in co-design process at a specific time, and for such people it is better to provide them a webpage facility. Due to this web page they can be able to watch a co-design process videos and designing detail and whenever they want, can send their stories to designers. Some interviewees suggested updates in VNC softwaresuchas video, audio and text chat. While some interviewees gave prefer to Radmin and suggest updates in Radmin viewer such as compatibility of different operating systemslike Linux, UNIX, MAC, and a viewer for mobile (iPhone, iPad, iPod) user.
It is observed that designing material is very necessary for a co-design process, and the occupation of beautiful view full space is also valuable for a co-design process. It is also observed that grouping among participators is also very necessary for a co-design workshop.
5.  Analysis and result

5.1 Analysis

The importance of analysis is to create a deeper meaning from the collected data. I have chosen three methods for data collection that is text analysis, interviews and an observation. In this chapter, I will compare the data received through the theoretical research with the data received through the empirical research, and try to find relevant answers for my research questions.

Sub question no 1

Why do we need a Virtual network for a co-design process?

The answer of the first question was found in both the theoretical study and the empirical study. A long debate was done on sub question 1 in chapter (3) and here the concept arise that passive communication is more effective than active communication, the human behavior changes with the change of environment, and there is no doubt that the Internet is an incredible creation in the modern world. Whenever you look, you're bound to see something related to the Internet. System thinking needs large numbers of perspective which is possible through a virtual network. Fallowing are some common advantages of virtual network for a co-design process.

- It is easy to exchange and take advantages of other’s knowledge
- It can attract new members very easily.
- Remove distance problems, as the international members can also participate very easily.
- It reduces risk, as the risk divide among all members.

Environment has been changed due to the wonderful innovation of informatics. Therefore, a change has also been seen in the human behavior. In a co-design process, a designer needs the priori knowledge of stakeholders, and it will be feasible or easy for stakeholders to use a virtual network instead of physically join a co-design process, and it is the nature of human behavior to adopt those perspective which are easy for him. In virtual group participators take part individually, and this type of communication is more effective than others type of communication.

It also stated in the interviews that many people want to participate in a co-design workshop for their own purpose, but can not participate due to the fallowing reason.

- Many people are busy in their jobs, and the time of co-design workshop does not match with their personal timetable.
Some people are out of the country.
Sometime international people also want to participate in the co-design workshop, but can not participate due to travel expense and long distance.

It is also observed from observation that people are want to express and explain their mental images, but could not find a proper place and situation. It is observed that the participators were aged, and look like retired or jobless person, and there are a lot experience employees working in various organization want to participant in a co-design workshop.

Hence, it is concluded that if there were a virtual network for a co-design process then the above problems can be solve through some extent.

Sub question no 2

What types of famous Virtual network are available now?

The answer was found in the theoretical research with a lot of important documents. The answer was also verified through the interviews, as discussed in chapter four (4).

It has been investigated through theoretical research that the famous virtual network soft-ware that are available nowadays are team viewer, VNC (Virtual Network Community), Wallcoller, and Radmin Remote access. These virtual networks software are used for collaborative communication. The purpose of finding these soft-ware is to discover an appropriate virtual network for a co-design process because there is no virtual network for a co-design process.

According to empirical research, I found no answer of this question in observation because there was no virtual network used in the co-design workshop videos that I have used for observation, but through interviews it is found that famous relevant virtual networks are team viewer, Real VNC and Redmin Remote access. While searching the answer for this question, some interviewee’s suggested me that we can also use a social website like facebook and twitter. Some told me that they have been only using Skype for collaborative communication.

Sub question no 3

How are the famous type virtual networks working?
It was argued in the theoretical research that the most suitable virtual network for a co-design process is VNC, Radmin and team viewer. In the theoretical study, I have briefly described the characteristics of these virtual networks.

It has been sought through theoretical research as well as through empirical research that Team Viewer is an excellent screen-sharing and file transferring application that can be used to facilitate business collaborations, remotely access a second computer. It provides tools for the user to share screens, security, and send files, but it can connect only two people at the same time, and works only on windows operating system, and there is no available any kind of chat that is why it is not appropriate for a co-design process.

Another famous virtual network is Radmin Remote administrator, is fast and secure remote access software that enables one to work on a remote computer as if one is set in front of it and access it from multiple places. The software is only work on window operating system. It also provides audio, video and text chat but cannot fulfill the requirement of a co-design process.

Similarly VNC is also a screen sharing software. It works on many platforms (operating systems). It has also VNC viewer for mobiles (iPhone, iPad, iPod), and can connect multiple users at same. It does not have audio video and text chat which is very necessary for co-design process.

Nowadays Team Viewer used by two personal for personal communication and collaboration, Radmin has been used in business offices for computer system managements and network administration and VNC is used in classrooms for teaching purpose.

Similarly to sub question 2, I found nothing in observation for this question because this question is totally related to the virtual network and my observations have taken place in such a co-design process where there is no virtual network software has been used.

Sub question no 4

Can the available networks be modified for a co-design process?

During the interviews more discussion was done on this question, and I got a lot from the interviewees. Most of the interviewee point out two virtual network community software that is “Radmin” and “VNC”. The interviewees were confused that which software will be appropriate for a co-design process. During the interviews, some participants preferred me Radmin because of their experience of it, while others preferred VNC because they having the experience of VNC. It was found in the theoretical study that Radmin is very efficient in audio, video and text chat while on the other hand VNC is largely used because of its features, many platform viewers, and it was also proved through the empirical study. So from both the empirical research and the
theoretical study, I come to the point that virtual network for a co-design process is possible if we merge some feature of Radmin and VNC, and create new remote access software.

I took this decision because I found some new factor in observation while observation a co-design workshop. I observed that designing material is very necessary in co-design process. So we must also need to add a designing toolbox with this virtual network software.

Another factor that I have observed that grouping is very necessary among the participators. Therefore, we must add a feature that provides a facility of grouping among participator.

Trough observation I found that providing a beautiful and inspiring location is also valuable for a co-design process, but adding this feature seem difficult to me at this stage.

5.2 Result Summary

Here is the result summary of my research which is related to research questions. The data collectedthrough both the theoretical and the empirical study has been analyzed successfully. Co-design process is a designing process among others (Stakeholders). The efficiency of designing increase if the stakeholders interest is include in the design process, and for this purpose my research investigate a virtual network to facilitate a co-design workshop. Due to this virtual network more people will be able to participate in a co-design process, and the designer will receive more interesting ideas. We have the facility of internet media, and we should need to take advantages of it. While it has argued that passive communication is more effective than direct communication, and the internet is a best example of passive communication. Another interesting reason is that human behavior has been changed (See chapter 3.5.3) due to the use of internet media. Now people need relaxation, and I think that it will be more relaxation for stakeholder to use virtual network instead of physically participant in a co-design workshop. The need of a virtual network for co-design process can also be expressed due to the following problem in a physical co-design workshop. These problems are discussed in the interviews.

- Many people are busy in their jobs, and the time of co-design workshop does not match with their personal timetable.
- Some people are out of the country.
- Sometime international people also want to participate in the co-design workshop, but can not participate due to travel expense and long distance.

So, if there will a virtual network for co-design workshop then these problems can be reduced with some extents.

A lot of virtual network soft-ware are available in market which can be used to facilitate a co-design workshop. I have discussed some of these virtual network soft-ware in both the
theoretical and the empirical research. The names of these virtual networks are team viewer, Radmin remote access, WallCooler and Real VNC. There virtual networks are used for different purposes, but we can also use it, to carry out a co-design workshop, but there are some limitations in these networks (See chapter 3.5.7).

The relevant virtual network soft-ware can be modified, but in the observation, I found some other feature related to co-design process (See chapter 4.6), due to which I have decide to give an idea of creating a new virtual network software to facilitate a co-design process. Off course the feature will be taken from all the existing virtual networks. I am putting the name of virtual network software as virtual network co-design process (VNCDP).

As the main question of my research is “What aspects should be considered to create an efficient virtual network for a co-design process?” So following is a list of all those aspects (Features or characteristic). VNCDP must have a VNCDP server and VNCDP viewers. In the list below, wherever I have written VNC or Radmin in brakets, it means that the aspect has taken from this virtual network.

**Aspect or Characteristics of VCDP**

1. Compatibility with Window, Mac, Solaris, Linux and Unix (VNC)
2. Multi monitor support (Radmin)
3. Cross chatting (audio, video and text) (Radmin)
4. Java viewer (VNC)
5. VNC viewer for mobile iPhone, iPad, iPod (VNC)
6. Integrated session security (VNC)
7. System authentication (vnc&Radmin)
8. Http proxy support (VNC)
9. Desktop scaling (VNC)
10. File transfer (VNC &Radmin)
11. Highest speed of work (Radmin)
12. Designing toolbox
13. Grouping facility

- **Compatible with windows, Mac, Solaris, Linux, UNIX.** The compatibility of different operating system is necessary because in a co-design process, it may be possible that the participant might work on different operating system.

- **Multi monitor support.** This feature is necessary in a co-design process. Especially in the project of urban relocation, a designer needs the ideas from large numbers of stakeholders.

- **Cross chatting (Audio, video, text).** Audio, video and text chat is very necessary for a co-design process because each participator want to express their ideas.
As in a co-design process the stakeholders write stories about a particular part of a design that is why, text chat is also necessary for this process. Chatting facility will be optional during the process. The participator must take permission of the head of the project if he wants to add something in the designing.

- **Java viewer.** Due to this feature the participant will be also able to access the server through his website. So there will be no complexity for participants to install VCDP viewer.
- **VCDP viewer for iPhone, iPad and iPod.** This will be easier for participant to access the server through iPhone, iPad and iPod.
- **Integrated session security.** Integrated Session Security provides protection from connection snooping, man-in-the-middle attacks and packet-tampering attacks, to name but a few.
  - VCDP Server Authentication uses 2048-bit RSA (which stands for Rivest, Shamir and Adleman who first publicly described it) keys to verify identity.
  - VCDP Viewer Authentication supports both usernames and passwords of up to 256 characters each.
  - Secure Communication with up to 256-bit AES (Advanced Encryption Standard)—the experts' choice for high performance encryption.
- **System Authentication** System authentication removes the need for separate VCDP and system passwords. Users can access their desktops using the same credentials with which they log on to the system. For Windows this is authentication via NT-Domain or Active Directory, and for UNIX is via NIS/NIS+.
- **HTTP Proxy Support.** HTTP Proxy Support allows you to configure VCDP Viewer to connect through various web proxies and filters, making it as simple to use as a web browser.
- **File Transfer.** File Transfer allows you to copy files between the two computers over the VCDP connection. There will be no need for additional configuration.
- **Desktop Scaling.** Desktop Scaling to a particular size, by a particular ratio, or dynamically to whatever size you choose.
- **Highest speed of work.** Radmin is the fastest remote control software available. Its new ‘Direct Screen Transfer™’ technology uses a video hook kernel mode driver to boost the capture rate to hundreds of screen updates per second. Its special low-bandwidth optimizations lets you control remote computer comfortably even on dial-up modem and GPRS connections. So if we put this technology in VCDP, it works efficiency will be more increased.
- **Designing toolbox.** During co-design process designers are busying in making sketches. Therefore designing material is very necessary for the process.
- **Grouping facility.** Grouping facility is also necessary in this virtual network software because we make groups of participators in a co-design process.
6. Discussions

6.1 Conclusions

Here in the conclusion I am repeating a sentence of the first paragraph of my thesis, “begins when first you view the world through the eyes of another” and this sentence is the cornerstone of a co-design process. If a co-design is a development of system thinking, then how can one think about the development of a system if he doesn’t look it through the eyes of others? It is argued in the thesis that the quality of designing increase if the stakeholder interest is considered in the designing process, which remind the words of Immanuel Kant “one has some information or knowledge” and every designer needs this knowledge. Therefore, my research investigates a virtual network for co-design process, since the discussion goes to two famous theories, Group supported systems (GSS) and Computer supported cooperative work (CSCW).

- Computer supported cooperative working (CSCW).

CSCW addresses (Wilson, 1991) "how collaborative activities and their coordination can be supported by means of computer systems", as related to my research which investigate that co-design process can be supported by means of a computer system. On the one hand, many authors consider that CSCW and groupware aresynonyms. On the other hand, different authors claim that while groupware refers to real computer-based systems, CSCW focuses on the study of tools and techniques of groupware as well as their psychological, social, and organizational effects.

In another place, Wilson (1991) stated that CSCW understands to be a generic term, which combines the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques.

It can be concluded from the above definition that CSCW aims to increase the effectiveness of group by using technologies. Therefore, the two major areas of concern are group working process, and the technology that might be used in this incensement. Here the discussion is similar to my research investigation. Co-design is a group of designer, researchers and stakeholder, and I am trying to increase the effectiveness of this group by using a technology (virtual network software).

i. Group process

Groups operate via the contributions of individuals. Therefore, to understand and support group processes it is also necessary to understand and support the individual (Wilson, 1991). Therefore, I have discussed human behavior (see chapter 3.5.3) and system thinking (see chapter 3.5.2) to understand and support the stakeholders.
ii. Enabling Technologies

The fundamental requirement for group work is communication indeed most aspects of CSCW enabling technology could be said to be communication facilities of one sort or another. However, only those systems which simply provide a two-way channel between people (electronic mail and video conferencing for example) are referred to as ‘communication system’ in this volume. Wilson stated that technologies enable people to share a physical workplace (For example a remote screen sharing system, which enables two or more people to work in a common area on their respective computer, screens (Wilson, 1991). Here the discussion is again goes to my research investigation as the creation of a virtual network for a co-design process facilitate communication requirement. The stakeholders will use electronic mail and video conferencing in co-design workshops. I have discussed different virtual network community, screen sharing soft-wares (see chapter 3.5.7) to investigate an appropriated screen sharing software, to facilitate a co-design process.

Group support systems (GSS)

Group support systems, as originally envisioned by Huber (1984), extended the concept of decision support system (DSS), which were intended for use by individual decision makers, to the group decision-making setting. Early research emphasized the support of group decision-making activities (Particularly in face-to-face meetings), and thus theses systems were labeled group decision support systems (GDSS). The seminal framework of the Sanitsis and Gullupe (1987) extended the role of GDSS to include the support of planning, brainstorming, negotiating, problem solving, and creative tasks (as well as decision-making activities), utilizing a variety of technologies, including but not limited to the “Decision room” setting. As a result of this broadened role and spectrum of underlying technologies, the “D” in ”GDSS” is commonly dropped, and the term ”GSS” (Group Support System) is used in its stead.(Kenneth, 1999)

Hence, GSS discussion goes to the information technology environment encompass communication, computing and decision support technologies which is not properly related to my research investigation.

GDSS are distinct from computer supported cooperative work (CSCW) technologies as GDSS are more focused on task support, whereas CSCW tools provide general communication support, and my research investigation relates to CSCW.

Hence, a long discussion has been done that why we need virtual network for a co-design process, what are the difficulties that we face in a physical co-design process and what will be the advantages of virtual network for a co-design process (See chapter 5.1 and 5.2)
Some relevant virtual network soft-wares have been investigated through the theoretical research which was also verified through the empirical research. It can also be concluded that interpersonal relationships are important in virtual communities. Knowledge creation is achieved through co-operation, and it is the mean of a co-design process.

The study found some aspects related to the nature of the co-design process, on the bases of which it is consider that co-design process is possible through a virtual community. In the thesis, I have also discussed various communication problems during a co-design process, and it has been concluded that communication through a virtual network is more effective than direct communication, because more people can take advantage of it. A lot of relevant characteristics of virtual network, for a co-design process have been found through the study of available relevant virtual network soft-wares, but still I have found some limitation in these available virtual network soft-wares. Therefore, at last, in the analysis phase, I have given an idea of creating new virtual network software which will be appropriate for a co-design process.

Following is a list of all those aspects (feature) which should be consider appropriated in the creation of a virtual network (virtual community) for a co-design process.

1. The network must have compatibility with Window, Mac, Solaris, Linux and Unix operating system.
2. It must needs to have the power of Multi monitor support.
3. It needsto have the ability of cross chatting (audio, video and text)
4. Java viewer aspect is also useful.
5. There is also a need of viewer for mobile iPhone, iPad, iPod.
6. Integrated session security feature is also necessary.
7. System authentication aspect is also valuable.
8. Http proxy support aspect will be use for web connection.
9. Desktop scaling aspect will be use for image setting.
10. File transfer aspect is also useful for the network.
11. The feature of “Highest speed of work” is also necessary.
12. Designing toolbox aspect is also very necessary.
13. Grouping facility must also be including.

Short descriptions of these aspects are also given in the analysis phase, in chapter 5.

6.2 Implications for Informatics

Co-design is an emerging technology in the field of informatics, and my research has been done in this area. My research result facilitates communication in a co-design process through virtual network as Participators will be able transfer their messages easily to each others.
I implicate for the user practice to improve the interest of participators in a co-design process, and how participator should be stimulate in virtual network for co-design process, and try to develop an efficient virtual environment.

Recently many researchers try to create a collaborative environment for teachers and students in eLearning system. Therefore, I am implicates for software designer to take an idea from my research result and design a collaborative virtual environment for eLearning system, and develop distance learning education.

My research investigation is related to CSCW. Therefore, computer is the main factor use in a collaborative virtual environment. Therefore, I am implicating for developers to pay attention that how computer system will be efficiently works in the process.

It is observed through empirical research, that providing a beautiful location for a co-design workshop is also valuable. I have not given the solution of this problem in virtual network of a co-design workshop.

During interviews, I received an idea that co-design process is also possible through a dynamic website, so I am implicate for informatics that also try to find a virtual community in this area.

6.3 Method evaluation

For doing this research, first, I have elaborated the whole method of the research. In chapter one (1), I have given an introduction of the research investigation, and then in chapter two (2), I have define my research strategy, the theoretical research method, the empirical research method (the interviews and the observation). In this chapter I have defined the references techniques and presentation method for research.

When I start write down the research method in chapter two, I was very confused that how can I define the research method before doing the theoretical and the empirical research, but later, I come to know that it is very necessary to define the method before the research start because It increase the researcher performance, and reduce research process time.

In theoretical research, I have used a method, in which, whenever an author wants to write something, he must give reference it to another text, written by previous authors. This method is
very effective because when I used to give references, I felt confidence that what am I write is right.

For Interview, first, I have defined sampling method, and I think it is very necessary to define sampling method because the interviewer comes to know his target interviewees, and the interview process become easy and valuable.

For observation, I used some video base observation. As I have no access to a co-design process workshop therefore, unfortunately, I used video base observation. But later, I come to know that this method is also very effective because, in video base observation, one has the opportunity to observe the situation again and again, and able to find the best solution for a problem.

At last, I used a method for analysis, in which I used to write down my research question, and then I put all the relevant answers of that question. I think it will become easy for the readers, and they can take advantage of the thesis more quickly because instead of waste their time on reading the whole thesis if a reader just reads the analysis phase, he can take benefit from the research result.

### 6.4 Result evaluation

The result evaluation is related to the quality of the result. In my research, the result quality has valuable through the criteria richness of meaning, structure and theory contribution. Richness of meaning relates to hermeneutics (Larsson, 1994 cited in Lind, 2005), and I have described in chapter two that my research perspectives are hermeneutics as I have integrate different parts of text to a whole which brings richness of meaning. The awareness of a concept has a great importance for the result. Therefore, I have combined several perspectives such as human behavior, system thinking, co-designing, collaboration, Computer supported cooperative work and virtual community.

A well define structure for research thesis, make the text clear, and remove complexity, but it is seem as opposite to the richness of the meaning because if we reduce the complexity, it will give us a good result structure, but the richness of meaning will be decrease (Larsson, 1994 cited in Lind 2005).
The theoretical contribution is related to how well the researchers have been able to add text to previous existing theory, and this criterion is central to my research because it also provides the confidence of writing something related to research investigation.

The result evaluation is also related to the validity of the result. If a research has base on both the theoretical and empirical research, it is important that there is a consistency between the parts (empirical verification). The reality and interpretation of it should thus be closely related to each other. After completion of theoretical research, I have almost found the result of my research investigation, but still, I have done an empirical research to prove my theoretical findings. So the result was successfully completed through both the theoretical and empirical research, and I take a lot of help from these results in the analysis phase. Some time it may happen that the theoretical result does not match with the empirical research, but in my research, I have found relatively smellers answers of my research questions.

In this thesis, I have selected qualitative research methods, and qualitative method base on hermeneutics perspective. Hence, I proved that my research vision is hermeneutics and research study is explorative.

6.5 Possibilities to generalize

In chapter 2, it has been argued that qualitative researchers are free to define their own research validity. Therefore I have defined my own research validity. For theoretical data collection, I used to predict the subject area and used to study the subject for the sense to find some arguments for the approval of the result. Any argument in the research study base on the predefined text of the other authors. The result was compared to the fact describe previously by the other authors. I have defined sampling method for collect empirical data. Empirical research was done for the verification of theoretical data.

In both the theoretical and the empirical research study, I have found many relevant answers for my research questions, and I have generalized the research, in the form of virtual network software in the analysis phase.

6.6 Ideas for continued research
As I have observed in the observation phase that providing a beautiful location for a co-design process is very necessary for improve the mental behavior of the participator as well as it stimulate the participant in the process. But I don’t know how to provide such facility to participant in a virtual co-design process. Therefore, I suggest for the researcher to continue this research and find a best solution for this problem.

Education providers try to develop an efficient eLearning system which base on co-design development as my research has been done in the area of a co-design process. Therefore, I suggest for researchers that it seems possible to modify the result of my research, and try to develop a new and efficient eLearning system for education.

Co-design is a collaborative thinking for the development of a particular system. In a co-design process, every participant has his or her own mental model as a background for the idea come in the mind. As the process goes on, the mental model of participant change and in some extent adopt each others that may endanger the co-design process and make it less efficient. So I suggest for researchers to continue the research, and find a best solution for this problem.

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8 Appendix

8.1 Interview Questions

1. What are you know about a co-design process or a co-design workshop?
2. Have you participate in any co-design process?
3. Is there any common interest that unites the stakeholder (participants) and designer?
4. Are the participants are welling to come to gather in a centralized area?
5. If there will be a virtual network for a co-design process then, are the numbers of participants will be increase?
6. Have you used any virtual network software which looks relevant to co-design process?

8.2 Co-design Videos

- http://www.youtube.com/watch?v=YliF-Wyopyk&NR=1
- http://www.youtube.com/watch?v=EargY99NqJ0
- http://www.youtube.com/watch?v=HWgJlwTDIRQ
University of Borås is a modern university in the city center. We give courses in business administration and informatics, library and information science, fashion and textiles, behavioral sciences and teacher education, engineering and health sciences.

In the School of Business and Informatics (IDA), we have focused on the students' future needs. Therefore we have created programs in which employability is a key word. Subject integration and contextualization are other important concepts. The department has a closeness, both between students and teachers as well as between industry and education.

Our courses in business administration give students the opportunity to learn more about different businesses and governments and how governance and organization of these activities take place. They may also learn about society development and organizations' adaptation to the outside world. They have the opportunity to improve their ability to analyze, develop and control activities, whether they want to engage in auditing, management or marketing.

Among our IT courses, there's always something for those who want to design the future of IT-based communications, analyze the needs and demands on organizations’ information to design their content structures, integrating IT and business development, developing their ability to analyze and design business processes or focus on programming and development of good use of IT in enterprises and organizations.

The research in the school is well recognized and oriented towards professionalism as well as design and development. The overall research profile is Business-IT-Services which combine knowledge and skills in informatics as well as in business administration. The research is profession-oriented, which is reflected in the research, in many cases conducted on action research-based grounds, with businesses and government organizations at local, national and international arenas. The research design and professional orientation is manifested also in InnovationLab, which is the department's and university's unit for research-supporting system development.