

**A PROPOSED METHODOLOGY TO DEVELOP DISASTER RECOVERY
PLAN FOR CICT UTM**

HUSSEIN YUSUF SHEIKH ALI

UNIVERSITI TEKNOLOGI MALAYSIA

UNIVERSITI TEKNOLOGI MALAYSIA

DECLARATION OF THESIS / POSTGRADUATE PROJECT PAPER AND COPYRIGHT

Author's full name: **Hussein Yusuf Sheikh Ali**

Date of birth : **9th September 1985**

Title : **A PROPOSED METHODOLOGY TO DEVELOP
DISASTER RECOVERY PLAN FOR CICT UTM**

Academic Session: 2013/2014(2)

I declare that this thesis is classified as :

CONFIDENTIAL

(Contains confidential information under the Official Secret Act 1972)*

RESTRICTED

(Contains restricted information as specified by the organization where research was done)*

OPEN ACCESS

I agree that my thesis to be published as online open access (full text)

I acknowledged that Universiti Teknologi Malaysia reserves the right as follows :

1. The thesis is the property of Universiti Teknologi Malaysia.
2. The Library of Universiti Teknologi Malaysia has the right to make copies for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:

SIGNATURE

P00201555

(NEW IC NO. /PASSPORT NO.)

SIGNATURE OF SUPERVISOR

DR. SITI HAJAR BINT OTHMAN

NAME OF SUPERVISOR

Date : 30 JUNE, 2014

Date : 30 JUNE, 2014

NOTES: * If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization with period and reasons for confidentiality or restriction.

“I hereby declare that I have read this project report and in my opinion this project report is sufficient in terms of scope and quality for the award of the degree of Master of Computer Science (Information Security)”

Signature :.....

Name of Supervisor : DR. SITI HAJAR BINT OTHMAN

Date : JUNE 30, 2014

A PROPOSED METHODOLOGY TO DEVELOP DISASTER RECOVERY PLAN
FOR CICT UTM

HUSSEIN YUSUF SHEIKH ALI

A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Computer Science (Information Security)

Faculty of Computing
Universiti Teknologi Malaysia

JUNE 2014

I declare that this project report entitled “*A Proposed Methodology to Develop Disaster Recovery Plan for CICT UTM*” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : HUSSIEN YUSUF SHEIKH ALI

Date : June 30, 2014

To my lovely mother, father, Wife and Sons

ACKNOWLEDGEMENT

First, I am indebted to the all-powerful ALLAH for all the blessings he showered on me and for being with me throughout the study. I am deeply obliged to my Supervisor, **Dr. SitiHajarBintOthman** for her exemplary guidance and support without whose help; this project would not have been a success. I take this opportunity to express my deep gratitude to the lasting memory of my loving family, and friends who are a constant source of motivation and for their never ending support and encouragement during this research.

Finally, it has been an exciting and instructive study period in the UniversitiTeknologi Malaysia and I feel privileged to have had the opportunity to carry out this study as a demonstration of knowledge gained during the period studying for my master's degree. With these acknowledgments, it would be impossible not to remember those who in one way or another, directly or indirectly, have played a role in the realization of this research. Let me, therefore, thank them all equally.

ABSTRACT

In a modern world of business and enterprise organizations process, the use of Information Technology (IT) has played a big important role. Almost every organization use different types of IT instruments in order to make their daily business operations become more efficient and effective. Even though business organizations operations' hugely dependent on using IT service, but there are problems which directly threatens IT services of business enterprises. One of the threats is disasters. Disaster is any event that causes a business interruption or discontinuation of a critical organization's services including its information infrastructure, for unspecified period of time. The effects from disasters, either man-made or acts of natural, can cause to be an organization helpless. Every organization is susceptible to disasters either natural or mad man such as earthquakes, hurricanes, and floods and viruses, which happen regularly throughout the world. Many organizations have tried to develop their own disaster recovery plan but the organizations do not have a systematic approach to follow and develop their DRP. Since disaster is an unpredicted event, and could strike any time but for every ten organizations, only one has Disaster Recovery Plan (DRP). However this study will propose a methodology for Centre for Information Communication and Technology of UniversitiTeknologi Malaysia (CICT UTM) to develop disaster recovery plan. The proposed methodology framework consists of nine steps which are Obtain Top Management Commitment, Develop Contingency planning policy, Risk Assessment, Conduct Business Impact analyse, Develop Recovery Strategies, Emergency Response and operations, Training and Testing, Maintaining and Review and Approve the disaster Recovery Plan. The proposed DRP methodology framework will help the CICT UTM to develop their own DRP.

ABSTRAK

Dalam dunia moden perniagaan dan organisasi perusahaan proses, penggunaan Teknologi Maklumat (IT) telah memainkan peranan yang penting. Hampir kesemua organisasi menggunakan jenis instrumen IT untuk membuat operasi perniagaan harian mereka menjadi lebih cekap dan berkesan. Walaubagaimanapun organisasi perniagaan operasi sangat bergantung kepada penggunaan perkhidmatan IT, tetapi terdapat masalah yang secara langsung mengancam perkhidmatan perusahaan perniagaan IT. Salah satunya ialah bencana. Bencana merupakan peristiwa yang menyebabkan gangguan perniagaan atau pemberhentian perkhidmatan sesebuah organisasi yang kritikal termasuk infrastruktur maklumat, bagi tempoh masa yang tertentu. Kesan daripada bencana tersebut disebabkan oleh tindakan manusia atau semulajadi. Setiap organisasi mudah terdedah kepada bencana alam semula jadi seperti gempa bumi, ribut taufan, banjir dan virus yang berlaku secara berkala di seluruh dunia. Banyak organisasi telah cuba untuk membangunkan pelan pemulihan bencana mereka sendiri tetapi organisasi tidak mempunyai pendekatan yang sistematik untuk mengikuti dan membangunkan DRP mereka. Memandangkan bencana merupakan sesuatu yang tidak boleh diramal dan boleh menyerang organisasi pada bila-bila masa, setiap sepuluh organisasi hanya satu yang mempunyai Pelan Pemulihan Bencana (DRP). Kajian ini akan mencadangkan kaedah untuk Pusat Penerangan Komunikasi dan Teknologi di Universiti Teknologi Malaysia (CICT UTM) supaya pembangunan rangka kerja metodologi tersebut dapat dibangunkan. Kaedah tersebut terdiri daripada sembilan langkah seperti berikut; mendapatkan pengurusan tertinggi komitmen, membangunkan dasar perancangan luar jangka, penilaian risiko, kelakuan perniagaan kesan menganalisis, membangunkan strategi pemulihan, respons kecemasan dan operasi, latihan dan ujian, mengekalkan dan kajian dan meluluskan pelan pemulihan bencana.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xiii
	LIST OF APPENDICES	xv
1	INTRODUCTION	
	1.1 Introduction	1
	1.2 Problem Background	3
	1.3 Problem Statement	4
	1.4 Project Objectives	5
	1.5 Scope of the Project	5
	1.6 The Importance of Project	6
	1.7 Organization of Report	6
	1.8 Chapter Summary	7
2	LITERATURE REVIEW	
	2.1 Introduction	8
	2.1.1 Case Study Overview	8
	2.2 Contingency Plan	9

2.2.1	Incident Response Planning (IRP)	10
2.2.2	Business Continuity Planning	10
2.2.2.1	Basic Components of Business Continuity Planning	11
2.3	Overview of Disasters	13
2.3.1	Types of Disasters	15
2.3.2	Disasters for the Last 20 Years	16
2.3.3	IT Consequences	17
2.3.4	Disaster Management Process	18
2.4	Disaster Recovery Plan(DRP)	19
2.4.1	Benefits of Disaster Recovery Plan	20
2.4.2	Difference between DRP and BCP	21
2.4.3	Different Concepts about DRP	22
2.5	Current Methodologies to Develop Disaster Recovery Plan	24
2.5.1	Chip Nicko let DRP Steps Methodology	24
2.5.2	NIST DRP Steps Methodology	25
2.5.3	RafaCegiea DRP Steps Methodology	26
2.5.4	Timothy J.Cousins DRP Steps Methodology	26
2.5.5	Wold DRP Steps Methodology	27
2.5.6	Wold DRP Steps Methodology	28
2.6	Analysis of Various DRP Steps Methodology	28
2.7	Analyzing Database Recovery for different Organizations fields (Financial &Educational)	30
2.7.1	Barclays Capital	31
2.7.2	Marsh &Mclenman	32
2.7.3	Tulane University	33
2.7.4	Results of the Analysis	33
2.8	DRP in Different Perspectives	34
2.8.1	DRP in Small Organizations and Large Organizations	35
2.8.2	DRP in IT and Non –IT Organizations	37

2.9	DRP Requirements for CICT UTM Organization	38
2.10	Chapter Summary	39
3	RESEARCH METHODOLOGY	40
3.1	Introduction	40
3.2	Research Methodology Framework	40
3.2.1	Phase 1: Problem Formulation Phase	43
3.2.2	Phase 2: Proposed DRP for CICT	44
3.3	Chapter Summary	46
4	THE PROPOSED DISASTER RECOVERY PLAN METHODOLOGY FRAMEWOK FOR CICT UTM	
4.1	Introduction	47
4.2	Selection of DRP Methodology Steps	47
4.3	Design DRP Methodology	49
4.3.1	Explanation and description of Selected DRP Methodology Steps:	51
4.3.1.1	Phase I	51
4.3.1.2	Phase II	56
4.3.1.3	Phase III	58
4.3.1.4	Phase IV	60
4.4	Chapter Summary	61
5	DISASTER RECOVERY PLANNING METHODOLOGY FRAMEWORK VALIDATION	
5.1	Introduction	62
5.2	Validation of the Proposed DRP Steps Methodology	63
5.2.1	Step 1: Obtain Top Management Commitment	63
5.2.2	Step 2: Develop Contingency Planning Policy Statement	65
5.2.3	Step 3: Conduct Risk Assessment	67

5.2.4	Step 4: Conduct Business Impact Analysis	69
5.2.5	Step 5: Develop Recovery Strategies	71
5.2.6	Step 6: Emergency Response and Operations	73
5.2.7	Testing and Training	74
5.2.8	Step 7: Maintaining and Review	76
5.2.9	Step 7: Approve the DRP Plan	78
5.3	Chapter Summary	79
6	CONCLUSION AND FUTURE WORKS	
6.1	Introduction	80
6.2	Achievements	80
6.3	Research Contribution	81
6.4	Challenges and Constraints	81
6.5	Future Works	82
6.6	Conclusion	82
	REFERENCES	84
	Appendix A	88

LIST OF TABLES

TABLE NO	TITLE	PAGE
2.1	Sample of Criticality levels and some recovery methods based on RTO and PRM	12
2.2	Disasters faced in a last 5 year period	14
2.3	Disasters and sub-categories	15
2.4	DRP Terminologies	23
2.5	List of Steps Methodology to develop DRP	24
2.6	List of potential DRP Steps Methodology mentioned by Authors	30
2.7	Comparison Small Business and large Business in terms of Disasters	36
3.1	Research Activities towards Objectives	43
4.1	Summary of Activities of Obtain Top Management Commitment	52
4.2	Summary of Activities of Develop Policy Statement	53
4.3	Summary of Activities of Risk Assessment	54
4.4	Business Impact Analysis	56
4.5	Summary of the Activities of developing recovery strategies	57
4.6	Summary of the Activities of Emergency Response and Operations	58
4.7	Summary of the Activities of Testing and Training	59
4.8	Summaries of the Activities of Maintaining and Review	60

4.9	Summary of the Activities of Approve the Plan	61
5.1	Experts of validation	63
5.2	Obtain Top Management Commitment Questions	64
5.3	Develop contingency planning Policy Statement Questions	66
5.4	Conduct Risk Assessment Questions	67
5.5	Conduct Business Impact Analysis Questions	69
5.6	Develop Recovery Strategies Questions	71
5.7	Emergency Response and Operations Questions	73
5.8	Testing and Training Questions	75
5.9	Maintaining and Review Questions	77
5.10	Approve the DRP Plan Questions	78

LIST OF FIGURES

FIGURE NO	TITLE	PAGE
2.1	Disaster Management frameworks	19
2.2	BCB and DRP Triangle	22
2.3	Organizational Structure of the CICT UTM	39
3.1	Research Methodology Frameworks	42
4.1	The Proposed DRP Methodology for CICT UTM	50
5.1	Expert Feedback for Obtain Top Management Commitment	64
5.2	Expert Feedback for Develop contingency planning Policy Statement	66
5.3	Expert Feedback for Conduct Risk Assessment	68
5.4	Expert Feedback for Conduct Business Impact Analysis	70
5.5	Expert Feedback for Develop Recovery Strategies	72
5.6	Expert Feedback for Emergency Response and Operations	74
5.7	Expert Feedbacks for Testing and Training	76
5.8	Expert Feedback for Maintaining and Review	77
5.9	Expert Feedback for Approve the DRP Plan	78

LIST OF ABBREVIATIONS

BCP	-	Business Continuity Plan
BIA	-	Business Impact Analyze
CICT	-	Centre for Information Communication and Technology
DRP	-	The Disaster Recovery Plan
IRP	-	The Incident Response Plan
NIST	-	National Institute of standards and Technology

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Interview Questions	88

CHAPTER 1

INTRODUCTION

1.1 Introduction

In a modern world of business and enterprise organizations process, the use of Information Technology (IT) has played a big important role. Almost every organization use different types of IT instruments in order to make their daily business operations become more efficient and effective. There are vast amount of advantages in IT that is used in business enterprises. The use of IT improves the efficiency of business which means that more tasks can be achieved with fewer resource which produces to more benefits for the organization. Business organizations are using different types of IT to increase company's productions in certain business activities to get a competitive benefit against other corporations that produce same goods and products.

IT services allow the companies to communicate with its customers, business partners, and with other employees across the world. IT provides organization to communicate with other organizations. IT also makes communications globally possible. The word communication is referred and considered the basic thing which allows business organizations to success their business operation; hence the word is becoming more interrelated and organized because of IT services. Inother word, when organization wants to communicate to its partner business it will use one of these IT facilities such as email, phone, mobile IT, video conferencing, Skype, etc.

Even though business organizations operations' hugely dependent on using IT service, but there are problems which directly threatens IT services of business enterprises. One of the threats is disasters. The word disasters defined any catastrophic event or human-caused occurrence that harmfully impacts the business operations or the environment. It disrupts business continuity and may affect long-term business objectives. Disasters are often seen as the failure to effectively manage risks to different business entities (Barker and Maxwell, 1995)

Disasters are generally divided into two categories which are natural disaster and man-made disasters. Natural disasters are often sudden, giving organizations only a small amount of time to deploy any security measures. Disasters have a negative effect on the environment and people. These types of disasters include natural hazards such as volcanic eruptions, earthquakes, and landslides that result in loss of life, property, and economy. Man-made disasters are caused by human error, ignorance, negligence, or individuals with malicious intentions. These disasters are unpredictable and can spread across a wide area. They are sometimes unpreventable as well. System failures, power and telecommunication outages, terrorism, and cyber terrorism fall under this category.

Business enterprises need protection against any disasters either natural or man-made. In order to do that, Disaster Recovery Plan (DRP) is needed. DRP is a planning which could enable organizations to analyze and identify the different ways to handle a disaster. It is also the preparation for and recovery from a disaster, whether natural or manmade. Disaster recovery Plan (DRP) helps organizations to develop and document procedures that enable them to achieve predefined business objectives before, during, and after a disaster (Andrews, 1994)

1.2 Problem Background

Even though many business organizations highly depend on the using of IT in their daily business operations, but, according to (Erbschloe, 2012), for every “ten organizations, only one has DRP”. Since disaster is an unpredicted event, therefore the catastrophe could strike any time. Disaster can include tumultuous political upheaval, civil war, terrorist attacks, weathermen earthquakes, earthquakes and floods. Hence day after day life missed with occurrence that can interrupt business, including power outages, broken water mains and so on

However to handle the organizations operations in the event of catastrophic events like a disaster and bring back to normal operations, organizations need a good DRP. In event of disasters the company has to organize all the talent and assets necessary to maintain and continue business services and bring back to normal situation as possible. Time is money, and in today’s economy, an hour could be worth thousands of dollars. As we know the main objectives of a business recovery plan are to describe the activities of the organizations that allow the organization to protect the business asset. Those assets include business employees, customers in the event of disaster happen. However business holders who did not plan well for disaster recovery are at a loss regarding how to proceed when things go wrong.

Disasters are the main obstacles that demolish medium and large organizations in Malaysia. Most of the companies only do whatever possible to when important data and business assets already lost. These results that the return of operations lasts weeks or months while some other companies have never been reopened after a disaster. For this research, one IT-based organization has been identified to be a case study of this research which is Centre for Information and Communication Technology (CICT), UTM which is responsible for Preparing and providing all services or ICT services to users from the administration, the teaching teams, research centers and marketing department. Some critical application and services that CICT UTM develop and maintain can be divided into two: a) Administration Application system and b) Academic Application system. For the

administration, the system are such: 1) Human Resource Portal, 2) UTM financial system, 3) Staff Email, 3) Leave and Attendance System, 4) Staff Information System, 5) Student Management System, 6) Laboratory Information System, 7) Vehicle Reservation Management System, and few others. Whereas for the academic-based system, they include: 1) AIMSS System, 2) Graduate Studies Management System, 3) e-Learning, 4) Lecture Schedule System, 5) Student Webmail, 6) Lecturer Evaluation System, 7) Industry Training System and many more system.

Based on observation, this research found that this organization still does not have any formal comprehensive DRP. As one of the most critical unit in UTM, CICT could possibly face some disaster problem such as a network Disaster and viruses any other kind of disasters which affects the critical systems in the CICT UTM.

1.3 Problem Statement

Every organization is vulnerable to disasters either natural or mad man such as earthquakes, hurricanes, and floods and viruses, which happen regularly throughout the world. According to The Federal Emergency Management Agency (FEMA) said that between 1976 and 2001, a total of 906 major disasters were stated and declared in the United States. These disasters affected by Tens of thousands of organizations of all sizes around the word. However the need of business continuity and recovery planning is very important for every organization. Many organizations have tried to develop their own disaster recovery plan but the organizations do not have a systematic approach to follow and develop their DRP.

Since the CICT UTM is a very important organization in UTM which responsible for preparing and providing all services or ICT services to users from the administration, the teaching teams, research centers and marketing department. Administrative staffs, lecturers, therefore by having the DRP are very important for

this organization. Based on the interview questions conducted with Mr.Jaffar one of the CICT UTM experts, he mentioned that CICT UTM has some sort of DRP, but they did not follow any DRP systematic approach to develop their own DRP. Therefore this project will focus to design and propose a methodology for CICT UTM to their DRP.

1.4 Project Objectives

This project is going to focus on the following objectives:

- i. To investigate various methodologies for developing DRP for IT-based organizations;
- ii. To design and propose a suitable methodology for developing DRP for a case study of an IT-based organization, the Centre for Information Communication and Technology (CICT), UniversitiTeknologi Malaysia (UTM).
- iii. To validate the Proposed Methodology

1.5 Scope of the Project

The investigation, studies will be conducted on the identification of various methodologies for developing DRP for IT based organizations. Based on the identification, the project will apply the proposed methodology by using a case study of one IT-based organization, the CICT UTM.

1.6 The Importance of Project

Since most of IT and non-IT based business organizations around the world offer huge services to the customers every day, and many employees earn money for daily life, to having a comprehensive DRP for these organizations is important. When the organization doing their business with their DRP ready, the organization could save time, money and effort in any stage of unpredicted disaster (before, during and after disaster) occurs. It can be found that DRP is like insurance for these organizations. DRP is capable to provide many benefits and guidelines control to develop and mitigate interruptions of many business activities. This framework also explains the disaster recovery framework that will assist businesses and help enterprise employees understand DRP procedures needed even before disaster happens.

1.7 Organization of Report

This research consists of six chapters. The chapters are organized according to different works involved in this study. Chapter 1 of this project consists of introduction of the study, problem background, problem statement, project objectives, scope and importance of study. Chapter 2 of this report presents a literature review of the DRP in this chapter, we discuss current or existing disaster recovery planning process.

The Chapter 3 consists of research methodology framework description that describes the flow of this project. However, Chapter 4 consists of disaster recovery planning design whereby the explanation on how the features, processes and the elements had been chosen and how the proposed design comes out, while Chapter 5 of this report consists of the results and the analysis of validation processes. Finally for Chapter 6 consists of the conclusion of this study, future works and limitations of the study are stated in that chapter.

1.8 Chapter Summary

This chapter discusses about the introduction of a project which consist of the formulation of the problem statement, objectives, problem background and lastly the scope of the project. Hence the key goal of this project is to offer and propose a DRP for CICT UTM. Therefore, this research will be achieved with literature review from some different resources like conferences, journals and books, and other of the Internet and gathering the important data from an enterprise organization is taken as a sample.

REFERENCE

- Alhazmi, O. H. and Malaiya, Y. K. 2013. Evaluating Disaster Recovery Plans using the Cloud. Proceedings of *The 2013 Reliability and Maintainability Symposium (RAMS), 2013 Proceedings-Annual: IEEE*, 1-6.
- Alhazmi, O. H. and Malaiya, Y. K. 2002. *Evaluating Disaster Recovery Plans Using the Cloud*.
- Andrews, R. A. 1994. An Ounce of Prevention: Guidelines for Preparing a Disaster Recovery Plan. Proceedings of the *1994 Aerospace and Electronics Conference, 1994. NAECON 1994., Proceedings of the IEEE 1994 National*. 23-27 May 1994. vol.802. 802-806.
- Asgary, A., Anjum M.I., and Azimi N.. 2012. Disaster Recovery and Business Continuity after the 2010 Flood in Pakistan: Case of Small Businesses. *International Journal of Disaster Risk Reduction*, 2(0): p. 46-56.
- Barker, L. and Maxwell, S. 1995. Telecommunications Resource Management for Disaster Response and Recovery. Proceedings of the *1995 Military Communications Conference, 1995. MILCOM '95, Conference Record, IEEE*. 7 Nov 1995 vol.852. 853-857.
- Bartolini, C., Stefanelli, C. & Tortonesi, M. 2009. Business-impact Analysis and Simulation of Critical Incidents in IT Service Management. In: *Integrated Network Management. IM '09. IFIP/IEEE International Symposium on*, 9-16.
- Castillo, C. 2005. Disaster Preparedness and Business Continuity Planning at Boeing: An Integrated Model. *Journal of Facilities Management*. 3(1), 8-26.
- CASTILLO, C. 2005. Disaster Preparedness and Business Continuity Planning at Boeing: An Integrated Model. *Journal of Facilities Management*, 3, 8-26.
- Cegiela, R. 2006. Selecting Technology for Disaster Recovery. *Proceedings of the 2006 Dependability of Computer Systems, 2006. DepCos-RELCOMEX '06. International Conference on*. 25-27 May 2006. 160-167.

- Cegiela, R. 2006. Selecting Technology for Disaster Recovery. In: *Dependability of Computer Systems. DepCos-RELCOMEX '06. International Conference on*, 25-27. 160-167.
- Engui, Z., ShanyuL., and Su. J. 2010. Case Study of Management Innovation Process of G Bank's Disaster Recovery Center.in*Logistics Systems and Intelligent Management, International Conference on*.
- Faulkner, B. 2001.Towards a Framework for Tourism Disaster Management.*Tourism Management*. 22(2), 135-147.
- FAULKNER, B. 2001.Towards a Framework for Tourism Disaster Management.*Tourism Management*, 22, 135-147.
- Grolinger, K., Capretz, M. A., Mezghani, E. and Exposito, E. 2013.Knowledge as a Service Framework for Disaster Data Management. Proceedings of the *2013 Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE), 2013 IEEE 22nd International Workshop on: IEEE*, 313-318.
- Haimes, Y. Y. 2005. *Risk Modeling, Assessment, and Management*, John Wiley & Sons.
- Iyer, R. K. and Sarkis, J. 1998. DRP in an Automated Manufacturing Environment.*Engineering Management, IEEE Transactions on*. 45(2), 163-175.
- Jaeger, C. 2004.Security Risk Assessment Methodology for Communities (RAM-CTM). Proceedings of the *2004 Probabilistic Safety Assessment and Management: Springer*, 1328-1332.
- Jaeger, C. 2004.Security Risk Assessment Methodology for Communities (RAM-CTM).*Probabilistic Safety Assessment and Management*.1328-1332.
- Kapucu, N. and Van Wart, M. 2006. The Evolving Role of the Public Sector in Managing Catastrophic Disasters Lessons Learned. *Administration & Society*. 38(3), 279-308.
- Lakshmi Narayanan, R. G. &Ibe, O. C. 2012.A Joint Network for Disaster Recovery and Search and Rescue Operations.*Computer Networks*, 56, 3347-3373.
- Leong lai, H. and Marthandan, G. 2011. Factors Influencing the Success of the DRP Process: A Conceptual Paper. In: *Research and Innovation in Information Systems (ICRIIS), International Conference on*. 1-6.
- Os, G. &Katsikas, S. 2012. Disaster Recovery Analysis and Management Method (DRAMM): An IT Management Tool. In: *Informatics (PCI), 16th*

- Panhellenic Conference on*, 5-7. 99-104.
- Rudolph, C.G.,1990. Business Continuation Planning/Disaster Recovery: A Marketing Perspective. *Communications Magazine, IEEE*, 28(6): p. 25-28.
- Snedakar, S., 2007.*Chapter 33 - Business Continuity/DRP Development*, in *The Best Damn IT Security Management Book Period*. Syngress: Burlington. p. 799-827.
- Vescoukis, V. and Dulamis, N. D. 2011.Disaster Management Evaluation and Recommendation.*Proceedings of the 2011 Games and Virtual Worlds for Serious Applications (VS-GAMES), 2011 Third International Conference on: IEEE*, 244-249.
- Wiboonrat, M. 2008. An Empirical IT Contingency Planning Model for Disaster Recovery Strategy Selection.*Proceedings of the 2008 Engineering Management Conference, 2008.IEMC Europe 2008. IEEE International: IEEE*, 1-5.
- Wiboonrat, M. 2008. An Empirical IT Contingency Planning Model for Disaster Recovery Strategy Selection. In: *Engineering Management Conference. IEMC Europe 2008. IEEE International*, 1-5.
- WIBOONRAT, M. An Empirical IT Contingency Planning Model for Disaster Recovery Strategy Selection.*Engineering Management Conference, 2008.IEMC Europe 2008.IEEE International*, 28-30 June 2008 2008.1-5.
- Wold, G. H. 2006.DRP Process.*Disaster Recovery Journal* 5(1).
- Wold, G. H. 2006.Disaster Recovery Planning Process.*Disaster Recovery Journal*.5(1).
- Yida, X., HongliangY., and WeiminZ.. 2012. A Consistent Backup Mechanism for Disaster Recovery that Using Container Based Virtualization. in*ChinaGrid Annual Conference (ChinaGrid)*.
- Yida, X., Hongliang, Y. &Weimin, Z. 2012.A Consistent Backup Mechanism for Disaster Recovery that Using Container Based Virtualization. In: *ChinaGrid Annual Conference (ChinaGrid), Seventh*, 2. 95-100.
- Zhuang, Y., Li, X., Xu, B. and Zhou, B. Information Security Risk Assessment Based on Artificial Immune Danger Theory. *Computing in the Global Information Technology, 2009.ICCGI'09.Fourth International Multi-Conference on, 2009. IEEE*, 169-174.

Zhuang, Y., Li, X., Xu, B. and Zhou, B. 2009. Information Security Risk Assessment Based on Artificial Immune Danger Theory. *Proceedings of the 2009 Computing in the Global Information Technology, 2009.ICCGI'09. Fourth International Multi-Conference on: IEEE*, 169-174.