CORRELATING FACTORS OF THE MANAGER'S DECISION TO USE

VIRTUAL PRIVATE NETWORKS

by

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A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

Capella University

July 2009

UMI Number: 3366093

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Abstract

There is a need in today's environment to provide high performance, scalable, and robust systems to almost all business, regardless of size (Twitchell, Infrastructure of electronic information management, 2004). A strong network infrastructure is the key to providing reliable information technology (IT) systems with minimal downtime for mission critical applications. Twitchell further indicated that a major component of insuring data is the provision of network security. The research problem addressed in this study was the lack of Virtual Private Networks (VPNs) within organizations as a component of value-added IT network-based services to the business. This study used an existing conceptual framework developed by Babb (2004) in the context of Southern California. The purpose of this quantitative study is to identify particular management perceptions on the use of Virtual Private Networks to enable managers to make better informed decisions. In particular, it will help them determine whether the technology is becoming widely adopted and if security and reliability aspects of the system are generally acceptable to technology management professionals. A survey of senior executives and IT professionals from information technology organizations was sent to a list of 2500 companies operating in the Southeast. A sample of 154 participants had completed the online survey. The Statistical Package for Social Sciences (SPSS®) was used to perform a Chi-square test of independence and/or dependence. The results of the Chi-square tests performed supported each of the four alternate hypotheses. The research clearly show that security, reliability and cost-benefit are reasons technology professionals choose a solution and these topics will continue to be of utmost important to executives, managers and vendors of information technology.

Dedication

I would like to dedicate this dissertation to my parents, Oscar and Mattie Lee

McEady, and my son, Erasmus W. McEady Jr., (Walter). They are no longer on this earth,

but their sprit is with me daily.

Acknowledgment

I wish to thank Dr. Lawrence Ness, my mentor and Dissertation Chair, for his excellent support throughout this dissertation process. The dissertation research would not have been possible without the help, patience, and support of many, to include the staff and adjunct faculty of both Capella and Webster University.

I would like to thank my committee members, Dr. Zhenhu Jin and Dr. Gordon Graham. You provided valuable feedbacks guiding me to enhance the content and the form of my dissertation adhering to a worthy scholarly Ph.D. work. A special thanks to Dr. Danielle L. Babb for her outstanding support and words of encouragement.

Last but not least, I would like to thank my family and friends. My wife, Loverette, my sons, Eric and Walter, and my Grands, for their love and support. I wish to thank all the participants of my study who took the time and completed the survey questionnaire.

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CHAPTER 1. INTRODUCTION

Introduction to the Problem

According to Twitchell (2004), there is a need in today's environment to provide high performance, scalable, and robust systems to almost all business, regardless of size. A strong network infrastructure is the key to providing reliable information technology (IT) systems with minimal downtime for mission critical applications. Twitchell further indicated that a major component of insuring data integrity is the provision of network security.

As wide area networks become increasingly common to connect disparate offices or remote users to corporate networks, many companies are relying on the use of Virtual Private Networks (VPNs) to establish these connections. The popularity of this technology has led to concerns with regard to security and reliability, often leaving the recommendation and purchase of such a system to the Technology Manager, Chief Information Officer or Director responsible for the department implementing network infrastructure. Magazine publishers often differ in their survey of managers and their perceptions of Virtual Private Networks, leaving little in the way of data to aid management in making a solid technology choice for their organization.

According to Ward and Peppard (2002), most organizations in all sectors of industry, commerce, and government are fundamentally dependent on their information systems. In industries such as telecommunications, media, entertainment, and financial services, where the product is already or being increasingly digitized, the existence of an organization crucially depends on the effective application of information technology

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(IT). This research effort attempted to identify management perceptions on the use of Virtual Private Networks to enable managers to make better decisions.

Background of the Study

According to Babb (2004), Wide Area Networks in their traditional sense are often costly because Internet Service Providers charge for both distance and bandwidth, making organizations with remote sites spend thousands of dollars monthly for data communications costs. With traditional Wide Area Networks, remote users are often connected with dialup modems that open security holes and cause speed issues, or with Remote Access Services that can be difficult to configure, often have numerous security holes, and require a high degree of technical support. Johnson (2008) indicated that Wide Area Networks communications is not a strategic for every organization. Companies that are geographically compact, and interact infrequently with remote parties, probably won't benefit from a state-of-the-art Wide Area Networks.

Virtual Private Networks have changed the way companies can offer Wide Area Networking services. Virtual Private Networks create virtually private tunnels over public communication channels; primarily the Internet. These networks can also be configured to run over dedicated frame relay or point-to-point connections, though the study will focus specially on the use of Virtual Private Networks over the Internet. This type of network offers stable, simple, and fast ways for remote users to connect to the core network, and offer companies an opportunity to save significant communications dollars while maintaining connectivity standards. There are three primary VPN technologies in use today: (a) trusted VPNs, (b) secure VPNs and (c) hybrid VPNs.

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Habraken and Hayden (2004) stated that Cisco Systems, Microsoft, and a host of others provide VPN software that uses IPSec for authentication and security.

Babb (2004) indicated that Virtual Private Networks inherently come with their own risk. When they use public lines, they require different types of security than dedicated lines do. Virtual Private Networks inherently open up security holes that would not otherwise be an issue on corporate networks. Virtual Private Networks have changed the way many businesses configure and connect their network backbones with hopes of offering a competitive advantage and minimizing security risks. Anonymous (2005) stated that VPN technology is an extremely secure method of communications, there remain risks associated with its use. No communication across a public network should be considered 100% secure. Weak points that would be hackers will try to exploit will always exist, no matter how diligently and securely the remote access solution is design. Twitchell (2004) indicated that security features provided by Java are intended for a variety of audiences, including end users and developers. For users, there is built-in security that prevents malicious program such as viruses from running, while maintaining privacy about their files and any information about them. Developers can use application programming interface (API) to invoke security for programs (Twitchell, 2004 p. 198). Combs, Alphand, Berthou, and Gayraud (2005) indicated that not all applications will need complex resource management functions or per-flow admission control.

Statement of the Problem

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According to Luftman (2000), the premise that IT and its services brings value to the business has been established; however, many organizational leaders today still find it difficult to harness these values and services that IT brings to the business. The problem to be addressed within the proposed study is the lack of Virtual Private Networks (VPNs) within organizations as a component of value-added IT network-based services to the business. According to Babb (2004) 57% of executives did not select a VPN. This work will add to the extant research in investigation of manager's perception related to security, reliability, cost savings and need.

Babb (2004) identified IT managers and executives representing the areas of Los Angeles, Orange and San Diego Counties of California and indicated that companies with the number of users ranging from 200 or more recommended Virtual Private Networks far more than those supporting less than 200 users. Babb (2004) indicated that only 42.1% of IT managers and executives strongly recommended VPNs. Babb further stated that managers and executives did not have the information to make informed decisions to select a VPN or not. Virtual Private Networks have become increasingly important in enterprises that require multiple office connectivity and desire a reduction in their overall costs of doing business. Cisco Systems estimates that an organization with 1000 dial-up users and 3000 users on an 800 number, with an average number of hours online of only 5 per week per user, will save anywhere from $376,000 per month to $481,00 per month. The most significant factors identified in Babb's conceptual framework provide the basis for this study, which examines firms operating in the Southeastern of the United States. The goal this study is to fill the gap in the previous scholarly work in the manager's

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perception of VPNs security, cost, perceived need, and perception of its reliability and manager's decision-making.

Purpose of the Study

The purpose of this quantitative study is to identify particular management perceptions on the use of Virtual Private Networks to enable managers to make better informed decisions. In particular, it will help them determine whether the technology is becoming widely adopted and if security and reliability aspects of the system are generally acceptable to technology management professionals. This quantitative study build on the work done by Babb (2004) to identify particular management perceptions on the use of Virtual Private Networks to enable managers to make better informed decisions. To do so, this study takes into consideration managers' perception of its security, costs, perceived need, and perception of its reliability, independent and dependent variables. Analysis of these four factors were performed in this study with relation to the Information Technology manager's decision to recommend Virtual Private Networks in an effort to discover which of these factors are more strongly related to Virtual Private Networks. Participants included executives, IT directors and IT managers from information technology organizations in Southeastern United States. The findings of this study will help them determine whether the technology is becoming widely adopted and if security and reliability aspects of the system are generally acceptable to technology management professionals.

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Rationale

     Determining whether technology is appropriate is often a guessing game, based on word of mouth, vendor and consultant recommendations, and trade magazine reviews (Babb, 2004). This study will help executives and managers make better informed decisions by evaluating the criteria relating to Virtual Private Networks to help gauge technology managements' perceptions of the technology. Perception often makes or breaks a technology and can provide real-life clues into the usefulness of a new method or device. The findings of this proposed study will be a significant contribution to IT professionals and vendors since no such study has been conducted before on such important subject as correlating factors of the manager's decision to use Virtual Private Networks. Howe and Oestreicher (1988) suggested that when forming a new Management Information System (MIS) group; recommend carefully evaluating and selecting an MIS approach before determining the related MIS structure. This same approach applies to managers when making decisions to use Virtual Private Networks.

     According to Shupe (2006), in preparation for developing a technology strategy, the following processes must be in place:

1. Committed executive-level involvement - IT supports management and operational strategies of an organization. Therefore, the IT strategy must parallel the organizational strategy and must be accepted by organization.

2. A structured decision-making process - This is necessary so that all issues are evaluated in a consistent manner, regardless of the application of functional unit being considered. Consistency in decision-making criteria is the only way

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an organization can be sure it is following the path to improvement through effectively using IT. It will also show that the IT department exists to support the organization as whole, not as discrete entities.

3. An effective model for organization-wide communication - One of the biggest mistakes an organization can make is to restrict input on the IT decision to executive level. Two-way communication is critical for acceptance of IT decisions. Therefore, a structured process should be established to promote communications at all levels. The executive level is still responsible for making the final decisions. However, executives do not operate in a silo, and critical inputs from organizational members about how a decision will affect existing processes will contribute to the success of the overall strategy.

Research Questions

According to Cooper and Schindler (2006), a useful way to approach the research process is to state the basic dilemma that prompts the research. The central research question addressing the management dilemma for this study is "Why do Information Technology managers recommend Wide Area Networks instead of Virtual Private Networks?" Emanating from this central question are four sub-questions focused on (a) evaluating the manager's perception of Virtual Private Networks as it relates to security, (b) assessing respondent's perception of Virtual Private Networks as it relates to cost versus benefits, (c) examining to the need for Wide Area Networking, and (d) gaining a perspective of the respondent's view of reliability of the technology. Research Questions 1, 2, 3, and 4 are as follows.

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RQ 1: To what extent, if any, is perceived security related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 2: To what extent, if any, is the desire to save money in communications costs related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 3: To what extent, if any, is the perceived need for wide area networking related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 4: To what extent, if any, is perceived reliability related to an information technology manager's decision to recommend Virtual Private Networks?

Hypotheses

H1o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perception of its security.

H1a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its security.

H2o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her desire to save money in communications costs.

H2a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her desire to save money in communications costs.

H3o: An Information Technology manager's decision to recommend Virtual

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Private Networks is independent of his/her perceived need for wide area networking.

H3a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perceived need for wide area networking.

H4o: An Information Technology manager's decision to recommend Virtual Private Networks is independent on his/her perception of its reliability.

H4a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its reliability.

Significance of the Study

This study will significantly contribute to the data in the field of Information Technology and Networking. It will help determine business reasons managers may recommend this particular remote access technology, and whether or not they are concerned about security. It will help to present ideas to understand why managers may recommend one technology over another and will offer other organizations considering the use of Virtual Private Networks some areas for consideration. Today, business and technology managers are interested in this data when contemplating the choice to move to Virtual Private Network technologies. It is creating new knowledge in the field of Information Technology and bring into view the perceptions of professionals (Babb, 2004). Anonymous (2005) indicated that the technology involved in creating secure network connections over the public Internet is complex, and can involve a number of communications protocols along with various hardware and software components.

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Han (2003) stated that as the Internet is a shared public network of networks with open transmission protocols, IP-based VPNs must include measures for packet encapsulation, encryption, and authentication to ensure that the sensitive data reaches its destination without being tampered by unauthorized parties.

<div align="center">Definition of Terms</div>

To address these questions, this research will focus on the following constructs: Encryption, Local Area Network, Virtual Private Networks, and Wide Area Network. A brief overview follows for each.

Encryption

Lowe (2008) defined encryption as "a security technique in which data is stored in an encoded (encrypted) form that can be decoded (or decrypted) only if the key used to encrypt the data is known" (p. 807).

Local Area Network

Fitzgerald and Dennis (2002) defined LAN as " a network that is located in a small geographic area, such as an office, a building, a complex of building, or a campus, and whose communication technology provides a high-bandwidth, low-cost medium to which many nodes can be connected. These networks typically do not use common carrier circuits, and their circuits do not cross public thoroughfares or property owned by others. LANs are not regulated by the FCC or state public utilities commissions" (p.435).

Virtual Private Networks

Fitzgerald and Dennis (2002) defined VPN as "a hybrid network that includes both public and private facilities. The user leases a bundle of circuits and configures the

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VPN on an as-needed basis so that some traffic travels on the private leased network and some travels on the common carrier's public network" (p. 445).

Wide Area Network

Fitzgerald and Dennis (2002) defined WAN as "a network spanning a large geographical area. Its nodes can span city, state, or national boundaries. WANs typically use circuits provided by common carriers. Contrast with backbone network (BN), local area network (LAN), and metropolitan area network (MAN)" (p. 446).

Assumptions and Limitations

The assumption made in this study that the correlation between Virtual Private Networks and Wide Area Networks effectiveness have been established by the work of Babb (2004). Such assumption is important in directing this study towards assessing the strength of each factor the manager's decision to use Virtual Private Networks. Such assession is based on studying and analyzing particular management perceptions on the use of Virtual Private Networks to enable managers to make better informed decisions. Towards that effort, this study was limited to taking into consideration the contributing factors to managers' choices to recommend Virtual Private Networks technologies. Future studies and research on the subject of factors influencing use of Virtual Private Networks should take into consideration the individual components of security, such as availability, accuracy, authenticity, confidentiality, integrity, utility, and possession.

Conceptual Framework and Nature of the Study

This study was conducted using quantitative research inquiry. The findings of this study were based on analyzing data that were collected from surveying Information

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Technology professional managers and executives. The conceptual framework for this study was based on the findings presented by Babb (2004) study. In her study, Babb provided empirical evidence that showed a positive correlation between Information Technology manager's perception of Virtual Private Networks security, costs, perceived need, and perception of its reliability within the same regression equation. Rohde (2006) indicated Multi-Protocol Label Switching (MPLS) is now for all intents and purposes a true IP Virtual Private Network, linking authorized sites in a connectionless, any-to-any manner over a native IP backbone. The network supports a number of emerging technologies and innovative applications that help stimulate customer involvement and sales of entertainment products. Such findings are important in the fact that they aid future research efforts, such as this one, in focusing on accessing the strength of each factor the manager's decision to use Virtual Private Networks. As a result, the findings of such studies will aid Information Technology managers to make better informed decisions.

Organization of the Remainder of the Study

The next chapter will focus on reviewing pertinent literature that deals with Virtual Private Networks and their use in industry. Such review will set the direction as well as the theoretical framework for this proposed study. Chapter 3 will focus on discussing the methodology that will be utilized throughout this study with focus on research design, sample, instrumentation, data collection and analysis methods. Chapter 4 will focus on data collections and analysis. The final chapter will discuss the results and any implications and/or recommendations derived from this study.

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CHAPTER 2. LITERATURE REVIEW

Introduction

The literature review provides a comprehensive framework for understanding the criticalness of studying Virtual Private Networks and their use in industry. The section begins by exploring computer networks and the use of Wide and Local area networking in business. It moves through the types of Wide Area Networks (WANs) used, and the costs, risks and benefits of the technology. The review moves through the efforts of cost reduction and business enhancement, as well as common issues associated with any wide area network, including quality of service, line issues, compression, risks, remote offices and downtime. An example of how WAN can be used to boost competitive advantage will be given, as well as comparison of WAN technology to Virtual Private Network technology. The effort moves forward through the types of VPNs available, issues for consideration including performance, security, reliability, quality of service and service level agreements, and will take into consideration common business issues such as convergence and the management and organizational implications of VPN technology. The literature review concludes with a summary of the benefits of VPNs and expected business changes as a result of using the technology.

IT and Managerial Decision

Information technology is now used as a competitive arsenal; however, many people lack a clear understanding of issues determining its influence and implementation. Ward and Peppard (2002) stated that strategic systems require more nurturing, to gain organizational acceptance through demonstrated contribution to future strategy.

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Today in a fast changing information technology world, adaptability is an important feature that leaders must apply in the business arena, especially managerial personnel responsible for decision-making. Different approaches and techniques must be employed in order to achieve the development of adaptable systems of modern computing, programming languages and software engineering with the effects of information technology (Francisco, 2004).

For decades, managers have been frustrated with the dilemma of getting things done faster. Not too long ago many people living today witnessed the use of carbon paper to copy a document. The typewriter has revolutionized the 20th century and now in the 21st century, computers have become one way of communicating and processing various types of information. Technology is available and being used to allow people, managerial decision-makers real time decision-making at the snap of sound. Video teleconferencing has largely replaced the old teleconferencing system and allowed hundreds of locations and parties to link together in observing and participating in the process and discussion while observing each other. In their research study Ward and Peppard (2002) stated that a number of important forces affect the pace and effectiveness of progress in using IT and delivering business benefits. The relative weighting of each factor varies over time, and will also vary from one organization to another. These factors include: the capabilities of the technology; the economics of deploying the technology; the applications that are feasible; the skills and abilities within the organization to use the applications; the pressures on the particular organization or its industry to improve performance.

Computer Networks

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In their research study, Habraken and Hayden (2004) stated that computer networks are everywhere. We get our cash from the ATM (a computer), and computers are used by telemarketers to call us on the phone. Each of these instances of computer use requires a network. We all rely on the largest network in the world, the Internet, whenever we send email or browse the Web. Even your digital cable television is served to your home via a network. We really can't escape computers or the networks that enable the various computers that populate the networks to share data.

Local and Wide Area Networks

Computer networks can be divided into two main categories: Local Area Network (LAN) and Wide Area Network (WAN). Other types of networks can be established as well though they are less common, such as Metropolitan Area Networks (MANs) and Global Area Networks (GANs). According to Babb (2004) LANs are the least complicated and are contained to one location. A LAN is a group of computers and devices that share common communications lines and share the resources on the same network. Habraken and Hayden (2004) indicated that LANs have the following parameters:

1. They occupy one physical location and one physical location only.

2. They have high-speed data transfer rates, typically 100 or 1000 megabits per second.

3. All data travels on the local network wiring. LANs are often used to share databases, files and printers in an organization.

Technical Definitions - Local Area Network

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A Local Area Network is nothing more than a group of computers linked through a network, all located at a single site. Networked computers can share their hard disk space with each other. Although sharing files is an important reason for networking, sharing applications is another, equally important reason (Habraken & Hayden, 2004).

There are several ways that a LAN can be configured, or topologies can be used. There are three main types of network topologies. They are the bus topology, the ring topology and the star topology. The bus topology is a network topology in which all computers are serially connected to a length of cable. Bus networks are not terribly reliable; if one cable segment goes bad, the whole network fails. 10BASE-2 and 10BASE-5 are example of bus networks (Habraken & Hayden, 2004). Babb (2004) indicated that bus topologies are relatively inexpensive and easy to install.

The ring topology connects all devices through a closed loop, which enables the data to circulate in a ring around the network. The physical layout of ring topologies that use network architectures such as Token Ring and FDDI, will be arranged in the same physical star as the Ethernet star topology. They are very expensive to install and operate, so it is normally used only for high-end applications that demand the capability to push a lot of data over a wire (Habraken & Hayden, 2004). Babb (2004) indicated that they have the disadvantage of taking down an entire network when one node has an issue because of the way they are physically connected.

More complex networks are built on a physical star topology because it is more robust and less prone to interruptions than a physical bus topology. In contrast to the bus topology in which the wire runs serially from computer to computer, star topology networks us a hub to connect computers to one another. Networks built on physical star

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topologies have a couple advantages over bus topologies. First and foremost is reliability. In a bus topology network, disconnecting one computer is enough to crash the whole network; in a star topology network, one can connect computers on the fly without causing network failures (Habraken & Hayden, 2004).

Technical Definitions - Wide Area Network

According to Fitzgerald and Dennis (2002) a Wide Area Network (WAN) is a network spanning a large geographical area. Its nodes can span city, state, or national boundaries. Wide Area Networks typically use circuits provided by common carries. Dodds (2007) indicated that the growing trend toward globalization means enterprises are deploying more employees in remote branch offices, and these employees may often need to collaborate with one another. The need to enable effective real-time collaboration over the WAN has generated technologies and devices designed specifically to improve WAN application performance. Several pieces of hardware can be used to link LANs. The most common devices are routers. A router is a device that handles the traffic flow for data packets that are not addressed inside the local network. It is the long distance post office sorting machine that passes data between multiple networks (Habraken & Hayden, 2004). Horak (2000) indicated that WAN options for internetworking geographically distant LANS include dial-up option such as X.25 Packet Switching, Integrated Service Digital Network (ISDN), and Switched 56/64 Kbps. Dedicated leased line options include Dataphone Digital Service (DDS), T-carrier, and Fractional T1.

WANs and the Internet

The last 10 years have seen an explosion of publicity for the Internets. The proliferation of Web addresses, email address, and references to cyberspace have

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pervaded the public consciousness. Even though the Dot-com mania invaded and was

quickly followed by the Dot bomb. Many Internet companies collapsed. This still has not

cooled the public's desire to connect on the Internet nor has it changed the fact that the

Internet provides a unique worldwide communication platform. Habraken and Hayden

(2004) stated:

> The Internet is a series of private computer networks (LANs and WANs)
> connected to each other through larger networks run by Internet service provides
> (ISPs), many of whom are in some way related by business ties to the telephone
> business. Each individual private network (called an Autonomous System in
> networking-ese) is composed of a series of connected computers within an
> organization. Each organization takes responsibility for only the computers in its
> sphere of influence. Typically, the individual networks are connected by special
> devices called routers and firewalls that are responsible for figuring out what data
> should stay inside the local network and what data should be passed on to other
> networks. Each private network also takes on the responsibility of telling the rest
> of the world which systems they have on their network (but only if they want the
> rest of the world to be able to find them. (p. 20)

Virtual Private Networking

According to Babb (2004) with technology and business requirements changing at

a rapid pace and the continued need for financial savings, many Information Technology

departments are being asked to explore alternatives to traditional connectivity as a

method of reducing their operating cost. The research will explore the advantages and

disadvantages to using Virtual Private Networks to gain outside access securely into a

private network in an effort to reduce costs and increase performance. Several network

concepts will be explored and data provided to lead to a conclusion on the efficiencies of

this technology. A Virtual Private Network is also described as a network established

over a carrier's digital phone line (such as AT&T or Sprint lines) and dedicated solely to

connecting several specific client sites. VPN services are intended for use by very large

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user organizations. Classis voice VPNs are circuit switched, creating the effect of a private, leased line network, but without the associated issues of design complexity, long deployment time, high recurring cost, and vulnerability to failure (Horak, 2000; Smaling, 2002).

Motivation for using VPN

As the Internet became more and more accessible and bandwidth capacities grew, organizations began to offload their Intranets to the web and create extranets to link internal and external users. Using the Internets, organizations can connect their remote branch offices, project teams, business partners and e-customers by using local Internet Service Providers (ISP). However, as cost-effective and quickly-to-deploy as Internet is, there is one fundamental problem - security (Han, 2003; Morrissey, 2004).

The fundamental motivation for VPNs is the communication privacy. To ensure security in a network environment, the following three secure aspects must be considered: (a) authentication, (b) confidentiality, and (c) integrity. VPN solutions are designed to deal with these security factors. Using special tunneling protocols and complex encryption procedures, data integrity and privacy is achieved in point-to-point connections (Horak, 2000; Martin, 2008). Because the VPN provides such operations over public networks without changing the existing router hardware equipment (Morrissey, 2004), VPNs can cost significantly less to implement than privately owned or lease services. Therefore, communications economics is another basic motivation for deploying VPN.

VPN Technologies

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As the Internet is a shared public network of networks with open transmission protocols, OP-based VPNs must include measures for packet encapsulation, encryption, and authentication to ensure that the sensitive data reaches its destination without being tampered by unauthorized parties (Han, 2003; Anonymous, 2005). Organizations are using an Internet VPN to establish links to the local access points of their ISP. From here, they let the ISP ensure that the data is transmitted to the appropriate destinations via the Internet, leaving the rest of the connectivity details to the ISP's network and the Internet infrastructure.

<center>Enterprise Resource Planning</center>

The purpose of Enterprise Resource Planning (ERP) technology is to integrate all departments and functions across an organization into a single computer system with a single, centralized database. The ERP should be able to respond to the requirements of all the departments, including their need for shared information and effective communication. Identify the factors that affect the success of ERP implementation strategies in organizations. Contrast and compare different ERP implementation strategies. Propose an organizational change management strategy that will maximize productivity and customer satisfaction leveraging the benefits of ERP technology.

A Brief Historical Overview of ERP Implementations

In their research article, Muscatello and Chen (2008) stated that ERP systems have been widely implemented by numerous firms throughout the industrial world. While success stories of ERP implementation abound due to its potential in resolving the problem of fragmented information, a substantial number of these implementations fail to meet the goal of the organization. In today's business environment, organizations must

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remain agile in the areas of innovation and competitive performance, and managers are relying more on information technologies such as ERP systems to bolster their agility (Sambamurthy & Bharadwaj, 2003). However, as noted within the research article by Burt, Dobler and Starling (2003), these ERP systems are very expensive and they take a long time to implement. More importantly, failure rates for ERP implementations can run as high as 50 percent of those attempted (Muscatello & Parente, 2006). Only recently have researchers begun to earnestly study these failures to arrive at an explanation for the high failure rate.

The technical people who comprise a company's IT department are usually very much in favor of this cutting edge technology but managers may not fully understand what they are getting into. The main point is there is ample room for useful knowledge surrounding this subject area and not much empirical research accomplished to date. One of the few researchers to look at this problem area recently is Kang (2007), who analyzed some of the post-deployment IT changes affecting firms. Kang suggested "that even custom-developed software can be plagued by misfit and a learning-in-working perspective should be added to understand and resolve the misfit between IT and the organization" (p. 11). Kang further suggested the need to study these post-deployment changes has become urgent as more companies are opting for ERP systems (2007). Kang's research is a start, but much more is needed so that managers can make good decisions about which IT systems to adopt.

Critical Success Factors for ERP Implementation and Upgrade

Nah and Delgado (2006), discussed seven categories of critical success factors that were identified from the ERP literature (a) business plan and vision, (b) change

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management, (c) communication, (d) ERP team composition, skills and compensation, (e) management support and championship, (f) project management, (g) system analysis, selection and technical implementation. These seven categories and their sub-factors are discussed next:

1. Business Plan and Vision-it is very important to have a clear vision, goal, and business plan for an ERP project. A business case should be established for both ERP implementation and upgrade. A business plan is very critical and should specify benefits, resources, costs, risks and timeline.

2. Change Management-recognizing the need for change in order to stay competitive is very important. A culture of shared values and strong corporate identify is critical to facilitate change, and an enterprise wide structure and culture change should be managed. Formal education and training should be provided so users can gain an understanding of how the system works and how it will impact their work. User involvement and feedback in the design of the system is also important. In order to effectively solve user problems and manage organizational change, a support organization should be in place.

3. Communications-expectations and goals must be communicated effectively among stakeholders and throughout all levels of the organization. It is very important for stakeholders to understand the capabilities and limitations of the ERP system. ERP systems may fail to meet expectation due to "overselling" the software (Nah & Delgado, 2006, p. 100). The communication plan should include the rationale for the ERP implementation, details of the business

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process management change, demonstration of the software, change

management strategies, contact points, scope and project progress.

4. ERP Team Composition, Skills and Compensation-an ERP project includes all

   functional areas of an enterprise. The effort and cooperation of technical and

   business experts as well as end-users is necessary for the success of an ERP

   implementation. Therefore, involving people with both business and technical

   knowledge into the project is essential for success. The involvement of the

   implementers, vendors and consultants is also critical.

5. Project Management-effective project management is critical to the success of

   ERP implementation. Not only should responsibility for the project be clearly

   assigned, the scope of the ERP implementation project also needs to be clearly

   defined and controlled. Any changes in the original project should be

   evaluated based on their business benefits and, if possible, implemented at the

   later time (Nah & Delgado, 2006).

6. Top Management Support and Championship-top management support is a

   necessary condition for ERP implementation success. It is critical to have

   support and approval from top management for an ERP implementation. The

   ERP project must be clearly and explicitly designated as top priority by top

   management. In addition, the top management must be willing to allocate

   valuable resources to the implementation project. These resources include

   time, money and personnel necessary for the ERP implementation. The

   importance of a project champion in an ERP implementation is greater than in

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other IS implementations because the project relies heavily on organizational support perseverance.

7. Systems Analysis-Selection and Technical Implementation, for an ERP implementation to be successful, the complexities of existing business legacy systems must be successfully managed. Customization of the ERP system should be avoided as much as possible. Customizing an ERP system has been associated with an increase in IT costs, a longer implementation time, and the inability to benefit from the vendor's software maintenance and upgrades. To justify customizing the system, a strong business case on the loss of competitive advantage should be developed. The overall architecture of the system must be configured before the deployment. One of the first and most important steps in an ERP implementation is the selection of an ERP package (Nah & Delgado, 2006).

ERP Implementation Strategies

Nah and Delgado (2006) used a process theory approach to understand the importance of the different critical success factors for ERP implementations and upgrades. This theory organizes the series of events that lead to an ERP project completion into four phases: chartering, project, shakedown, and onward and upward. The chartering phase focuses on creating the business case for the project and identifying the solutions constraints. The project phase comprises system configuration and rollout where the system is integrated with other systems in the business, the system is tested, and users are trained on its functionality. The shakedown phase occurs between the time from going live until normal operation or routine use. During this phase, outstanding

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bugs are fixed, the system is find turned for performance, and users may be trained if necessary. The onward and upward phase refers to ongoing maintenance and enhancement of the ERP system and relevant business processes to fit the evolving business needs of the organization.

Nah and Delgado (2006) discussed a similar model proposed by Cooper and Zmud which focuses on IT implementation in general and which comprise six stages: initiation, adoption, adaptation, acceptance, routinization, and infusion. The initiation and adoption stages describe the events in the chartering phase of the ERP project lifecycle. The adaptation stage maps directly to the project phase. The acceptance and routinization stages match the shakedown phase, and finally the infusion stage is the same as the onward and upward phase. Nah and Delgado further discussed Markus and Tanus's 4-phase model. Nah and Delgado stated that Markus and Tanus's 4-phase model was used instead of Cooper and Zmud's 6-stage model because of its simplicity and conciseness. Cooper and Zmud's model might involve a higher level of granularity, the Markus and Tanis' model was adopted because it is more users friendly.

Remus (2007) discussed critical success factors for implementing enterprise portals. Like ERP implementation project, large enterprise portal implementation projects tend to differ from traditional IS projects in scale, scope and complexity. Organizational changes, project costs, and need for business process reengineering (BPR), often making portal implementations a complex, time and cost consuming and risky challenge. However, in most cases the proposed benefits of enterprise portals outweigh the risks of implementation, leading to a steady growth in total investments in enterprise portal solutions. By 2009, the market for application integration, middleware and portals is

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expected to grow to $7.1 billion, with a five-year compound annual growth rate of 2.7 percent (Correia et al., 2005).

Organizational Change Management Strategy

There is no shortage of information concerning change management strategy that will maximize productivity and customer satisfaction leveraging the benefits of ERP technology, both good and bad, with implementing ERP systems. Only a small sample of the experiences is presented to provide an overview of the most salient issues. Most ERP system vendors will readily extol the benefits for a company purchasing an ERP system, but often will downplay the costs and impacts (negative side) of such a system. It is important for managers to understand both the positives and negatives of purchasing an ERP system.

According to Turbit (2005) a succinct summary of the positive reasons for going to an ERP follows:

1. A single system to support rather than several small and different systems.

2. A single application architecture with limited interfaces.

3. Access to management information unavailable across a mix of applications.

4. Access to best practice systems and procedures.

5. More integration hence lower costs.

6. More "automation" of tasks Generic Costs and Impacts. (p.1)

Beheshti (2006) suggested the reasons for implementing an ERP system are "to remain competitive or to gain advantage over the competition" (p. 188). While the potential advantages of an ERP system are numerous, there are also many costs which accompany these advantages.

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Again, Turbit (2005) provided a succinct summary of the negative reasons or problems associated with an ERP as follows:

1. The cost is likely to be underestimated.

2. The time and effort to implement is likely to be underestimated.

3. The resourcing from both the Business and IT is likely to be higher than anticipated.

4. The level of outside expertise required will be higher than anticipated.

5. The changes required to Business Processes will be higher than expected.

6. Scope control will be more difficult than expected.

7. There will never be enough training – particularly across different modules.

8. Most important of all, and the single biggest failure point for ERP implementations, is the need for change management. The need for change management is not likely to be recognized until it is too late. The changes required to corporate culture are likely to be grossly underestimated. It is going to be hard enough to cope with the technical issues without having to address major people issues as well. (p. 5)

From this brief presentation of the pros and cons of ERP systems implementation, one can conclude there are significant benefits to be gained by having an ERP system. It would behoove managers of companies contemplating an ERP system today to learn about positives and negatives before launching into an implementation process. The point of providing a research methodology or paradigm to create new knowledge in this area is to assist managers in future decisions about implementing ERP systems.

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In her research article, Babb (2004) stated that security and reliability have become increasingly important topics in Information Technology literature. These findings help to understand the factors surrounding the willingness of managers to recommend the technology. It showed that there are multiple reasons an individual may or may not recommend a solution, and both vendors and managers should be aware that technologies often require many benefits to be adopted. This implies that organizations requires reliability, cost saving and security before solutions touching their core network from the outside will be recommended, a key into the future of technology growth and decision making for IT executives. The study indicated that many factors play a role in decision-making; further study could indicate which factor plays more of a role than others. Babb presented empirical evidence that show Wide Area Networks using traditional connectivity means are being replaced with this newer, secure encrypted, reliable and cost-effected solution. Based on such findings, Babb concluded that technology managers evaluate technology based on many criteria, and that before funding projects executives are requiring substantial research and information related to the benefit of the solution, the cost and its return, the security of solutions and the reliability when technology is so critical to companies.

<div align="center">Methodological Approach</div>

A person contemplating research in the area of management would be well advised to have an understanding of basic methodological approaches as well as some knowledge of past research. This notion is succinctly captured by Lamond (2005), who stated:

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> Let us then, seek to absorb the past in order to understand the present and inform the future and, in remembering the past, build on it rather than merely repeat it. Then we will be practical. Then we will better able to provide thoughtful and provocative insights into current management practice. (p. 1279)

Researchers are influenced by their knowledge and understanding of previous research in that this knowledge of the past becomes the springboard for future research. From that perspective, management theory is evolutionary in nature, in a somewhat similar manner to the evolutionary nature of scientific research espoused by Kuhn (1996). Therefore, it is most reasonable to review the paradigmatic assumptions and concepts involved in each of the three basic methodological approaches in organization and management research.

The three basic methodological approaches are labeled the analytical approach, systems approach and actors approach by Arbnor and Bjerke (1997). Before describing the basic tenants of these three approaches, it is worth mentioning other writers describe the methodological approaches or paradigms differently, such as the positivist and the phenomenological approaches (Karami, Rowley, & Analoui, 2006). In general terms, the positivist approach uses quantitative and experimental methods to test hypothetical deductive generalizations, while the phenomenological approaches uses qualitative approaches to inductively understand human experiences (Karami et al.). In other words, the positivist approach searches for external causes or fundamental laws while the phenomenological approach tries to understand and explain a phenomenon (Karami et al., 2006). As the analytical, systems and actors approaches are discussed, it will become clear the positivist approach aligns mostly with the analytical approach (quantitative) and the phenomenological approach most closely aligns with the systems approach (qualitative) and to a lesser degree with the actors approach (also qualitative). Gephart

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(1999) suggested the three paradigms common in contemporary social research are positivism, interpretivism, and critical postmodernism.

This review of the paradigmatic assumptions and concepts involved in each of the three basic methodological approaches will be limited to covering only the most significant aspects rather than attempting to describe all the nuances of the three approaches. In the analytical approach, the truth (or knowledge) is determined by casual relationships by starting with what is given and then ask how we can explain what is given (Arbnor & Bjerke, 1997). The objective reality reached through observing and measuring this cause and effect for specific items then become models for similar behavior in other instances, and these models usually contain quantitative elements which adhere to the laws of mathematics (Arbnor & Bjerke). The second key assumption of the analytical approach is knowledge created from this approach is independent of the observer (Arbnor & Bjerke). And a final assumption is reality is objective (Arbnor & Bjerke).

Next is the systems approach, which emphasises studying components which are in inevitable interaction with each other instead of in potential cause-effect relations as described in the analytical approach (Arbnor & Bjerke, 1997). In other words, the behavior of individuals is predicated on the systems principles rather than individual parts. Therefore knowledge (or explanations) is developed by studying systems, not individuals. Thus, the search is for finality relations. A key assumption of the systems approach is reality is arranged in a way the whole differs from the sum of its parts, or a synergy exists such that the whole may be plus or minus the sum of the parts.

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The actors approach is somewhat different than the other two as the end product is not an explanation, but is trying to understand social wholes (Arbnor & Bjerke, 1997). The actors approach suggests organizations as such can not act, only the individuals in the organization can act; and thus, knowledge is dependent on the actors. In this approach, reality's ambiguity and changeability are a result of the creator of knowledge interacting with that being studied. The assumptions are knowledge is dependent on actors, the whole exists as meaning structures which are socially constructed, and the whole is understood via the actors' finite provinces of meaning.

At first glance, much of the research in the area of ERP (and other IT) implementations looks like it would fall predominantly in the systems approach, but closer scrutiny reveals some strong resemblances of the analytical approach as well. A lot of research focuses on what ERP can do for the company, or dependent variables which technologies presumably affect or change as they are implemented and used, with discrete processing capabilities separated from how they operate in contexts (Kang, 2007). In other words, researchers from different disciplines and backgrounds search for dependent variables in the contexts of IT use. As an example of a rather quantitative approach, Lall and Tryaravhakul (2006) used a technique called data in development analysis (DEA), which is a mathematical programming technique using multiple inputs and outputs to calculate the relative efficiencies of multiple decision-making units, which are converted into a single measurement of relative efficiency.

Most of the emphasis is on upfront planning of what ERP can do without much consideration of post-deployment designed changes to an ERP system necessary as a result of social and organizational changes driven by conflicts between old and new

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business processes associated with old and new technologies (Robey, Ross, & Bourdreau, 2002). Thus, research approaches most used were studies conducted using the hypothetico-deductive approaches (Vessy, Ramesh, & Glass, 2002).

Although much of previous research was somewhat analytical and focused on events leading to the selection, evaluation, and implementation of ERP systems, research in the current era (past few years through present time) seem to have shifted more towards the systems approach. For example, Muscatello and Parente (2006) based their research on a qualitative research design using case study methodology with eight companies involved. However, their research methodology would appear to have spilled over to the actors approach as the researchers were an active part of the implementation team for six months (Muscatello & Parente, 2006). An important point, and one recognized by these researchers, is a study involving only eight companies is not a sufficient basis to formulate generalizations with what widespread applicability. In another study, Furumo and Melcher (2006) suggest studying the effects of an ERP system on an organization requires a dynamic method different from the traditional model in which independent and dependent variables are identified and studied at one point in time. An important point is not only will individuals modify their personal relationships within a firm after ERP implementation, but internal and external business process (functional areas within the company and business to customer relations) will change (Furumo & Melcher, 2006).

While there are numerous other studies, each with approaches which differ, the ones outlined above are sufficient to provide a feeling for the variety of research methods currently in use. The quantitative approach or analytical approach traditionally used for

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research has yielded to the systems approach and to some degree, the actors approach, in most current research about ERP implementation.

The Distinction

To understand the distinction between qualitative and quantitative methodologies, let's define the latter. Quantitative research attempts precise measurement of something. In business research, quantitative methodologies usually measure consumer behavior, knowledge, opinions, or attitudes (Cooper & Schindler, 2006, p.198). Qualitative research, on the other hand, aims to achieve an in-depth understanding of a situation. Qualitative research draws data from a variety of sources, including the following: (a) People (individuals or groups); (b) Organizations or institutions; (c) Texts (published, including virtual ones); (d) Settings and environments (visual/sensory and virtual material); (e) Objects, artifacts, media products; and (f) Events and happenings (Cooper & Schindler, 2006, p.196).

Robson (2002) referred to flexible research design rather than the more usual qualitative research design, and fixed design research, typically involving the collection of quantitative data. Robson further suggested that fixed designs are usually concerned with aggregates, with group properties and with general tendencies. Generally, research using fixed methods remains at a greater physical and emotional distance from the study than those using flexible, qualitative methods. (p. 98). Long, White, Friedman, and Brazeal (2000) stated that a great deal of criticism has been aimed at empirical analytic research because of its narrow focus. However, a similar criticism can be leveled at qualitative research. Robson (2002) stressed that trustworthiness or otherwise of findings from flexible, qualitative research is the subject of much debate. Fixed design

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experimentalists criticize the absence of their 'standard' means of assuring reliability and validity, such as checking inter-observer agreement, the use of quantitative measurement, explicit control for threats to validity, and direct replication. (p. 168). Maxwell (1992) has presented a useful typology of the kinds of understanding involved in qualitative research. The main types are description, interpretation and theory. Each of the main types has particular threats to its validity.

Creswell (2003) stated that throughout the late 19th and 20th centuries research models associated with the quantitative strategy of inquiry were those that appealed to the post-positivist point of view. These strategies included true experiments (use of random assignments of subjects to treatment conditions), single subject experiments/quasi-experiments (use of nonrandomized designs) (Keppel, 1991), and correlation studies (Campbell & Stanley, 1963).

The necessary steps in developing a quantitative research model is to first examine the relationships between and amid the variables in order to address the hypothesis, null hypothesis and questions proposed in the research via experiments and surveys. Objective data results are derived from the pragmatic measurement studies that are systematically reviewed to provide the means to test a theory (Creswell, 2003).

Creswell (2003) suggested that a quantitative research model employs the use of a survey where the design provides a numeric description of trends, attitudes, or opinions of a population by studying a sample of that population, thereby making assertions regarding that population based on the sample survey. (Scandura et al., 2000) suggested that increased triangulation should improve the ability of researcher to draw conclusions

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from their studies. The use of a variety of methods to example a topic might result in a more robust and generalizable set of findings (higher external validity).

The data collection methods that can be used in business research are (a) sampling, (b) interviews, (c) observation, and (d) survey.

According to Cooper and Schindler (2006) sampling sizes for qualitative research vary by technique but are generally small, sampling sizes for quantitative research are generally larger. Cooper and Schindler further stated that qualitative research involves nonprobability sampling, where little attempt is made to generate a representative sample.

The interview is the primary data collection technique for gathering data in qualitative methodologies. To use the interview technique, one must understand that interviews vary based on the number of people involved during the interview, the level of structure, the proximity of the interviewer to the participant, and the number of interviews conducted during the research (Cooper & Schindler 2006, p.204).

Observation qualifies as scientific inquiry when it is conducted specifically to answer a research question (Cooper & Schindler 2006, p.224). Cooper and Schindler further stated that the versatility of observation makes it an indispensable primary source method and a supplement of other methods. A researcher must have good observation skills because beside collecting data visually, observation involves listening, reading, smelling, and touching (p.225).

A survey is a measurement process used to collect information during highly structured interviews, sometimes with a human interviewer and other times without. The great strength of the survey as a primary data collecting approach is it versatility. A

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survey that uses the telephone, mail, a computer, e-mail, or the Internet as the medium of communication can expand geographic coverage at a fraction of the cost and time required by observation (Cooper & Schindler 2006, p. 245). One must understand the characteristic of the communication approach in gathering data (Cooper & Schindler, 2006 p. 245) states that the researcher choice of communication approach affects the following: (a) the creation and selection of measurement questions, (b) instrument design, (c) sampling issues, and (d) data collection process, which create the need for follow-up procedures. Once a researcher has determined that survey is the appropriate data collection approach, various means may be used to secure information individuals (Cooper & Schindler, 2006). Within the IT field, nowhere has the computer revolution been felt more strongly than in the area of the self-administered survey (Cooper & Schindler, 2006). Cooper and Schindler further stated that computer-delivered self-administered questionnaires use organizational internets, the Internet, or online services to reach their participants.

Babb (2004) presented a quantitative study where she sought to assess the Information Technology manager's perception of the security and reliability of Virtual Private Networks, and to identify the relationship of their perceptions with their willingness to recommend them. She concluded that technology managers evaluate technology based on many criteria, and that before funding projects executives are requiring substantial research and information related to the benefit of the solution, the cost and its return, the security of solutions and reliability when technology is so critical to companies. Babb further indicated that managers were using the Virtual Private Network in their company to provide after-hours access to information stored online,

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indicating the ability of the technology to make a solid contribution to quality of service for customers. Anonymous (2005) stated that VPNs are divided into three categories: remote access, intranet, and extranet. Remote access VPNs connect remote users and smaller satellite offices with minimal traffic to a corporate wide area network (WAN) where internal company resources can be accessed. Intranet VPNs connect branch office and home offices with higher network traffic to a company's intranet. Extranet VPNs supply secure connectivity and provide shared information to business partners, such as suppliers or customers. (p. 4)

This study builds on the work presented by Babb (2004) by focusing on factors influencing use of Virtual Private Network. Towards that effort, this study assesses the strength of each factor the manager's decision to use Virtual Private Networks. This study presented findings that will aid in assessing the relationship between perceptions of Virtual Private Networks and manager's decision to recommend their use.

Summary

This chapter contains a comprehensive framework for understanding the criticalness of studying Virtual Private Networks and their use in industry. It showed that there are multiple reasons an individual may or may not recommend a solution, and both vendors and managers should be aware that technologies often require many benefits to be adopted. Today in a fast changing information technology world, adaptability is an important feature that leaders must apply in the business arena, especially managerial personnel responsible for decision-making.

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CHAPTER 3. METHODOLOGY

The results and findings of this study were based on the utilization of quantitative methods as the means by which the data was manipulated and analyzed. Such data was collected using the survey questionnaire method of data collection which is an appropriate method utilized in such quantitative studies. Since the goal of this study to assess the strength of each factor the manager's decision to use Virtual Private Networks, the use of quantitative methods is most appropriate since such methods are well suited for "discovering associations between variables" (Cooper & Schindler, 2004, p. 161).

Research Design

Understanding the strategy of the organization is a must for developing an effective IT strategy (Shupe, et al. 2006). However, if the IT strategy does not fit with the overall organization's vision, there will be constant conflict. Top leadership will need to invest valuable time in articulating the organizational vision and determining how IT will help with meeting and sustaining the vision. The focus of this study was on IT professionals on the Eastern Coast of the United States. The study did not require a manager to support a particular number of users, but only he/she is familiar with the use and implementation of Virtual Private Networks. The results of the study provided feedback on Information Technology manager's decision to recommend Virtual Private Networks. Towards that effort, the following questions were the basis for this study:

RQ 1: To what extent, if any, is perceived security related to an information technology manager's decision to recommend Virtual Private Networks?

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RQ 2: To what extent, if any, is the desire to save money in communications costs related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 3: To what extent, if any, is the perceived need for wide area networking related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 4: To what extent, if any, is perceived reliability related to an information technology manager's decision to recommend Virtual Private Networks?

To answer these questions, the following hypotheses are made:

H1o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perception of its security.

H1a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its security.

H2o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her desire to save money in communications costs.

H2a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her desire to save money in communications costs.

H3o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perceived need for wide area networking.

H3a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perceived need for wide area networking.

H4o: An Information Technology manager's decision to recommend Virtual

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Private Networks is independent on his/her perception of its reliability.

H4a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its reliability.

This is a non-experimental quantitative study using a survey design for this research. Robson (2002) refers to quantitative research design as fixed research design involving the collection of quantitative data. The data collection method used was a survey instrument (see Appendix A) that was created by Babb (2004) to collect data related to factors influencing use of Virtual Private Networks.

Sample

The theoretical population was all Information Technology professionals in a management role. The study population included executives (VP of IT, CTO, and CIO), IT Directors and IT Managers from small, medium and large-size information technology organizations operating in Southeastern of the United States that requires an IT department in order to conduct their line of businesses. These high-level executives or their delegates are responsible for the business strategic planning and decision making for network selection.

A power analysis using G*Power 3 software (Faul, Eradfelder, Lang, & Buchner, 2007) was conducted to confirm the minimum number of responses required to ensure statistically significant results. Applying a medium effect size of 0.30, a significance (alpha) level of .05 and a Power of .80. G*Power3 indicated an effective sample size is 142.

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The source of the sampling frame was provided by a Web hosting company with public access information. A mailing list of 2,500 records covering the Southeastern of the United States was provided.

The participants received a memo via e-mail that includes a direct link to an online survey at surveymonkey.com. This method of data collection is an effective method since it would be easier to gather the data in a central repository where access to such data will be secured and efficient. This data was directly imported into Statistical Package for the Social Sciences (SPSS®) software package for analysis and manipulation. The direct import of data from a database will eliminate the chances of errors if data was to be recorded manually from paper-based surveys. Selection of participants for pilot testing will not be required as validity and reliability was addressed through the use of survey instrument from Babb's (2004) previous research, as cited in Instrument section.

Instrument

Data used in this study was gathered using a survey questionnaire published by Babb (2004), which is located in the Appendix A. This researcher obtained e-mail confirmation to build on Babb's study. Validity was measured through the use of pretest validity assessments. Peer reviews assisted in assessing whether the researcher has accurately stated the questions from a technical perspective. Reliability was measured to ensure repeatability through the use of the Cronbach Alpha in SPSS (Babb, 2004). The survey instrument is composed of five sections. The first section will evaluate the manager's perception of Virtual Private Networks as it relates to security. The second section will refer to the respondent's perception of Virtual Private Networks as it relates

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to cost versus benefits. The third section will refer to the need for Wide Area

Networking. The fourth section will gain a perspective of the respondent's view of

reliability of the technology. The fifth section will gain an understanding of the

respondent's general attitude toward Virtual Private Networks. Sections one through five

uses a five-point Likert scale, in which only the first (*strongly disagree*) and fifth

(*strongly agree*) points are defined. The last section addresses the demographics of

participants and their organization, such as title of participant, number of users support,

and the organization experience implementing Virtual Private Networks and Wide Area

Networks, and asks open-ended questions with regard to the individual's perceptions of

the technology. The survey will take approximately 10 minutes to complete.

Participants were not required to provide any personally identifiable information

(i.e., name, date of birth, gender, race, education, and contact information) during the

completion of the survey instrument. The participants were informed that the researcher

respects the privacy and confidentiality of their responses and only the summarized

results of the study will be published.

Data Collection

Data for this study was collected using the survey questionnaire method, which

was Web based (see Appendix A). This survey was administered via the Internet by the

researcher to capture the responses from IT directors, managers, CIOs, or individual

involved with VPN. The participants was informed that soft and hard copies of data

generated from the survey will be locked in a home safe and the soft copies will be stored

in a secure SQL database for researcher use only through an authentication scheme that

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will be applied to the database. The data collected was analyzed using SPSS 14.0 for windows.

Data Analysis

The data analysis in this study was based on the four hypotheses that guided this study using the Chi Square Test of Independence. A level of significance of .05 was utilized for each test to help the researcher assess the significance of the factors of interest. In addition to the statistical analysis of the hypotheses formulated, the calculated means of each system was tested to investigate if there is a relationship between the four hypotheses at 5% significant level. Furthermore, the data analysis used in this study was based on the methods and procedures utilized in the study presented by Babb (2004). The Statistical Package for Social Sciences SPSS[R] 14.0 software was used to perform Chi Square test of independent and/or dependence in an effort to determine the relationship, if any, between the independent variable (perception of security, cost, need, and reliability) and dependent variable (decision to use VPN). Survey results for this research was assessed using the chi-square (2x2) to ensure that the hypothesized relationships exist between the factors influencing the decision to use Virtual Private Networks per the Likert-scale. Chi Square tests were used to confirm the results of the four hypotheses.

Hypothesis 1 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perception of its security. This hypothesis was evaluated by comparing responses to question 1 and question 15 on the survey. Question 1 is "I feel that Virtual Private Networks are Secure"; question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization

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rather than using traditional Wide Area Networks." Since a response of strongly agree is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). The same Chi Square test was utilized in this study based on the dependent variable a manager's decision to recommend Virtual Private Networks to their organization; the independent variable is as follows: Security is the perceived level of concern and/or comfort the manager has with Virtual Private Networks. This variable was measured by response to question 1 in the survey.

Hypothesis 2 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her desire to save money in communications costs. This hypothesis was evaluated by comparing responses to question 6 and 15 on the survey. Question 6 is "Virtual Private Networks provide a good value for their costs"; question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks." Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). The same Chi Square test was utilized in this study based on the dependent variable a manager's decision to recommend Virtual Private Networks to their organization; the independent variable is as follows: Desire to save money in communications costs with Virtual Private Networks. This variable was measured by response to question 2 in the survey.

Hypothesis 3 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perceived need for wide

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area networking. This hypothesis was evaluated by comparing responses to question 10 and question 15 on the survey. Question 10 is "My organization needs the ability to connect remote users to the corporate backbone"; Question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks." Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). The same Chi Square test was utilized in this study based on the dependent variable a manager's decision to recommend Virtual Private Networks is dependent on his/her perceive need for remote user and remote site access. This variable was measured by response to question 10 in the survey.

Hypothesis 4 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent on his/her perception of its reliability. This hypothesis was evaluated by comparing responses to question 12 and 15 on the survey. Question 12 is "Virtual Private Networks are inherently reliable." Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). The Chi Square test was utilized in this study based on the dependent on his/her perceived reliability of the technology. This variable was measured by response to question 12 of the survey.

Using SPSS, one-way ANOVA analysis was performed to determine the probability that the hypotheses may be true. Computational analysis using chi-square as utilized by Babb (2004) in an effort to "to ensure that the four hypothesized relationships

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exist" (p.62) between the variables: Security, cost, need, and reliability per the Likert-scale.

Validity and Reliability

Validity was measured through the use of pretest validity assessments by Babb (2004). Peer reviews assisted in assessing whether the researcher has accurately stated the questions from a technical perspective. As indicated by Babb, internal validity is not considered critical to data analysis for exploratory studies of this nature because its primary purpose is not to establish causality (Yin, 1994). Reliability was measured to ensure repeatability through the use of the Cronbach Alpha in SPSS. Reliability was found to be relatively high, with a Cronbach Alpha of .74 (Babb, 2004).

The population for this proposed study consists of Information Technology Professionals in a management role and executives in Southeastern of the United States representing small, medium and large-sized business.

Ethical Considerations

The Institutional Review Board (IRB; 2008) stated that "before any research-related recruitment or interaction takes place, the Institutional Review Board (IRB) or its designee must approve all research conducted under the auspices of Capella University that involves human participants and/or their records" (p. 3). This process is designed to comply with federal regulations regarding the research using human participants. Belmont's (2008) report argues for three important ethical principles (a) informed consent and respect for individuals, (b) assessment of risks and benefits, and (c) equity in the sampling process.

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PhD learners must take an IRB training course as part of the dissertation process in order to understand ethical guidelines, rules applicable to human subjects, risk assessment, informed consent, rights of individuals to privacy, and Capella University's policies.

Participants consenting to participate in the survey questionnaire for this study received a survey questionnaire stating that the survey is anonymous, treated confidentially with results being reported only in summary, and no individual responses will be revealed. Participants were made aware that their participation in the survey questionnaire was strictly voluntary and that their withdrawal at any time will be understood.

CHAPTER 4. DATA COLLECTION AND ANALYSIS

Introduction

This chapter presents the findings of the study. The purpose of the study was to identify particular management perceptions on the use of Virtual Private Networks to enable managers to make better informed decisions. In particular, it will help them determine whether the technology is becoming widely adopted and if security and reliability aspects of the systems are generally acceptable to technology management professionals.

Results

The survey questionnaire for this study was published by Babb (2004), which is located in the Appendix A. The total number of questions is 22 which were divided into five logical groupings: Security, cost-benefit, need for Wide Area Networking, reliability, and general information (see tables 1 – 22). There were 154 respondents to the survey, which represents over five percent of the populated tested. It is assumed that the results are representative of the population as the list members include professionals from various companies with varying size and industry.

Table 1. Survey question 1 *(N=154)*
Security *(Questions 1-5)*

Q1. I feel that Virtual Private Networks are secure.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.6%	1
Disagree	5.8%	9
Neutral	5.8%	9
Agree	29.9%	46
Strongly Agree	57.8%	89
	Total	154

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Table 2.
Survey question 2 *(N=154)*

Answer Options	Response Percent	Response Count
Q2. I am/would be concerned with the type of authentication Virtual Private Networks use when implementing them in my organization.		
Strongly Disagree	1.9%	3
Disagree	2.6%	4
Neutral	1.9%	3
Agree	35.1%	54
Strongly Agree	59.1%	91
	Total	154

Table 3.
Survey question 3 *(N=154)*

Answer Options	Response Percent	Response Count
Q3. I am/would be concerned with the encryption capabilities when implementing Virtual Private Networks as my organization.		
Strongly Disagree	1.3%	2
Disagree	3.9%	6
Neutral	1.3%	2
Agree	40.3%	62
Strongly Agree	53.2%	82
	Total	154

Table 4.
Survey question 4 *(N=154)*

Answer Options	Response Percent	Response Count
Q4. I am willing to use Virtual Private Networks to transfer sensitive information at my organization.		
Strongly Disagree	0.6%	1
Disagree	5.2%	8
Neutral	6.5%	10
Agree	31.8%	49
Strongly Agree	55.8%	86
	Total	154

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Table 5.
Survey question 5 *(N=154)*

Q5. Virtual Private Networks weren't secure eight years ago.		
Answer Options	Response Percent	Response Count
Strongly Disagree	1.3%	2
Disagree	3.9%	6
Neutral	31.8%	49
Agree	57.8%	89
Strongly Agree	5.2%	8
	Total	154

Table 6.
Survey question 6 *(N=154)*
Cost-Benefit *(Questions 6-8)*

Q6. Virtual Private Networks provide a good value for their costs.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.0%	0
Disagree	0.6%	1
Neutral	12.3%	19
Agree	39.6%	61
Strongly Agree	47.4%	73
	Total	154

Table 7.
Survey question 7 *(N=154)*

Q7. The cost of maintenance is lower with Virtual Private Networks that with tradition Wide Area Networking methods.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.0%	0
Disagree	4.5%	7
Neutral	14.3%	22
Agree	44.8%	69
Strongly Agree	36.4%	56
	Total	154

Table 8.
Survey question 8 *(N=154)*

Q8. I would consider Virtual Private Networks a considerable cost savings over traditional Wide Area Networks in my organization.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.6%	1
Disagree	4.5%	7
Neutral	12.3%	19
Agree	48.1%	74
Strongly Agree	34.4%	53
	Total	154

Table 9.
Survey question 9 *(N=154)*
Need for Wide Area Networking *(Questions 9-11)*

Q9. My organization needs the ability to connect remote sites to the corporate backbone.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.0%	0
Disagree	4.5%	7
Neutral	8.4%	13
Agree	22.1%	34
Strongly Agree	65.6%	101
	Total	154

Table 10.
Survey question 10 *(N=154)*

Q10. My organization needs the ability to connect remote users to the corporate backbone.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.0%	0
Disagree	5.8%	9
Neutral	7.1%	11
Agree	22.7%	35
Strongly Agree	64.3%	99
	Total	154

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Table 11.
Survey question 11 *(N=154)*

Answer Options	Response Percent	Response Count
Q11. Wide Area Networks provide a significant benefit to my organization.		
Strongly Disagree	0.6%	1
Disagree	0.6%	1
Neutral	9.7%	15
Agree	38.3%	59
Strongly Agree	50.6%	78
	Total	154

Table 12.
Survey question 12 *(N=154)*
Reliability *(Questions 12 -14)*

Answer Options	Response Percent	Response Count
Q12. Virtual Private Networks are inherently reliable.		
Strongly Disagree	0.0%	0
Disagree	1.9%	3
Neutral	13.0%	20
Agree	33.8%	52
Strongly Agree	51.9%	80
	Total	154

Table 13.
Survey question 13 *(N=154)*

Answer Options	Response Percent	Response Count
Q13. The Internet is reliable enough to transfer time-sensitive data within my organization.		
Strongly Disagree	0.6%	1
Disagree	10.4%	16
Neutral	5.8%	9
Agree	35.1%	54
Strongly Agree	48.1%	74
	Total	154

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Table 14.
Survey question 14 *(N=154)*

Q14. Virtual Private Network hardware is reliable.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.0%	0
Disagree	0.6%	1
Neutral	13.6%	21
Agree	31.2%	48
Strongly Agree	54.5%	84
	Total	154

Table 15.
Survey question 15 *(N=154)*
General Information *(Questions 15 – 22)*

Q15. I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.6%	1
Disagree	3.9%	6
Neutral	12.3%	19
Agree	25.3%	39
Strongly Agree	57.8%	89
	Total	154

Table 16.
Survey question 16 *(N=154)*

Q16. I feel that Virtual Private Networks use proven technology.		
Answer Options	Response Percent	Response Count
Strongly Disagree	0.0%	0
Disagree	1.3%	2
Neutral	12.3%	19
Agree	28.6%	44
Strongly Agree	57.8%	89
	Total	154

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Table 17.
Survey question 17 *(N=154)*

Q17. My experience implementing Virtual Private Networks or Wide Area Networks and their use in my organization has been:		
Answer Options	Response Percent	Response Count
Short Statement		
Total	100.00	154

Table 18.
Survey question 18 *(N=154)*

Q18. My additional comments on benefits or concerns with Virtual Private Networks are:		
Answer Options	Response Percent	Response Count
Short Statement		
Total	100.00	154

Table 19.
Survey question 19 *(N=153)*

Q19. My organization supports:		
Answer Options	Response Percent	Response Count
0 to 199 users	39.2%	60
200 to 500 users	35.3%	54
500 to 2000 users	13.7%	21
Other	11.8%	18
	Total	153
	Missing	1

Table 20.
Survey question 20 *(N=153)*

Q20. I have implemented Virtual Private Network technology for remote user connectivity:		
Answer Options	Response Percent	Response Count
Yes	71.9%	110
No	23.5%	36
Inprocess	4.6%	7
	Total	153
	Missing	1

Table 21.
Survey question 21 *(N=153)*

Q21. I have implemented Virtual Private Network technology for corporate office connectivity:		
Answer Options	Response Percent	Response Count
Yes	66.0%	101
No	30.1%	46
Inprocess	3.9%	6
	Total	153
	Missing	1

Table 22.
Survey question 22 *(N=153)*

Q22. My Title is:		
Answer Options	Response Percent	Response Count
IT Manager	24.2%	37
IT Director	8.5%	13
VP of IT	2.6%	4
CTO	1.3%	2
CIO	2.6%	4
Other IT	46.4%	71
Not IT	16.3%	25
	Total	153
	Missing	1

Analysis and Evaluation of Results

Hypothesis 1

Hypothesis 1 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perception of its security. This hypothesis was evaluated by comparing responses to question 1 and question 15 on the survey. Question 1 is "I feel that Virtual Private Networks are Secure"; question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks" (see tables 23 and 24). Since a

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response of strongly agree is the only response that equates to a fully committed

recommendation, the responses were coded into two possible categories: *strongly agree*

(coded as 1) and *less than strongly agree* (coded as 2).

Table 23
Crosstabulation Results for Hypothesis 1

		I feel that Virtual Private Networks are secure.		
		1.00	2.00	Total
I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks	1.00	84	5	89
	2.00	5	60	65
	Total	89	65	154

Table 24
Chi Square Test Results for Hypothesis 1

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	115.733[a]	1	.000		
Continuity Correction[b]	112.206	1	.000		
Likelihood Ratio	135.973	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	154				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 27.44
b. Computed only for a 2x2 table

Since the p-value is .0000 which is less than 0.05, the null hypothesis was

rejected. As a result, it can be concluded that an Information Technology Manager's

decision to recommend Virtual Private Networks is associated on his/her perception of its

security. A Chi-Square test of independence indicated there is a significant relationship

between question 1 and 15, X^2 (1, $N=154$) = 115.73, $p < .05$.

Hypothesis 2

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Hypothesis 2 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her desire to save money in communications costs. This hypothesis was evaluated by comparing responses to question 6 and 15 on the survey. Question 6 is "Virtual Private Networks provide a good value for their costs"; question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks" (see tables 25 and 26). Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2).

Table 25
Crosstabulation Results for Hypothesis 2

		Virtual Private Networks provide a good value for their costs.		
		1.00	2.00	Total
I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks.	1.00	71	18	89
	2.00	2	63	65
	Total	73	81	154

Table 26
Chi Square Test Results for Hypothesis 2

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	88.632^a	1	.000		
Continuity Correction[b]	85.582	1	.000		
Likelihood Ratio	105.587	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	154				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 30.81
b. Computed only for a 2x2 table

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Since the p-value is .0000 which is less than 0.05, the null hypothesis was rejected. As a result, it can be concluded that an Information Technology Manager's decision to recommend Virtual Private Networks is associated on his/her perception of the technology's value. A Chi-Square test of independence indicated there is a significant relationship between question 6 and 15, X^2 (1, $N=154$) = 188.63, $p < .05$.

Hypothesis 3

Hypothesis 3 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perceived need for wide area networking. This hypothesis was evaluated by comparing responses to question 10 and question 15 on the survey. Question 10 is "My organization needs the ability to connect remote users to the corporate backbone"; Question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks" (see tables 27 and 28). Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2).

Table 27
Crosstabulation Results for Hypothesis 3

		My organization needs the ability to connect remote users to the corporate backbone.		
		1.00	2.00	Total
I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks.	1.00	87	2	89
	2.00	12	53	65
	Total	99	55	154

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Table 28
Chi Square Test Results for Hypothesis 3

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	102.867[a]	1	.000		
Continuity Correction[b]	99.443	1	.000		
Likelihood Ratio	119.423	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	154				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.21
b. Computed only for a 2x2 table

Since the p-value is .0000 which is less than 0.05, the null hypothesis was rejected

for both remote users and remote sites. As a result, it can be concluded that an

Information Technology Manager's decision to recommend Virtual Private Networks is

associated on his/her perceived need for remote user and remote site access. A Chi-

Square test of independence indicated there is a significant relationship between question

10 and 15, X^2 (1, $N=154$) = 102.87, $p < .05$.

Hypothesis 4

Hypothesis 4 stated (null): An Information Technology manager's decision to

recommend Virtual Private Networks is independent on his/her perception of its

reliability. This hypothesis was evaluated by comparing responses to question 12 and 15

on the survey. Question 12 is "Virtual Private Networks are inherently reliable" (see

tables 29 and 30). Since a response of *strongly agree* is the only response that equates to

a fully committed recommendation, the responses were coded into two possible

categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2).

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Table 29
Crosstabulation Results for Hypothesis 4

		Virtual Private Networks Are inherently reliable.		
		1.00	2.00	Total
I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks.	1.00	79	10	89
	2.00	1	64	65
	Total	80	74	154

Table 30
Chi Square Test Results for Hypothesis 4

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	114.496[a]	1	.000		
Continuity Correction[b]	111.028	1	.000		
Likelihood Ratio	140.369	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	154				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 31.23.
b. Computed only for a 2x2 table

Since the p-value is .0000 which is less than 0.05, the null hypothesis was
rejected. As a result, it can be concluded that an Information Technology Manager's
decision to recommend Virtual Private Networks is associated on his/her perceived
reliability of the technology. A Chi-Square test of independence indicated there is a
significant relationship between question 12 and 15, X^2 (1, $N=154$) = 114.50, $p < .05$.

Representation of Population

A Chi Square Goodness of Fit test reveals no significant difference between the
distribution of company sizes in the sample versus the population; refer to tables 31and
Figure 1).

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Table 31
Size of Company (*Number of users*)

		Frequency	%	Valid %	Cumulative %
Valid	0 to 199	60	39.0	39.2	39.2
	200 to 500	54	35.1	35.3	74.5
	500 to 2000	21	13.6	13.7	88.2
	Other	18	11.7	11.8	100.0
	Total	153	99.4	100.0	
Missing	99.00	1	0.6		
Total		154	100.00%	100.00%	100.00%

Figure 1. Distribution of company size vs. population
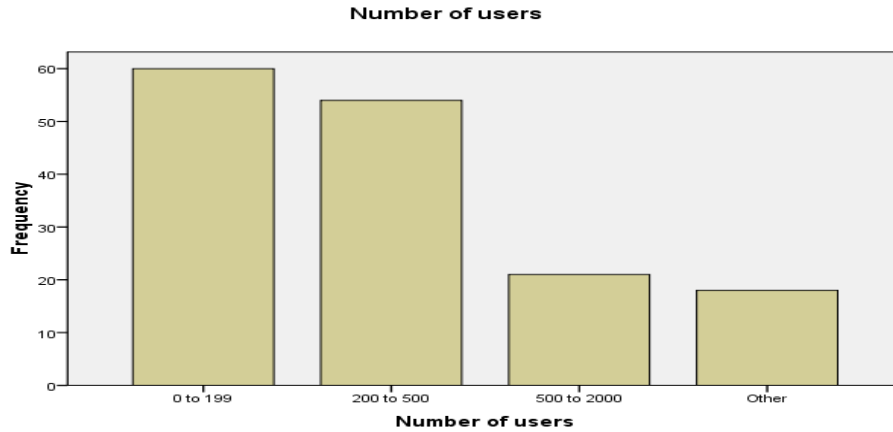
Crosstabulation analysis on the number of users the manager supports and their

willingness to recommend the technology provided results indicating that those

supporting smaller companies would less likely to recommend the technology than those

supporting larger companies. Refer to table 32 for the Crosstabulation analysis.

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Table 32
Number of Users and Recommendation Crosstabulation

			I would feel comfortable recommending Virtual Private Networks in my organization rather than Using traditional Wide Area Networks.		
			1.00	2.00	Total
Number of users	0 to 199	Count	31	29	60
		%	51.7%	48.3%	100.00%
	200 to 500	Count	48	6	54
		%	88.9%	11.1%	100.00%
	500 to 2000	Count	6	15	21
		%	28.6%	71.4%	100.00%
	Other	Count	4	14	18
		%	22.2%	77.8%	100.00%
	Total	Count	89	64	153
		%	58.2%	41.8%	100.00%

The distributions of titles in the sample are representative of the population.

Companies generally have fewer Vice Presidents and CIO's than IT directors and

managers. 39.2% of the respondents hold the title of Chief Information Officer's, Chief

Technology Officers, IT directors, IT managers, or VP of IT. 46.4% hold the title of

Other IT. These may include other managers, including consulting management, Chief

Security Officers, Knowledge Management Officers, and network architect managers.

Table 33 and Figure 2 depict the responses to the variable title.

Table 33
Title

	My Title is	Frequency	%	Valid %	Cumulative %
Valid	CIO	4	2.6%	2.6%	2.6%
	CTO	2	1.3%	1.3%	3.9%
	IT Director	11	7.1%	7.2%	11.1%
	IT Manager	37	24.0%	24.2%	35.3%
	Not IT	25	16.2%	16.3%	51.6%

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Table 33 c*ontinued*

	Other IT	70	45.5%	45.8%	97.4%
	VP of IT	4	2.6%	2.6%	100.0%
	Total	153	99.4%	100.0%	
Missing	99.00	1	0.6		
Total		154	100.00%	100.00%	100.00%

Figure 2. Distribution of title vs. population
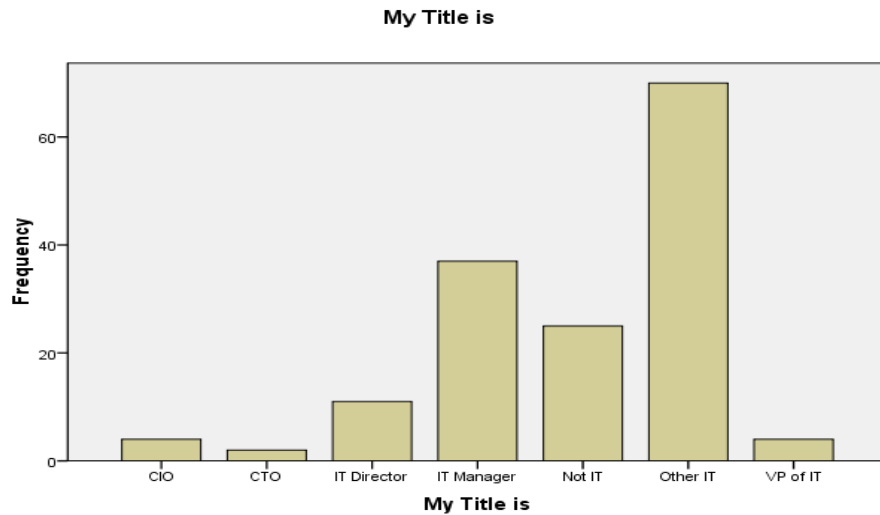
    An analysis using Crosstabulation by title and recommendation show that seven
out of eleven, 63.6%, IT directors; twenty six out of thirty seven, 70.3%, IT managers;
and forty five out of seventy, 64.3%, Other IT strongly agree to recommend Virtual
Private Networks, but only one out of twenty five, 4%, Not IT strongly agreed. Table 34
displays the results of this analysis.

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Table 34
Title and Recommendation Crosstabulation

			I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks.		
			1.00	2.00	Total
My Title is	CIO	Count	4	0	4
		%	100.00%	0.0%	100.00%
	CTO	Count	2	0	2
		%	100.00%	0.0%	100.00%
	IT Director	Count	7	4	11
		%	63.6%	36.4%	100.00%
	IT Manager	Count	26	11	37
		%	70.3%	29.7%	100.00%
	Not IT	Count	1	24	25
		%	4.0%	96.0%	100.00%
	Other IT	Count	45	25	70
		%	64.3%	35.7%	100.00%
	VP of IT	Count	4	0	4
		%	100.00%	0.0%	100.00%
	Total	Count	89	64	153
		%	58.2%	41.8%	100.00%

The individuals responding to the survey with regard to their experience

implementing Virtual Private Networks. Approximately 66% of the respondents had

experience implementing the solution. Approximately 30% did not have experience with

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the technology. Approximately 4% were in process of implementing. Refer to tables 35

and Figure 3 for the analysis.

Table 35
Experience

I have used VPNs to connect to corporate offices

	My Title is	Frequency	%	Valid %	Cumulative %
Valid	In process	6	3.9%	3.9%	3.9%
	No	46	29.9%	30.1%	34.0%
	Yes	101	65.6%	66.0%	100.0%
	Total	153	99.4%	100.0%	
Missing	99.00	1	0.6		
Total		154	100.00%	100.00%	100.00%

Figure 3. Experience (frequency distribution)
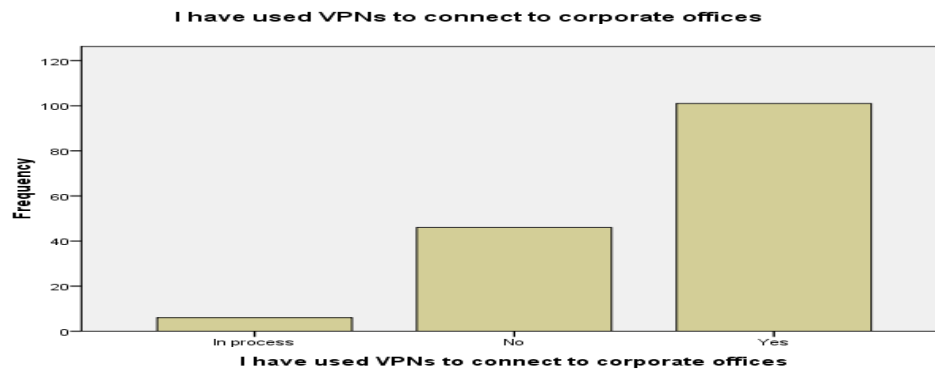
Summary

These findings provide empirical evidence supporting the research hypotheses. As

a result, it can be concluded that an Information Technology Manager's decision to

recommend Virtual Private Networks is dependent on his/her perception of its security.

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Further, the hypothesis that an Information Technology Manager's decision to recommend Virtual Private Networks is dependent on his/her perception of the technology's value. Further, the hypothesis that an Information Technology Manager's decision to recommend Virtual Private Networks is dependent on his/her perceived need for remote user and remote site access. Lastly, the hypothesis that an Information Technology Manager's decision to recommend Virtual Private Networks is dependent on his/her perceived reliability of the technology. The results of the Chi Square tests performed supported the four hypotheses. The results also made intuitive sense, as security and reliability have become increasingly important topics in Information Technology literature.

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CHAPTER 5. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter presents results, conclusions, and recommendations for further study on Virtual Private Networks and related topics. The central research question addressing the management dilemma for this study is: Why do Information Technology managers recommend Wide Area Networks instead of Virtual Private Networks? Emanating from this central question are four sub-questions focused on (a) evaluating the manager's perception of Virtual Private Networks as it relates to security; (b) assessing respondent's perception of Virtual Private Networks as it relates to cost versus benefits; (c) examining to the need for Wide Area Networking; and (4) gaining a perspective of the respondent's view of reliability of the technology.

Summary

This study focused on contributing factors to managers' choice to recommend technologies. The study will help decision makers determine what components of Virtual Private Networks are still of concern to other professionals, and may provide vendors with data to help them determine what is important to their customer base. Mostly importantly, it will help decision makers develop the right solutions for their organizations.

Perceptions of technology, its reliability and use in organizations, and in today's marketplace the security of the product are paramount to a decision to use it in a business (Babb, 2004). Information Technology professionals and executives are doing what they can to maximize their return on investment; this is becoming increasingly so in Information Technology where cost-benefit analyses are becoming a part of manager's

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everyday terminology. In the technology booms, companies were often adopting

technology and finding out after implementation whether it was of value. Those days are

gone, and managers are required to do the same analysis other business sectors were

forced to do for years. For that reason, the study of technology and its factors for

decision-making are increasingly important.

For decades, managers have been frustrated with the dilemma of getting things

done faster. Not too long ago many people living today witnessed the use of carbon paper

to copy a document. The typewriter has revolutionized the 20th century and now in the

21st century, computers have become one way of communicating and processing various

types of information. Technology is available and being used to allow people, managerial

decision-makers real time decision-making at the snap of sound. Video teleconferencing

has largely replaced the old teleconferencing system and allowed hundreds of locations

and parties to link together in observing and participating in the process and discussion

while observing each other. In their research study Ward and Peppard (2002) stated that a

number of important forces affect the pace and effectiveness of progress in using IT and

delivering business benefits. The relative weighting of each factor varies over time, and

will also vary from one organization to another. These factors include: the capabilities of

the technology; the economics of deploying the technology; the applications that are

feasible; the skills and abilities within the organization to use the applications; the

pressures on the particular organization or its industry to improve performance.

The purpose of this quantitative study was to identify particular management

perceptions on the use of Virtual Private Networks to enable managers to make better

informed decisions. In particular, it will help them determine whether the technology is

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becoming widely adopted and if security and reliability aspects of the system are generally acceptable to technology management professionals.

The study did not require a manager to support a particular number of users, but only he/she is familiar with the use and implementation of Virtual Private Networks. The results of the study provided feedback on Information Technology manager's decision to recommend Virtual Private Networks. Towards that effort, the following questions were the basis for this study:

RQ 1: To what extent, if any, is perceived security related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 2: To what extent, if any, is the desire to save money in communications costs related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 3: To what extent, if any, is the perceived need for wide area networking related to an information technology manager's decision to recommend Virtual Private Networks?

RQ 4: To what extent, if any, is perceived reliability related to an information technology manager's decision to recommend Virtual Private Networks?

To answer these questions, the following hypotheses were made:

H1o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perception of its security.

H1a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its security.

H2o: An Information Technology manager's decision to recommend Virtual

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Private Networks is independent of his/her desire to save money in communications costs.

H2a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her desire to save money in communications costs.

H3o: An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perceived need for wide area networking.

H3a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perceived need for wide area networking.

H4o: An Information Technology manager's decision to recommend Virtual Private Networks is independent on his/her perception of its reliability.

H4a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its reliability.

The research findings provided empirical evidence supporting these hypotheses, and each can be compared or contrasted with each of the above findings as follows:

H1a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its security (accepted)

H2a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her desire to save money in communications costs (accepted)

H3a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perceived need for wide area networking (accepted)

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H4a: An Information Technology manager's decision to recommend Virtual Private Networks is dependent on his/her perception of its reliability (accepted)

The survey instrument was composed of five sections. The first section evaluated the manager's perception of Virtual Private Networks as it relates to security. The second section referred to the respondent's perception of Virtual Private Networks as it relates to cost versus benefits. The third section referred to the need for Wide Area Networking. The fourth section gained a perspective of the respondent's view of reliability of the technology. The fifth section gained an understanding of the respondent's general attitude toward Virtual Private Networks. Sections one through five used a five-point Likert scale, in which only the first (*strongly disagree*) and fifth (*strongly agree*) points are defined. The last section addressed the demographics of participants and their organization, such as title of participant, number of users support, and the organization experience implementing Virtual Private Networks and Wide Area Networks, and asks open-ended questions with regard to the individual's perceptions of the technology.

The data analysis in this study was based on the four hypotheses that guided this study using the Chi Square Test of Independence. A level of significance of .05 was utilized for each test to help the researcher assess the significance of the factors of interest. In addition to the statistical analysis of the hypotheses formulated, the calculated means of each system was tested to investigate if there is a relationship between the four hypotheses at 5% significant level. The Statistical Package for Social Sciences SPSS® was used to perform Chi Square test of independence and/or dependence in an effort to determine the relationship, if any, between the independent variable (perception of security, cost, need, and reliability) and dependent variable (decision to use VPN).

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Survey results for this research was assessed using the chi-square (2x2) to ensure that the hypothesized relationships exist between the factors influencing the decision to use Virtual Private Networks per the Likert-scale. Chi Square tests were used to confirm the results of the four hypotheses.

Hypotheses

Hypothesis 1 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perception of its security. This hypothesis was evaluated by comparing responses to question 1 and question 15 on the survey. Question 1 is "I feel that Virtual Private Networks are Secure"; question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks." Since a response of strongly agree is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). A Chi-Square test of independence indicated there is a significant relationship between question 1 and 15, X^2 (1, *N=154*) = 115.73, *p* < .05.

Hypothesis 2 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her desire to save money in communications costs. This hypothesis was evaluated by comparing responses to question 6 and 15 on the survey. Question 6 is "Virtual Private Networks provide a good value for their costs"; question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks." Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree*

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(coded as 1) and *less than strongly agree* (coded as 2). A Chi-Square test of independence indicated there is a significant relationship between question 6 and 15, X^2 (1, *N=154*) = 188.63, *p* < .05.

Hypothesis 3 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent of his/her perceived need for wide area networking. This hypothesis was evaluated by comparing responses to question 10 and question 15 on the survey. Question 10 is "My organization needs the ability to connect remote users to the corporate backbone"; Question 15 is "I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks." Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). A Chi-Square test of independence indicated there is a significant relationship between question 10 and 15, X^2 (1, *N=154*) = 102.87, *p* < .05.

Hypothesis 4 stated (null): An Information Technology manager's decision to recommend Virtual Private Networks is independent on his/her perception of its reliability. This hypothesis was evaluated by comparing responses to question 12 and 15 on the survey. Question 12 is "Virtual Private Networks are inherently reliable." Since a response of *strongly agree* is the only response that equates to a fully committed recommendation, the responses were coded into two possible categories: *strongly agree* (coded as 1) and *less than strongly agree* (coded as 2). A Chi-Square test of independence indicated there is a significant relationship between question 12 and 15, X^2 (1, *N=154*) = 114.50, *p* < .05.

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The findings for this study are based on the results of survey feedback received from 154 IT executives, CIO's, CTO's and IT Management Professionals in all size businesses from the Southeastern United States. The 154 responses received represented a sufficient sample exceeding the power requirement of 142 as well as the number of respondents in prior research by Babb (2004) at 53 (IT executives, CIO's, CTO's and IT Management Professionals).

Conclusions

The results of the Chi Square tests performed supported each of the four alternate hypotheses. The results also made intuitive sense, as security and reliability have become increasingly important topics in Information Technology literature.

This study provides important insights for Information Technology scholars and practitioners involved in the strategic information systems planning regardless of what strategic planning approaches are chosen. These findings help to understand the factors surrounding the willingness of managers to recommend the technology. It shows that there are multiple reasons an individual may or may not recommend a solution, and both vendors and managers should be aware that technologies often require many benefits to be adopted. This implies that organizations require reliability, cost savings and security (Babb, 2004) before solutions touching their core network from the outside will be recommended, a key into future of technology growth and decision making for IT executives.

It can be concluded that technology managers evaluate technology based on many criteria, and that before funding projects executives are requiring substantial research and information related to the security of solutions, the benefit of the solution, the cost and its

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Return On Investment (ROI), and the reliability when technology is so critical to companies.

The survey provided respondents with a chance to further explain their selections and to explain any of their concerns, suggestions or general information about the technology. Several managers that appeared to work in Information Technology industry responded to the survey, indicating that they were using the Virtual Private Network in their company to connect remotely from home company via Checkpoint VPN to resolve network/server problems. There were several comments indicating that implementing Virtual Private Networks have been very rewarding. Several respondents mentioned this as a core benefit to the solution.

<div align="center">Recommendations</div>

The future research should focus on three areas. The need for organizational commitment to Information Technology. It is very difficult for a small or large information technology project to be successful if the organization itself does not value information technology.

Researchers may choose to study Information Security. The study of security breaches in Virtual Private Networks as they relate to Enterprise Resource Planning (ERP) technology. A research may choose to explore the critical characteristics of information security, such as availability, accuracy, authenticity, confidentiality, integrity, utility, and possession.

Finally, components of an Information System is an important topic with continually increasing virus threats and breaches keeping Information Technology professionals up at night. A researcher may choose to explore the components of an

Information Systems, such as hardware, software, data, people and procedures. These are the five critical components that enable information to be input, processed, output, and stored. Each component of the information system has its own security requirements.

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APPENDIX A. SURVEY QUESTIONNAIRE

This Virtual Private Network survey is design to evaluate the perception of Virtual Private Networks among technology managers. While the questionnaire is anonymous, the demographic information is important to differentiate the views among managers. Completed surveys will be treated confidentially with results being reported only in summary. The results of this survey may be used for doctoral dissertation or subsequently in academic or trade publications. No individual responses will be revealed. Your response represents your agreement to participate in this study.

Please indicate the most appropriate response for each question.

Security

For the following questions, please answer by choosing one of the options to the right.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I feel that Virtual Private Networks are secure.	☐	☐	☐	☐	☐
2. I am/would be concerned with the type of authentication Virtual Private Networks use when implementing them in my organization.	☐	☐	☐	☐	☐
3. I am/would be concerned with the encryption capabilities when implementing Virtual Private Networks at my organization.	☐	☐	☐	☐	☐
4. I am willing to use Virtual Private Networks to transfer sensitive information at my organization.	☐	☐	☐	☐	☐
5. Virtual Private Networks weren't secure eight years ago.	☐	☐	☐	☐	☐

Cost-Benefit					
For the following questions, please answer by choosing one of the options to the right.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
6. Virtual Private Networks provide a good value for their costs.	☐	☐	☐	☐	☐
7. The cost of maintenance is lower with Virtual Private Networks that with traditional Wide Area Networking methods.	☐	☐	☐	☐	☐
8. I would consider Virtual Private Networks a considerable cost savings over traditional Wide Area Networks in my organization.	☐	☐	☐	☐	☐

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Need for Wide Area Networking					
For the following questions, please answer by choosing one of the options to the right.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. My organization needs the ability to connect remote sites to the corporate backbone.	☐	☐	☐	☐	☐
10. My organization needs the ability to connect remote users to the corporate backbone.	☐	☐	☐	☐	☐
11. Wide Area Networks provide a significant benefit to my organization.	☐	☐	☐	☐	☐

Reliability

For the following questions, please answer by choosing one of the options to the right.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
12. Virtual Private Networks are inherently reliable.	☐	☐	☐	☐	☐
13. The Internet is reliable enough to transfer time-sensitive data within my organization.	☐	☐	☐	☐	☐
14. Virtual Private Network hardware is reliable.	☐	☐	☐	☐	☐

General Information

For the following questions, please answer by choosing one of the options to the right.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
15. I would feel comfortable recommending Virtual Private Networks in my organization rather than using traditional Wide Area Networks.	☐	☐	☐	☐	☐
16. I feel that Virtual Private Networks use proven technology.	☐	☐	☐	☐	☐

For the following questions, please answer with a short statement.
17. My experience implementing Virtual Private Networks or Wide Area Networks and their use in my organization has been:
18. My additional comments on benefits or concerns with Virtual Private Networks are:

For the following questions, please answer by choosing one of the options to the right.		
19. My organization supports:		
0 to 199 users	☐	
200 to 500 users	☐	
500 to 2000 users	☐	
Other	☐	
20. I have implemented Virtual Private Network technology for remote user connectivity:		
Yes	☐	
No	☐	
In process	☐	
21. I have implemented Virtual Private Network technology for corporate office connectivity:		
Yes	☐	
No	☐	
Inprocess	☐	
22. My Title is:		
IT Manager	☐	
IT Director	☐	
VP of IT	☐	
CTO	☐	
CIO	☐	
Other IT _____	☐	
Not IT	☐	

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