Journal of Applied Science and Advanced Technology
Journal Homepage : https://jurnal.umj.ac.id/index.php/JASAT

The Backup Recovery Strategy Selection to Maintain the Business Continuity Plan

Faisal[1*]
[1]*Industry Creative and Telematics Faculty, University Trilogy, Jl. TMP Kalibata Jakarta 12760, Indonesia*

A R T I C L E I N F O

JASAT use only:
Received date : 30 May 2018
Revised date : 21 June 2018
Accepted date : 25 July 2018

Keywords:
Analytical hierarchy process
Backup Recovery Strategy
Business Continuity Plan
Disaster recovery plan

A B S T R A C T

Indonesia must face the risks of volcanic eruptions, earthquakes, floods and tsunamis, destruction of its land areas, and resulting in damage to client and server computer systems. The demand for the information technology availability and performance becomes high. Disaster recovery plan is designed to ensure the vital business processes continuation in the event that a disaster occurs. The problem is how to make the best way in selecting backup recovery strategy based on the benefits to the cost ratio so as to minimize the business losses that will be caused by the failure of an application system. The research aims to make decisions that can help make certain parties take the best decision in choosing the backup recovery strategy selection for a business continuity plan in the University Trilogy. The method used is the multi-criteria decision making and analytical hierarchy process using the expert choice software. From the data processing results can be concluded that the first order is hot standby option 59.4%, followed by cold standby option 23.3%, then the choice of warm standby option 17.4%. The data inconsistency rate is 0.02, smaller than 0.1 as the maximum value of inconsistency ratio.

INTRODUCTION

Located in the Pacific Ring of Pacific, Indonesia must face volcanic eruptions, earthquakes, floods, tsunamis, and the destruction of land (including many infrastructures that result in economic losses). Here are some events that ever happened volcanic eruption in Central Java November 3, 2010; earthquake in Sumatra December 26, 2004 with the victims of 283,106; floods and landslides in many parts of Indonesia; and an earthquake in the Indian Ocean preceded by a tsunami, killing 167,000 people in Indonesia (mainly Aceh) in 2004 [6].

This disaster has tremendous strength and scale of damage which results in unplanned power outages and damage to client computer systems. Damage can also occur due to virus attacks on information technology due to the data exchange through the internet connected to databases worldwide which also resulted in economic losses. Konsa, K and Kaie Jeeser, 2017, says although natural disasters and different types of emergencies are relatively uncommon, they can nevertheless cause extensive damage, the consequences of which are usually very expensive to recover from [7]. Otair, M. and Aiman Al-Refaei, 2015, suggested that although cybercrimes are radically different from other kinds of crimes, the damage caused by cybercrimes cannot be separated from the damage that results from other kinds of crimes, and so it should not be underestimated [9].

Given these conditions have alerted the information technology management to immediately implement a disaster recovery strategy. A disaster recovery plan can be used as a guide if the company's business is paralyzed, unable to operate properly when a disaster occurs. Bryan C. Martin, 2002 suggests that this disaster recovery plan is designed to ensure the important business processes sustainability when a disaster occurs [1]. This disaster recovery plan will provide an effective solution that can be

* Corresponding author.
E-mail address: faisalpiliang@trilogi.ac.id

DOI: https://dx.doi.org/10.24853/JASAT.1.1.23-30

used to restore all important business processes within the required timeframe of vital records stored off-site.

The University's Trilogy academic information system is one of the important assets, which includes student data, lecturer data, and other academic data. In addition, there are other very important complex data transactions such as financial data as well as human resource data. The disaster recovery plan implementation at University Trilogy will be used as a reference in measuring the implementation of a viable disaster recovery plan on critical business support applications so that business operations can continue to run normally in the event of a disaster or system failure.

With the increasing academic process in the University Trilogy, the demand for the information technology availability and performance becomes high. The information technology components that do not work will cause huge economic losses because the system component has become an integral part of the company's operations. In addition, with increasing levels of dependence on information technology then to avoid the risk of disruption in operational performance requires the good and maximal disaster recovery plan implementation and supported by reliable technology so that business processes can continue to run because the necessary data can be stored.

Based on the problem identification, then the problem formulation is how to make the best way in selecting backup recovery strategy at University Trilogy based on the benefits ratio to the cost ratio so as to minimize the business losses that will be caused by the failure or malfunction of an application system besides it can also be used for business continuity plan. The method used in this research is the multi-criteria decision making and analytical hierarchy process using the expert choice software. The research aims to make decisions that can help make certain parties take the best decision in choosing the backup recovery strategy selection for a business continuity plan at University Trilogy.

The disaster recovery plan is defined as an anticipatory planning process for unpredictable events and no organization knows when it occurs and its effect on the continuity of existing business processes [3]. The disaster recovery plan is also defined as a planning that focuses on information systems to restore operability target system, applications, and computer facilities at alternative locations in emergency conditions [11]. The causes that can be a threat of system failure include flooding; earthquake; fire; tsunami; terrorist acts; sabotage acts; the act of war; electrical power failures; uninterruptible power supply failure. This will cause the malfunctioning system without being predictable.

The location of diversion during a disaster should also be considered based on the following alternatives [11].

a. Hot Standby is a fully prepared environment. Including hardware, software, data, communications and other supporting facilities such as accommodation, and transportation.
b. Warm Standby is a ready-made environment. It has almost all recovery needs except some needs that can be provided within maximum acceptable outage time (MAOT) time range, e.g. hardware.
c. Cold Standby is a ready-to-go location with only supporting infrastructures such as power, water, and air conditioning.

Analytical hierarchy process was developed by Dr. Thomas L. Saaty of the Wharton School of Business in the 1970s to organize information and judgment in choosing the most preferred alternative [10], [8], [13], [4]. The working principle of the analytical hierarchy process is criteria and alternative assessments are assessed through pairwise comparisons. According to Saaty, 1983, for a variety of issues, the scale 1 to 9 is the best scale in expressing opinions [10]. The value and definition of qualitative opinion from the comparison scale of Saaty as shown in the following table.

Table 1. Comparison scale Saaty [10], [8]

Grade	Explanation
1	Criterion / Alternative A is equally important with criterion/alternative B
3	A is slightly more important than B
5	A is clearly more important than B
7	A is clearly more important than B
9	A is absolutely more important than B
2,4,6,8	When in doubt between two adjacent grades

The value of comparison A with B is 1 (one) divided by the value of comparison B with A.

Here is the review of previous related studies according to Konsa, 2017, using Analytical Hierarchy Process approach in determining the risk of disaster rating in the museum [7]. Soedarmaji, 2000 conducted a study of research on the planning of disaster recovery center due to system failure in the capital market of PT. Jakarta Stock Exchange [12]. Cahyadi, 2006 discusses the business continuity plan with aviation industry PT. Garuda Indonesia [2]. Wulandari, 2008 review disaster recovery plan with the Analytic Hierarchy Process approach at PT. Bank Mega Tbk [13].

EXPERIMENTAL METHOD

Below is a research frameworks table.

Table 2. The research framework

Feedback: Analysis, surveys, interviews, and discussions with expert respondents in the University Trilogy; Objectives: Obtained research thinking; Method: Focus group discussion with expert respondents; Output: Review the backup process selection.
Feedback: Data from questionnaires distributed to expert respondents; Objectives: Define the benefit criteria; Method: Focus group discussion with expert respondents and Cochran Q test approach; Output: Risk; Reliability and Maintenance; Trust.
Feedback: Data from questionnaires distributed to expert respondents; Objectives: Define cost criteria; Method: Focus group discussion with expert respondents and Cochran Q test approach; Output: Disaster Recovery Centre; Infrastructure and Training; Backup; Testing.
Feedback: Data from questionnaires distributed to expert respondents; Objective: Define Risk sub-criteria; Method: Focus group discussion with expert respondents and Cochran Q test approach; Output: Hardware; Software; Infrastructure and Procedure; Backup; Test.
Feedback: Data from questionnaires distributed to expert respondents; Objective: Define Reliability and Maintenance sub-criteria; Method: Focus group discussion with expert respondents and Cochran Q test approach; Output: Hardware; Software; Infrastructure; Backup.
Feedback: Data from questionnaires distributed to expert respondents; Objective Define benefit alternatives; Method: Focus group discussion with expert respondents and Cochran Q test approach; Output: Hot Standby; Warm Standby; Cold Standby.
Feedback: Data from questionnaires distributed to expert respondents; Objectives: Define cost alternatives; Method: Focus group discussion with expert respondents and Cochran Q test approach; Output: Hot Standby; Warm Standby; Cold Standby.
Feedback: Data from paired comparison questionnaires from each criterion, sub-criteria, and alternatives in terms of benefits and cost side; Objective: To provide recommendations for decision-makers on alternatives from the results of the research; Method: Focus group discussion and expert choice implementation; Output: The Backup Recovery Strategy Selection for the Business Continuity Plan.

The aforementioned framework illustrates the research study that begins by seeking references through literature studies, company surveys, interviews and discussions with expert respondents using the focus group discussion method. Data and information were collected from expert respondents using interview and observation techniques at University Trilogy. Then proceed to determine the attribute criteria, sub-criteria, and alternatives from the benefit ratio and the cost ratio that is distributed to the respondent's experts using the focus group discussion method and the Cochran Q test.

Term contained in this research study are risk identification is the process of identifying and determining possible tangible and intangible risks; performance and reliability of the system is the performance and reliability of the system maintained; maintenance and system changes is that during maintenance activities and system changes will not affect business processes; and customers trust is the customers trust in the company can remain well established because it already has disaster management procedures.

In order to avoid inconsistencies in the model, focus group discussion with expert respondents to determine the stages of making a valid model with elements that significantly affect the model. The results obtained from the focus group discussion questionnaire are criteria, sub-criteria, and significant alternatives on the benefits ratio and on the cost ratio. This method uses an iterative approach in which the improper attributes through the analysis process are discarded so that the attributes that are left are really the attributes that are important to be researched.

The research begins with observations of research studies. This research uses a descriptive-analytic method by presenting the summary of interviews and survey results in the form of questionnaires. With this method will be described the current conditions. The questionnaire was given to several respondents who acted as experts, namely one head of information technology section, four staff information technology staff, one dean of the faculty of creative industries and telematics, one head of information systems study program, and four lecturers of information system courses at the University Trilogy where the research was conducted. The research also used the multi-criteria decision making and analytical hierarchy process method using expert choice software computer.

Furthermore, a secondary data search was conducted in the field through various media, such as internet, literature book and journals and articles to obtain accurate information about the research. In addition, the identification of the system by considering the variables supporting the research by conducting interviews and giving questionnaires to experts. This is an important step because the model must be accurate and accountable.

The next strategic step that should be done based on the results of interviews with the respondents expert on the data processed by using an analytical hierarchy of the process. Decisions should be immediately followed up in the form of action or can also be reviewed if the decision was obtained new information that can affect the results to reduce uncertainty, and then the new decision will be obtained. The following is a table of benefits and cost hierarchy diagrams.

Table 3. The Benefit Hierarchy Diagram

AIM	Backup Recovery		
Focus	Benefit		
Criteria	Risk	Reliability and Maintenance	Trust
	Hardware	Hardware	
	Software	Software	
	Infrastructure and Procedure	Infrastructure	
	Backup	Backup	
	Testing		
Alternative	Hot standby	Hot standby	Hot standby
	Warm standby	Warm standby	Warm standby
	Cold standby	Cold standby	Cold standby

Table 4. The Cost Hierarchy Diagram

AIM	Backup Recovery			
Focus	Cost			
Criteria	Disaster Recovery Center	Infrastructure and Training	Backup	Testing
Alternative	Hot standby	Hot standby	Hot standby	Hot standby
	Warm standby	Warm standby	Warm standby	Warm standby
	Cold standby	Cold standby	Cold standby	Cold standby

According to Marimin, 2005 steps determine the size of weight as follows [8], [4].

$$\frac{w_i}{w_j} = a_{ij} \quad (1)$$

$_{i,j}$ = 1, 2, 3, ... , n
w_i = weights of inputs in rows
w_j = weights of input on the lane

$$w_i = a_{ij} \cdot w_j \quad (2)$$

$_{i,j}$ = 1, 2, 3, ... , n
For common cases have a form:

$$w_i = \frac{1}{n}\sum_{j=i}^{n} a_{ij} w_j \quad (3)$$

w_i = average of $a_{i1}.w_1, \ldots, a_{in}.w_n$

If the estimate a_{ij} is good, it will tend to close to $\frac{w_i}{w_j}$ ratio. If b also changes, then n is converted to λmax so obtained

$$w_i = \frac{1}{\lambda_{max}}\sum_{j=i}^{n} a_{ij}.w_j \quad (4)$$

$_{i,j}$ = 1, 2, 3, ... , n
The measure of consistency of answers that will affect the validity as follow:

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad (5)$$

The consistency ratio is considered well if CR ≤ 0.1. The Consistency Ratio formula as follows:

$$CR = \frac{CI}{RI} \quad (6)$$

Consistency ratio is a parameter used to check whether pairwise comparisons have been done consequently or not. The value of RI is the random index value released by Oakridge Laboratory as shown in the following table.

Table 5. Index random value scale the Oakridge Laboratory index [8], [4]

N	1	2	3	4	5	6	7
RI	0	0	0.58	0.9	1.12	1.24	1.32
N	8	9	10	11	12	13	
RI	1.41	1.45	1.49	1.51	1.48	1.56	

RESULTS AND DISCUSSION

The following results from the data processing, analysis and interpretation for the benefit to cost ratio that affect the research review. Data analysis and interpretation preceded by determining the significant elements at each level of benefit and cost ratio. The steps undertaken in this research is first to determine the focus of benefit ratio: backup recovery strategy. The second determines the benefit ratio criterion: risk; reliability and maintenance; trust. The third determine the sub-criteria of benefit ratio. The three specify alternatives: hot standby, warm standby, and cold standby.

Next, determine the focus of cost ratio. Then determine cost ratio criteria: disaster recovery center; infrastructure and training; backup; and testing. Specify alternatives: hot standby, warm standby, and cold standby. Further studies conducted to answer the problem of research submitted based on the analytical hierarchy process, as shown in the following discussion.

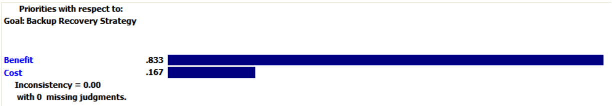

Fig. 1. Research weighting

The benefit ratio value weighted is 83.3% and the cost ratio is 16.7%.

Here are the benefits of weight ratio.

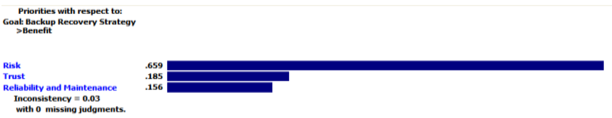

Fig. 2. Weighting the Benefit Ratio

Risk weight value 65.9%; trust 18.5%; and reliability and maintenance 15.6%.

Weight each of the risk criteria.

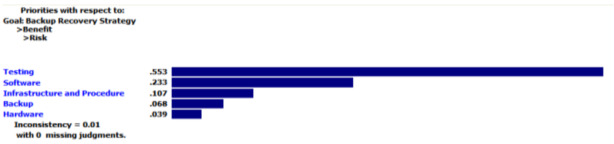

Fig. 3. Weighing the Risk

Testing weight value 55.3%; software 23.3%; infrastructure and procedure 10.7%; backup 6.8%; and hardware 3.9%.

Weight each of the reliability and maintenance criteria.

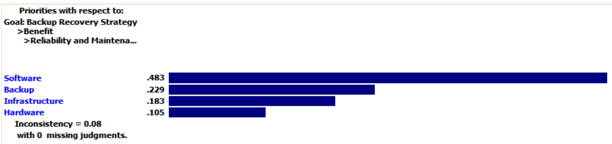

Fig. 4. Weighting the Reliability and Maintenance

Software weight value 48.3%; backup 22.9%; infrastructure 18.3%; and hardware 10.5%.

Weight each of trust criteria.

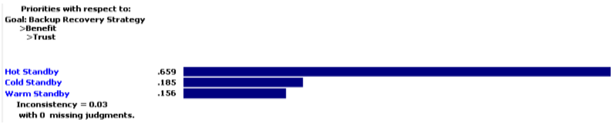

Fig. 5. Weighting the trust

The value of hot standby weight is 65.9%; cold standby 18.5%; and a warm standby 15.6%.

Here's the weight of each of the cost ratio.

Fig. 6. Weighing the Cost Ratio

The disaster recovery center weighted value 52.2%; backup 20%; testing 20%, and infrastructure and training 7.8%.

The global alternate weights that influence the research study are:

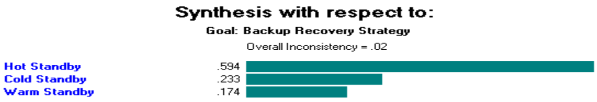

Fig. 7. Global alternative weighting

The value of hot standby weight is 59.4%; cold standby 23.3%; and a warm standby 17.4%.

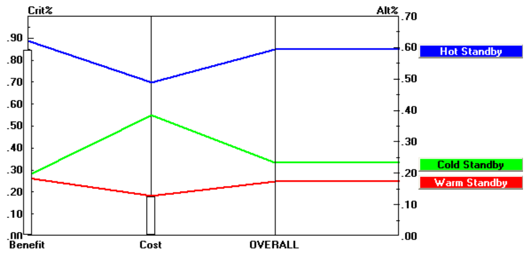

Fig. 8. Global alternative weighting

Based on the above graph concluded that of the three strategic alternatives if sorted then the order is hot standby, cold standby, and warm standby.

Inconsistency ratios of the weighted value of data that have been collected from the expert respondent are parameters used to check whether pairwise comparisons have been done consequently or not. The data inconsistency ratios are considered good if the inconsistency ratio (CR) value is ≤ 0.1, can be seen in the following table.

Table 6. Inconsistency Ratio

No	Matrix Comparison of CR Element	Value
1	Comparison of research	0.00

2	Comparison of the benefit ratio	0.03
3	Comparison of the risk ratio	0.01
4	Comparison of the reliability and maintenance	0.00
5	Comparison of the trust	0.03
6	Comparison of cost ratio	0.02
7	Globally	0.02

It can be concluded that the paired pairs given by the expert respondent have inconsistency ratio values smaller than 0.1 as the maximum value of the inconsistency ratio. Thus the results of geometric calculations combined data of expert respondents are quite consistent.

CONCLUSION

From the results of data processing from the respondent's experts can be concluded that the first order is hot standby selection 59.4%; followed by a second order of 23.3% cold standby, and then the third order is the choice of warm standby 17.4%. The data inconsistency rate is considered good because it is 0.02, smaller than 0.1 as the maximum value of inconsistency ratio.

By doing this research using hot standby can be implemented in University Trilogy, in order to minimize the risks posed by the disaster. Message for other researchers in this research is related to University Trilogy condition at this time, so for different time and condition need to do further research. It requires commitment and understanding from top management in the implementation of a disaster recovery plan.

ACKNOWLEDGMENT

We would like to thank the University Trilogy for permitting the use of all available resources. We would like to extend our gratitude to all shareholders who have helped so that this article can be completed and published. This research has been presented at the Annual Scientific Announcement -The 5th IKATAN AHLI KEBENCANAAN INDONESIA (IABI).

REFERENCES

[1] Bryan C. Martin, SANS Institute, 2002. Disaster Recovery Plan Strategies and Processes. As part of the Information Security Reading Room, 2002.

[2] Cahyadi, Eddy, 2006. Review Business Continuity Plan Based on Quantification of Economic Value of Application System on Aviation Industry: Case Study at PT. Garuda Indonesia. The thesis final report of an academic research article at Magister Teknologi Informasi University Indonesia, 2006.

[3] Carl, Neumann, 2003. Disaster Recovery Planning. Final Research Paper. Stevens Institute of Technology, 2003.

[4] Faisal, 2010. Disaster Recovery Plan Information Technology Strategy on UICO Core System with Analytical Hierarchy Process Approach. The thesis final report of an academic research article at Magister Ilmu Komputer STMIK Nusa Mandiri Jakarta, 2010.

[5] Faisal, 2015. Decision Support System Image Processing Software Selection with Multi-Criteria Decision Making Method and Analytical Hierarchy Process. The scientific academic proceeding, published in the Seminar National on Information Technology and Multimedia (SEMNASTEKNOMEDIA 2015), STMIK AMIKOM Yogyakarta, ISSN 2302-3805.

[6] Indonesia Investments, 2017. Natural Disasters in Indonesia. https://www.indonesia-investments.com/id/bisnis/risiko/bencana-alam/item243.

[7] Konsa, K and Kaie Jeeser, 2017. Preparing Museum Disaster Plan: Risk Ranking Through the Analytical Hierarchy Process. International Journal of History and Cultural Studies (IJHCS) Volume 3, Issue 1, 2017, PP 19-26 ISSN 2454-7646 (Print) & ISSN 2454-7654 (Online).

[8] Marimin, 2005. Techniques and Applications of Decision-Making Some Criteria. PT. Gramedia Widiasarana Indonesia. Jakarta, 2005.

[9] Otair, Mohammed and Aiman Al-Refaei, 2015. Cybercrime Fighting Readiness Evaluation Using Analytic Hierarchy Process. Proceedings of 48th the IIER International Conference, Spain, Barcelona, 11th December 2

[10] 015, ISBN: 978-93-85832-61-1. (Accessible 10 Dec 2017).

[11] Saaty, R.W., 1983. The Analytic Hierarchy Process-What it is and how it

used. Journal of Mathematical Modelling Vol. 9 no. 3-5, 1983.p. 161-176.

[12] Saaty, T.L., 2004. Decision Making - The Analytic Hierarchal Process and the Analytic Network Process. Journal of Systems Science and Systems Engineering. Volume 13(1): 35.

[13] Sharing Vision, 2008. Professional Workshop: Step by Step Approach Building Disaster Recovery Strategy and Procedure. A Framework for Developing and Reviewing Enterprise Disaster Recovery Management. Bandung, 2008.

[14] Soedarmaji, Mas Mokhamad, 2000. Business Planning Based on Disaster Recovery due to Computer System Failure in One of Capital Market Management Company, Case Study of PT. Jakarta Stock Exchange. The thesis final report of an academic research article at Magister Teknologi Informasi Universitas Indonesia, 2000.

[15] Wulandari, D.A., 2008. The IT Disaster Recovery Planning Strategy on Core Banking System with Analytic Hierarchy Process Approach: Case Study at PT. Bank Mega Tbk. The thesis final report of an academic research article at Magister Ilmu Komputer University Budi Luhur Jakarta, 2008.