12-1999

Defining Virtual Interactions: A Taxonomy for Researchers and Practitioners

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THESIS

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THESIS

Presented to the Faculty of the Graduate School of Engineering and Management

of the Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Masters of Science in Information Resource Management

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November 1999

AFIT/GIR/LAS/99D-8

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Acknowledgments

I would like to express my sincere appreciation to my faculty advisors, Major Michael Morris and David Biros for their guidance and support throughout the course of this thesis effort. Their insight and experience were invaluable and greatly appreciated. would also like to thank Dr. Alan Heminger, although not officially part of my advising team, his example in critical thinking has been a basis for the development many of the ideas contained in this thesis.

Most importantly, I would like to express my appreciation to my wife, Janelle, and my sons, Joseph, Joshua, Jared, Jonathan, and my daughter, Jessica. Their unwavering love, understanding, and sacrifice over the past eighteen months have allowed me to focus on my studies for this graduate program. The countless hours Janelle has spent in helping this, and other, projects progress throughout this program has been invaluable. Without their support, this journey would have been a whole lot tougher and less fulfilling. As we like to say, "Families are forever." Thank God for mine!

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ABSTRACT

Many uses for virtual technology are being identified by diverse organizational entities around the world. Before these technologies can be fully utilized, it is important to have a common definition and understanding of what is meant by the term "virtual." It is also important to understand the structural configurations possible using virtual technology and the types of virtual interactions that may occur using these technologies.

This thesis will define the basic premises, structures, and definitions applicable to virtual interactions. It also defines various types of virtual interactions that may occur using virtual technology. These designations will help both practitioners and researchers to focus on appropriate virtual technologies and identify the critical factors that will determine success or failure in each instance. Above all, this taxonomy will provide a foundation upon which to build a coherent, sustained, and directed study of virtual interactions that will result in improved integration of technology into organizational strategic plans. Such integration will optimize financial outlays for information technology and produce the maximum benefits for all virtual components involved.

DEFINING VIRTUAL INTERACTIONS: A TAXONOMY FOR RESEARCHERS AND PRACTITIONERS

I. Background/Introduction

Before the nineteenth century all human interaction was face-to-face with an occasional written interaction for those privileged enough to be literate. During the twentieth century, advances in technology have enabled new and revolutionary types of human interactions to occur without the need for personal contact. For example, the telephone is one type of modern technology that enables human interaction without requiring a face-to-face presence. Throughout the twentieth century uses for the telephone have grown and increased as technological advances have increased.

The advent of the computer age has enabled other types of human interactions between individuals separated by both space and/or time. With the introduction of new types of human interactions, the need for understanding these interactions, in a technical and social setting, has evolved. This paper identifies the technologies that allow interpersonal interactions across space and/or time as virtual technologies. Understanding these virtual technologies and the interactions that may occur over them is the focus of this thesis.

The concept of "virtual" connotes the operation of functionally independent entities in a manner that simulates face-to-face interactions. For the purpose of this thesis a virtual interaction is any interaction made through virtual technology of any type that bridges space and/or time. Electronic media enabling virtual interactions is one example of virtual technology in the form of hardware, software, or a combination of hardware and software. Other examples of electronic media includes telecommunications suites, computer networks, multimedia/collaborative applications, shared information resources (like those utilized on the World Wide Web (WWW)), and many others that the reader can identify.

This thesis will refine the meaning of the term "virtual" and present several structural configurations that may use virtual technologies. It will present a taxonomy for virtual interactions that will allow practitioners and researchers to precisely describe and investigate different types of virtual interactions. The literature review explores current information available on the subject of virtualness with the purpose of developing a basis from which to build an understanding of what "virtual" means. The review will look at factors of importance in describing virtual interactions such as the components involved in the interaction, the type of interaction, and the media effectiveness of the transaction. Chapter 3 will present several models to help identify virtual interactions based on significant factors identified in the literature review. The final chapter in the thesis will discuss the implications of this research and discuss the need for continued research in this subject area. The final chapter also explores the limitations of this research and presents several specific areas that require follow-on research.

Motivation for This Research

Many uses for virtual technology are being identified by diverse organizational entities around the world. One such entity is the United States Department of Defense (DoD). It is currently exploring various aspects of virtual technology to help meet national defense objectives. Within the DoD is the Department of Defense Intelligence Information Systems agency (DoDIIS). The DoDIIS is developing a plan to implement a Joint Intelligence Virtual Architecture commonly referred to as JIVA (Intelligence Authorization Act, 1997). Before this architecture can be fully utilized by the intelligence community, it is important to have a common definition and understanding of what is meant by virtual, the possible structural configurations using virtual technology, and the types of virtual interactions that may occur using these technologies. One of the uses for virtual technology within the DoDIIS is in the gathering, analysis, and distribution of intelligence information (Staff Study, 1997).

In 1996, the One Hundred Fourth Congress, Second Session of the House of Representatives was presented the Intelligence Authorization Act for fiscal year 1997 which, among other things, discussed the JIVA program. The Act incorporated portions of a report submitted on May 15, 1996 to the full House by the Committee on National Security. The finalized Act, known as the Intelligence Authorization Act of 1997 was approved as part of House Resolution (HR) 3259 of the same year. The Intelligence Authorization Act for fiscal year 1997 and the accompanying staff study by the Permanent Select Committee on Intelligence for the House of Representatives One Hundred Fourth Congress contains many of the questions and recommendations that

drive the JIVA program and the research topic of this thesis. Appendix A presents applicable excerpts from these documents.

Several important factors in the 1997 Intelligence Authorization Act have bearing upon the research and direction this thesis is designed to pursue. One important point states that the Committee on National Security supports the Intelligence Community's efforts towards creating a virtual intelligence architecture that links collectors, exploiters, analysts, and, intelligence customers electronically. The Committee hopes that a virtual architecture will transcend organizational boundaries and allow policymakers and intelligence communities to continually reevaluate requirements. Additionally, The Committee hopes that JIVA will provide virtual technology that can quickly refocus resources, provide flexibility, and achieve less bureaucratic rigidity (Staff Study, 1997).

The Staff Study accomplished by the Select Committee, states that the intelligence community should "look to the military's test-bed programs for creating a 21st century intelligence operating environment" (Staff Study, 1997:14). The operating environment, known as JIVA, is mentioned particularly as a program that should focus on creating a virtual work environment using virtual technology that will transcend organizational and technological (stovepipe) boundaries (Staff Study, 1997).

In a final statement on virtual technology, the Congressional Committee requires the Director of Central Intelligence to "thoroughly examine what effect this will have on the Intelligence Community's traditional production and management procedures and culture" (Intelligence Authorization Act, 1997:33). The committee presented a series of questions that would identify factors that must be recognized and dealt with when using virtual technology in the Intelligence Community (See Appendix A Intelligence

Authorization Act, 1997). Functionally, Congressional leadership seems to desire an architecture that will break down organizational boundaries and create a synergy beneficial to intelligence collection, analysis, and production.

The Committee may be assuming that a complete understanding of virtual technology and its uses exists. Unfortunately, in reviewing the literature, this does not appear to be the case. A focused basis for understanding the uses of virtual technology and the types of interactions occurring over these technologies does not exist. The purpose of this thesis is to provide a conceptual foundation for:

1) Understanding the terminology associated with virtualness.
2) Determining what factors should be considered in developing a taxonomy for virtual interactions.
3) Determining what types of virtual interactions may occur.
4) Determining how these virtual interactions can be identified and categorized.

The resultant analysis may be applied by JIVA or any other practitioner and/or researcher as foundational in understanding different types of virtual interactions and the important factors associated with each.

JIVA's success depends upon the ability of intelligence users to interact and accomplish specific tasks using virtual technology. The use of virtual technology for this purpose presents many advantages and disadvantages for Department of Defense (DoD) intelligence collectors, producers, and end users. The current JIVA program office seeks to accomplish three general missions relative to intelligence production. The first is to change the process of intelligence production by leveraging current technological capabilities. Second, pull together complimentary assets from across the intelligence

community in a virtual manner. Third, to improve the overall quality of intelligence products and services provided to decision-makers and end users (JIVA, 1998).

Contemporary research involving virtual technology may be effective in preparing for full JIVA usage by providing an understanding of the different types of virtual interactions possible and the critical success factors associated with each. The first requirement of such research is a consistent classification schema that describes virtual interactions so that researches and practitioners have a common frame of reference. Later sophisticated technology and advanced applications will provide the physical foundation for virtual interactions. Defining effective use of advanced technologies and applications will allow the human factor to maximize information exchange and provide high quality products to intelligence consumers.

Applicability of this research

In any discipline, underlying theories and definitions provide a foundation upon which to build. This thesis is an attempt to define the basic premises, structures, and definitions applicable to virtual interactions. As a basis for future research, this thesis will define pertinent terms and concepts that can be applied to all areas of virtual interactions. It will give very specific and detailed analysis of how those terms and concepts can and should be used in defining further research. It will also define various types of virtual interactions that may occur using virtual technology. The resulting definitions will provide structure and convention for researchers and practitioners when working with the concept of virtualness.

This research will also be useful as a basis for further research in exploring virtual interactions. This thesis is broadly based in theory and current understanding of virtual interactions. However, because the concept of virtual is in its infancy, future researchers should fine tune the ideas and concepts presented here based on current technology and cutting edge research. This fine-tuning should focus on individual aspects of virtual interactions such as trust in virtual teams, or management in virtual organizations, not on redefining the umbrella for virtual interactions that this thesis provides.

The analysis section of this thesis defines the several salient variables in making each virtual structure effective. These variables, in the context of virtual interactions, must be understood and manipulated to achieve success in a virtual setting. Although not critical in the development of a taxonomy for virtual interactions these variables have a direct bearing upon the quality of any virtual interaction. For this reason, Appendix B and C are included as a reference for practitioners in helping identify some of the more common factors of importance associated with virtual interactions. In this sense, the thesis provides a list of critical factors relating to the virtual interactions presented in Chapter 3. Furthermore, using these concepts and definitions in a business environment should provide a blueprint for determining if virtual interaction is the proper method for information exchange in a given setting. It will then help the practitioner determine the appropriate structure for the virtual interaction needed and how these interactions may occur.

Ultimately, this author hopes to provide a framework under which the Joint Intelligence Virtual Architecture (JIVA) may be used effectively. By identifying the virtual interactions appropriate for any given intelligence function the JIVA program

office should be able to apply the fundamental principals presented in this document to the formation of virtual structures that will facilitate the accomplishment of the Department of Defense intelligence mission.

II. Literature Review

The focus of this literature review will be to find out how contemporary researchers define virtualness. These definitions will be used to determine the clarity of each concept and how applicable the definitions are to practitioners and researchers. This section will also determine the different contexts in which these terms are used with the goal of determining global definitions and global meanings that can be applied by practitioners and researchers interchangeably without confusion.

This review will then focus on the different structures under which virtual interactions can occur. These may range from one-on-one intra-organizational to group inter-organizational. The common factor in each of these interactions is the use of technology to interact, where the technology bridges space to achieve interaction. Another aspect of virtualness is whether the interaction is real time or if the technology used bridges both space and time.

JIVA

The importance of JIVA to national defense relies on the capability to effectively share intelligence resources and expertise across organizational bounds. The ability to share intelligence information and resources can have dramatic effects on the outcome of regional conflicts. Raw intelligence information collected for analysis could be instantaneously uploaded to applicable data repositories at any time and from any

location. Subject area intelligence experts in regional politics, personalities, and situations can access, in minutes, critical information needed for accurate situational analysis. Resulting information can then pass virtually to decision-makers enabling a time effective method of intelligence information exchange. This method of intelligence collection, production, and dissemination has great potential to thwart terrorism and rogue threats to US interests.

Currently, Intelligence Community managers-situated at the top of a vertical, hierarchical structure-largely control the information flow to and from policymakers. Using JIVA, managers will probably have less direct control over the information flow. Instead, they will act as facilitators who monitor the dialogue between policymakers and substantive experts to ensure that community resources are appropriately allocated for priority tasks and to help say no to requests when resources are not available (Intelligence Authorization Act, 1997). The House Select Committee believes that the Intelligence Community must begin now to prepare for the issues and problems that may arise as analysts increasingly communicate electronically with little management supervision. Collectors and other analysts must have the ability to operate effectively under a future virtual intelligence architecture.

As with any technology or innovation certain characteristics lead to inherent advantages and disadvantages while other characteristics are variable factors that, when controlled, minimize problems and increase success. For example, an inherent advantage in a word-processing application is the ability to make corrections without the need of retyping the entire document. Conversely, the way a document is written or formatted are variable factors that may be controlled. The effect of control, in this example, could

be measured by the quality of the final document based on the identified variables. This same reasoning may be applied towards virtual technologies and the resultant interactions. The ability to categorically describe virtual interactions will help determine what factors, both positive and negative, are inherent in virtual interactions and which can be controlled to optimize success and minimize failures.

The Joint Intelligence Virtual Architecture, by definition, is the institutional processes and technologies related to the processing, analysis, production, dissemination, and evaluation of intelligence. It includes cognitive analytic methods and procedures as well as the administrative processes needed. It also includes information technology and the related systems support required for the processing and dissemination of intelligence information (JIVA, 1999). JIVA leadership states that their primary objectives are to (JIVA 1999):

1) Improve the quality of analysis, and utility of intelligence products.

2) Provide specific and tailored intelligence to enhance the warfighter's ability to visualize the battlespace and ensure total operational awareness.

3) Improve the throughput and speed of delivery of intelligence information.

4) Reduce or eliminate unnecessary redundancy and duplication.

5) Strengthen information and production management and ensure policies, procedures, concept development, training, and technical-human engineering to assist operations within a new information environment.

6) Establish and integrate standards (based on mandated Department of Defense (DoD) community standards/architectures) for commonality, interoperability, and modernization in coordination with appropriate elements and activities.

7) Explore and examine very advanced technology and concepts for the future.

Objectives 1, 2, 4, 5, and 7 are all dependent upon the ability of intelligence gatherers, intelligence analysts, and intelligence leadership to operate and interact effectively using virtual technology. However, the virtual organizational forms needed to accomplish these objectives are variable and undefined by any precedence. Without a clear understanding of the types of virtual interactions needed to accomplish a given objective, it is unlikely that the stated objectives can be achieved.

Definitions

The capability to interact virtually requires both a medium of interaction, such as that supported by virtual technology, and the components that use that technology. Being able to state what the definition of a virtual interaction is and develop a taxonomy for virtual interactions requires the identification of the components that may be involved in virtual interactions. This thesis presents and in-depth review of these components in Section 2.3. These components include the computer, individual, team, organization, and customer, each interacting virtually for a specific purpose. Before discussions on virtual components, it is important to have a common understanding of various terms used when discussing virtual interactions. This section will explore those terms and, where applicable, present a synthesized definition for use in developing a taxonomy for virtual interactions.

Because the concept of virtual in a technological sense is relatively new, defining what is meant by various terms relating to the concept is critical to an overall

understanding of this research. One definition of virtual, helpful as a basis for this thesis, is found in The New Webster International Dictionary of the English Language, it reads: Virtual - "Being in essence or effect, not in fact; not actual but equivalent, so far as result is concerned" (Webster, 1971:1108). Conceptually this is a relatively easy definition to understand. In practice, the ability to achieve true virtual interaction using technology is extremely difficult.

Using common structures for interactions that may occur over virtual technology enables parallels between virtual and actual to be made. These comparisons can be used to determine if these virtual interactions are in-fact equivalent to actual face-to-face interactions. This thesis defines three basic types of interaction structures of interest using virtual technology. These interaction structures are person-to-person, team, and organizational interactions.

Because technologically enabled virtual interactions are relatively new the research in the field is disorganized and in disagreement on various definitions and the importance of different factors effecting virtual interactions. This thesis is an attempt to add structure to the existing research and bring together factors that are important for success in any virtual structure. Possible areas for reference include diverse fields of study such as psychology, organizational behavior, computer science, management, economics, etc.

Virtual

As stated earlier, the dictionary definition of "virtual" is "being in essence or effect, not in fact; not actual but equivalent, so far as result is concerned" (Webster, 1971:1108). This broadly stated definition could be applied to many daily interactions

such as telephone conversations, television viewing, or leaving a sticky note for a coworker. Current academic and commercial literature is filled with the term "virtual." It is prevalent everywhere but the meanings are often contradictory and misleading. In one recent invitation to the 2nd International Workshop on Organizational Virtualness the organizers define virtualness as "the ability of the organization to manage the interdependence between customer interaction, asset configuration, and knowledge management" (Venkatraman and Henderson, 1998). This definition is wholly based on technological mediation between customer interaction, asset configuration, and knowledge management.

In another article Allcorn (1997) states that the prevalence of computers in the workplace, linked together to form intraorganizational networks (intranets) are enabling unprecedented electronic employee connectedness. This interconnectedness may cause a collision between the traditional hierarchically organized physical workplace and the less understood possibly more chaotic virtual workplace (Allcorn, 1997). From this context, the essential ingredient to virtual is the use of technology in the interaction within an organizational setting. As can be seen from the previous examples, technological mediation seems to be a key factor in defining many types of virtualness. Mediation connotes the ability of the technology to carry information and exchange ideas between using components. This leads, inevitably, to an examination of media richness for technologies used in virtual interactions (addressed later in this paper).

Another popular use of the term virtual is in the realm of "virtual reality." An example of this type of virtualness in a business environment can be seen in an example from a Pennsylvania-based supplier of hospital decontamination and surgical equipment.

This organization commissioned a graphics studio to create a 3D library of their products and generate walkthrough animations that the company's sales people could use to help potential clients—hospitals and other medical facilities—visualize how the products might fit into their facilities. Later the company trained its own staff to create animations that would allow their sales people to build virtual worlds with which they could interact in real time using their product base (Mahoney, 1995). In this instance virtual is a concept of interaction with inanimate and/or imaginary factors. Imaginary in this instance denoting possible representations and uses of company products and services presented in virtual reality. This is a widely divergent use of the term virtual from a human-to-human interactive sense. The common thread is again the use of technology as the mediation between reality and pseudo reality referred to as virtual. Because virtual reality is such a commonly used term, any definitive definition of virtual in today's technologically oriented world should take into account the concept of virtual in this setting.

In one article on telecommuting Pliskin (1998) states that the separation between users and computers is can be bridged using data communication equipment and telephone lines linked to host computers. This interconnectivity to user terminals, enables a "virtual proximity" to host-stored information resources (Pliskin, 1998). Now the term virtual is used to denote the distance between users and computers. This type of proximity must simulate closeness or the lack of great distances between users and their computer assets. This is a good example of technology bridging space.

Thus, it is apparent that the different aspects of "virtual" referred to in relation to modern technical advances has no basis for use or commonality of meaning. This is

surprising based on the prevalence of the term to denote collaborative interactions of individuals, teams, and organizations. It is also surprising in light of technological expenses to organizations creating "virtual architectures" and relying on the ephemeris term "virtual" to denote how technology can be used to increase productivity and guarantee competitiveness in the modern business environment. Table 2-1 summarizes some of the definitions of "virtual" found in this literature review.

Table 2-1 Summary of Definitions for "Virtual"

SOURCE	DEFINITIONS (VIRTUAL)
Webster 1971	Being in essence or effect, not in fact; not actual but equivalent, so far as result is concerned
Allcorn 1997	Computers in the workplace, linked together to form intraorganizational networks
Mahoney 1995	Animations that allow sales people to build virtual worlds with which they can interact in real time using their product base
Pliskin 1998	Data communication equipment and telephone lines linked to host computers

The term virtual seems to refer to something that simulates reality and has a technological basis for the simulation. In the context of this paper virtual interactions simulate interpersonal or, in the case of virtual reality imaginary interactions, over an electronic medium. Therefore, the definition for virtual from a technological perspective is any simulated interpersonal or imaginary interaction between virtual components that is enabled by virtual technology. A discussion on what is meant by virtual technology follows shortly.

Using the above stated definition, the list of virtual possibilities is extensive. However, it is not important to list every possible virtual interaction that virtual technology mediates. What is important, is to develop an all-encompassing definition

into which ALL such interactions may be categorized. What this definition does not include is machine-to-machine interactive functions such as handshaking, data updates, BIOS operations or any other purely machine oriented operations that take place irrespective of human intervention or interaction. Also not included in this definition is the use of replication to update database servers and synchronization applications that maintain data integrity at disparate locations.

Virtualness

Similar to the term virtual is the term "virtualness." According to researchers at the Systems Research Center, Boston University School of Management, "Virtualness is the ability of an organization to consistently obtain and coordinate critical competencies through its design of value-adding business processes and governance mechanisms involving external and internal constituencies to deliver different, superior value in the market place" (Venkatraman and Henderson, 1996:8). This definition is very specific to business process and not to virtual interactions or technologies. Such a definition has merit within a limited scope but cannot be broadly applied beyond a business setting.

According to Palmer and Speier (1998) virtualness "can be defined by the degree to which a team is producing work deliverables across different locations, at differing work cycles, and across cultures" (Palmer et. al, 1998:28). This definition relates to virtualness with respect to virtual teams and the ways that virtual teams interact. It appears that "virtualness," like the term "virtual," can be used in several different ways depending upon the context in which it is used. Table 2-2 summarizes some of the definitions of "virtualness" found in this literature review.

Table 2-2 Summary of Definitions for "Virtualness"

SOURCE	DEFINITIONS (VIRTUALNESS)
Venkatraman and Henderson, 1996	The ability of an organization to consistently obtain and coordinate critical competencies through its design of value-adding business processes and governance mechanisms involving external and internal constituencies to deliver different, superior value in the market place
Venkatraman and Henderson, 1998	The ability of the organization to manage the interdependence between customer interaction, asset configuration, and knowledge management
Palmer and Speier 1998	The degree to which a team is producing work deliverables across different locations, at differing work cycles, and across cultures

From the diversity of these definitions, it is clear that a precise and reasonable definition for the term "virtualness," that can be broadly applied, is required. For the purpose of this thesis, virtualness is defined as a state of interaction involving at least two virtual components that is mediated by virtual technology. This includes telephone conversations, virtual gaming involving human vs. human or human vs. computer interactions, virtual reality, and on-line message exchange applications such as Lotus Notes or any of the various e-mail applications commonly used.

Virtual Technology

In a recent article on virtualness and media choice the authors state that the "fluidity of creating and disbanding teams as needed has been brought about by advances in communication technologies. Innovations in communication media and information technologies, such as voice and electronic mail (e-mail), facilitate more rapid exchange of information. In addition, more recent technological innovations, such as groupware and

video teleconferencing, enable sharing of nonverbal communication, including documents, annotations, facial expressions, and interactive discussion, to more effectively emulate the face-to-face communication processes that exist in traditional organizations" (Palmer and Speier, 1998:31). This statement presumes a strong link between technology and virtualness.

According to Pliskin (1998), there are several ways in which technology, since the 1980s, has enabled virtual interactions using telecommunications. Telecommuting, by definition of this paper, is a form of virtualness and because the same technologies that enable telecommuting also enable other types of virtualness, these advances are relevant to this thesis.

The following are a list of these important technological advances (Pliskin, 1998):

- First, greatly simplified screen navigation, monitors enhanced with graphics and colors, and user-friendly software systems have made computers more useful to a greater number of people than before.
- Second, with a continuous decrease in costs and a parallel increase in performance, microcomputers penetrated the home arena.
- Third, relatively inexpensive matrix and letter-quality printers were introduced, making printer sharing no longer mandatory and thereby improving the quality of work performed by individual computer users.
- Fourth, with the introduction of portable laptop computers, whose sizes and prices were falling fast, the opportunities for mobile telecommuters could grow as well.

- A fifth way that technology has enabled virtualness, not mentioned by Pliskin, is in the sophistication and use of network technologies. This technology has enabled the Global Internet along with isolated Intranets to gain widespread usage that allows for access by geographically dispersed entities throughout the world. As technology continues to gain capability, the ability to interact virtually will certainly increase.

From a technological perspective, the individual/computer virtual interaction can occur with the most basic of human computer interfaces, namely a keyboard, mouse, and monitor. Interconnectivity to the Internet provides expanded access to information using chat, message boards, email, specialized applications, and on-line data repositories (Blau, 1997., Kishore and others, 1998). Technology based virtual reality promises advances in education and learning to those who can obtain the requisite technology. (Johnson and others, 1998., Hall and others, 1998., Stansfield and others, 1998) The basic applications needed for these services are readily available as freeware and as additions to popular operating systems.

Among the more common forms of technologically based individual virtual interactions that have been widely used for generations is telecommunications. This allows individuals to interact using voice media that has a moderate degree of richness and allows real time interaction in most instances. Along the same vein as the telephone is the computer-moderated teleconference that also allows individuals to interact using voice media. Although not widely used in individual virtual interactions because of the need for relatively high bandwidth, certain applications allow full duplex multimedia type virtual interactions in real time over widely available hardware suites. These

applications, while not high quality, have the advantage of low costs and the ability to interact virtually with any other similarly connected individual around the world.

Even more basic than the individual/computer interaction from a technical perspective is the individual/individual interaction using non-electronic technologies. Any written interaction using whatever medium (i.e. paper and pencil, parchment and dye, etc) can be described as having a virtual component (Adams, 1998). As such, any taxonomy for virtual interactions must consider these types of interactions as relevant. Although seemingly trivial from a technological perspective, the volumes of virtual interactions that have occurred using the written symbol make them important for classification purposes. Non-electronic virtual technologies, as referenced above, will include any mechanical device used in the exchange of information that does not occur in a face-to-face manner.

Using the concepts and ideas found above, "virtual technology" can be defined as any technology that enables interaction by virtual components across space and/or time. The technologies and improvements in technologies are enablers of interactions that bridge space and/or time and, as such, are defined as virtual technologies regardless of how they are being used or if they are electronics based. Any technology, regardless of use, that has the capability to support virtualness should be defined in the domain of a virtual technology. This broad definition will allow practitioners, particularly, to recognize the potential capabilities inherent in these types of technologies.

Virtual Interaction

Based on the above definition of virtual technology and upon identification of different virtual components that may use those technologies, a definition for virtual

interactions may be derived. Applicable to this thesis, a virtual interaction is defined as any action enabled by virtual technology between one or more virtual components. Purposes for virtual interactions may include such things as e-commerce, entertainment, socialization, and information sharing/gathering. Undoubtedly, the definition represents a very broad scope. The reason for this breadth is that any model depicting virtualness must take into account the important aspects of virtual interactions identified earlier in this Chapter. This, by necessity, implies a broad view of what constitutes a virtual interaction. It is also important to include interactions that, by the definitions presented in this thesis, have been virtual, but not recognized as such. One example of this type of virtual interaction is a telephone conversation. Since its invention, the telephone has enabled virtual interactions, but has seldom been identified as a virtual technology. That is because of the widespread paradigm that for an interaction to be "virtual" it must involve a computer.

Virtual Reality

For the purpose of this thesis very little will be said about virtual reality. The reason the definition is provided here is because the author identifies virtual reality as a specifically named type of virtual interaction. The basic components of this interaction are the person and the computer. The purpose of the interaction can be for entertainment, education, or a variety of other reasons. It is logical to assume that as other types of virtual interactions are better understood and better defined that they also will be named so that their study and identification will have meaning to practitioners as well as researchers. Therefore, for the purpose of this thesis virtual reality is defined as a specific type of virtual interaction involving the human and computer component in a

technologically enabled setting that simulates multidimensional space and where time is imaginary or exists independently of reality.

Virtual Interaction Components

According to Skyrme (1998), three important interactions available to achieve effective virtual work include person-to-person, person-to-computer, and computer-to-computer. The components identified by Skyrme are the person and the computer. However, from a business perspective the addition of other components such as the team, the organization, and the customer would seem to be important. One author states that virtual entities, be they organizations or teams within or across organizations, enable organizational or individual core competencies to be brought together when needed and disbanded when no longer required (Peters, 1992). These entities/components from a business perspective should all be foundational units (such as the computer and the person) upon which larger business entities or enterprises are based (such as the team and the organization). This thesis identifies the computer, the person, the team, the organization, and the customer as the basic components involved in virtual interactions. Although the team and the organization are composed of individuals, the factors affecting individual, team, and organizational interactions are different and should be viewed as such (Clark, 1998., Lipnack and Stamps, 1997).

Computer

Because computers are technology and tools, and in many cases used, in accomplishing virtual interactions, the reader may question the validity of their inclusion as a virtual interactive component. Model development in this thesis is an attempt to describe and categorize all virtual interactions. To accomplish this, any categorization must include all past virtual interactions and all future virtual interactions enabled by technological advances. For this reason, the computer is included as a possible interactive virtual component because of the advances and development of smart computer systems that approach true artificial intelligence. As these technologies gain power, the possibility of computer-to-computer interactions unaided and uninitiated by direct human involvement is very possible. One example of such computer initiated interaction may be Electronic Data Interchange (EDI) which is defined as the direct computer-to-computer transfer of business information (Executive Overview, 1999). Another example may be a holographically generated simulation of an individual created by a computer to characterize individuality such as in modern science fiction genre (Card, 1985). This is an example of a possible computer based interactive virtual component.

In some sense, the computer is a different type of component because it includes artificial intelligence programmed to behave in a predictable manner. However, because the computer is the "thinking" part of the technological interface that makes virtual interactions possible, it is included as a virtual component. Another important aspect of the computer is that it can provide information to other components (including other computers) that auxiliary parts of the technological interface cannot. In this sense, the

computer (defined as any non-human component with a processor used for information transfer and retrieval) is a peer of the other components involved in virtual transactions.

Individual

The next basic or foundational component to explore is the individual. The individual brings the concept of purpose into focus when dealing with virtual interactions. Individuals may interact with the computer component for specific purposes such as enjoyment or education, or may be bored and "surf the web" to kill time. All of these (as defined in this thesis) are virtual interactions in a strict sense but have little significance from a business perspective.

On the other hand, an individual may be part of a virtual team or virtual organization and be interacting with the computer component to locate information or gain a knowledge base from which to participate in team and organizational virtual interactions (Harasim 1993, Ives and Jarvenpaa 1991). These types of interactions are vital to business concerns and should be recognized as purposeful with respect to other virtual components. From a virtual component perspective, the computer is the basic or foundational entity. Next the individual may interact virtually with the computer as in virtual reality or virtual gaming, or may interact with other individuals as in telephone conversations, e-mail, chat, or video conferencing.

Team

According to Kishore and Zhao (1998), a virtual team may be thought of as a collection of individuals brought together for a specific purpose. These teams are usually cross-disciplinary in that the members come from different functions, specialties, or even

institutions (Kishore and Zaho, 1998). Another way of stating this is that the definition of a virtual team is a group of specialized individuals working together to achieve a common goal.

Pickard (1998) states that new technologies allow users to not only communicate across the organization, but also to work together as one. This can simply be across distances simultaneously, with people from the same functional group (virtual teams). It can also be people working in different functions or business units (as cross-functional virtual teams) or even across time zones. "Dynamic" cross-functional virtual teams are those that are organized to meet new business challenges as quickly as possible (Pickard, 1998).

Another common definition of virtual teams derived from Lipnack and Stamps (1997) says a virtual team is a group of people who interact through interdependent tasks guided by common purpose. Unlike conventional teams, a virtual team works across space, time, and organizational boundaries with links strengthened by webs of communications technology (Lipnack and Stamps, 1997). Other definitions and characteristics of virtual teams state that a virtual team can be physically distributed, complementary competencies can remain dispersed and still be synthesized into a coherent productive resource, one whose synthesized character is invisible or borderless (Goldman and others, 1995). Or that in virtual teams serial work processes are replaced by flexible combinations of concurrent, parallel and serial work processes, optimized to the requirements of each project (Goldman and others, 1995).

The definition of "virtual team" seems endless just as the definition and use for the term virtual seems endless. Building upon the ideas and perspectives presented in

this review, a virtual team may be defined as a collection of virtual components working together across space and or time using virtual technology who interact because of interdependent tasks which are given direction by a common purpose that is of limited duration (see Table 2-3 for definition summaries). It is worth noting that the interaction uses technology to bridge space and or time, and that the virtual team is independent of organizational boundaries.

It is possible to have interorganizational, intraorganizational, or virtual teams consisting of multiple components inside and outside an organization. This distinction is important because management, technologies, trusts, and several other factors affecting virtual team success are affected by the organizational team composition. For instance, an intraorganizational virtual team may have established guidelines for administration, management, and technologies. Conversely, an interorganizational virtual team should establish these guidelines as a basis for effective interaction. This and many other factors are important to successful virtual team interactions based on the organizational composition of the group (Maznevisky, and Chudoba, 1999).

Table 2-3 Summary of Definitions for "Virtual Teams"

SOURCE	DEFINITIONS (VIRTUAL TEAM)
Kishore and Zaho, 1998	A collection of individuals brought together for a specific purpose. These teams are usually cross-disciplinary in that the members come from different functions, specialties, or even institutions
Pickard, 1998	New technologies allow users to communicate across the organization and work together as one. This can be across distances simultaneously, with people from the same functional group (virtual teams) or people working in different functions or business units (as cross-functional virtual teams) or across time zones.
Lipnack and Stamps, 1997	A group of people who interact through interdependent tasks guided by common purpose. Unlike conventional teams, a virtual team works across space, time, and organizational boundaries with links strengthened by webs of communications technology
Goldman and others, 1995	A collection of physically distributed, complementary competencies that can remain dispersed and still be synthesized into a coherent productive resource, one whose synthesized character is invisible or borderless where serial work processes are replaced by flexible combinations of concurrent, parallel and serial work processes, optimized to the requirements of each project

From a hierarchical perspective, the virtual team (like the virtual organization) is made up of individuals who are brought together for a finite time and for a specific purpose. It is key to note that although the virtual team and organization is made up of individuals, it is the capacity in which those individuals are acting that determines his/her role as a virtual component. The individual may interact with other individuals for reasons unrelated to team goals. In this case, any virtual interaction would be individual-to-individual. In all cases, the capacity in which the individual acts determines the virtual component relevant to that interaction.

The virtual team uses technology to mediate some of its interactions, other interactions may occur in a face-to-face manner where the capability exists. From an interactive perspective, the team may interact within itself individual-to-individual or individual-to-computer. In this instance, the team is made up of multiple low-level virtual interactions that together define the virtual team. These teams may function within an organization (intraorganizational) to fulfill a stated need, or function interorganizationally to the mutual benefit of all organizations involved.

The virtual team may also interact as a group with other legacy or virtual teams if the need arises. Defining these interactions is important because leadership and decision making are often required functions that must be well established when interacting outside of the immediate virtual group. Failure to define leadership roles and responsibilities can lead to confusion and conflict within the team (Maznevisky, and Chudoba, 1999). Finally, the team component can interact directly with the computer in the form of information mining and resource gathering. This function allows the team to use available information systems to achieve team goals. Many times when the team component, in mass, interacts with other components; special application software is used that facilitates the reason for the interaction. Examples of these applications may include a GSS, DSS, or whiteboard when applicable. However, virtual teams do not constitute an "all-purpose silver bullet" (Sengupta and Zhao, 1998). While such teams may indeed be advantageous to use in unique situations, virtual is not always virtuous (Chesbrough and Teece 1996). For reader convenience, Appendix B is included, as a compilation of various advantages and disadvantages associated with virtualness is a business setting,

also included as Appendix C are 25 proven practices to optimize success in virtual interactions (Skyrme 1998).

Organization

While following one thread on a Virtual Organization discussion group, an individual put forth the idea that "An organization is perhaps virtual if it emphasizes projects instead of permanent organizational structures. Thus, Virtual Organizations might be minimally structured organizations in which multiple projects comprise the core activity" (VO Net 1998). Other ideas on what virtual organizations are says that virtual organizations are characterized as edgeless, with permeable and continuously changing interfaces between company, supplier, and customers (Davidow and Malone, 1992). They can also be considered as a temporary network of companies coming together in response to a market opportunity (Goldman and Nagel, 1995).

Clark (1998) gives the classic explanation of several traits of a virtual organization when he states that "virtual organizations have at least one of the following four characteristics relative to their individual units or members: geographic separation, functional specialization with separate reporting hierarchies (or including multiple firms), transitory membership driven by evolving needs over time, and separation of production across different time dimensions (e.g., shift workers performing the same task at different times)" (Clark, 1998:4). These traits fit in nicely with the concept that virtual technology is an essential enabler of virtual interactions. Clark further states that "one important aspect of virtual organizations for researchers in the field of information technology is that these organizations tend to be very communications-intensive. Thus information

technology, especially various forms of communications capabilities, has been critical in enabling the growth of virtual organizations" (Clark, 1998:5).

Arnold (1995) states that "A Virtual Organization is a form of cooperation involving legally autonomous companies, institutions, and/or individuals delivering a product or service on the basis of a common business understanding. The cooperating units participate in the collaboration primarily with their core competencies and present themselves to third parities as a unified organization, when delivering the product or service. In so doing, they largely dispense with the institutionalization of central management functions for shaping, managing and developing the Virtual Organization, through the use of appropriate information and communication technologies" (Arnold and others, 1995:185).

The virtual organization as defined above, is a conglomeration of other components presenting themselves to perspective customers as a unified organization. This includes the possibility that the virtual organization is comprised of some or all of the other virtual components. Therefore, the virtual organization may be comprised of multiple individuals, computers, teams, and other corporate entities. The differentiating factor is that the virtual organization is a legally autonomous entity that provides products or services based on component competencies and specialization. Management in the virtual organization will be responsible for forming components into virtual groupings (teams, individuals, and computers) that provide the most advantageous mix for reaching organizational goals.

This form of organization should not be confused with the organization that uses virtual technology or other interorganizational relationships. The virtual organization is a

group of components that cooperate and belong to a common identity based on shared objectives and strategies (Holland, 1998:56). Holland in his work on virtual organizations defines them as "a group of separately owned organizations that for specific group(s) of activities behave as if they were a single organizational entity and co-ordinate their behavior through relationships based on trust and shared information systems. The motivation for this type of behavior is to achieve competitive advantage by allocating resources and matching different capabilities, or core competencies, together in a more effective manner than through the traditional market/hierarchy dichotomy" (Holland, 1998:56). As with the case of virtual teams, the virtual organization has distinct advantages and disadvantages to the components involved, Appendix B is compilation of some of these concerns.

Table 2-4 is a summary of definitions and characteristics for virtual organizations from the preceding literature review. From this information is derived the definition of a virtual organization as a conglomeration of virtual components using primarily virtual technologies to interact and operating as a single entity to provide products or services to the customer. This definition integrates the important components of virtual organizations mentioned above with a focus on the customer. The customer, by this definition, may be part of the virtual organization or a separate independent entity.

Table 2-4 Summary of Definitions for "Virtual Organizations"

SOURCE	DEFINITIONS (VIRTUAL ORGANIZATION)
VO Net 1998	Emphasizes projects instead of permanent organizational structures might be a minimally structured organization in which multiple projects comprise the core activity
Davidow and Malone, 1992	Characterized as edgeless, with permeable and continuously changing interfaces between company, supplier, and customers
Goldman and Nagel, 1995	A temporary network of companies coming together in response to a market opportunity
Holland, 1998	A group of separately owned organizations that for specific group(s) of activities behave as if they were a single organizational entity and co-ordinate their behavior through relationships based on trust and shared information systems
Arnold and others, 1995	A form of cooperation involving legally autonomous companies, institutions, and/or individuals delivering a product or service on the basis of a common business understanding. The cooperating units participate in the collaboration primarily with their core competencies and present themselves to third parities as a unified organization, when delivering the product or service
Clark, 1998	Have at least one of the following four characteristics relative to their individual units or members: geographic separation, functional specialization with separate reporting hierarchies (or including multiple firms), transitory membership driven by evolving needs over time, and separation of production across different time dimensions (e.g., shift workers performing the same task at different times)

Customer

The addition of the customer as a component for virtual interaction is based upon the business aspects of many virtual interactions. The majority of interactions occurring in a business environment will have customer satisfaction at the root of the interaction.

Additionally, with the rapid growth of electronic commerce it is increasingly common to deal with customers and potential customers in a virtual setting. Since this thesis is both researcher and practitioner oriented the inclusion of the customer as a virtual component will help focus the primary purpose for many virtual interactions; namely to satisfy the customer by providing better products or services.

It is important to note that the customer may be an individual, a group, an organization, or any other entity requiring goods or services. The importance of the customer in a business respect is the realization that virtual interactions occurring between the supplier and the customer may be in a virtual fashion and that these interactions will be *fundamentally different* from interactions between other virtual components (e.g. individuals, teams, etc.). For instance, the customer may interact with a supplier through a façade known collectively as a virtual organization. Communications, responsiveness, and product support are all factors that must be considered differently in these examples.

In many respects, the customer is the foundational component in a virtual interaction. This perspective is important to keep in mind because in most cases a virtual hierarchy may be established to support the business hierarchy. The way the business hierarchy is interpreted begins with the customer as the basic unit. The virtual organization is the component that interacts with the customer to provide a product or service.

Supporting the business hierarchy is the virtual hierarchy, which is composed of teams and individuals and possibly other organizations that provide key competencies used by the virtual organization to support customer requirements. Hierarchically, the

individual relies on the computer component to mediate interconnectivity, information transfer, and in many cases product delivery to higher business components such as the team and/or organization. It is important to note that these business and virtual components may or may not operate virtually. The probability is that some mix of virtual and face-to-face interactions will take place under any given circumstance.

Types of Virtual Interactions

Since one purpose of this thesis to present a categorization schema that can be used to identify different types of virtual interactions, it is important to have an understanding of what is commonly referred to as virtual. Below is a list of the most commonly used and understood types of virtualness.

a) Virtual products and services; these often refer to commercial transactions taking place over the Internet such as material sales, and product services (Skyrme, 1998., Mahoney, 1995).

b) Telework; which is considered a legitimate form of virtualness by virtue of the mechanism (i.e. telephone, computer, etc) by which the individual teleworker interacts with other organizational entities. Using home PCs and modems millions of people around the world are working from home with minimal contact with a higher organizational structure except for assignments and deliveries (Pliskin, 1998., Stephens and others, 1998).

c) Virtual Offices are closely related to teleworking but includes office services, which are provided on a first-come first-serve basis. This allows various

locations to duplicate capabilities and personnel to use the most convenient office facilities (Skyrme, 1998).

d) Virtual Teams and Virtual Organizations, which, as the newest virtual structures, seek to leverage virtual technology in an attempt to provide better products and services to the consumer (Holland, 1998., Pickard, 1998).

e) Virtual reality is the final type of virtual interaction commonly used. Included with virtual reality is virtual gaming. The key factor in this category is that time has no meaning within these virtual realms. From a true reality perspective, time within virtual reality and gaming is imaginary. However, research in collaborative augmented reality is trying to bridge the time factor between reality and virtual reality (Ohshima and others, 1998). For the purpose of this thesis, all virtual reality concepts will exist in an imaginary time frame.

This is a brief overview of the different types of virtualness defined in today's literature. There are many other types of virtualness mentioned in the literature but not discussed in this thesis. The different types of virtualness mentioned in literature could fill a volume in itself and would add nothing to the direction this thesis intends to pursue. Sufficient to say that many types of virtualness exists in addition to those mentioned above are virtual communities, virtual dating, virtual business, and virtual meetings to name a few.

Finding commonality among the different types of virtualness is something that has not been widely attempted. However, one author working on a similar line of

research finds the following common characteristics in all types of virtual operation: (Skyrme, 1998)

- Use of information and communications technology to allow dispersed operations
- Reduced importance (even collapse) of time and space
- New kinds of networking organizational structures, often dynamic in nature
- Changing ways of interfacing with customers and markets
- New ways of working for employees and associates (business partners, suppliers, customers etc.).

This list reflects a narrowed perspective when applied against all types of virtualness. For instance, where would the concept of virtual gaming fit within this categorization? While the need to categorize and understand virtualness exists, any categorization schema that excludes current or possible future types of virtualness is incomplete.

Media Richness and Virtual Technologies

Tightly coupled to the technologies used in virtual interactions is the amount of information exchange possible with each. This concept is collectively studied under the heading of media richness and communications theory (CT). Communications theory is grounded in the hard sciences, such as engineering. It looks at the impact of such factors as bandwidth, channel capacity, and coding on the communication of information from sender to receiver. The basic premise is that C (capacity/Information) will increase as

S/N (Signal to noise ratio) increases or the bandwidth increases (McMullen, 1968: 250-251). While informative in direct applications of information exchange, these concepts do not lend themselves readily to model building for virtual interactions.

Because CT is unsuited for model development, this thesis will expand upon Media Richness Theory (MRT) which introduces "richness"—defined as the potential information-carrying capacity of data (Daft and Lengel, 1984:191-233). Several researchers (e.g. Daft, and others, 1987; Trevino, and others, 1987; Webster and Trevino, 1995) have proposed that media richness depends on whether the media gives the sender and receiver instant feedback, whether the media utilizes multiple cues, and whether the media uses natural language to convey natural subtleties. Face-to-face would be the richest medium since it encompasses all three of the areas and therefore would decrease ambiguity more quickly. Telecommunications is less rich since it uses two of the areas, instant feedback and natural language, but is very weak when it came to multiple cues. While written documentation is the least rich, since although it uses natural language, it is very limited in the cues that it produces and is very slow in the feedback it could provide to the communicators (Daft, and others, 1987; Trevino, and others, 1987; Webster and Trevino, 1995: 1546).

Media Richness of Interactions

Therefore, next factor that plays an important role in the concept of a virtual interaction is the richness of the virtual interactions. Media richness in this instance is the degree to which the virtual interaction simulates face-to-face interactions. In a face-to-face interaction, the individuals are able to hear verbalization, note facial expressions, and observe body language. Based on the receiver's perceptions, understanding, and

observations a plethora of important information can be exchanged. Another aspect of media richness is the importance of immediate feedback to the sender. Based upon these standards an understanding and analysis of the amount of information transferred over any given virtual technology would be beneficial. Unfortunately, such an analysis is beyond the scope of this thesis and is unnecessary for development of a taxonomy for virtual interactions. For the purpose of this thesis, the author supports the claim that there are degrees, or levels, of media richness associated with different types of virtual technologies as proven by contemporary MRT researchers such as Adams and others, 1998; Daft, and others, 1987; Palmer and Speier, 1998.

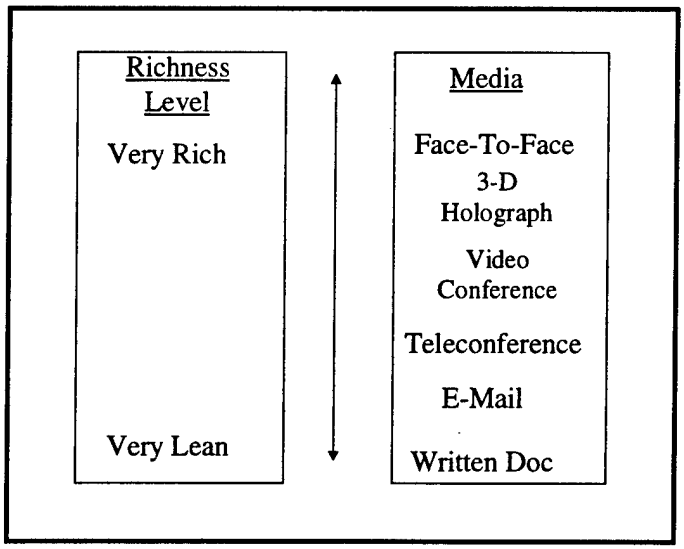

Figure 2-5. Richness Continuum

Media richness theory (MRT) is predicated on the notion that "individuals are able to identify highly equivocal situations and select a rich medium. Traditionally, face-to-face communication was thought to provide the richest communication environment.

In a more virtual context, there are fewer (and sometimes no) opportunities to meet face-to-face. Individuals may gravitate to GroupWare products to provide rich document sharing or rely on videoconferencing to increase the types of cues communicated across the medium" (Palmer and Speier, 1998:32). Figure 2-5 presents a medium richness continuum based on work accomplished by Adams in 1996. Adams proposed a continuum of media richness based upon the information carrying capability of several types of medium. Her original continuum included, from "leanest" to "richest," written interactions, email, telephonic, and face-to-face (Adams, 1996).

Figure 2-5 is a modification of this continuum based on current and possible future technological trends. Unlike Adams and others, (1998) who tested perceived media richness of several technologies empirically, this thesis will use technological capability as a basis for media richness. Since face-to-face interactions pass information both verbally and non-verbally, with the entire body adding to the non-verbal communication, this type of interaction is the richest with respect to information transfer and is the basis from which all virtual interactions are to be measured. By simplifying the continuum based upon technological capabilities, Figure 2-5 restates the richness of media based upon information sharing capability. Little difference is seen in the continuum with the written transfer of information as least rich and electronics based email as second. Next in the continuum is the verbal transfer of information, then the verbal and two-dimensional video sharing of information and finally the somewhat futuristic three-dimensional audio/video sharing of information. The latter could be seen in examples of full holographic imaging that may someday incorporate other senses besides sight and sound into the exchange of information.

Conclusion

From this literature review, it is clear that a consistent understanding of what in meant by virtual and virtualness does not exist. Various applications of these words leave readers confused and frustrated at the apparent lack of consistency. Additionally, there are several types of virtual interactions that occur using modern technology. The one consistent variable in the use of the terms virtual, virtualness, and the interactions they represent, is the use of technology to compensate for distance between interacting components. Another factor occurring on a regular basis is the ability of dispersed workers to interact in their own time frame on larger virtual tasks. These three factors, technology, space, and time seem to be important elements in describing and categorizing virtual interactions.

The literature also looked at different types of virtual interactions and the purposes for each. It was shown that the terms associated with virtualness are inconsistently used which causes confusion when discussing such concepts. The review also looked at Media Richness Theory (MRT) with respect to virtual technology and presented a modified media richness continuum based on work accomplished by Adam (1997). The literature review also explored important factors associated with virtual interactions. These factors were presented in terms of basic interactive components, namely individual-to-individual/computer, team/group interactions, and inter/intra organizational interactions. Appendix B presents several factors effecting each type of interaction and categorizes them into advantageous, or factors relating to success in virtual interactions, and disadvantages, or factors that lead to failure in virtual

interactions. While coverage of these individual topics is not exhaustive, it is presented for practitioner convenience and is representative of the different factors affecting each type of virtual interaction.

III. Model Development

If, as noted earlier, the use of technology is one defining factor in determining virtualness, then why, before the advent of computer technology, was the term virtual not used to describe early technologically mediated interactions? The use of technology to mediate interaction has been widely used for over fifty years in the form of telephone and radio communications. Yet, it is just within the last decade that the term virtual has been applied to technologically mediated interactions. The answer to this question seems to be that before the advent of the personal computer, technologically mediated interactions were not (and still are not for the most part) recognized as being virtual. Perhaps the likeness to reality experienced over telecommunications devices is not sufficiently close to reality to merit the title of virtual. This leads to the conclusion that media richness is (based on the virtual technologies used) a key factor in determining the degree of virtualness of an interaction. This is an important determination in developing a taxonomy for virtual interactions.

The dilemma becomes how to reconcile early use of virtual technologies (i.e. telephone and radio) with current virtual technologies. The type of interaction also seems to be relevant to determining "virtualness." For instance, early telephone interactions were person-to-person; later, computer technology was used to mediate group and organizational interactions in a virtual sense. All of these interactive techniques are/were used to bridge the space between the interactive components (space, being one of the key factors determined in Chapter 2 relating to virtualness).

The final variable effecting any model depicting virtualness must account for time as a factor. Time, in this instance, may have two dimensions, real and imaginary. In a real time dimension, technologically mediated interactions may occur real time (as in telephone conversations), or in a delayed sense (as in using an answering machine). An example of an imaginary time variable can be seen in virtual reality where time can take on any facet within the application or interaction. Consider the example of virtual reality gaming where time has meaning specific to the application being utilized. Viewed from within normal time/space reality this virtual reality time frame is imaginary, without correlation to the real world. The time frame within that virtual reality only has meaning within that reality, perhaps the beginning of the game is time zero, or 1 billion AD depending on the initial perspective of that reality. However, when the game is over real time reasserts itself whether the participant of the game played one day or one hundred years in the virtual reality of the game.

In summary, the three factors that must be accounted for in developing a model for virtualness are: first, *media richness* as determined by the degree of information transfer possible between interactive components, second, *space*, as determined by the distance between participating components, and third, *time*, consisting of real and imaginary and the delay in which technologically mediated interactions occur. All of these factors are dependent upon the technological bridge used by the virtual interaction taking place. Determination of these factors relative to one another, with virtual technology as the enabler or bridge for the virtual interactions, should provide a basis from which to build an accurate classification schema for virtual interactions. Before

proceeding with model development it is informative to draw together the definitions presented in Chapter 2.

Virtual - any simulated interpersonal or imaginary interaction between virtual components that is enabled by virtual technology.

Virtualness - a state of interaction involving at least two virtual components that is mediated by virtual technology.

Virtual Technology - any technology that enables interaction by entities across space and/or time.

Virtual Interaction - any action enabled by virtual technology between one or more virtual component.

Virtual Components – the primary (macro) business entities to which virtual interactions may convey information (computer, individual, team, organization, and customer).

Virtual Team - a collection of virtual components working together across space and or time using virtual technology, who interact because of interdependent tasks which are given direction by a common purpose that is of limited duration.

Virtual Organization - a conglomeration of virtual components using primarily virtual technologies to interact and operating as a single entity to provide products or services to the customer.

Virtual Reality - a type of virtual interaction involving the human and computer component in a technologically enabled setting that simulates multidimensional space and where time is imaginary or exists independent of reality.

Models of Virtual Interactions

Up to this time, a wide range of seemingly diverse and unrelated interactions, technologies, components, and factors have been discussed in describing the various types of interactions and technically mediated exchanges that have been labeled "virtual." This section is an attempt to develop a conceptual model from which practitioner and researcher alike can identify the type of virtual interaction occurring. The primary advantage of this work is to allow practitioners and researches to recognize the diverse types of interactions called virtual and to determine the type(s) that are appropriate for any given business situation.

This section will integrate the information presented in the literature to provide a comprehensive and succinct picture of the different types of virtual interactions possible. The resulting information may then be used by interested parties in determining the appropriateness of each virtual interaction to a given situation and as a basis for researchers from which to develop specific areas of research within the larger umbrella classified as virtual interactions. The presentation of this information should result in a realization that not all virtual interactions are the same and that certain factors have higher correlations to success or failure depending upon the type of virtual interaction being investigated.

Individual Virtual Interactions

Figure 3-1 provides the basic model used to develop a graphical depiction of virtual interactions between the components defined earlier in this thesis.

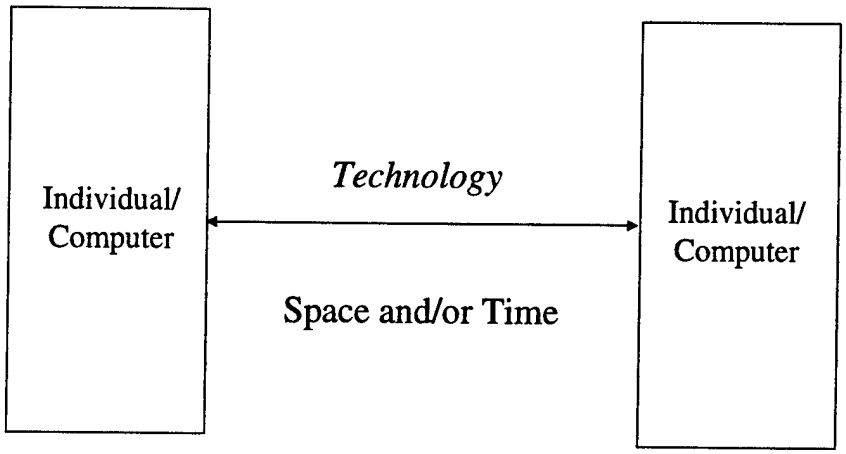

Figure 3-1 Basic Virtual Interaction

Figure 3-1 shows the two basic virtual components interacting in a virtual environment. This is the basis for all higher level interactions. The individual/computer is interacting with counterparts in a virtual fashion. The importance of this figure is the fact that technology is the medium used to bridge space and/or time. This means that all face-to-face interactions unmediated by technology are excluded from the title of "virtual." It also means that any other interaction from a real time telephone conversation where technology bridges only space to collaborative information sharing across continents and time zones where technology bridges both space and time are, technically speaking, virtual interactions.

Virtual Teams

Composed of individuals, the virtual team is the next component that uses technology to bridge space and/or time. If the individual and computer are the foundation of the virtual hierarchy, then the virtual team is the frame and support structure. As such the virtual team is the smallest group interacting through virtual technology that can achieve significant synergy through the interaction. Figure 3-2 below is a representation of the conceptual layout of a virtual team. As defined earlier, the virtual team is comprised of lower level virtual components such as computers and/or individuals. However, these components may be part of a larger structure such as a corporation or organization. This group interacts to achieve a common purpose, each working on interdependent tasks required to accomplish the team's purpose.

It is important to note that the appropriateness of the technological fit can determine success or failure in these endeavors. Where a simple teleconference may be sufficient for some interactions, it may be necessary to have media rich interactions when important topics or key decisions are being discussed. The determination of technological fit and appropriateness is an area that warrants further research with respect to virtualness and virtual teams.

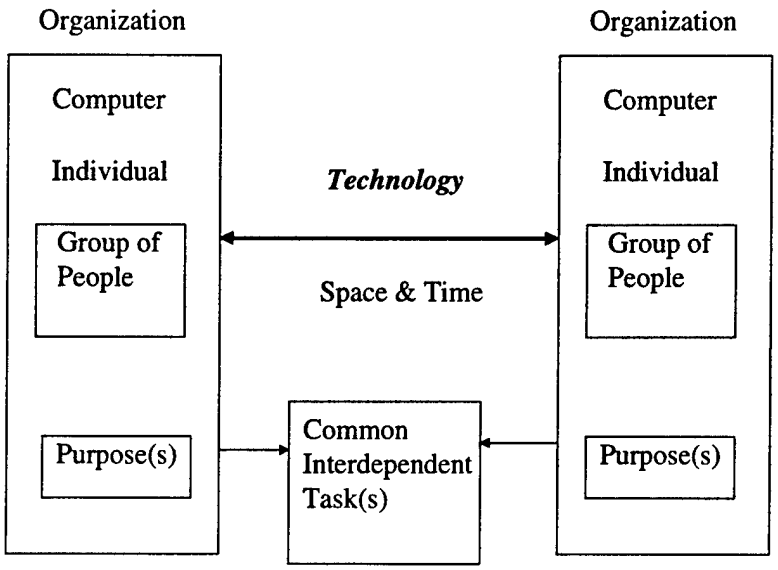

Figure 3-2 Virtual Team

Purpose of Virtual Teams

Stamps and Lipnack (1997) recently published a book dedicated to the topic of virtual teams. In a recent interview about the book the interviewer asks why in the introduction they say that they do not discuss the various reasons that virtual teams are formed. To this question Lipnack replied that they omitted the reason in order to do away with the argument that virtual teams are formed only to do X, Y, and Z. Lipnack says: "I've had people say to me, 'Software-development teams are the only teams that are truly virtual.' Well, that's patently ridiculous. Every team that needs to work together and whose members are more than 50 feet apart is a virtual team" (Pape, 1997:1). Stamps further states that people form virtual teams for "every reason under the sun" (Pape, 1997:2). Such reasons may be because the technology is available or because of the advantages of working with people at a distance. The most likely reason is that the expertise they need is not all in the same place (Pape, 1997).

There may be validity in this approach to defining (or not defining) the purpose of virtual teams. However, it seems important that several additional advantages from the literature review accomplished previously be incorporated into this section. From a telecommuting perspective there are definite advantages to working from home, especially seen in the perspective of flexibility of schedule, commuting time saved, and family involvement to name a few (Stephens et. al., 1997). Additionally, the ability to work with a global virtual team allows unique perspectives from diverse participants that was difficult, if not impossible, to obtain before the advent of virtual technology and the formation of virtual teams.

Virtual Organization

Figure 3-3 is a graphical representation of the final two virtual components defined earlier. The customer, as the foundational entity in the virtual business interaction, interacts directly with a unified front or façade known collectively as the Virtual Organization. The box around the virtual components in Figure 3-3 represents the unified façade presented to the customer. In this instance, the virtual organization is comprised of different business entities, each providing core competencies to the larger virtual organizations. Core competencies may be different things for different components. For the individual it may be his/her specialty and the associated information they supply to the virtual organization. The institution may provide financial resources while the traditional organization may supply support, technology, and personnel services. This allows diverse entities to contribute specialized ingredients to successfully fulfill customer requirements.

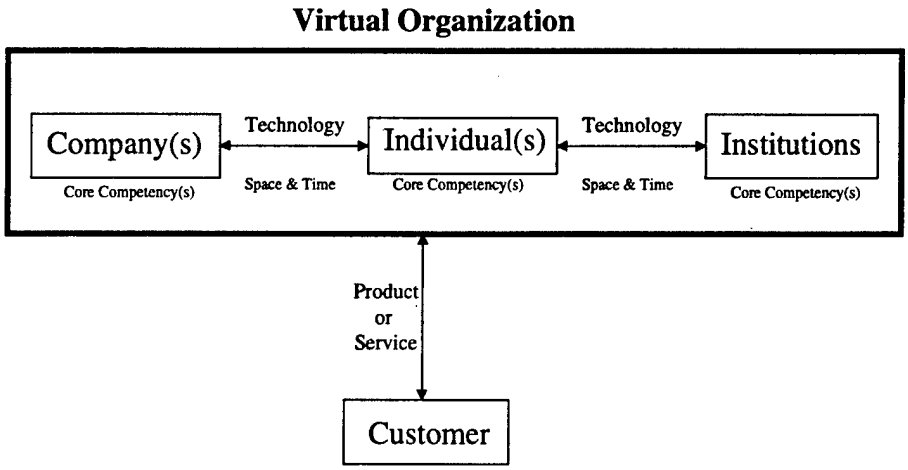

Figure 3-3 Virtual Organization

As with the other components of virtualness, the virtual organization builds on the technologies and functionalities inherent in the lower order virtual components. Therefore, the virtual organization may have several different organizational structures dependent upon the components involved. Companies that work completely in a distributed mode, with employees located individually around the world characterize one type of virtual organization. The employees and management only meet periodically at hotels and similar facilities. Some literature refers to these virtual organizations as virtual corporations. Virtual corporations are characterized as alliances formed by multiple firms for a specific purpose. The firms may cooperate on one project and compete on others. The virtual corporation may be divisions of large firms, alliances of small firms,

or mixtures of the two. A particular firm may be a member of several virtual firms (Goldman et. al 1994).

Media Richness/Components Model

Research accomplished up to this point has been largely foundational in an attempt to gather the different definitions and factors important to the concept of virtualness. After analysis of this data it appears that no single model will adequately catagorize virtual interactions. The reason a single model is insufficient is primarily due to the many types of interactions that may occur, the diverse components involved in the interactions, and the important factors that must be accounted for such as time and space. For this reason two models should be used in catagorizing and describing virtual interactions: one model will be used to delineate the level of media richness involved in the virtual interaction, and the other will be used to delineate the time factor relative to the sender and receiver. Both models rely heavily upon the definitions compiled earlier in this section and upon the relevant factors mentioned. This section of the thesis will describe the first model based upon the concept of media richness of the virtual interactions taking place. The next model, presented in the following section, relies heavily on the time plane of the virtual interaction to differentiate between types. Using these two models will allow practitioners and researchers to specifically define, catagorize and reference the precise type of virtual interactions of interest.

Figure 3-4 below is a graphical representation of the Media Richness/Components Model of Virtual Interactions. The components for convienience are shown on the face of two three-dimensional blocks. Each three dimensional block has identical characteristics but are physically separated from each other to represent the technological

bridge that, by definition, separates all virtual interactions. The width of the shape is segmented into quadrants with each virtual component assigned the three-dimensional quadrant as representing their respective spheres of direct influence. The depth of the shape is again segmented into quadrants that represent the degree of media richness associated with each depth quadrant.

For convenience each of the depth quadrants is assigned a degree of virtualness based on the media richness associated with the virtual interaction. These degrees of virtualness are based upon face-to-face interactions. In face-to-face interactions the components can not only hear the information, but see the other components in three dimentions. This allows an extremely rich interaction that exchanges many types of information to the sensory inputs of the receiver.

The first order virtual interaction, denoted 1st Order VI in figure 3-4 and notionally written as 1VI.[1], is high in media richness. This virtual interaction is directly below a face-to-face interaction in the amount of information exchanged. Technologically it can be thought of as using a true three-dimensional holgraphic interaction much like that shown in popular science fiction genre. This type of interaction, although not currently supported by technology, would offer a rich virtual experience that closely simulates face-to-face interactions. Also falling into 1VI is the realm of virtual reality and virtual gaming. Current virtual reality technology supports stereo sound, three-dimensional realms, and in many cases movement as part of the

[1] As a note of convention, whenever the notation XVI (where X is the order/degree designator) is used it is read as an X order Virtual Interaction. For instance, 2VI is read as a 2nd order Virtual Interaction.

virtual reality experience. As technological capabilities increase, the possibility exists to involve other senses in the experience.

The second order virtual interaction or 2VI is what many business entities think of as cutting edge technology. This is the exchange of limited video such as camera shots of participants faces and torsos, stills of briefing slides, video clips, multimedia presentations, and in some cases interactive virtual applications such as whiteboards. Notionally this is represented in figure 3-4 as video teleconferencing, which refers to the use of both audio and video to produce media richness. 2VIs are technolgically feasible and the basis for most virtual architectures being conceived and developed with respect to bandwidth requirements, memory requirements (both static and dynamic) and processing capabilities. The power of 2VIs will greatly increase as applications supporting them become more powerful. 2VI applications that allow virtual knowledge sharing are still relatively rare. The use of distributed computing, and shared information resources are foundations from which true virtual applications that allow virtual components to seamlessly interact will be developed. An example may be a real time product design virtual team. They may be geographically on different parts of the Earth, but using the proper application(s) have the capability to design, modify, and simulate use of their product. All this is done with real time input from all virtual components.

3VIs have been widely used since the advent of telecommunications and radio. It denotes the use of any audio technology without the use of video. Because the media richness of video is not included, this virtual interaction is 3rd order. It is important to note here that within each order of virtual interaction there may be different virtual components and levels. For example, a worldwide teleconference with several dozen

participants would have a higher degree of virtualness than a simple person-to-person telephone conversation which in turn would have a higher virtual content than a simplex type audio technology such as radio. With the advent of the computer era (beginning in the 1970's) the power of 3VIs have dramatically increased. Pagers and Personal Communication Systems (PCSs) are both examples of how the capabilities of these types of virtual interactions have grown.

The final order of virtual interaction defined in this model is the 4th order virtual interaction or 4VI. This is reserved for virtual interactions involving the exchange of written media. This does not have any visual or audio media richness involved in the interaction. E-mail and FTP are common applications that support this type of virtual interaction. All written exchanges of information will also fall into this category and may be defined as non-electronic 4VI. The distinction is important because of the history and prevelance of non-electronic 4VI vs. the relatively new nature of electronic based 4VI.[2]

Categorizing virtual interactions should be relatively easy using this model. Whenever virtual components interact the highest level (with respect to media richness) of virtual interaction occuring determines the degree of the virtual interactions. As an example suppose an individual receives an email containing an audio voice file describing some aspect of a shared project. At first glance this would be a 4VI. However, because of the exchange through voice media it becomes a 3VI. From a practitioner or researcher perspective the focus would be upon the type of virtual

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[2] No further discussion will be made of non-electronic 4VI. The discussions and taxonomy presented will focus on electronics based virtual interactions enabled by modern advances in electronics media and interchange technologies.

interaction of interest, either the 3VI or the 4VI. But, technological architectures would be based upon the highest degree of virtual interaction requiring support.

The arrows occuring in figure 3-4 are examples of some of the types of virtual interactions that can occur between the various components. There are no restrictions placed upon these interactions. Although not shown, it is conceivable to have an interaction begin as 2VI and be received as 4VI. This may occur in cases where proceedings from a video teleconference are transcribed into a written document at the receiving terminal. Although not widely used, this capability exists within many current video cards. Interaction 1, denoted by the double arrowed line labeled 1 in figure 3-4, shows the futuristic possibility of artifical intelligence that generates holographic representations for interaction with other virtual components. This is currently a product of science fiction but may well occur as improvements are made in technology, artificial intelligence, and the need for more robust human computer interactions occur.

The other virtual interactions depicted in figure 3-4 are self-explanatory when understood in light of previous descriptions. Interaction 2 is a 2VI occuring between the individual components. An example would be a video phone conversation. Interaction 6 is an example of a 4VI where the customer component interacts with the organizational component through a written media such as email. Again, it is import to reiterate that any conceivable virtual interaction may occur between quadrants. The value of this effort depends upon depicting all past and all future interactions that may occur.

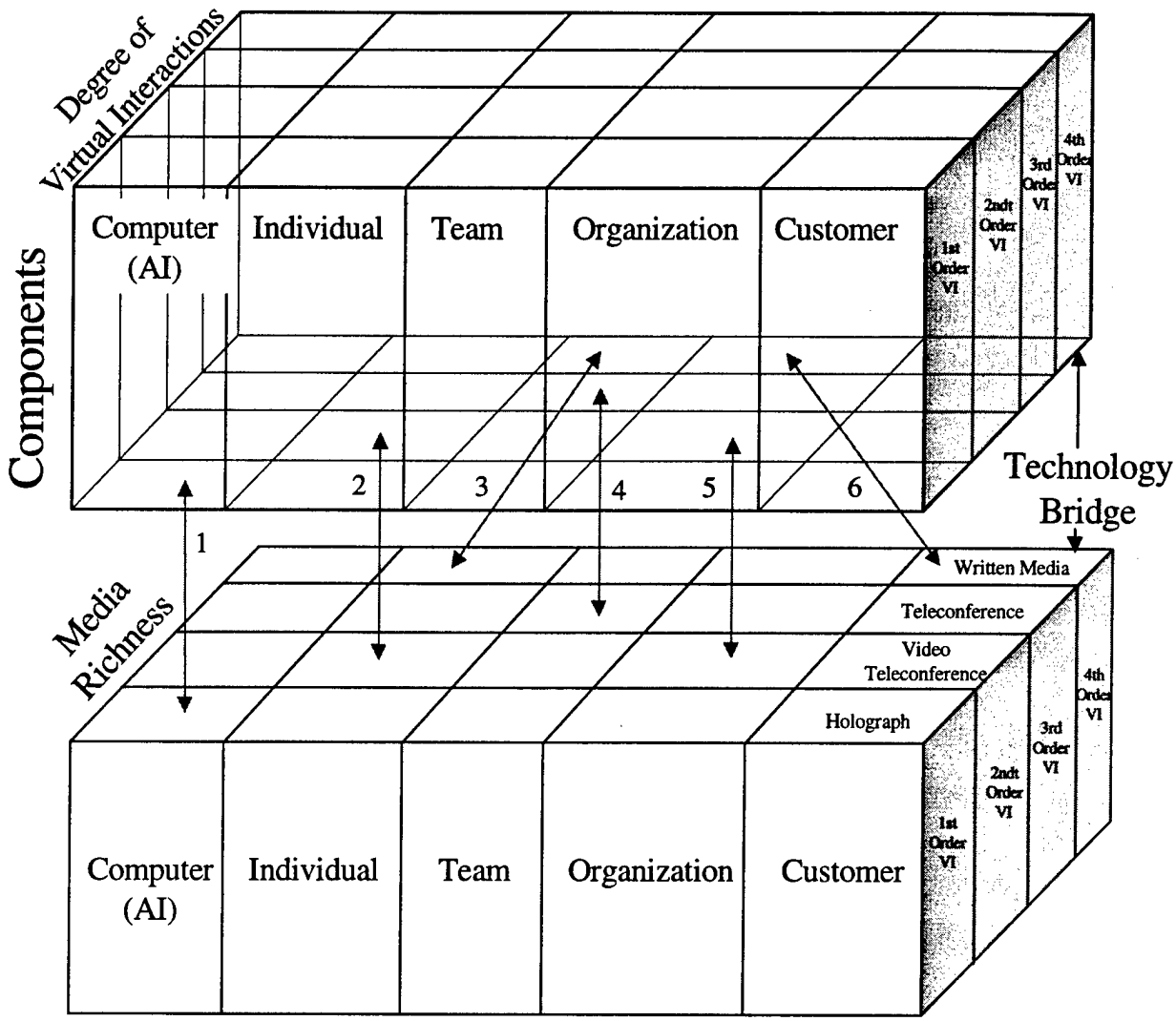

Figure 3-4 Media Richness/Components Model

Time Relationship/Components Model

Although media richness is a key factor in model development, it is not the only factor that has value when explaining virtual interactions. Because virtual interactions take place over a technological medium it is conceivable that time delays can occur within a given interaction. In fact, as shown in the literature review, this is one of the major advantages to virtual interactions. The ability to interact with any component

located anywhere in the world in a component's chosen time frame. This time factor makes it important to model virtual interactions in this setting also. From a business and technological perspective practitioners and users of virtual technology must understand that the social interactions taking place in same time different place virtual interactions are different from the social interactions occurring in different time different place interactions. A first observation may conclude that these distinctions apply to only 3VI and 4VI. However, as technological capabilities increase it is reasonable to assume that stored holographic interactions may be played at any time much as a message left on an answering machine is used currently.

Figure 3-5 is the Time Relationship/Components Model of virtual interactions. This model provides additional and critical insight needed to accurately categorize and study virtual interactions. As with the Media Richness/Components Model of virtual interactions the Time Relationship/Components Model shows the virtual components on the face of two three-dimensional blocks. Each three dimensional block has identical characteristics but are physically separated from each other to represent the technological bridge that, by definition, separates all virtual interactions. As in the Media Richness/Components Model of virtual interactions the width of the shape is segmented into quadrants with each virtual component assigned the resulting three-dimensional quadrant as representing their respective spheres of direct influence. The depth of the shape is again segmented into quadrants, but instead of representing degrees of virtualness based on media richness, they now represent the time factor. Instead of four divisions the time component model is segmented into two divisions representing real time interactions and time delayed virtual interactions. It is important to note that these

divisions are not based on time scale, but are graphical representations of their respective time spheres. This means that any virtual interaction not occuring real time is calssified as a time delayed virtual interaction.

In addition to the divisions described above is an area on the time continuum that represents imaginary time. This is defined as any virtual realm or interaction where time is not based in reality. Examples of this are virtual reality and virtual gaming where the virtual environment establishes the time domain for their respective users. This time sphere is only relative to that virtual interaction and has no meaning in a real time domain. The imaginary time domain is also applicable to applications that attempt to simulate real time as a method for realism.

Where the Media Richness/Components Model of virtual interactions showed virtual interactions as being bi-directional within each quadrant, the Time Relationship/Components Model has a definite well-defined initiator or sender and receiver for each virtual interaction. The relevance of this distinction is to establish a baseline in time from which to measure delays in virtual interactions. Because time zero for a virtual interaction begins with the sending component, some time later the receiving component receives information and acts upon it. Delay is therefore defined as the amount of time relative to the sender's time zero that elapses before the receiver receives the information associated with that segment of the virtual interaction. An example may be a virtual team comprised of components located around the world. An individual team member may use a 4VI to contact another member of the virtual team. If the 4VI is in the form of an email the receiving team member may not open that email for several days.

The delay may or may not be significant in the example above. What is important is the fact that this delay will have an impact on the virtual interaction. Real time virtual interactions, of any degree, for example, are those in which immediate feedback from the interacting components is available. This is important to both practitioner and researcher since the methods of the interaction both technically and socially will be different. Therefore describing a real time 4VI (RT/4VI) might consist of a chat application while a time delayed 4VI (TD/4VI) might use email as the application of choice. The lines labeled 1 and 2 on Figure 3-5 show the above situation for a team-to-team and a team-to-individual situation respectively. This line of reasoning is applicable to all degrees of virtual interactions and between all components.

As alluded to earlier, the time delayed virtual interaction is one in which immediate feedback is not available. These types of interactions may involve distributed work environments where knowledge bases are used to retrieve previously stored pieces of information in any relevant subject area. Another example of the time delayed virtual interaction is individual telework where assignments are made electronically with due dates set by at higher component level. This type of interaction may occur over email and would be denoted as TD/4VI or, left on an answering machine and be denoted as TD/3VI.

The advantage of this methodology is that researchers and practitioners can investigate or design information systems that cater to the highest common factor associated with any virtual interaction. Delineating the time relationship involved in an interaction and the associated components will help focus other factors of a social and technical nature that may not be readily apparent without time delineation. One final

example to illustrate the point is labeled 3 in Figure 3-5. This represents a real time virtual interaction between individuals. Depending upon the technology used it could have any virtual order associated with it. In a future scenario where holographic imaging may be common place, the interaction would be designated as RT/1VI.

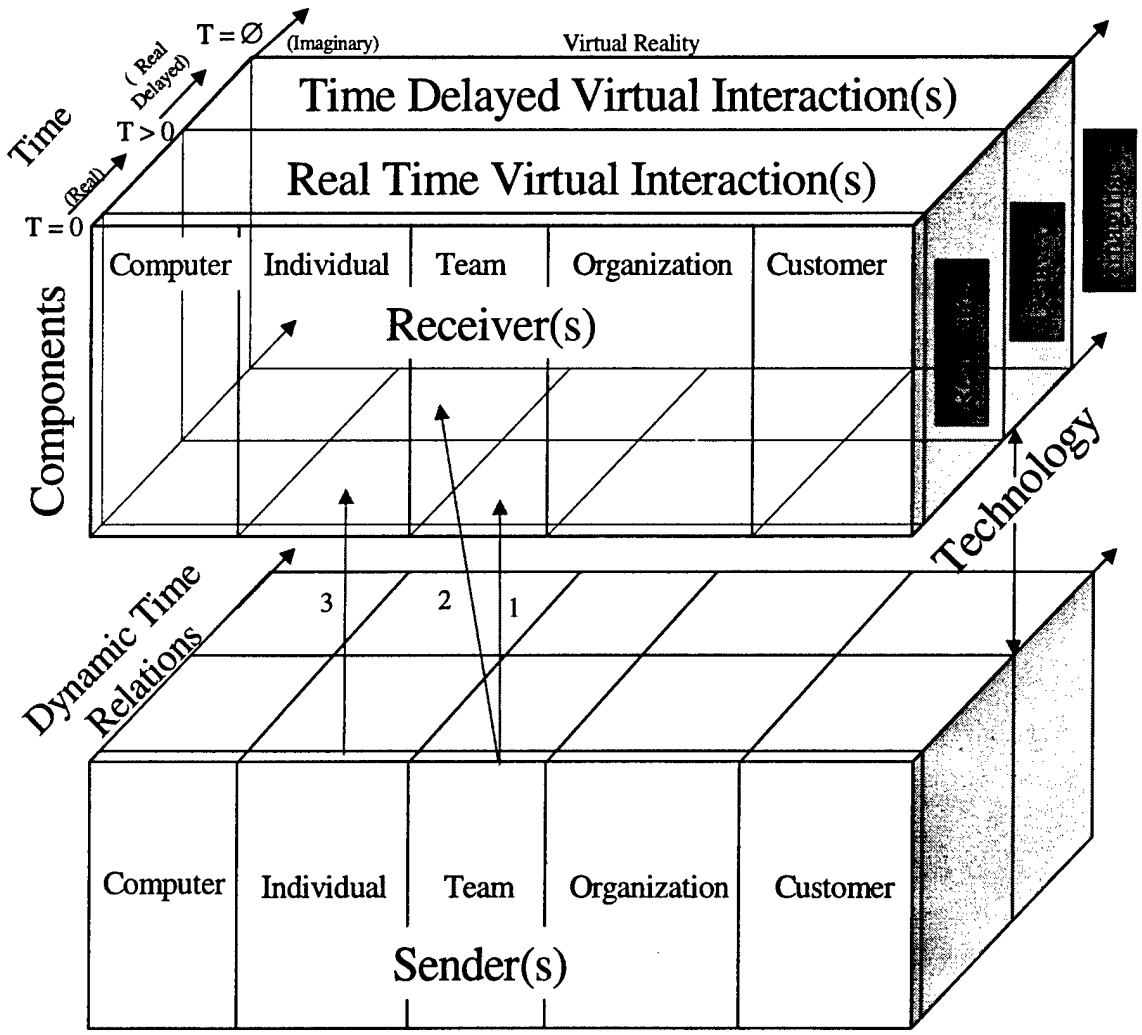

Figure 3-5 Time Relationship/Components Model

Table 3-1 below summarizes the nine types of virtual interactions that are possible based on the analysis of this thesis. The table also gives an example of the types of

technologies that may be used to mediate each type of virtual interaction. These examples are not meant to be exclusive to any class of virtual interaction. They are merely examples of technologies that may enable each type of virtual interaction.

Table 3-1 Summary of Virtual Interactions

		Degree of Virtual Interaction			
		1VI	*2VI*	*3VI*	*4VI*
Time Aspect of Virtual Interaction	*Real Time (RT)*	Holograph	Video Teleconference	Telephone	Chat
	Time Delayed (TD)	Holograph	Computer Based Training	Answering Machine	Email
	Imaginary (I)	Virtual Reality	N/A	N/A	N/A

To conclude this chapter of the thesis a suggested notation for designating each type of interaction is presented. The notation is based upon the intersection of the degree with the time factors used previously in describing virtual interactions. The following is a complete list of designators along with their respective meanings.

- RT/1VI – Real time first order virtual interactions
- RT/2VI – Real time second order virtual interactions
- RT/3VI – Real time third order virtual interactions
- RT/4VI – Real time forth order virtual interactions
- TD/1VI – Time delayed first order virtual interactions
- TD/2VI – Time delayed second order virtual interactions

- TD/3VI – Time delayed third order virtual interactions
- TD/4VI – Time delayed forth order virtual interactions
- IVI – Imaginary virtual interactions (always denotes first order)

Using these conventions, the problems associated with confusing definitions relating to virtual interactions could be brought to an end. These designations will help both practitioners and researchers to focus on appropriate virtual technologies and identify the critical factors that will determine success or failure in each instance.

IV. Application and Conclusion

Implications to Virtual Technology Researchers and Practitioners

As stated throughout this thesis the term "virtual" has been used to describe various types of interactions that occur. In most cases, the interactions describe interactions that are enabled by some technological medium. In other cases, the term virtual has nothing to do with technology and is a popular buzzword used whenever a particular wordsmith desires for whatever reason. This thesis has been an attempt to logically conceptualize what is meant by the term "virtual" from a technological standpoint. It has stated the underlying reason for the research as an attempt to support the JIVA Program Office by identifying the operational forms for virtual interactions.

From a conceptual perspective, the purpose of this thesis has been achieved through identification of the nine possible forms of virtual interactions. However, much more research must be accomplished to accurately identify and categorize critical factors associated with each virtual form. Proper use of this information should help the JIVA Program Office to achieve success in the following five objectives as stated by the JIVA Program Office:

- Improve the quality of analysis, and utility of intelligence products.
- Provide specific and tailored intelligence to enhance the warfighter's ability to visualize the battlespace and ensure total operational awareness.
- Reduce or eliminate unnecessary redundancy and duplication.

- Strengthen information and production management and ensure policies, procedures, concept development, training, and technical-human engineering to assist operations within a new information environment.
- Explore and examine very advanced technology and concepts for the future.

These same ideals can be applied to many different practitioners and users of virtual technologies. The basis for success must lie in understanding what type of interaction is being dealt with. Only then can identification of success factors and possible problems be accurately determined. Trying to correct problems and achieve success in virtual interactions without this basis would be haphazard at best.

From a researcher perspective, this thesis provides a basis from which to expand into lower lever or more detailed research topics. Many of these can be applied to and from other areas of research, but many are unique to virtual interactions. These research areas will help lay the foundation for virtual interactions into the 21st century. As technological advances increase the need to have a foundational understanding from which to work is critical to avoid repeating past mistakes and misutilizations of virtual capable technologies. The researcher's function is to guide the use of this technology through research into the various types of virtual interactions possible to determine the following:

- In what circumstances each type of virtual interaction is appropriate?
- What technologies, such as networking and computing are most appropriate for each type of virtual interaction?
- What type of applications/data management systems best supports each type of virtual interaction?

- What type of critical success factors is associated with each type of virtual interaction?

These are a few of the types of research that would be invaluable for practitioners if properly performed.

Lessons from models

Many lessons and conclusions can be drawn from the various models presented in this paper. The most important lesson of these models to the reader should be the realization that there is more than a single type of virtual interaction. This will allow researches and practitioners to focus efforts relative to each type of interaction. In the case of the researcher, the focus may be on understanding what factors are important in each type of interaction. For the practitioner the focus may center on the types of virtual interaction(s) that would support a given endeavor. Either focus can provide valuable information to the interested parties.

Based on the conclusion that more than one type of virtual interaction exists, then following one more logical iteration, leads to the determination that for each type of virtual interaction different factors are important in determining the outcome. These factors are of critical importance if the use of virtualness, in a business setting, is to be effective. It is also important to the continued development of the technologies that support these interactions to understand what factors are important to each. The possibility exists for technology to help minimize undesirable factors and enhance supportive factors using innovative hardware and software design.

The final realization for the reader should be that to have successful virtual interactions it is first important to identify what type of virtual interaction it is and the components involved. Only by determining the specific type(s) of interactions and the components used in each circumstance can an empirical study of effectiveness and commonality be made. Such studies could prove invaluable in diverse areas of research such as human computer interaction (HCI), organizational behavior, computer science, engineering, and many others. As a basis for these types of research the results of this thesis will be invaluable.

Application to Real World Scenario

The goal of this thesis was to develop a foundational model of virtual interactions that would provide structure to a chaotic world of virtualness. Application of the models to real world scenarios should provide structure and direction to practitioners from which to determine the type of virtual interaction appropriate to a given need. Unfortunately, this thesis in and of itself is insufficient for that requirement. While providing a sound foundation upon which to build, it does not provide the level of detail necessary to determine appropriate virtual interactions in a given circumstance. It can however be a beginning point in the thought process of what virtual interactions entail and what type(s) may be appropriate to a given need.

DoD Intelligence Community

For the DoD intelligence community, this thesis provides a blueprint from which to help subordinate organizations determine their individual virtual requirements. For instance, any give intelligence organization may require the capability to collaborate virtually using video teleconferencing. Furthermore, the requirement may exist to collect all such interactions to share with other intelligence organizations at different times. This requirement may be driven by various factors unrelated to the subject of this paper but supporting intelligence community strategic operations.

After determination and validation of the need for a TD/2VI the JIVA Program Management Office (PMO) would need to determine the available COTS or GOTS applications that would support this requirement. The JIVA PMO could then design and the required hardware suites including network interconnectivity and bandwidth to support the required interaction. The comparison of these determinations with what the given subordinate intelligence organization currently has would constitute the required architectural upgrade(s) needed to support the requirement.

Supposing the architecture is approved installed and tested the next step would be a determination (again based on a TD/2VI) of critical factors relating to this type of virtual interaction. As stated previously, this thesis provides a basis for categorization of the virtual interactions but not the in-depth research needed to answer specific questions about each type of interaction. It would be in the best interest of practitioners to sponsor further research in these areas (see suggestions outlined later in this chapter) so that a detailed picture will emerge concerning virtual interactions and the important factors effecting each type.

Limitations of this thesis

One of the primary weaknesses of this research is in the lack of empirical evidence to substantiate the possible types of virtual interactions presented and the applicability of each. However, before the presentation of this thesis any attempt at meaningful empirical research, in this area, would have been without directed focus or scope. Using this thesis as a basis will allow empirical investigation of the different types of virtual interactions, their applicability to given requirements, and the factors of importance to each. Another weakness is the lack of depth when delineating important factors relative to each virtual interaction. Although some of the factors such as trust have been well investigated (broadly speaking) from many academic disciplines, other factors such as time displacement between interactions have had little research attention. Again, this research must be foundational in a focused approach to these types of investigations.

Another major weakness of this thesis is the need to broadly cover important issues relative to virtual interactions. Differences (such as technologies used specifically for each type of interaction, what the best technological configuration or process can or should be used, and how the technology should be used) exist that must be understood before effective virtual interactions can consistently occur. The lack of details relative to some factors may lead the reader to assume that they have little or no relevance to virtual interactions. This is certainly not the case. The better understood the factors associated

with virtual interactions are the higher the probability that successful virtual interactions will occur. The reader should remember that this is a foundational study and as such is meant to provide an overarching framework that will accurately and methodically categorize all virtual interactions. By so doing, a common understanding of terms and ideas will occur allowing more methodical structured research in the area of virtualness.

Although the intent of this research was to provide an overarching framework that would describe and categorize all virtual interactions, the value of this work will come from applying it to the micro components making up each type of virtual interaction. The need to methodically investigate each factor and modify the overarching framework will allow these models and theories to become foundational in the field of information technology. Subsequent benefits to practitioners and business entities could prove invaluable.

Areas of future research

Based on the order of the virtual interaction involved and upon the factors determining success and failure of the interaction it should be a simple matter to begin research in the various areas presented by this thesis. As solid research is applied to the individual aspects of the broad framework provided here, it should solidify and modify the workings of virtual interactions in the modern business setting. Additionally, the framework provided would allow for future technological growth and innovation as

three-dimensional holographic technologies are developed that provides for media rich interactive experiences.

As mentioned in Chapter 3, the basic components of virtual interactions are generally hierarchical. This premise can be used to develop the foundational success factors such as technology, trust, and management that must be applied correctly at each level to ensure successful virtual interactions. Future research should be done to determine the precise amount of commonality and differences between these factors and each level of virtual interaction. For instance, from a technological perspective what additions (or deletions) would provide a better fit for the virtual team as opposed to the individual virtual interaction. Contrast these to the virtual organization and the emergent picture provides a detailed picture of this aspect of virtualness. This same approach applies to trust between individuals interacting virtually, as opposed to virtual teams and virtual organizations. What differences and similarities exist? What factors are important to successfully establish trust? Are these factors the same for individual virtual interactions, for virtual team interactions, and for virtual organization interactions?

Those factors mentioned above (technology, trust and management) are by no means the only factors important in virtual interactions. Many other factors exist, some are described and discussed in the literature review, and some are not. Future research could focus on determining these factors for virtual individual interactions, virtual team interactions, and virtual organization interactions. Again, the comparison and contrasts between the factors and the types of interactions could help practitioners use virtual interactions more advantageously and with a higher success rate. This information could

also be applied by researchers to other types of electronically mediated interactions that may not fall within the realm of virtualness.

Another area of research is the exploration of management functions for virtual individual interactions, virtual team interactions, and virtual organization interactions. Because of the dynamic and unique nature of managing virtual interactions, research in this area would be interesting and valuable. Determining the areas of expertise that virtual managers must posses, the employee characteristics for employment in virtual organizations, and the degree of technical expertise needed are all areas of possible exploration on this topic.

Conclusion

The ultimate purpose of this thesis was to provide the JIVA program office a framework under which to classify and identify virtual interactions applicable to the DoD intelligence community. Use of the taxonomy provided in Chapter 3 would allow the JIVA program office the ability to identify the virtual interactions appropriate and applicable to any given intelligence function. As a result of this identification the program office could identify standardized applications and architectures appropriate for each type of interaction. Additionally the program office can use this information to commission further research into the specific types of interactions. Such research may focus on critical success factors like trust, management, and leadership.

Identification of the primary factors applicable to categorizing virtual interactions, will help focus researchers in exploring the way the factors individually and collectively influence virtualness. These factors are first, *media richness* as determined by the degree

of information transfer possible between interactive components, second, *space*, as determined by the distance between participating components, and third, *time*, consisting of real and imaginary and the delay in which technologically mediated interactions occur. All of these factors are dependent upon the technological bridge used in the virtual interaction taking place.

Using these classifications will provide a basis for further research in the realm of virtual interactions. These designations will help both practitioners and researchers to focus on appropriate virtual technologies and identify the critical factors that will determine success or failure in each instance. Above all, this taxonomy will provide a foundation upon which to build a coherent, sustained, and directed study of virtual interactions that will result in improved integration of technology into organizational strategic plans. Such integration will optimize financial outlays for information technology and produce the maximum benefits for all virtual components involved.

Appendix A

Excerpts from the

INTELLIGENCE AUTHORIZATION ACT FOR FISCAL YEAR 1997

Creating a "Virtual Intelligence Architecture"

The Committee supports the Intelligence Community's initial efforts towards creating a "virtual intelligence architecture" that will link collectors, exploiters, analysts and intelligence customers electronically. The Committee believes that a virtual architecture will transcend organizational boundaries and, by providing more flexibility and less bureaucratic rigidity, electronic connectivity will allow the policy and intelligence communities continually to reevaluate requirements and refocus resources on those issues of paramount importance. Breaking down these boundaries will help synergy in all areas of the Community---collection, analysis, production and requirements formulation and vetting. Programs such as INTELINK and Joint Intelligence Virtual Architecture (JIVA) are harbingers of an era where collaborative reporting will be the standard among analysts throughout the Intelligence Community.

As the Intelligence Community moves towards implementing a virtual intelligence architecture, however, it must thoroughly examine what effect this will have on the Intelligence Community's traditional production and management procedures and "culture." Currently, Intelligence Community managers-situated at the top of a vertical, hierarchical structure-largely control the information flow to and from policymakers. In a virtual intelligence architecture, managers will probably have less direct control over the

information flow. Instead, they will act as facilitators who monitor the dialogue between policymakers and substantive experts to ensure that Community resources are appropriately allocated to priority tasks and to help say "no" to requests when resources are not available.

The Committee believes that the Intelligence Community must begin now to prepare for the issues and problems that may arise as analysts increasingly communicate electronically-with less management supervision-with policymakers, collectors and other analysts. The DCI's Non-Proliferation Center (NPC)---as an IC Center that works intimately with policymakers and other Intelligence Community components and as a Center that has been more "forward-leaning" in utilizing electronic communications resources than most other Community offices and Centers-would serve as an excellent test-bed for examining the management issues that are likely to arise under a future virtual intelligence architecture. Accordingly, the Committee requests that the Community Management Staff, working with the Director of the NPC and the head of the Intelligence System Secretariat, supply to the Director of Central Intelligence a report addressing the questions outlined below. In compiling the research for this report, input from managers throughout the Intelligence Community should be sought. The Director of Central Intelligence shall forward this report to the congressional intelligence committees by March 15, 1997. The report should address the following questions:

- What "cultural" and procedural hurdles will Intelligence Community management have to overcome as the Community moves into a virtual environment?
- What current practices will have to change?

- To what extent should Intelligence Community offices and Centers, like the NPC, be electronically connected to their policy customers and other elements of the Intelligence Community?
- What are near-term and long-term plans for enhancing this connectivity?
- What role do managers-for example, NPC managers-play in controlling the information flow, particularly in electronic media, between their offices, policymakers and the Intelligence Community as a whole? How might a "virtual intelligence architecture" change this role?
- What, if any, procedures does or will NPC have in place to monitor and differentiate between the electronic distribution of official NPC products and ad hoc spot assessments, evaluations or informal communications between individual NPC collectors/ analysts and policymakers? If none, what procedures need to be considered or developed?
- As the Community moves towards a "virtual intelligence architecture, what problems or issues might arise as various Community entities begin posting, electronically, separate analytical products-whether they are single-source or all-source products-for intelligence customers?
- What mechanisms might be used to monitor/control the information flow to ensure those intelligence customers can differentiate between the Community's official, all-source products and single-source, possibly uncoordinated products from individual Intelligence Community components? Should there be a central "clearing house" for all analytical products before they are posted electronically?

- What ground rules should govern the information flow between collectors and policymakers? Should these rules be different from those governing the information flow between analysts and policymakers or between analysts and collectors?

Excerpts from the

STAFF STUDY BY THE PERMANENT SELECT COMMITTEE ON INTELLIGENCE; HOUSE OF REPRESENTATIVES, ONE HUNDRED FOURTH CONGRESS

Requirements Vision for the 21st Century

The Intelligence Community should implement a "virtual analytic environment" linking collectors, exploiters, analysts, and customers electronically, as appropriate, to improve the Community's responsiveness to customer needs.

As a model for achieving electronic connectivity, the Intelligence Community should look to the military's test-bed programs for creating a 21st century intelligence operating environment. This operating environment, known as JIVA (Joint Intelligence Virtual Architecture), focuses on creating a virtual work environment that transcends organizational and stovepipe boundaries. A virtual architecture will allow analysts and collectors to more efficiently work requirements and maintain continuous contact with policy makers. This will also allow the policy and intelligence communities to constantly refine requirements and refocus resources on those issues of paramount importance.

Managers should function less as intermediaries who control the information flow to and from policy makers and more as facilitators who monitor the dialogue between policy makers and substantive experts. Managers also should ensure that intelligence does not become politicized as a result of the close analyst-policy maker working relationship.

Appendix B

Advantages of Virtual interactions

The primary focus of this Appendix will be a presentation of the advantages of virtual interactions to the individual, team, and organization respectively. Using this analysis will allow the practitioner to understand some of the possible benefits of virtual interactions to each respective component. This Appendix should allow practitioners to focus on essential aspects of virtual interactions to determine if the factors are significant with respect to the interactive component goals and strategies.

Overall there appears to be four primary trends that are driving virtual interactions, they are:

1. Products and services are becoming more information and knowledge based. They can therefore, be marketed and even delivered virtually.
2. The Internet revolution, this network of computer systems is fundamentally redefining the way that business is conducted, and allows work and services to be carried out over a distance.
3. Networking and interdependence - new ways of organizing and collaborating which give access to resources, combined with flexibility and responsiveness.
4. Globalization of markets and resources; companies can more easily sell their products worldwide and draw on 'world-class' expertise, irrespective of their base of operations (Skyrme, 1998:25).

These trends, from a business perspective, seem to sum up the advantageous reasons for using virtual technologies. However, other reasons may exist outside of the

business realm for using these technologies. Teenagers on the telephone are one example of virtual technology use, not only for information sharing, but also for entertainment and socialization. Other such advantageous factors must motivate users of virtual technologies to some extent.

Factors of Success/Advantages

From a practitioner perspective, each type of virtual interaction has certain elements that can be considered critical. This section will examine three fundamental interactions in terms of the success factors and advantages of using virtual interactions. The three fundamental virtual interactions to be examined are individual-to-individual/computer, team/group, and inter/intra organizational. The purpose of this examination is to determine the advantages of these types of virtual interactions and to identify some of the critical factors associated with each. Determination of this information should give practitioners a starting point for determining what type(s) of virtual interaction may be applicable and beneficial in their respective situations.

Individual-to-Individual/Computer

The advantages, considering the necessary investments in time, money, and personnel, should be significant. Surprisingly however, little research has been done concerning advantages of virtual interactions to the individual. In April of 1998 the first ever conference on Organizational Virtualness was held in Bern, Switzerland. Prefacing the conference was a presentation of discussions involving inputs from various scholars involved in Information Technology (IT) research in virtual interactions. Details from these discussions have provided the foundation for what the advantages of virtualness is

to the individual component. Further research areas providing significant information on individual advantages of virtualness is in the realm of telework. This can be applied to the problem based on the definition that any technology bridging space and/or time is a valid study for virtualness.

According to the preface in *Organizational Virtualness*, the advantage of virtualness to the individual is that each person may contribute to larger objectives while retaining their individual autonomy. At the same time, virtual participants can reap the benefits of collaboration and the synergy that come from interaction (Sieber and Griese, 1998:10-12). Because workers are becoming more focused on specific knowledge domains and sharing expert knowledge with peers, they are relying heavily on virtual information technology for support. Individuals can avoid having to travel to and from work by using computer and communication technologies to do their jobs away from the workplace. Whether it originates at home, on the road, or in a satellite office, telecommuting, as a virtual interaction, can be of value to employers and employees alike (Pliskin, 1998., Stephens and Szajna, 1998).

According to Duxbury and others in their research on after hours telecommuting, computer based homework has been praised for expanding individual autonomy, control, flexibility, convenience, and family togetherness (Duxbury et. al. 1992, Stephens and Szajna, 1998). In many cases, these same advantages apply to the individual using other virtual technologies such as teleconferencing. In some instances however, the parallel does not hold. Many organizations are establishing satellite offices where employees can interact virtually but from an organizational environment (Young, 1998). This has the

advantage of providing employees with a sense of community and social interaction, but takes away many of the advantages of individual virtual work from the home.

Team/Group

Virtual teams can free international organizations from the constraints of working time and staff availability, allowing them to operate 24 hours a day (Young, 1998). According to one source, "if knowledge is the primary asset to be properly managed by the knowledge-intensive organization, then virtual, cross-functional teams that create and share new, high-quality knowledge are the new primary business units. Communication, collaboration and co-ordination are their daily activities" (Young, 1998:3).

One example of the advantages of virtual teams is that a researcher based in Minneapolis could collaborate with another researcher in London—and several other researchers in Germany with the research project team leader in Melbourne Australia. They might all work at different times on the same project, but they could use synergy to produce a much higher-quality output for a client faster than one of them working alone (Clark, 1998). With a virtual team, working hours or the availability of people in your office no longer restricts you.

Some international organizations now never sleep. The processes keep running 24 hours a day. When the European part of the virtual team stops work, the US collaborators have started. When they stop, the Japanese part of the team takes over. When it stops, the Europeans are back working on the same project that has completed two cycles around the world since they went home (Young, 1998).

Another advantage of virtual teams is from Buckman Laboratories International Inc., a $400 million chemicals maker. The system they use is designed to support

spontaneous collaboration among far-flung workers. Users from different departments and locations can form virtual teams and collaborate regardless of their location. These teams usually form when an employee needs to solve a customer's problem fast. "These teams come together and work on a problem for a couple of days, and then they go away and work on another problem," says Alison Tucker, a Buckman market analyst who participates in teams. The system gives every employee access to every other employee's knowledge—something Buckman considers a competitive advantage (Hibbard, 1998).

The following (including references) is an excerpt from a recently published article by Sengupta and Zhao (1998) that provides further information on the advantages of virtual teams (Sengupta and Zhao, 1998:50).

> The use of virtual teams offers several putative advantages to organizations (Mowshowitz, 1994). First, the ability to create temporary, dynamic project-oriented structures enables flexibility (Nohira and Berkley, 1994). Second, the composition of the teams can be tailored to provide an "optimal" mix of skills for accomplishing a task (Grenier and Metes, 1995). Third, because the teams do not have to be collocated, they can include members who are also engaged in other tasks performed at other locations. Thus virtual teams constitute a handy mechanism for bringing together expertise that is otherwise dispersed across, or even located outside, an organization (Dubinskas, 1993). Fourth, because of their transient nature, virtual teams are less likely to be burdened with the entrenched organizational routines and authority relationships that so often inhibit performance in more permanent organizational structures (Nelson and Winters, 1982). These potential benefits have led organizations to employ such teams for a variety of purposes: for example, product design (Sweha, 1996), software development (Voegtli, 1996), management consulting (Dubinskas, 1993), and health care (Pomerantz and others, 1995).

The ability to form virtual teams gives individuals and organizations the capability to quickly gather subject area experts from around the world. These experts have access to information resources individually and collectively through the collaborative medium. The results are higher quality products and greater resource

availability that support customer requirements without the need for direct face-to-face interactions.

Inter/Intra Organizational

Many advantages exist for organizations properly using virtual technologies. Unfortunately, confusion exists as to what exactly a virtual organization is and how virtual technologies should best be used. Most researchers do agree that when virtual technology is properly used it results in the ability to react faster than highly bureaucratic or tradition organizations in meeting customer needs (Sieber and Griese, 1998:11). This is perhaps the biggest advantage from an organizational perspective. One author states:

> "Virtualization offers organizations of all types significant benefits in the new knowledge economy. They can source intellectual resources globally; they can gain flexibility through dynamic structures and contractual arrangements; they can tackle projects or problems which might otherwise have been beyond their capabilities; they can reach global markets without a local presence and they can significantly reduce costs over conventional ways of working. All are reasons to explore the different ways of operating virtually" (Skyrme, 1998:26).

Another researcher states that "there is greater potential now than ever before to coordinate product development processes electronically across organizational, geographical and cultural boundaries" (Blau, 1997:5). From the information presented above it is obvious that many advantages exist for the virtual organization. Following is a comprehensive list of advantages, success factors, and tips relating to virtual organizations (Sieber and Griese, 1998:16-18).

Advantages:

- Contribution of core competencies only,

- Entrepreneurial independence,
- High flexibility,
- Partners unite quickly, no lengthy negotiations,
- Partnership disbands without any problems,
- Company can be a partner of several virtual corporations.

Success Factors:

- The Virtual Organization sustains member interest through short-term projects for mutual advantage or by focusing on broad-based, longer-term themes, which appeal to all sectional interests.
- The technology is reliable, easy to use and facilitates significant gains in members' productive efficiency, effectiveness, and / or value.
- Operational rules are minimal, voluntarily agreed, and capable of broad interpretation and enforcement by each member.
- Structures are egalitarian and flat, but allow for efficient decision-making at an appropriate level.
- General leadership is low-key, chairman-like and enabling, it relies on consensus and democratic self-regulation.
- Specific "topical" leadership can be dynamic and based on authoritative expertise.
- Communication is an essential attribute. Interactions through e-mail, newsgroups, and newsgroups should be brief and succinct.
- Failure to respond, silence and non-compliance between members, while indicating general lack of interest are also far more effective sanctions than direct criticism.

- Written communication is not the ideal medium for an extended argument, this is better done verbally by telephone or in person.

In addition to this list of advantages, success factors, and tips relating to virtual organizations, Appendix C presents a comprehensive list of important factors relating to success in all virtual interactions. This list is presented for use by practitioners when exploring the concepts of virtualness as applied to business settings.

Disadvantages of Virtual interactions

Just as virtual interactions have inherent advantages that lead different business entities to invest large sums of money, there are also disadvantages that must be considered. This section will explore the disadvantages associated with virtual interactions. The ability to weigh the advantages and disadvantages of any factor effecting efficiency and effectiveness is critical to good management decision making. The goal of this section is to identify some of the more common disadvantages associated with virtual interactions to the individual, team, and organization, and present the findings in an easily identifiable manner.

Factors of failure/disadvantages

Because there are problems associated with virtual interactions, identification of essential factors associated with these problems will help practitioners identify and possibly correct these problems. Again, as in the proceeding sections, the author will use the three fundamental virtual interactions of individual-to-individual/computer, team/group, and inter/intra organizational. The purpose of this examination is to

determine the disadvantages of these types of virtual interactions and to identify some of the factors associated with failure in each.

Individual-to-Individual/Computer

At the individual level, there is evidence that work is accomplished through relationships and informal political systems, facilitating networks of human contact within the organization. Knowledge of work skills and procedures is transferred from one worker to another, facilitating effective work practices (Sachs, 1995). The obvious problem for individuals using virtual interactions stems from the fact that the reality of the relationship is severely limited. Furthermore, knowledge of work skills and procedures cannot be passed on or exchanged in a traditional manner.

In addition, individuals must also communicate with colleagues to find out about, adjust to shifting organizational priorities, and coordinate the performance of interdependent tasks. Individuals isolated by technology are unaware of shifting priorities and changing organizational requirements. Thus, the individual must be constantly aware of organizational shifts and nuances that are a part of daily gossip in most non-virtual settings (Perrow 1967).

This leads to the fact that social or non-task-related interaction among members is an important factor for individual success in the modern organizational structure. According to Igbaria (1998), from an individual perspective, there are three important considerations for the teleworker to understand when dealing with any organization, they are:

1. Understand the emergent work environment
2. Understand the changing social order

3. Understand the dynamic requirements of the knowledge worker

Isolation seems to be the primary disadvantage for the individual user of virtual technologies. Isolation as presented here results in the individual being out of touch with organizational norms and issues. The virtual interactions that occur lack the same social advantages that face-to-face interactions provide in that small talk is absent. Interaction in this setting focuses on the job at hand, not on the latest organizational news.

Team/Group

According to James E. Challenger President of Challenger, Gray & Christmas, Inc., an international outplacement firm one consequence of telecommuting and virtual teams may be increased worker isolation. As e-mail and voice mail replace face-to-face exchanges, workers' social skills could deteriorate, destroying team problem-solving capability and reducing productivity. Another problem with the virtual team is the lack of communications and coordination in the virtual office (Watson et. al. 1998:8). Without the organization providing guidance and structure, virtual teams are left to provide and manage required structure and communications without support by external entities. In a mature virtual team, this is certainly an advantage, but for new virtual teams, this is a hurdle that must be successfully negotiated (Challenger, 1998).

The main issues involved in virtual teams is difficulties in communications associated with feedback and understanding. These problems lead to feelings of isolation by team members, and difficulty trusting other team members. Additionally, leadership is an identified problem for virtual teams. The apparent reason is that Virtual teams often pick those individuals with the most leadership experience to be leaders. Unfortunately, the skills and competencies gained in face-to-face interactions do not necessarily transfer

to the virtual environment (Sieber and Griese, 1998:16-18, Young, 1998, Jarvenpaa, et. al., 1998).

Trust

One of the best-understood and investigated aspects of virtual teams is the need for trust among the participants. According to John Grundy, Director of Global Teamwork Associates, trust is a major factor in determining the success or failure of virtual teams. He advises that:

"...teams meet physically at the beginning-perhaps the only time they will ever meet to agree on a shared set of business goals and objectives. The social aspects of this meeting are crucial; introductions take place and the seeds of trust begin to grow. We put the emphasis in this meeting not on deciding clear roles for each member but on helping the team to map out the business, impact of their collaboration and to set shared goals and metrics (Grundy, 1998:52). Using this approach Grundy and others have been successful in integrating individuals into virtual teams.

Grundy further states that: (Grundy, 1998:54)

> "Video conferencing offers an enormous advantage because the alignment and trust that were developed at the initial meeting can be enhanced in subsequent video meetings. Of course, first impressions are critical, but in our experience with video conferencing, you do get a second chance. People can see the person they are working with; they can watch body language. Signs of mistrust, lack of agreement, misunderstanding and boredom are obvious. We coach team members to be alert to these signs and to make sure they present themselves in a way that is consistent with their aims for that particular virtual meeting. These days, more and more work teams are operating on a "fit and split" basis. They do not have the luxury of time to build trust gradually, and physical meetings are rare. In our experience, the visual dimension adds a very powerful means for team members to establish and maintain trust throughout the life of the team."

This advice seems to be applicable to all virtual technologies including telephones. However, it is likely that this advice is much more relevant to virtual interactions that occur over virtual technologies providing a low level of media richness.

True holographic virtual interactions would (ideally) provide near face-to-face interactive richness. When technology advances to this level the need to any face-to-face meeting for the purpose of establishing trust may be gone.

Inter/Intra Organizational

One of the greatest disadvantages to organizations according to one source is the risks for companies to manage knowledge and maintain their core competencies in increasingly virtual organizations (Blau, 1977). According to Rod Coombs, a professor at the Manchester School of Management, in the United Kingdom, "there's a huge danger in allowing technology to run wild and undermine the ability of individuals to interact personally and creatively in physical teams. And there's also a huge danger in having research managers lose control of R&D knowledge within their organizations" (Blau, 1977:8). Grimshaw and Kwok (1998). state that in a virtual organization, working across cultures is the biggest challenge ... transferring their business policies and culture to work with dispersed business teams-spanning organization, geography, and culture (Grimshaw and others, 1998) These are a few of the challenges of working in a virtual organization.

Management

One factor of special importance to the virtual organization is management. According to historically based research (Taylor, 1989) the fundamental purpose of management is to provide employees with consistency and predictability. It seems near

impossible to provide this consistency and predictability in a virtual organization where the component involved in the virtual interactions change based on product demand. According to one source: (Stevenson and Moldoveanu, 1995)

> "The manager's primary responsibility, of course, is to ensure that the organization does what it sets out to do as efficiently as possible. But meeting that challenge means enlisting other people, who won't be able to work efficiently if they feel that there is no order around them and if they can't determine where their actions will lead them. That is not to say that managers should reject the various programs that promise organizational improvement. Such programs are some of the only tools for survival in an intensely competitive and uncertain world. But managers must recognize the paradox that many of those tools are in fact destroying what holds organizations together."

Providing stability in an ever-changing environment can be a challenge beyond the capabilities of many conventional managers. Some researchers and practitioners such as those Digital Electronics believe that members of virtual organizations must be well educated and require above-average networking skills (Merrick 1996). Managers must be cognizant of the many factors effecting employees and ultimately the success of the virtual organization. In addition to conventional management skills, other areas of expertise useful to successful managers of virtual organizations may include technical disciplines such as computer science, software engineering, and database management.

Appendix C

25 Principles of Proven Practice

Prerequisites (Individual Attitudes and Behavior)

1. Every individual must have a sense of self-value and must value every other team member for their contribution - these should become explicit and expressed as the teams core competencies. Individuals should learn from each other, from the results of their own actions, and from collective experience.

2. There must be a high level of trust - this may take time to build up. The starting point is to trust every other person until they abuse this trust.

3. Individuals must be mutually supportive; commitments made should be met – where circumstances prevent this, other team members must be informed as soon as possible.

4. Reciprocity must reign - give as much as you get, in terms of support, transfer of information and knowledge. Lack of reciprocity leads to unbalanced relationships and ultimately to hierarchy, withdrawal or team collapse.

5. Individual feelings must be recognized and expressed. Sharing these is a good way to start and end team meetings.

Teams and Teaming (Composition)

6. Teams are the organizational units that create focus and allow work to proceed. Work in a team, and individually if you want to continue to develop your knowledge and success.

7. The most productive teams for knowledge work are small multi-disciplinary groups. e.g. 5-8 people with a variety of backgrounds and personality traits.

8. Teams of large numbers are not productive for knowledge work - they are assemblies, gatherings, committees which may be used to pass information (often ineffectively), motivate (or demotivate), provide a sense of importance. Their most valuable use is creating and maintaining a sense of belonging, cohesion and reinforcing values - and of course, networking opportunities (but many people who organize meetings, conferences and such gatherings do not provide enough 'white space' for this to happen effectively).

9. Every knowledge worker should belong to at least two separate teams. This helps the organization achieve cross-functional co-operation; it helps the individuals gain a broader perspective.

10. An individual can have several roles in the team. These roles can change and be exchanged (for example during holiday periods, to balance workloads, or to broaden individual experience). Distinguish the role from the person.

Team Norms and Relationships (Mission, Purpose, and Culture)

11. Every team must have a purpose if it is to act as a team and not as a collection of individuals. Its must have its own vision, mission and goals which reinforce those of a higher level.

12. Every team should develop a strong set of cultural norms and values. Hence, regular team meetings should take place. A set of working principles should be developed (print them on a laminated card!).

13. Each team should identify other teams carrying out related or dependent activities. It should draw a network diagram with:

- itself (and its mission) at the center
- an inner ring of teams (nodes) where interdependencies are high (formal relationships)
- an outer ring of collaborative teams (mostly info sharing)

Where possible major activity sequencing and interdependencies should be shown (who provides what to whom).

14. Individual members of teams should be encouraged to maintain their personal networks, even beyond the identifiable needs of the current project or team. Professional and external networks are particularly important.

15. Some 'stack' should be built into the network. A certain amount of duplication/overlap should not be viewed as bad. This slackness permits a higher quality of output, plus a resilience to cope with the unexpected.

Communications

16. Just as in electronic networks, a set of protocols needs to be defined and agreed. These may be implicit (common standards set by cultural values or 'like minded people'). Often it needs to be made explicit what the various signals mean e.g. trial balloon, idea, request for action, demand, vote, decision etc. MISCOMMUNICATION is probably the worst obstacle to effectiveness in any organization.

17. Frequent communication throughout the network (including outer ring) must be encouraged. This is particularly valuable for half-baked ideas, tentative positions. A small group developing its own 'final communiqué' does not foster the network spirit.

18. In addition, as in electronic communication 'NODE NOT RESPONDING' is an important signal. If something has not registered, or some work is failing behind, then a signal to ripple round the network so that the repercussions can be analyzed.

19. Formal relationships (e.g. inner ring) are best cemented by having agreed written processes (hand-offs) and/or common members on both teams. Critical linkages need higher trust and openness rather than higher formality. In a sequenced set of tasks this can be provided by cascading teams (i.e. shared members)

20. Recognize the unpredictability and fuzziness of the process for making decisions. Who makes decision will often be ambiguous. An action taken might imply a decision taken. In general, decisions should be made when and where they need to be made, by whoever is appropriate. Be guided by the mission, values, and principles. Types of decisions that are fundamental should be agreed up front, and simple formal processes developed for these. Otherwise, formality should be kept to a minimum.

Technology and Working over a Distance

Enabling technology is the most effective means of enhancing the quality of network communication. Electronic mail, distribution lists, GroupWare products such as Lotus Notes and videoconferencing all contribute, but they must be used effectively. Here are some principles to apply in virtual team communications. They apply mostly to the lowest common denominator - email - since that is how many virtual teams start and is still the daily bread-and-butter of most.

21. In your emails, select the TO and CC addresses appropriately. Use explicit titles – in particular avoid simple relies that generate Re: Re: titles when the subject matter has moved on. Be explicit in what action you want the reader to take - is it for information or action, or is it a request for help? Similar principles apply to threads in a computer conference - use appropriate titles.

22. Use one email per topic, especially when multiple recipients with different roles and interests are involved. This allows each to be filed and actioned separately. Keep emails short - give some opening context, repeat portions of incoming mail selectively and close with requested actions (if any).

23. If a face-to-face conversation is important, capture the essence in a follow-up email. It also acts as a point of reference for the parties involved. It may throw up different interpretations of the same meeting, and highlight ambiguities that need to be resolved. It also acts as part of the 'team' memory.

24. Build on knowledge that exists or has been expressed. Recognize the contributions of others. Ideally, appoint a knowledge editor who takes the best from transitory information and compiles it into a more structured document or Web page.

25. Above all - be human and informal. Emails and discussion lists are conversations, and if you are not face-to-face, you need to insert a level of informality and smileys ,where appropriate:-)

From the article "The Realities of Virtuality" by David Skyrme 1998.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
15-11-1999	Master's Thesis	

4. TITLE AND SUBTITLE

Defining Virtual Interactions: A Taxonomy for Researchers and Practitioners

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Air Force Institute of Technology
2750 P Street
WPAFB OH
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8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GIR/LAS/99D-8

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Chris Demme / GS-15
DIA/DM/JV
Bldg 6000, DIAC
Bowling AFB, Washington DC
20340

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Many uses for virtual technology are being identified by diverse organizational entities around the world. Before these technologies can be fully utilized, it is important to have a common definition and understanding of what is meant by the term "virtual." It is also important to understand the structural configurations possible using virtual technology and the types of virtual interactions that may occur using these technologies.

This thesis will define the basic premises, structures, and definitions applicable to virtual interactions. It also defines various types of virtual interactions that may occur using virtual technology. These designations will help both practitioners and researchers to focus on appropriate virtual technologies and identify the critical factors that will determine success or failure in each instance. Above all, this taxonomy will provide a foundation upon which to build a coherent, sustained, and directed study of virtual interactions that will result in improved integration of technology into organizational strategic plans. Such integration will optimize financial outlays for information technology and produce the maximum benefits for all virtual components involved.

15. SUBJECT TERMS

Virtual, Virtual teams, Virtual organizations, Virtual technology, Virtual interactions, Virtual components

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Michael G. Morris
Unclassified	Unclassified	Unclassified	Non	113	19b. TELEPHONE NUMBER *(Include area code)* 937-255-3636 ext 4578