

Disaster Recovery: In Transition from Physical to Virtual

Brian D. Otte

Capella University

Disaster Recovery: In Transition from Physical to Virtual

Business continuance planning is as much a part of business as making money and producing a product. The level of priority management puts on business continuance grows as the business grows in size. Business continuance should exist in one form or another in any business which desires to survive in the event of a disaster. The level of preparedness can be quantified by the amount of planning and preparation a business has taken towards business continuance. This literature review will examine chronologically the changes in business continuance with respect to the disaster recovery component of business continuance since 2000. To gain a baseline of disaster recovery techniques, the state of disaster recovery before 2000 and after will also be analyzed.

Technology has enabled different methodologies for disaster recovery. Before 2000, tape technology was the de facto standard storage media for businesses which conducted backups of their information systems. After 2000, technology advances opened the gates for other options minimizing the role of tape technology. According to Cocheo and Bielski (2002), “firms will . . . expand their use of mirroring technology . . . and networked storage, relying on tape storage only for less critical information” (p.29). The tape technology has kept up with the increased data volumes which businesses now need to deal with. However, increasing speeds and volumes cannot keep pace with changing needs businesses deal with respect to disaster recovery.

Disaster recovery enables a business to recovery data to a state which existed before disastrous event occurred. Businesses need to minimize data processing outages. This process requires that significant planning and preparation occur before an event occurs to ensure that the data can be recovered should the need arise. The recent changes and maturation of virtual technologies have sparked a shift in backup and restore methodologies. A new player in disaster

recovery processes is virtualized servers. Fabian et al., (2006) lists multiple reasons to virtualize, which are not directly associated with business continuance. However, these enabling features of virtualization, coupled with other technology, enable a new type of disaster recovery process. Some reasons to virtualize presented by Fabian et al., are enhanced standardization, legacy operation, check-pointing, performance isolation, and distributed virtual machines (Fabian, et al., 2006). Distributed virtual machines are the main enabler of the new disaster recovery methodology, but check-pointing also facilitates point in time recovery. These options are important if multiple systems need to be recreated, and require synchronization of data between multiple systems (Azagury, Factor, & Micka, 2003). There are other reasons to virtualize an environment like power, cooling, and rack space (Fabian, et. al.). These reasons do not specifically enable business continuance but the value that businesses can obtain from virtualizing can be a driver for implementing virtualization technologies. These additional benefits of virtualization are beyond the scope of this literature review.

This literature review surveys literature concerning the transition from one type of disaster recovery method, which is tape based and each server is physically linked to one hardware platform, to a different type of disaster recovery, in which the data migration is continuous and each server is virtual. Either method can have multiple copies of the data over time. Virtualization can mirror the environment in real time. Azagury, Factor, & Satran (2002), state that methods to move data from one location to another can use split-mirror, changed block, or concurrent point-in-time data migration. Each of these methods has benefits and drawbacks and can be used based off of the business needs which are appropriate for the application.

The sequence of literature review is chronological and looks at the shift from backup restore methods to virtualization methods. The shift from tape based physical methods, to

virtualized methods for disaster recovery cannot succeed without other technologies supporting virtualization. In other words using virtualization technology, while not completely dependent on, leans heavily on other new technologies in order to gain the most impact for disaster recovery. Virtualized machines, coupled with SAN technology and corresponding data migrations tools offer a method to automate the migration of one system to a disaster recovery location. One copy of the machine is not running, but in the event of a disaster could be brought online and processing start from the remote location. There are issues with this type of situation, but the underlying technology is coming of age.

The potential for a disaster the size of what happened in New York on September 11th, 2001 has always existed. According to Rike (2003) there are three possible areas of threat origination, which are natural or environmental, technical or mechanical, and human activities or threats. The second attack on the World Trade Towers in 2001 brought into focus that natural disasters are not the only issue data systems are vulnerable to. Singhania (2001 para. 19), remarked about market transactions which were kept on pieces paper to be committed to a data system, writes a day after the attack that “. . . the paper is gone because the building is gone. The employees who might otherwise been able to recreate the transactions might've been killed.” Any disaster has hurdles which must be overcome. Getting the data on a medium and physically moving that data to another location is one hurdle that can be solved today with appropriate use of technology. In this case tape backup methodologies and virtualized methods would have failed as the data and the people who knew about the data were gone. Businesses must understand the risks associated with their business processes and the risk to their data and the risk to their people.

There are five stages in risk management: 1) acceptance of risk, 2) identification and assessment of risk, 3) elimination or minimization of potential risks, 4) creations of formal disaster plan(s), and 5) transfer of risk (Pember, 1996). Businesses must accept that risk exists. Identification of risk can be quantitative or qualitative. Rainer, Snyder, & Carr (2001), offer both methods to aid a business to qualify the critical nature of an asset to a business. Quantitative methods use statistical analysis to define the potential for a given system to be unavailable. Quantitative methods are used by putting a business need on an information system. Then measuring the value to the business based off of the need of an information system. Qualitative methodologies deal with descriptive variables, whereas qualitative analysis can deal with dollars or discrete events (Rainer, et al., 2001). In contrast to this methodology, Rike (2003) states that disasters must be identified by the extent of their influence. The classification of a disaster would look at the macro level and work towards the micro. This theory helps to identify the resources which everybody will need in a disaster like food, water, electricity, or something as simple as a tape drive, computer, and the tape media.

The need for business contingency plans grew as the realization that information systems became essential in day to day business activities. A perspective which resonated before 2000 was the need to have general guidelines should disruptions in electricity, telecommunications, or other services occur (Bielski, 1999). Smith (1994) reinforces this list with emergency, back-up, recovery, test and maintenance plans. These approaches are the state of mind before 2000. These approaches included backing up data to tape and having the ability to restore the data should a server become unavailable. Another historical perspective Smith posits is that businesses ensure that they can acquire temporary facilities during a disaster (Smith, 1994). However, what happens when the business, servers, and people who know how to restore the

systems are no longer available. This need became more apparent after September 11th, 2001 when disaster struck the businesses housed at the World Trade Center. That re-enforced the need for business continuance planning on a large scale.

Current trends for server provisioning are moving towards server virtualization. With servers virtualized the data can then be copied real time to a remote location. While server virtualization is nearing maturation, infrastructure virtualization is not. According to Cummings (2006) “open standards for getting all the layers talking and working together aren’t ready yet” (p. 67). Nonetheless virtualization is becoming more popular as more servers are required by businesses; budgets are not necessarily allocating more resources to enable the needed infrastructure to increase server capacity.

Virtualized servers in a physical Storage Area Network (SAN) environment are a popular deployment layout. The SAN environment enables the block level migration of data seamlessly from one location to an appropriate offsite location (Azagury, Factor, & Micka, 2003). The coupling of virtualized servers with SAN technology gives the disaster recovery benefits which tape backup and restore methods can’t give. This is especially true when it comes to automatically moving the data offsite and in real time or as point in time images (Azagury, Factor, & Micka 2003). This scenario entails the primary server being virtualized with the data stored on a disk subsystem accessed through SAN technology. Users accessing the server are unaware that the system is virtualized accessing the data through a SAN or that the data resides on a storage subsystem. Additionally, as users access the system they also are unaware that the data which they are working with is automatically migrating, real time, to another location as a backup copy. This is the real disaster recovery benefit to virtualizing servers.

Future trends in virtualization must include the ability to virtualize the data center in its entirety. Virtualizing data systems through an Open Systems Interconnect (OSI) model like Cummings (2006) suggested may be the future of disaster recovery. Morris & Truskowski (2003) see the future of storage virtualization through the use of a meta-data manager, where the data is stored based on defined policy. Once the data is stored it can be replicated to remote locations via diverse paths (Morris, R., & Truskowski, B., 2003). Perhaps Fiber Channel SAN technology is not the mechanism which will allow storage virtualization. Another technology, called Internet Small Computer Systems Interface (iSCSI), may be the lower level technology employed to allow storage virtualization to the disk. The iSCSI protocol is dynamically routable, and may provide the needed dynamic communications mechanism which SAN technology over Fiber Channel has not been able to provide.

Morris & Truskowski (2003) bring one additional preview as to what the future may bring. A SAN file system is the term for data whose meta-data is under the control of a meta-data server. The storage term for a SAN file system is called *Autonomic Storage* (Morris, R., & Truskowski, B., 2003). Another concept relating to this called *Object Based Storage* or OBS. This concept allows objects or files to reside in storage but the direct link to the file is abstracted, and references to the files are through a call to the object-handle (Azagury, Factor, & Satran, 2002). This is the beginnings of virtualizing the entire data center environment. These technologies are not mature enough to understand if there is a trend associated with their development. The future is difficult to predict but one thing is known, the industry does not have the tools to virtualize at a level which Cummings calls *Virtualization At Every Layer* (Cummings 2006).

Concerning disaster recovery there is no question of the importance of backing up data. If backups do not exist and the main data source becomes unavailable, then the company whose data is lost is in serious trouble. Rike (2003) states that according to the U.S. Bureau of Labor, 93 percent of companies that suffer a significant data loss are out of business within five years. Business continuance is not just disaster recovery. It is a whole series of events, one of which is disaster recovery. This process is changing as the technology is changing. The changes allow the data and the machines to migrate real-time to an area deemed appropriate to house the information.

Virtualizing the server has merit by itself for business continuance with respect to disaster recovery. Moving the data real time through a Storage Area Network (SAN) provides an automatic update of the data in near real time. However, this is not the end game with respect to new methodologies for disaster recovery. Rather this is the first step to system wide virtualization. The process is not without its drawbacks. According to Cummings (2006), the more components which get virtualized the more complex diagnosing issues become especially when defining who owns the problem is the issue. Server virtualization is becoming mature, but the rest of the infrastructure has made very little attempts towards virtualization. The whole infrastructure needs virtualizing to get independent of any failure. Business continuance, and especially disaster recovery is about ensuring, “An effective disaster plan will help you and your organization return to business-as-usual as soon as possible” (Rike, 2003, p. 32). What is changing is the mechanisms available and employed to make IT happen after a disaster.

References

- Azagury, A., Factor, M., & Micka, W. (2003). Advanced functions for storage subsystems: Supporting continuous availability. *IBM Systems Journal*, 42(2), 268. Retrieved November 4, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=10084993&site=ehost-live>
- Azagury, A., Factor, M., & Satran, J. (2002). *Point-in-time copy: Yesterday, Today, and Tomorrow*. IBM Research Lab in Haifa. Retrieved November 8, 2007, from <http://romulus.gsfc.nasa.gov/msst/conf2002/papers/d05bp-aaz.pdf>
- Bielski, L. (1999, April). Is your contingency plan all that it can be? *ABA Banking Journal*, 91(4), 45. Retrieved November 3, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=bth&AN=1799846&site=ehost-live>
- Cocheo, S., & Bielski, L. (2002, September). Can your bank bounce back in real-time? (Cover story). *ABA Banking Journal*, 94(9), 28. Retrieved September 17, 2007, from <http://search.ebscohost.com/login.aspx?direct=true&db=bsh&AN=7269425&site=ehost-live>
- Cummings, J. (2006, November 13). Virtualization at every layer. *Network World*, 23(44), 64-67. Retrieved October 8, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=buh&AN=23123700&site=ehost-live>

- Fabian, P., Palmer, J., Richardson, J., Bowman, M., Brett, P., Knauerhase, R., et al. (2006, August). Virtualization in the Enterprise. *Intel Technology Journal*, 10(3), 227-242. Retrieved October 8, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=buh&AN=22445029&site=ehost-live>
- Morris, R., & Truskowski, B. (2003). The evolution of storage systems. *IBM Systems Journal*, 42(2), 205. Retrieved November 4, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=10084975&site=ehost-live>
- Pember, M. (1996, April). Information disaster planning: An integral component of corporate risk management. *Records Management Quarterly*, 30(2), 31. Retrieved October 21, 2007, from <http://search.ebscohost.com/login.aspx?direct=true&db=f5h&AN=9605151979&site=ehost-live>
- Rainer, R., Snyder, C., & Carr, H. (1991, Summer). Risk Analysis for Information Technology. *Journal of Management Information Systems*, 8(1), 129. Retrieved October 6, 2007, from <http://search.ebscohost.com/login.aspx?direct=true&db=bsh&AN=5748013&site=ehost-live>
- Rike, B. (2003, May). Prepared or Not...That Is the Vital Question. *Information Management Journal*, 37(3), 25. Retrieved November 3, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=9808154&site=ehost-live>

Singhania, L. (2001, September 12). Financial Firms Put It Together. *USA Today*. Retrieved October 31, 2007, from <http://www.usatoday.com/money/finance/2001-09-12-rebuilding.htm>

Smith, L. M. (1994, June). Planning for Disaster. *CPA Journal Online* (June 1994), Retrieved November 3, 2007 from <http://www.nysscpa.org/cpajournal/old/16097614.htm>

Annotated Bibliography

Brian D. Otte

Capella University

Annotated Bibliography

Business Continuance Planning and Methodology--Disaster Recovery:

Bielski, L. (1999, April). Is your contingency plan all that it can be? *ABA Banking Journal*, 91(4), 45. Retrieved November 3, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=bth&AN=1799846&site=ehost-live>

This peer reviewed article discusses the preparations for the year 2000 transition, and about being prepared should catastrophic issues arise due to the millennium bug. This journal article has some statistics concerning the number of institutions under FDIC jurisdiction receiving satisfactory ratings for being able to producing plans of action relating to contingency planning. The parallels to year 2000 issues are aligned with business continuance planning. Some topics covered include the business resumption in case of disruptions in electricity, telecommunications, or other services. The authors put forward the beginner's mind thought process to recheck work, as opposed to looking at things as an expert. Testing of contingency plans and remediation plans are highly encouraged. Businesses should anticipate and consider the effects of loss of any services required to function are another focus of this article.

This journal article is useful as it brings up points about the training people should have so that they do not need to work with a manual when an emergency arises. Key people and positions are identified not during emergencies, but before emergencies. An approach to everything should be understood by key people.

Ebsco host lists this journal as an Academic Journal. The publisher's web site is: <http://www.ababj.com>. The articles are short, have glossy pictures, and no references. This journal accepts advertising. This is a trade journal.

Business Continuance Planning and Methodology--Disaster Recovery:

Cocheo, S., & Bielski, L. (2002, September). Can your bank bounce back in real-time? (Cover story). *ABA Banking Journal*, 94(9), 28. Retrieved September 17, 2007, from <http://search.ebscohost.com/login.aspx?direct=true&db=bsh&AN=7269425&site=ehost-live>

This peer reviewed article details some of the changes which the banking industry and businesses should consider since September 11th 2001, and the considerations taken for granted before the attacks. Location of disaster recovery hot sights, expectations of services like timely airline flights, or even cell phone and land line phone functionality are discussed. The article espouses the virtue of re-evaluating business continuance planning in respect to new disaster paradigms which businesses may encounter. The authors hypothesize on the changes businesses are making towards business continuity as a subset disaster recovery. Businesses managers are charged with the task of contextualizing disasters, which make the news, and applying those disaster situations to their businesses.

This article is important because it details how important people are in business continuance planning. Additionally, the current trend is business continuance; this article has some transitional concepts from disaster recovery theories to business continuance methods. Ebsco host lists this journal as an Academic Journal. The publisher's web site is: <http://www.ababj.com>. The articles are short, have glossy pictures, and no references. This journal accepts advertising. This is a trade journal.

Business Continuance Planning and Methodology--Disaster Recovery:

Singhania, L. (2001, September 12). Financial firms put it together. *USA Today*. Retrieved September 22, 2007, from <http://www.usatoday.com/money/finance/2001-09-12-rebuilding.htm>

This article, which is written the day after the World Trade Center attacks, details the reality that businesses faced that day. Expectations are high in the article that operations will resume as normal within a few days. This did not fully bear out as planned. The article also details the resources which become unavailable due the attack such as work lost if backups were not automated and removed from location. The people who can restore the data systems are also gone.

This article is important as it gives an understanding of what events close to September 11th occurred and the means to prevent data loss, what to do to prepare should people loss occur, and a general understanding to be prepared for the unexpected. This article is not peer reviewed.

USA Today is a newspaper published by Gannett Company, Incorporated. References are rarely given. Many advertisements are in the newspaper.

Business Continuance Planning and Methodology--Disaster Recovery:

Pember, M. (1996, April). Information disaster planning: An integral component of corporate risk management. *Records Management Quarterly*, 30(2), 31. Retrieved October 21, 2007, from <http://search.ebscohost.com/login.aspx?direct=true&db=f5h&AN=9605151979&site=ehost-live>

This article details the method of business continuance by identifying potential risks and then envisioning the scenarios to eliminate or control or contain the identified risks. The article stresses as much pro-activity as possible. This article details the basic stages of risk management, and the steps to mitigate the risk, or plan for the risks are also detailed. The article also details the prioritizing of risk via the use of a risk quadrant. An alternate method to estimate or project risk is also given.

The journal is peer reviewed and is published 4 times a year. The publisher is the Association of Records Managers and administrators. Ebsco host lists this journal as an academic journal (<http://search.ebscohost.com/login.aspx?direct=true&db=f5h&jid=RMQ&site=ehost-live>). The journal changed its name to *The Information Management Journal*, in 1999. The current journal accepts advertising. This article is heavily referenced. This link is of high interest: <http://www.arma.org/bookstore/search.cfm> as disaster recovery can be selected as a topic to search for additional articles. This is a trade publication, but it still may be a resource nonetheless.

Business Continuance Planning and Methodology--Disaster Recovery:

Rainer, R., Snyder, C., & Carr, H. (1991, Summer). Risk Analysis for Information Technology.

Journal of Management Information Systems, 8(1), 129. Retrieved October 6, 2007, from

<http://search.ebscohost.com/login.aspx?direct=true&db=bsh&AN=5748013&site=ehost-live>

This article details risk from IT's perspective, and attempts to iterate each of the risks.

The article offers models to mitigate risk, and attempts to quantify the methodologies. Formulae are offered to help the quantification process. Statistical probability also is used to quantify risk.

This article uses both quantitative and qualitative methods to analyze risk. Ultimately the system offers an 8-step process to analyze risk. This article is heavily referenced.

This journal is published by M.E. Sharp Incorporated 4 times a year. EBSCO host lists this journal as an academic journal. The publisher URL is:

<http://www.mesharpe.com/index.htm>. Articles are well referenced, and scholarly in nature. This is a scholarly journal.

Business Continuance Planning and Methodology--The Virtual Environment:

Fabian, P., Palmer, J., Richardson, J., Bowman, M., Brett, P., Knauerhase, R., et al. (2006, August). Virtualization in the Enterprise. *Intel Technology Journal*, 10(3), 227-242.

Retrieved October 8, 2007, from

<http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=buh&AN=22445029&site=ehost-live>

EBSCO host lists this journal as an Academic Journal, with no peer review

(<http://ezproxy.library.capella.edu/login?url=http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=buh&jid=IHD&site=ehost-live>). The journal is published 4 times a year.

The average article length in the May 2007 issue (Volume 11 issue 2) is about seven and one half pages long. The articles have color pictures and are supportive of material. The editor listed is Lin Chao, who has academic credentials listed but no academic affiliation. Lin Chao is an Intel Employee, as are the extensive listing of peer reviewers Intel lists as the peer review board.

None of the peers list academic credentials, academic affiliation, but they all are Intel employees.

The articles ascribe to no generally accepted writing style, and they have few if any references to backup the material presented. The journal has few if any advertisers, although the publisher is

Intel, and the material is highly related to Intel's products. The link to this journal on EBSCO host is:

<http://ezproxy.library.capella.edu/login?url=http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=buh&jid=IHD&site=ehost-live>

The publication web site is: <http://developer.intel.com/technology/itj/index.htm>

This is a trade journal. There will great difficulty using material from this source due to the material, peer review methodology, and the relationship between the publisher and the

material with respect to bias. Good source for general trending information or supporting information.

The article lists virtues of Virtual Machines with respect to current abilities that are useful for a computational environment. This is Intel publishing and article about their product. It would be difficult to find an article which has more potential for bias. A case study is also included to help reinforce the need to move towards virtualizing the datacenter.

Business Continuance Planning and Methodology--The Virtual Environment:

Cummings, J. (2006, November 13). Virtualization at every layer. *Network World*, 23(44), 64-

67. Retrieved October 8, 2007, from

<http://search.ebscohost.com/login.aspx?direct=true&db=f5h&AN=23123700&site=ehost-live>

The journal is a trade publication, and not peer reviewed. It is published 51 times a year, and the average article length is less than one page (Vol. 23 Issue 44, 13 November, 2006). The articles contain many consumer quality color pictures. The editor-in-chief is Jon Dix and has no academic credentials listed or academic affiliation. There is no peer review group, no adherence to a writing style, and no sources listed. There is advertising. The link to this journal on EBSCO host is: <http://search.ebscohost.com/login.aspx?direct=true&db=f5h&jid=0NA&site=ehost-live> The link to the publication web site is: <http://www.networkworld.com/>

The article, while pro-virtualization, brings up some important considerations when researching virtualization. The general use for virtualization is covered, and the next logical step to move the virtualized server across SAN environments is brought up. Here are some of the challenges that administrators may face. Security and access to servers is the issue when these “VM images” are moved from one location to another.

Diversity and classification of articles:

Vessey, I., Ramesh, V., & Glass, R. (2002, Fall). Research in Information Systems: An Empirical Study of Diversity in the Discipline and Its Journals [Electronic version]. *Journal of Management Information Systems*, 19(2), 129-174.

This peer reviewed journal article examines the nature of publications from 1995 to 1998 with respect to a diversity models which the authors devised. The publications are in the field of Information Systems. The authors define the characteristics of research, and examine the top five journals in the field. This article seems to be a self assessment of the Information Systems field. The main purpose of this document is to understand the diversity of Information Systems research. This is dealt with by the authors developing a classification system within the confines of their five characteristics of diversity (reference discipline, level of analysis, topic, research approach, and research method). The article also provides a mechanism to classify research for future applicability should the need arise to increase diversity in the literature referenced.

This article is very useful for my research in understanding that during the literature review, an understanding of the sources and diversity of the sources is an important factor in determining if the research is skewed. Additionally, a bias may exist just by nature of the types of references used in a document. An understanding of the concept of diversity can be applied to any research during the literature review phase of research. The use of the research as a template to apply to any research will help to ensure a diverse base of articles to get a good foundation for the literature review and sources used.

This journal is published by M.E. Sharp Incorporated 4 times a year. EBSCO host lists this journal as an academic journal. The publisher URL is:

<http://www.mesharpe.com/index.htm>. Articles are well referenced, and scholarly in nature. This is a scholarly journal.

Research Method—Qualitative: Grounded Theory

Calloway, L. J., Knapp, C. A., (1995). *Using Grounded Theory to Interpret Interviews*.

Retrieved September 26, 2007, from PACE University, Seidenberg School of Computer Science and Information Systems web site: <http://csis.pace.edu/~knapp/AIS95.htm>

This peer reviewed article examined Grounded Theory to analyze two sets of interview data. Interview data is a source of information where context is important. The data gathered is used to devise a theory which is based or grounded in the data gathered. Calloway and Knapp (1995) state that “qualitative methods use codes to categorize data rather than to quantify it.” One rationale for this is that some people have a different context of a language. Some factors are cultural, societal, or relative organizational roles. Grounded Theory attempts to create theories based on observed data.

The strength of the qualitative method Grounded Theory is that the researcher can interpret the context that a response was given, especially if Ethnographic methods are used. Conversely, a weakness of Grounded Theory is that the results must be influenced by the researcher.

This source is of interest to me because it makes a good argument that quantitative methods alone are not enough to make good judgments concerning information technology choices. The numbers do not always tell the whole story. This article makes the argument that the numbers must be put into context. The reference section is also valuable as it contains many other references to Qualitative research methods. This source may be of interest in future courses if an example of a Grounded Theory research method paper is needed.

The article is well referenced, and scholarly in nature.

Research Method--Quantitative:

Davidson, A. R., Stern, L. W., (2004). A quality self-assessment model. *Managerial Auditing Journal*, 19 (7), 859-868. Retrieved September 26, 2007, from ABI/INFORM Global database. (Document ID: 700542831).

This peer reviewed article looked at the different ways that data was collected from a Total Quality Manufacturing system. Numerical data was gathered, stored, and observed. The data was generated from machines producing product in a factory. The gathering of raw data like line speeds, output per minute, and efficiencies are perfectly suited for quantitative methods.

Strengths of data collection through Quantitative methods are that it is quick to integrate with information systems, and the information is precise. Weaknesses of Quantitative methods are that the data may be so abstract that it is not useful. Additionally, an understanding of the surroundings needs to be modeled before the raw data means anything.

This source has value in depicting a Quantitative research method. Additionally, the article has value in that the methodology used is clearly defined in the article. There are references which may be of interest. Notably one reference on W. Edwards Demming seems interesting.

The value of this article concerning disaster recovery, or business continuance is not applicable. The applicability of this article for future courses in Information Technology is questionable. This source is valuable for a model of Quantitative research methods. Additionally, this document may be applicable in my career when modeling TQM projects.

This journal is published by Emerald Group Publishing, Limited, and its home page is <http://www.emeraldinsight.com/info/journals/maj/maj.jsp>. The articles are scholarly in nature, and contain many references. This is a scholarly journal.

Research Methods—Knowledge Base:

Trochim, W. M., (2006, October 20). The Research Methods Knowledge Base, 2nd Edition.

Retrieved September 27, 2007, from <http://www.socialresearchmethods.net/kb/>

Research Methods Knowledge base is a textbook which addresses social research methods. The author is frequently cited. This Knowledge Base is a guide, from start to finish, in understanding the research process. This guide starts by defining the terminology, and progresses through the whole research process.

The author uses a novel approach to aid the reader in navigating the Knowledge Base: Table of contents, Yin-Yang map, Road map, and a Search Page. The Road map follows the research process sequentially, and will be the most useful in referring to the appropriate area of interest.

This guide is an invaluable resource for conducting research. The layout is setup for easy access to the phase of research the user may currently be in. Multiple methods exist to get at the data. This resource is to be referenced throughout the rest of the research process. The Knowledge Base is presented in plain conversation language while remaining focused in content.

This Knowledge Base is valuable for reference in future courses and career especially with respect to conducting any research when a quick reference to accepted research methods is desired. There is a 3rd edition of the Knowledge Base in print and available from Atomic Dog publishing.

This is an original work, detailing research methods. This is to be used for techniques to gather research, and best practices concerning research. This is for academia.

Business Continuance Planning and Methodology--Virtualization

Sun Microsystems And Fujitsu Expand SPARC Enterprise Server Line With First Systems

Based On The UltraSPARC T2 Processor; Innovative Design Delivers High Performance, Eco-Efficient Servers With Virtualization Built-in; New Systems on Solaris Deliver Higher Performance in 1/4 the Space at Nearly 1/4 the Cost of Competitive RISC Systems, Enable Customers to Meet Peak Web Scale Demand. (2007, October 9).

M2PressWIRE, Retrieved October 24, 2007, from

<http://search.ebscohost.com/login.aspx?direct=true&db=nfh&AN=16PU617687440&site=ehost-live>

This peer reviewed article is really an announcement of Sun Microsystems T2 CPU.

There are comparisons made between CPU's of different vendors and their supposedly unbiased evaluation (using the SPECint) of their relative performance in relation to other CPU's.

With respect to virtualization, this technology is Sun's approach. Each CPU has 8 core or CPU's. Each CPU can process 8 operations simultaneously. Each CPU is represented as 64 CPU's to the operating system. The systems which these CPU's go into are perfect to host many virtualized servers. Lots of CPU power, very little space.

The article is marketing. The data produced from the benchmarking programs may be useful, albeit with a caveat concerning the source and reproducibility with respect to the computational aspects. This article is more useful when running electrical or HVAC numbers concerning virtualization and efficiencies. All companies are moving towards multi core systems. SUN is by far further with respect to cores and threads. 64 processes concurrently executed on one CPU. This is the future.

Business Continuance--Disaster Recovery:

Smith, L. M. (1994, June). Planning for Disaster. *CPA Journal Online* (June 1994), Retrieved November 3, 2007 from <http://www.nysscpa.org/cpajournal/old/16097614.htm>

This peer reviewed journal article compares and contrasts a disaster recovery and a business continuance plan. Remarkably, this article was published in 1994, and discusses the World Trade center bombing (the first one), and hurricane Hugo, and their effects on disaster recovery and business continuance. This article espouses the need for “Temporary facilities” and relocation facilities in the event of a disaster.

Business Continuance--Disaster Recovery:

Rike, B. (2003, May). Prepared or Not...That Is the Vital Question. *Information Management*

Journal, 37(3), 25. Retrieved November 3, 2007, from

[http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=98](http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=9808154&site=ehost-live)

[08154&site=ehost-live](http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=9808154&site=ehost-live)

This peer reviewed journal has statistics about companies that do not have a disaster recovery/business continuance plan. The article tries to enable a business manager to grasp the concept of what a disaster could be, and the level of impact and the measures to mitigate the disaster. Interestingly, the source of the disaster may prove useful. 1) Natural or environmental, 2) Technical or mechanical, or 3) Human activities or threats.

This article lays out many formal steps which should be in a business continuance plan, specifically a disaster recovery plan.

Business Continuance--The evolution of Storage:

Morris, R., & Truskowski, B. (2003). The evolution of storage systems. *IBM Systems Journal*, 42(2), 205. Retrieved November 4, 2007, from <http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=10084975&site=ehost-live>

This peer reviewed article discusses the history of storage and relates the evolution of other technologies and their use based off of the advancement speed through time. Specifically one example dealing with the data density of storage devices versus access to bandwidth is brought up and how it related to set top HDD video recorders as opposed to Video on demand systems.

This article also depicts the different types of data migration through electronic means. Point-in-time and mirroring are two types of data migration discussed.

Note References 8-9 for disaster recovery.

Virtual tape libraries are discussed. Block virtualization and copy services are discussed. The concept of a *SAN file system* is introduced. The metadata of a file system is under the control of a control server, which can make non-disruptive changes allowing new capabilities. Introduces the autonomic computing model which consists of three levels: 1) component, 2) homogenous or heterogeneous systems, 3) heterogeneous systems work together toward a goal specified by the managing authority—Policy management.

Future challenges are discussed. Creating data in a form that is self-describing; that is, it comes with the data structures and programs needed to interpret the data, coded in a simple universal language.

Point-in-time copy has become required for baking up systems. Backup time issues are not as important as restore time issues. References 8,9,11 deal with new research and developments.

Parts of the conclusion fit nicely into the future section of the final paper, specifically the place storage plays with respect to virtualization, and disaster recovery.

Disaster recovery--Migrating data technologies:

Azagury, A., Factor, M., & Micka, W. (2003). Advanced functions for storage subsystems:

Supporting continuous availability. *IBM Systems Journal*, 42(2), 268. Retrieved

November 4, 2007, from

<http://search.ebscohost.com.library.capella.edu/login.aspx?direct=true&db=aph&AN=10084993&site=ehost-live>

This is a peer reviewed journal which discusses moving data with current tools available from some vendors (IBM, EMC, and Hitachi). These tools allow 4 different types of data migration:

1. Synchronous, continuous copy solutions
 - a. PPRC
 - b. Symmetrix Remote Data Facility (SRDF)
2. Asynchronous, continuous copy
 - a. XRC
 - b. Hitachi's NanoCopy
3. Asynchronous continuous copy
 - a. Extended Distance (IBM)
 - b. Adaptive Copy (EMC)
4. Asynchronous, periodic copy

- a. SnapMirror
- b. IBM's split mirror

This article also mentions host-driven replication (Symantec). Use this text as a reference for moving data with SAN technology.

Disaster Recovery--SAN and data migration tools:

Azagury, A., Factor, M. E., & Satran, J. (2002). *Point-in-time copy: Yesterday, Today, and Tomorrow*. IBM Research Lab in Haifa. Retrieved November 8, 2007, from <http://romulus.gsfc.nasa.gov/msst/conf2002/papers/d05bp-aaz.pdf>

This document discusses split-mirror, changed block, and concurrent point-in-time data migration. The document also espouses the virtues of each. The authors are employees of IBM, and IBM offers a storage array. Other storage arrays are mentioned in the article like EMC, Hitachi, whereas IBM's storage system is actually minimized. The references used from this article should only reference the general technology. I do not think that this will pose a bias issue.

Additional topics brought up are Object Based Storage (OBS) which is a potential step towards virtualizing the environment. EMC bought Documentum which uses this methodology. This article does not appear to be peer reviewed.