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Recovery of Municipalities after a Disaster through Virtualization

Jarod Dickerson

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RECOVERY OF MUNICIPALITIES AFTER A DISASTER THROUGH VIRTUALIZATION

by

JAROD DICKERSON

(Under the Direction of Christopher Kadlec)

ABSTRACT

Municipalities are cities and towns that contain numerous businesses and organizations, which in turn drive the economic growth and stability throughout that municipality. Many businesses and organizations today have critical and sensitive data and information that is vital to the survival of that business. Therefore, it is essential that municipalities and businesses account for the risks of natural disasters, outages, and errors. This involves having a proper information technology disasters recovery plan in place that would eliminate any risk of losing that data forever, should a disaster occur this paper seeks to examine virtualization technologies and the impact virtualization could potentially have on municipalities by using it for disaster recovery. Findings indicate that by having more municipalities invest in virtualizations, they will be able to start the rebuilding process more quickly because communications and data will be reestablished in a shorter period of time.

INDEX WORDS: Virtualization, Disaster recovery, Municipalities, Businesses

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VIRTUALIZATION

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DEDICATION

I would like to dedicate this paper and its research to all communities and organizations that have been dealing with the tremendous loss and suffering associated with natural disasters. Also, I want to dedicate this paper to all the men and women who have taken it upon themselves to be a part of the solution and start the rebuilding process in many of these communities and towns.

ACKNOWLEDGMENTS

I would like to acknowledge an IT professor at Georgia Southern University, Dr. Kadlec. He gave me the vision and overall plan for my research for this project. Also, I want to acknowledge my mother for helping with the corrections in my paper with regards to proper punctuation and grammar. Lastly, I want to acknowledge my brother for providing me with the proper knowledge of the topic introduced in my research paper.

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CHAPTER 1

INTRODUCTION

Purpose of the Study

With the recent devastating events that have occurred in Japan (2011) and Haiti (2010), disaster recovery planning has played a vital role in the recovery process of many municipalities across the globe. Disaster recovery planning is a plan that involves several different policies and procedures to be carried out before, during and after a disaster. Information technology disaster recovery planning (DRP) is a collection of policies and procedures that allow for the recovery of a technology infrastructure. Information technology disaster recover planning is extremely necessary to municipalities of all kinds because the degree to which a town and community can recover quickly, will translate to how fast businesses will return to normal operations and how fast the lives of the people who live in those communities will return to normal. A municipality is a defined area or population like a city or town that is governed by a mayor and council. Right now, there are numerous municipalities that do not have appropriate or adequate IT disaster recovery plans in place for events like a natural disaster or outages (eHow, 2011). The purpose of this study is to propose that virtualization technology will allow for many municipalities to have a proper information technology disaster recovery plan in place, resulting in secure data and a rapid recovery time .

Chapter 2 will contain a review of related literature on the impact of natural disasters, impact of the loss of data, and how virtualization technologies can be a key tool in aiding municipalities' infrastructures. Chapter 3, will lay out a prescription for

planning and implementing virtualization technologies into a business and will also describe an information technology disaster recovery planning and implementation process using different types of virtualizations technologies.

CHAPTER 2

Review of Related Literature Review

Many towns and cities across America are dependent on businesses and organizations within their communities for development and economic growth. “Businesses that are part of the community are more likely to care about the community, its environment, and the welfare of its residents so they'll come up with even more ideas” (Stengel, 2010). A successful business will fuel job growth in communities, which in turn would leads to more money and economic stimulation. Growing business that serves additional communities will increase innovation and support economic growth.

The Impact of the loss of critical data and Information

In this modern age, access to information and data is paramount. Businesses today need to be ready for worst case scenarios, such as a loss of data which could lead to major setbacks such as downtime, which in turn could lead to business availability or money loss. “Extended downtime can even be fatal to an organization industry research finds that a significant portion of companies that experience extended interruption to IT services soon go out of business” (VMWare White Paper, 2006). Today many enterprises and business keep all their information and records on servers to consolidate their information. These servers contain vital information like business records, client records, money orders, budget reports, salary reports, etc. that could be lost forever if these servers are ever lost or damaged,

Because of a lack of strategies and procedures on how to recapture data or information, natural disasters can be detrimental to the survival of many companies and

municipalities.. It was recorded by the U.S. Bureau of labor that “93 percent of companies that suffer a significant data loss are out of business [within] five years” (Rike, 2003). Today, data is the most important asset to a business, because it drives innovation and business intelligence and offers a wide range of potential in profitability and productivity. There are also many other consequences that can result from critical data loss such as financial loss, legal action, and repore. The loss of data or information could result in a loss of orders for a period of time and a significant loss in the market share. Additionally, there could be a loss in the reputation and credibility of the company, possibly leading to legal action. Legal action could potentially be brought to the organization or company depending on contractual breaches, personal details made public or infringing on data protection legislation (Gibb & Buchannan, 2006).

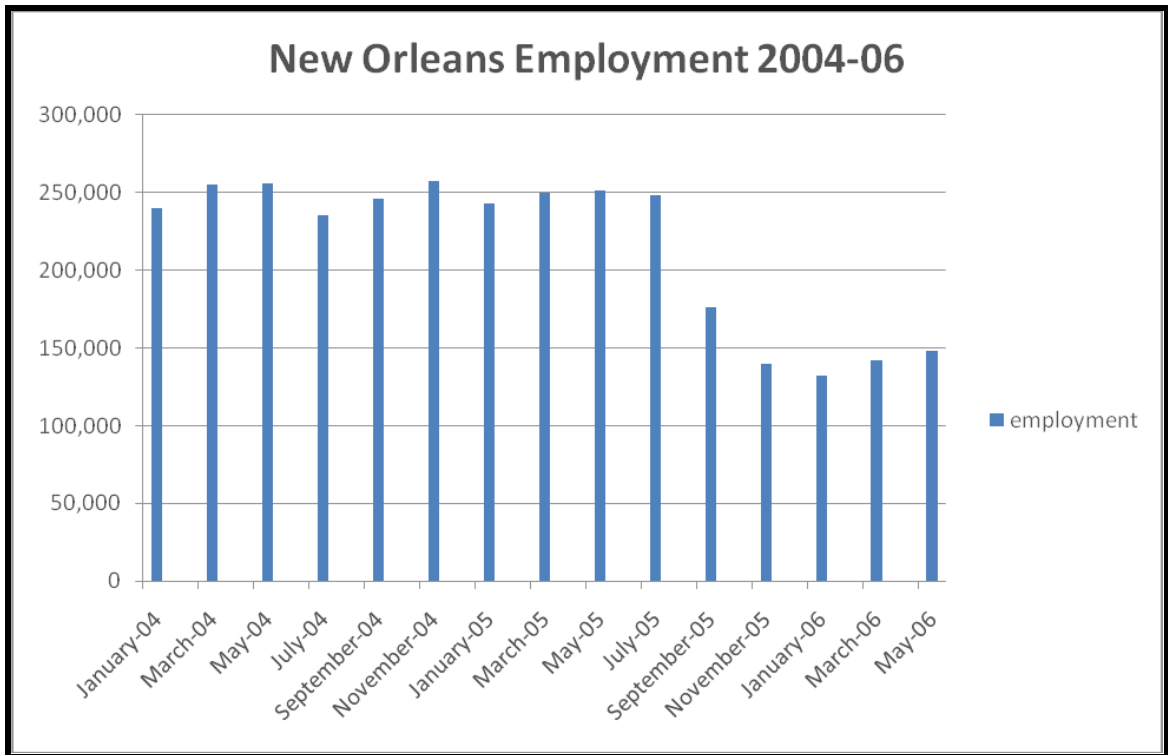
Impact of natural disasters on businesses

A disaster is defined as a sudden calamitous event bringing great damage, loss, or destruction. Natural disasters are one of several ways in which many companies and businesses can lose years of data and information forever. For example, Hurricane Katrina basically destroyed the whole city of New Orleans including many homes and local businesses. “In the aftermath of the storm, about 80 percent of the city (much of which is below sea level) was flooded, in some areas as deep as 20 feet” (Walker, 2005). A tremendous natural disaster like this not only affects businesses, but also the whole community or municipality. The main area that would be tremendously affected is the labor market in the municipality. Not only did Hurricane Katrina cause massive damage to the city of New Orleans, but it also created a massive loss in the job market. “The over-the-year loss to the city economy averaged 95,000 jobs during the first 10 months

after the hurricane” (Dolfman, 2007). The rapid employment drop in New Orleans is evident in Table 1.

Table 1

New Orleans Employment 2004-06



Note: Amended From the study on the effects of Hurricane Katrina on the New Orleans economy by Michael L. Dolfman, Solidelle Fortier Wasser, and Bruce Bergman.

The destruction of many natural resources from a disaster could effectively reduce and forever alter the sustainability of a community. It can take a long time for the city and many of its businesses to rebuild because of the mass damage and the loss of data and information. Many of these businesses would not be able to re-open again. “A 2002 Gartner survey found that only 35 percent of small and midsize businesses have a

comprehensive disaster recovery plan in place” (Rike, 2003). The majority of these businesses did not have adequate information technology disaster recovery plans to deal with the amount of damage they could suffer. Many businesses and companies today do not have proper disaster recovery plans in place if a disaster such as a hurricane, flood or fire were to occur. Having a type of DRP plan could save a business time, money, and even the business itself. One particular problem with having a DRP plan is that many businesses do not have an IT disaster recovery plan that will fully meet all the requirements of the entire organization. There are a number of challenges that prohibit businesses from having such plans. For one, “the cost of traditional solutions is often prohibitive, forcing organizations to limit what they protect and how well they protect it” (VMware white paper, 2006). Secondly, “the complexity of traditional disaster recovery limits the ability of IT staff to implement and manage disaster recovery plans for more than a few applications” (VMware white paper, 2006). Many of the challenges that are presented through information technology disaster recovery are far and wide, and include a number of different aspects.

A traditional recovery technique would include numerous amounts of manual steps such as, configuring, reinstalling, and testing hardware and software. This technique can encounter many problems during the recovery process of information and data. These obstacles in turn lead to the next challenge which is obtaining reliable recovery methods because many “organizations that have created a runbook to document the steps in the recovery process find that keeping that documentation up to date and complete can be nearly impossible” (VMware white paper). It would be very difficult for any team to execute a proper recovery plan without the accurate documentation of the recovery plan.

An additional challenge many businesses may face is having an affordable recovery plan. When planning and designing an information technology disaster recovery plan, businesses have to account for the cost of all the expectations and requirements that need to be met by the business; and as these expectations increase over time, so does the cost of that plan. Many companies will be able to combat these problems by turning to virtualization as a solution for disaster recovery.

Impact of Natural Disasters on Municipalities

Sustainability is one of the most important factors to many companies and organizations after a natural disaster has affected their operations. Virtualization is one of the key factors in providing sustainability for businesses and the surrounding communities after a natural disaster. A study by Barry Cumbie was reviewed on the issues and roles of how information technology adds effective recovery and sustainability to areas affected by disasters.

Cumbie's research focused on IT disaster recovery research, the impact of unavailable information, and the impact of disasters on communities. The goal of the research was to find an appropriate strategy for community stakeholders and companies for recovery after a disaster. Cumbie states that "the dissertation addresses the question of what factors influence decision makers in coastal communities to adopt IT disaster recovery methods that are perceived to ensure a successful recovery" (Cumbie, 2008). The research looks at different types of recovery techniques for disaster recovery plans, which led to ten different types of techniques for recovery. It included a Delphi study which was used to gather data and information about disaster recovery from experts on the topic. This study was used so that the researcher could gain further perspective on

how important data recovery is to the sustainability of local businesses. The Delphi study spanned over 3 phases with each phase containing at least 10 participants. The phases in the study included brainstorming, narrowing down, and ranking. The researcher was able to explain that the data from businesses is important to many businesses and the effort to recreate that information is potentially fatal to a business and will detract from community stability. The most important factor or priority in disaster recovery is the data generated during construction, modification, and reconstruction of the physical facility (Cumbie, 2008). The study did not address the concept of virtualization because of the date of the study and the type of study. The concept of virtualization will be addressed in the next section. The Delphi study required the participants to be aware of the importance of virtualization to municipalities, which is the intent of this research.

What is virtualization?

Virtualization was first developed by IBM in the 1960s. It was first created “as a way to logically partition large, mainframe hardware into separate virtual machines” (History of Virtualization, 2010). Virtualization was basically abandoned in the 80s and 90s by the IT world. Only in the past couple of years have virtualization technologies reemerged. Virtualization is the formation of a virtual version of a something like an operating system, server, or a storage device. This technology allows for multiple operating systems or applications to operate independently on a single server. To this date some of the most powerful computer hardware is designed to run a single operating system and a single application at one time, which keeps most computer systems from reaching full potential. With virtualization, multiple virtual machines can run on a single

physical machine, sharing the resources of that single computer across multiple environments as seen in figure 1.

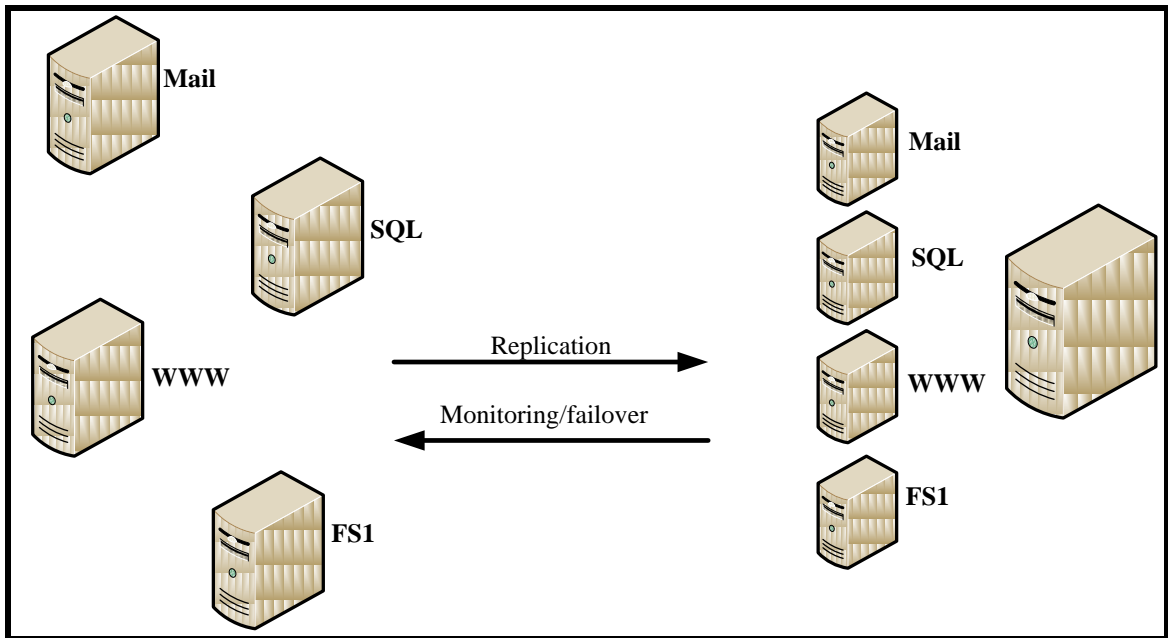


Figure 1. Basic Model of a Virtualized Environment

There are many areas in virtualization that have experienced an increase movement in innovation and advancement, like network, storage, and server virtualization. Together, all of these technologies make up what is known today as virtualization. Network virtualization is either internal or external; one will have many networks or parts of networks combined together into a virtual unit which will provide network-like functionality to the software containers on a single system. Desktop virtualization “is encapsulating and delivering either access to an entire information system environment or the environment itself to a remote device” (Desktop

Virtualization, 2008). With server virtualization, will essentially keep hidden the server resources which include operating systems, physical servers, and processors from the server user. Essentially, server virtualization is software that allows for multiple guest operating systems to run on a single host computer; with the guest operating systems believing they are running on their own hardware on the host computer. Virtualization also allows for portability of an information technology infrastructure, since the operating systems are running on virtual equipment. The servers can take several different operating system instances and applications workloads and seamlessly move them between different physical and virtual machines. In other words, virtualization will allow for several applications to be spread across several systems, in such a way that an individual environment can be altered to meet business's changing demands over time.

Impact of Virtualization

One area that virtualization contributes to is IT disaster recovery. Business of all sizes that are still backing up their entire systems using tape or disc technology can now turn to virtualization as the solution. Virtualization adds a new level of security for data and information. Whenever there might be natural disaster or outage that could harm normal business operations and its data, virtualization is a tool that can fix the problems because the servers can be hosted at an offsite location. When a company is rebuilding and needs to recapture its data back, the downtime for the business is cut significantly by using virtualization technologies. With small businesses able to recover and rebuild a lot quicker, communities are likewise able to rebuild more quickly. In an age where

communication is vital to production, virtualization can increase the recovery time in communication in communities where there have been natural disasters. Overall virtualization can be used as a utility to help municipalities that have been devastated by natural disasters. Virtualization can allow for communications in a town or city to be reestablished in a shorter period of time because of its benefits as a disaster recovery tool. More and more municipalities will be able to start the rebuilding processes more quickly because of how this technology can be used as a type of support tool.

Table 2

Impact of Virtualization on Disaster Recovery

Impact of Virtualization on Disaster Recovery		
	Benefit	Risk
IT Organizations	With virtualization as the disaster recovery strategy, it will allow for new data protection possibilities.	Its difficult to monitor traffic flow between virtual servers sharing the same physical server, it's hard to tell if confidential or legally protected data has been compromised
Business Organizations	Virtualization will allow for lower cost over traditional alternatives, and reducing fear of unplanned outages and disasters.	The risk is very small if the organization is already being ran by a virtualization environment
Business Competitiveness	With more virtualization technologies in place, it will allow for organizations to free up resources for other initiatives and investments.	Many enterprises, that use a large number of VMs can sometimes be left to rot and are never used, which could cause a hit in productivity.

In a research article by SunGard Availability Services (2008), two specific questions were addressed: first finding the obvious benefits of how virtualization improves disaster recovery and secondly, finding some of the hidden obstacles that IT professionals might face when using virtualization for disaster recovery. The focus of the study was interpreting how virtualization could be a major advancement to IT disaster recovery for small businesses. The study finds that one of the benefits of virtualization in IT disaster recovery is portability. Portability is the process that will facilitate the failure of one partition to another partition that can be located at different locations like a data center. Portability could be a huge help to municipalities of all sizes because they could potentially hold many of their servers at an offsite location that would have a limited threat from disasters. Another benefit found in the study was the ability to have faster recovery times of information. So whenever there is an unexpected error or disaster, it will not be necessary to rebuild the server, applications, or operating systems manually because virtualization software will reboot the virtual server image with all of its patches and updates. This type of technology could end up being a tremendous help for municipalities because their data and information is coming back online faster, cutting the downtime of their operations... In this study, another key advantage the research found in virtualization was security. When running applications in a virtual environment like a virtual machine, attacks on one virtual machine do not compromise the others because it is not exactly real. The results in this study support the questions that were stated, that SunGard is the answer to the hidden obstacles using virtualization as disaster recovery tool. "SunGard is a pioneering provider of off-site disaster recovery. With four million square feet of secure facilities, SunGard offers a complete range of information

availability solutions that include managed hosting, consulting and business continuity services.

Next, the topic dealing with other IT disaster recovery methods is addressed in Plate Spin's research of virtualization. It addresses two different types of problems: first, how businesses have a number of different traditional disaster planning solutions and second, how virtualization is transforming disaster recovery. The research considers the numerous amounts of techniques and options that businesses have used for their information technology disaster recovery planning methods. The article seeks to find how implementing virtualization into a business will transform disaster recovery by making it more affordable and flexible than other solutions. The results of the study indicate that businesses can use and have used many other options for Information Technology disaster recovery planning. Some of the options have been tape backup, image capture, high-end replication, and server clustering. Tape backup is the option that uses the most of the power in its operation process. This process requires external tape drives and magnetic tape for storing duplicate copies of the hard disk. In the research it was stated that "Many companies use magnetic tape in combination with additional magnetic disks and optical disk in a backup management program that automatically moves data from one storage medium to another" (Platespin, 2006). The research explains how this type of option can be negative for organizations, due to the fact that restoring a system from tapes can take several days because of the complicated manual rebuilding process. The study also discusses image capture as an alternative option for (disaster recovery?). An image capture essentially records an image of the entire system and makes an archive of that image that will be placed at a remote location in case of a disaster. But many

problems can be seen in using this approach. In the findings reveal that a common problem is “, when a workload running on an older hardware configuration fails, [and] the data center has no additional platforms of that server make and model to which they can restore the backup image” (Platespin, 2006). The study found that high-end replication is keeping multiple databases connected by consistently copying the entire databases to other servers that are located on the network. The last method the research discusses is that server clustering is an option for disaster recovery plan for businesses. The article states that “server clustering generally refers to multiple servers that are linked together in order to handle variable workloads and to provide continued operation in the event that one server or node in the cluster fails” (Platespin, 2006). A cluster generally refers to a group of servers, and how the cluster provides fault tolerance and load balancing. This means that if one server fails, the other servers take over operations that are still in use.

Table 3

Alternative Disaster Recovery Options

<u>Solution</u>	<u>RPO</u>	<u>RTO</u>	<u>Cost</u>	<u>Weaknesses</u>
Tape/manual rebuild	Hours+++	Days	\$	<ul style="list-style-type: none"> • Difficult to administer • Slow
Image capture	Hours++	Hours	\$\$\$	<ul style="list-style-type: none"> • Limited restore flexibility
High-end replication	Minutes	Minutes	\$\$\$\$	<ul style="list-style-type: none"> • Complicated configuration • Duplicate hardware
Server Clustering	0	0	\$\$\$\$\$	<ul style="list-style-type: none"> • Duplicated hardware • Complicated setup

The results also indicate that virtualization is rapidly transforming disaster recovery planning (DRP). The research found that businesses are rethinking the way they view data centers, not only as servers, but operating systems and application as well. Virtualization has helped businesses identify data centers as workloads that are portable. This means that the workload, which can include data, applications and operating systems, can be moved from an entire software stack of a server to any physical or virtual host. This type of power helps businesses move these workloads in any direction between the physical and virtual hosts. The research further suggests that this new technology allows workloads in a business to be well protected. The workload protection contains many tasks of copying and replicating physical or virtual server workloads to an off-site

location for use as a warm standby environment in the event of a disaster or outage. This is very important because more and more organizations can be confident that their system is protected from any error or outage that might unexpectedly occur in operations of the system.

Finding the correct components is a solution in designing a successful and effective disaster recovery plan using virtualization. There are three parts that make up an effective disaster recovery plan: infrastructure, data, and management. The study seeks to tell how VMware software, which makes virtualization technologies, can improve on disaster recovery by studying the three components of an effective disaster recovery plan. One component of the study was infrastructure. The infrastructure contains all the servers, storage and network facilities, and within the infrastructure, it needs to deliver on all the requirements for recovery of data. Also, the research found that another component is data. All the data a business holds, such as application and user data needs to be well protected. A business needs to have confidence that data integrity will always be held at the forefront of the system. The last component the study identifies is management. To ensure that the disaster recovery will be properly handled, the recovery needs to be managed by people who are fully knowledgeable in the area of information technology. The disaster recovery has many processes and applications that need to be managed, such as “implementation to ongoing monitoring and updates to executing it when required. Ensuring manageability requires building a solution that does not overburden IT staff with the effort required to implement, test, update, and ultimately execute recovery plans” (VMware, 4).

Cost saving benefits that can be attributed to virtualization can be found in the case study by Gaudin (2006). The research tells of the implementation process of virtualization technology at the Bowdoin College to meet the need of the growing population of the school and its IT needs. The main focus was to find a way to cut down on the cost for information technology equipment that would be needed to meet requirements for the school. They decided to turn to virtualization as the solution to the costliness of the project. Virtualization allowed the college to take all the physical servers they had and consolidate them. “This technology lets one physical server operate as multiple virtual servers, with each of the virtual servers able to run one or more distinct applications and even different operating systems (Gaudin, 2006). Also, by moving to a more virtualized setting, virtualization saved the data center floor space because they did not need to worry about new servers taking up space. The college expected that they would have needed about 100 servers to meet the college’s requirements, but the project only ended up needing 46 servers. The results of this study found that virtualization was able to save Bowdoin College numerous amounts of money. Initially, the IT department at the college estimated a 2 million dollar price tag with the original plan. But by using virtualization technology the college only had to spend \$200,000 on its whole virtualization project. The study indicates that businesses looking to save money not only through server consolidation but disaster recovery should turn to virtualization as the solution. Saving money is possible because moving to many virtualized servers means; there will be less of a need for physical servers. Furthermore, there will be less maintenance required because for the number of servers and less powered need to power the physical servers. Virtualization provides many key, cost-saving techniques with the

planning and implementation process being the only drawback. But a knowledgeable IT staff will be able to implement virtualization into a business without any hassle at all.

Next, the cost of downtime in relation virtualization as a disaster recovery tool is addressed in double-Take software research on virtualization. In the research article by double-Take software (2007), sets out to find the impacts of virtualization technologies on disaster recovery planning. The study found that many organizations and enterprises are not doing enough to protect their data, applications and systems from expected errors like natural disaster, viruses, human error and corruption. The research sought a different approach to protect an organizations precious data from ever being lost or destroyed by a number of unexpected instances. “By preparing for, preventing and minimizing the impact of a catastrophic event, such as a natural disaster, hardware failure, system corruption or operational error, companies gain in productivity (spend significantly less time recovering from a negative event), customer satisfaction (through its ability to meet recovery objectives), recovery cost savings and more” (Double-Take, 2). One main finding that resulted from this study was the significant downtime businesses experiences as result of a disaster. With so many unforeseen threats to a system, disasters can leave many organizations’ and business’s system’s down and inoperable for several hours or even days. The study found that “Gartner Group estimates that the average cost of network downtime for larger corporations is \$42,000 per hour; contingency planning research pegs the average hourly downtime costs for many businesses at roughly \$18,000 (Double-Take, 2). These types of disaster can be fatal to many businesses even lead to the closure of many businesses. In regards to downtime, the study introduces two new topics that must be taken into account: Recovery Point Objective (RPO) and Recovery Time

Objective (RTO). RPO is the time that the data for a business will need to be restored in order to meet the requirements for the owners. This will judge when the end user will be able to regain access to data on the system. RTO is the measured time a system or application will not be operational before it is considered insufferable to the business. Usually by having the RTO, it provides the business not only with key times for downtimes, but with a way to determine what type of backup process the business needs. The study found that Double-Take's virtualization software is a key way limit down on all of those times to make their disaster recovery plan more effective.

Not only is virtualization a tremendous help to businesses but it can also benefit the end users who will be using the technology. In a study by Liverpool Women's NHS Foundation Trust (2007), it set out to implement and design virtualization technologies into its business. The main point of the study was to make the organization more reliable and improve patient care with uninterrupted IT services at all times. Also, the research found that all their vital data and information about patients to be safe and always available. In the study, they took their old model of independent servers and changed it to a more consolidated model. "The hospital's 50 major applications have been consolidated from 30 separate servers to 5 servers, resulting in lower server acquisition and server maintenance costs" (Liverpool Women's NHS, 1). Also, the study seeks to find a way to improve patient care and increase speed in efficiency of members in the hospital. The results of the study found that the IT redesign of the infrastructure not only helped server consolidation but improved patient care in addition to administrative and business operations. The hospital staffed and contained more than 1,600 clinical and administrative people, and this new technology allowed people faster and easier access to

a majority of patient data and complex applications. The hospital was able to implement all of these new technologies for the staff, which in turn vastly improved patient point-of-care. “The staff now has 24x7x365 remote access to critical data and applications. There have been dramatic improvements to the hospital’s IT operations as IT resources are more efficiently utilized and managed” (Liverpool Women's NHS, 1). The results of this study also found that by having disaster recovery plans using virtualization technologies, the hospital had more access to clinical data and applications with virtually no data loss. With the planning and designing of this new infrastructure, it resulted in uninterrupted delivery of patient care. Also, by having a more consolidated method for their servers, the hospital was able to save a lot of money.

CHAPTER 3

Prescription

Introduction

Virtualization will be a major emphasis in the planning and implementation stages of the project's overall goal. The study is to bring virtualization technologies to municipalities' businesses that are located in places that can be hit by natural disasters. The main application of having these virtualization technologies is for disaster recovery of data and other information that an organization might contain. The ambition of the project is to increase community rebuilding and innovation by having many of these measures (virtualization) in place. Many communities that are hit by natural disasters go without power and communication for days at a time. With an increasing number of businesses investing in virtualization, towns and communities will benefit because business operations will be able to start again in shorter periods of time. With the downtime of business and organizations cut in half, communities would benefit by having better communication, more jobs, and more security. In the remaining sections, the study will lay out an example on how to bring virtualization to businesses, which will include the planning and implementation process

Virtualization Planning and Implementation

Before showing the planning and implementation of disaster recovery plans in the business, the study will start by planning how to implement virtualization into a business successfully. Before moving or touching any equipment, a team must take a close look at

the target business. In order to gain an understanding of the business and IT requirements the business needs to meet, an information technology team will have to examine all the different types of workloads that the business performs and find out which types of workloads they would want to protect.. Some requirements and goals that many businesses face is to reduce cost, improve efficiency of business operations, and consolidate servers for an increase in server utilization. Next in phase 2, the IT staff or professionals in place will need to find the assets and define all of the requirements. This will include inventorying all the hardware in the data center by calculating which hardware will still be usable. Another part of finding the assets will be searching for all of the applications that are supported by the current data center. The IT staff will need to define all the requirements that will be needed for the new virtualization infrastructure. Some of the requirements for a business will be defining the correct workload/server capacity, computer requirements, and types of virtualization solutions. The next phases in the planning process will be the analysis phases. As discussed earlier in my paper there will be a need to calculate the TCO (total cost of ownership) and the ROI (return on investing) for performing virtualization. Virtualization's main goal is to save on cost and expenditures in energy, hardware, software and maintenance. The next phase in the planning process would be testing this new infrastructure to find any problems, configuring, and adjusting the allocation of resources. To test this new hardware, each host server will need to be set up, and then tested to be able to perform all virtual machines applications and other software loaded on to them. The next phase would be implementing this new infrastructure by deployment and migration. In deployment, I will start by purchasing server hardware, assembling the hardware, and then integrating

networking and storage systems. When the hardware is ready, the IT staff will install the virtualization, and then the existing applications need to be migrated into their virtual environments. Deployment is complete once IT managers or professionals have established functional virtualized servers that are ready for integration into the existing IT infrastructure. The final step would be the overall turnover of the new software by employees in the business. This will include creating a guide for the new operations in using the virtualization processes in the new infrastructure. Overall, this will help the employees become accustomed to the transfer of the new technologies in the organization.

Disaster Recovery Planning and Implementation

This study will lay a framework for planning and implementing virtualization inside an organization, let see how plan and implement a successful disaster recovery plan using virtualization technology.

Table 4

Planning phase

<i>Phases</i>	<i>What is to be done</i>
Analysis	*Inventory all applications, data, operating systems, and physical servers.
Monitor	*Monitor workload data information like network utilization.
Build	*Build a disaster recovery plan that will be able to handle the workload information.
Configure	*Configure your entire virtual environment to be able to match the physical production of the servers.

First, an appropriate plan pertaining to a disaster recovery is needed. The planning phase would begin by locating and accounting for the entire IT infrastructure in place in the business. This is done by inventorying all the applications, data, operating systems, and physical and virtual servers. By having all the workloads accounted for, an IT team will be able to meet all the requirements for the business's operations. Next, the team of professionals will need to monitor the IT infrastructure to gain an understanding of all the workload data that is done by the business. Monitoring workload data consists of several devices like CPU, disk, network utilization. With all this data recorded, an information technology team will now be able to build the correct disaster recovery plan for the

business. This will allow a team of professionals to create a plan that will have a disaster recovery site for failover. It will also allow the team to build enough headroom in virtualization recovery environment that who or what? Will be able to handle the consolidated workloads from the organization's servers. The last step would be configuring the virtual recovery environment. This step is very technical for an information technology team because the team will literally be matching all the physical production servers with the virtual servers located in the recovery site. Configuration will have to be done in both locations to ensure the virtualization software runs correctly.

Once I have created and developed an appropriate plan for disaster recovery using virtualization, it is time to implement all of the hardware and software to make sure it runs correctly. The first thing that will need to be done is to create original system backups. A team will begin by performing an automated full system back up by moving all of the server workloads, like data and applications, to the virtual recovery center using portability. Next, there will be a need to make sure all data, new and old, will be kept up-to-date at a virtual recovery site. To ensure both sites have the exact same data and are synchronized, the team will perform incremental backups of the data. This is done by propagating all source changes at whatever the pace the business increments its data. Now any file that has changed or needs to be moved will be copied over to the virtual recovery system on the next scheduled synchronization. After all the backups are in place, the team can begin testing the integrity of the disaster recovery plan. Next the team will run the virtual recovery machines in test mode. While in test mode "incremental jobs are suspended and will resume upon the next scheduled incremental transfer once the test virtual machines are shut down (Novell, 11). Then, one of the biggest benefits comes in

the next phase, which is creating a one-click failover if the system goes down for any particular reason. If a certain system happens to shutdown or fail, the virtualization software will be able to initiate a system failover where the virtual machine will instantly start up and take over the production workload. In the next phase, a team of professionals can restore the original production facility with the virtual backups from the workloads that were transferred over. The workload portability allows an IT team to move all the data and information from the virtual environment to the physical one.

CHAPTER 4

Conclusion

Right now, virtualization is a type of technology that could be used as a tool in several different ways: server consolidation, software testing, project development, migration, and training. But as this study states, the true power of virtualization comes from its use in disaster recovery planning. Virtualization has become critical in the role of disaster recovery planning process because it cuts down on server space and more importantly, cost. . Municipalities that have been destroyed by natural disasters will have another viable option when trying to rebuild.. With these virtualization technologies in place, municipalities will be able to rebuild their network infrastructures more quickly. Virtualization technology will also be a huge help in communication because people will be able to communicate in shorter periods of time. As these municipalities begin to rebuild faster, businesses and organizations will only benefit because their operation will resume in shorter periods of time. As businesses and organizations come back online faster, residents of the municipalities will also benefit because people will be able to resume their jobs and return to their normal lives faster. Virtualization then becomes a tool that helps the entire municipality, from the big business to the people who work for the big business, recover faster.

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