

# Investment Portfolio Analysis at Data Center Information Technology; Case Study on PT. Telkominfra

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## ABSTRACT

The fastest growth of technology in recent era of globalization has provided many benefits in progress and challenges on various fields. Those Investments on information technology could lift the companies to optimize their business processes so it would have a positive affect, including by maintaining and increasing their competitive position, reducing costs, increase the flexibility, and responsiveness to customer needs. This research was carried out in order to revealed whether those three options of data center investment for information technology such as on-premise, colocation and private cloud which conduct by PT Telkominfra are worth financially and non-financially. Besides, it also aims to provide recommendations for which option is best among these available options. The basic data that used in this research was the period of August 2017 - July 2020. Financial feasibility analysis used Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR) and Profitability Index (PI) methods. Meanwhile, the non-financial feasibility analysis used the Analytical Hierarchy Process (AHP) method. The investment period took four years with recommendation selected option to provide the greatest benefit value.

**Keywords:** Data Center, Investment Feasibility, Paybak Period, Net Present Value, Internal Rate of Return, Profitability Index, Analytical Hierarchy Process

## INTRODUCTION

The fastest growth of technology in recent era of globalization has provided many benefits in progress of various fields.

The use of technology could lift the companies to optimize their business processes so they could provide better service to the customers. Information technology systems provide five main roles in an organization or company, such as to increase the efficiency, effectiveness, communication, collaboration and competition.

There are more companies that invest hugely on information technology. The most common reasons are because the need to maintain and improve competitive position, reduce the costs, improve the flexibility and increase the responsiveness towards customer needs.

PT Telkominfra is a subholding that owned by PT Telkom Indonesia (Telkom Group) which is engaged in telecommunications infrastructure services. As a developing company, PT Telkominfra are also investing in providing data centers as part of building information technology to support the company's business activities. PT Telkominfra currently chooses to use private cloud data center services.

Figure 1 shows that the costs incurred by PT Telkominfra for private cloud data center services amounted to 259,533,000 rupiah per month or with total of 9,343,200,000 rupiah for three years period. The cloud service procurement cooperation agreement contract would expire in July 2020. Cause of this situation, PT Telkominfra would face an option to invest in data center by three options,

namely Infrastructure as a service (IaaS) colocation.  
private cloud (As it is now) on-premise or

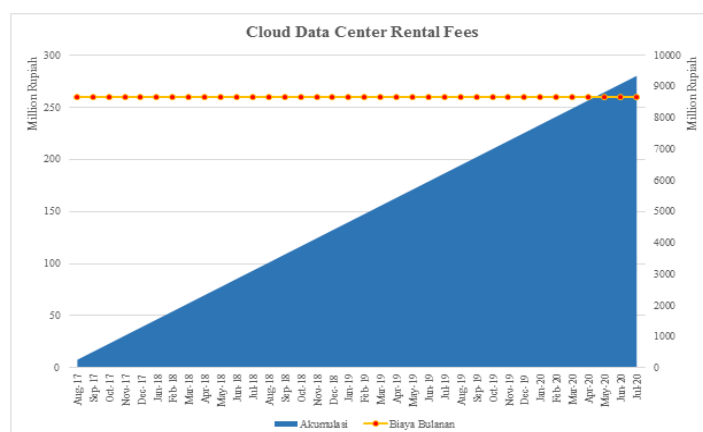


Figure 1. PT Telkominfra Cloud Data Center Rental Fees

## LITERATURE REVIEW

### Data Center

According to Yulianti and Nanda (2010), data center is a facility used to placing several sets of servers or computer systems and data storage systems that are conditioned by power supply settings, air control, fire prevention and usually equipped with a security system. According to Triwahyuni (2014) Data Center (sometimes spelled as datacenter) is a central storage, both physical and virtual, for keeping, managing and scattering media of data and information that organized by certain knowledge or fulfilling certain businesses.

### On-Premise data Center

On-premise data center is a data center whose entire infrastructure both main and supporting, is owned by the company or organization.

### Colocation Data Center

According to Basry and Malays (2017), a co-location server in data center is a technology that deploys the services through server center that provided by data center and has virtual nature for data and application maintenance purposes. Besides, co-location servers has become an significant information technology trend in increasing the speed of data transfer / traffic and minimize the use of data process

operating costs. In other word, the companies do not need to pay extra for server development and maintenance because many of data centers have offer these facilities.

### Private Cloud Data Center

The definition of cloud computing based on NIST (2011) could be explain as follows: "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (eg, networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Based on NIST (2011), there are 4 (four) cloud computing deployment models, namely Private Cloud, Community Cloud, Public Cloud, Hybrid Cloud. Private cloud is a infrastructure cloud which particularly provided for use of an organization which consist of several business units. Private clouds is owned, managed and operated by organizations, third parties, or a combination of both and could be put in the same or different place.

### Investment Feasibility

Frank K. Reilly and Keith C. Brown in their book with titled of "Investments: Analysis and Management" (2012, Pages 4) defines that investment as follows: "The

current commitment of dollars for a period of time in order to derive future payments that will compensate the investor for: (1) the time the funds are committed, (2) the expected rate of inflation, and (3) the uncertainty of future payments". From this definition, it could be interpreted that investment is an activity of delivering certain resources which carried out recently with hope to earn the benefits in the future.

### **Financial Feasibility Assessment of Investments**

These following are some of the methods that used while evaluating the financial investment feasibility:

#### **1) Payback period**

According to Laudon (2010) "Management information system in 10th edition", the payback period is a fairly simple method. This method is an estimation method that measure the time it takes to pay back the initial investment of a project.

#### **2) Net Present Value**

Net Present Value (NPV) is an estimation method of investment feasibility by taking consideration of time value of money. Sartono (2012) suggested that the NPV is the difference between present net cash flow and present investment value.

#### **3) Internal Rate of Return**

The IRR method used to rank the investment proposals through rate of investment return which calculated by finding a discount rate that equates to the present value of the project's expected cash inflows against the present value of the same costs project or discount rate which create the NPV equal to zero.

#### **4) Profitability Index**

According to Husnan and Suwarsono (2014), this method is calculates the ratio between present value of future net cash receipts and present value of investment. The investment proposal could be accepted if the profitability index (PI) shown is  $> 1$ . If the PI which

shown is  $< 1$ , then the investment proposal would be rejected.

### **Non-Financial investment Feasibility Assessment**

The method used to assess the feasibility of non-financial investment is AHP (Analytical Hierarchy Process). AHP is hierarchy function with the main input is human perception. Through this hierarchy the complex and unstructured problem could be solved into groups. Then arranged into a form of hierarchy (Thomas L. Saaty, 1998).

## **RESEARCH METHODS**

### **Research Methods and Research Stages**

In practice, this research was carried out by following the flow of the research methods and stages as follows:

- 1) Discover the research objectives, namely finding out the investment feasibility in on-premise data centers, colocation data centers, private cloud data centers and recommendations for choosing the most appropriate type of data center.
- 2) Conducting field observations at the research location and literature study from several prior research as reference regarding investment feasibility analysis and decision support methods.
- 3) Reveal the operational definition variables, namely data center investment feasibility and data center investment decisions.
- 4) Discover the population and research sampling
- 5) Conducting literature research on data center investment components
- 6) Conducting interviews with chosen respondents regarding the criteria, benefits and risks to find out the options of data center investment type.
- 7) Distributing the questionnaires to selected respondents in order to provide an assessment of predetermined criteria.
- 8) Evaluate the research process that has been carried out and put up the

conclusions and recommendations as the final result (output) of the research.

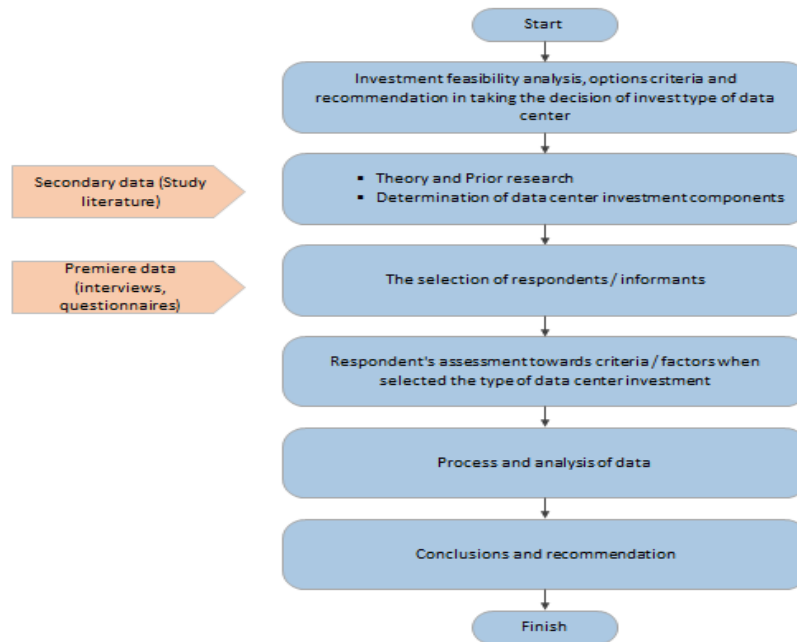


Figure 2. The Research Flows Methods and its Stages

### Population and Research Sample

To obtain the primary data, the population that used in this research were the employees of PT Telkominfra who

understood and involved in the data center investment planning process which was then called as an informant.

Table 1. Number of Informants

Unit/Division	Staff/Supervisor	Manager	Vice President	Total
Information Technology	4	-	-	4
Planning & Control	-	3	1	4
Solution Group	1	2	1	4
<b>Total</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>12</b>

### Data Collection Methods

The research data collection which carried out in this research both primary and secondary data through several techniques could be written as follows:

- 1) Primary data, done by conducting a group discussion forum and questionnaires.
- 2) Secondary data, obtained by studying research data, included the company documents related to the operational costs for the monthly rental of data center services or cloud servers from August 2017 until July 2020 and other data which related to this research

through literature research, such as data collection with references study and literature.

### Data Analysis Methods Financial Feasibility

Financial feasibility analysis was revealed about the elements of investment costs, risks and benefits that possibly appear on these three options. The investment feasibility analysis method that used to assess the financial investment feasibility is Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR) and Profitability Index (PI) methods.

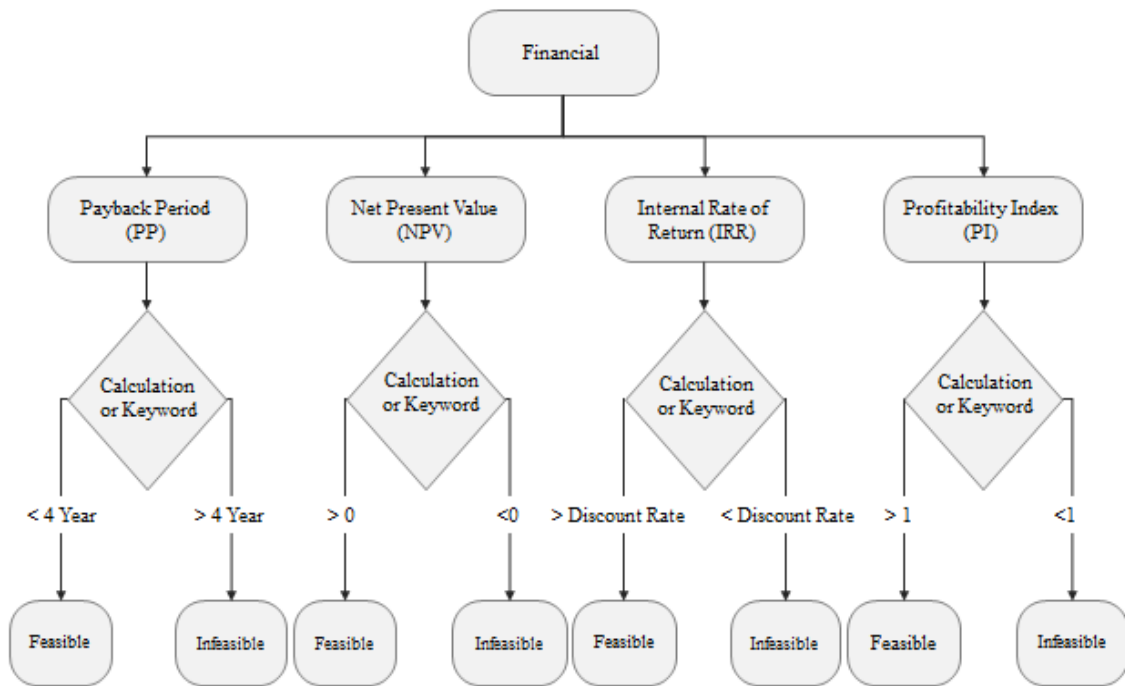


Figure 3. The Flowchart of financial Feasibility Analysis

### Non-Financial Feasibility

The procedure of Analytical Hierarchy Process that could be served as follows:

- 1) Explain the problem and discover the expect solution then arranged it as hierarchy
- 2) Revealed the priority element by creating pairwise comparisons and filled this pairwise comparison matrix by numbers to represent the relative important from each element to another
- 3) Synthesis: Sum up all the values of each column of the matrix and divide each value from the column by the total of the column concerned by obtaining normalized matrix and then add up the values of each row and divide by the number of elements to get the average scores.
- 4) Consistency measure: By multiplying each value in the first column with the relative priority of the first element, the value in the second column by the relative priority of the second element, and so on and adding up each row then sum of the rows and divided by the corresponding relative priority element and summing the quotient above by the

number of existing elements, the result is often called by max

- 5) To estimate the consistency index (CI), could be done with this following formula:
- 6)  $CI = (Max - n)/n$ , whereas the n is the number of criteria
- 7) Estimating the consistency ratio (CR)
- 8)  $CR = CI/IR$ , whereas IR is Index Random consistency
- 9) Checking the consistency of hierarchy, so if the CR value is less or equal to 0.1 then the calculation result could be said consistent.

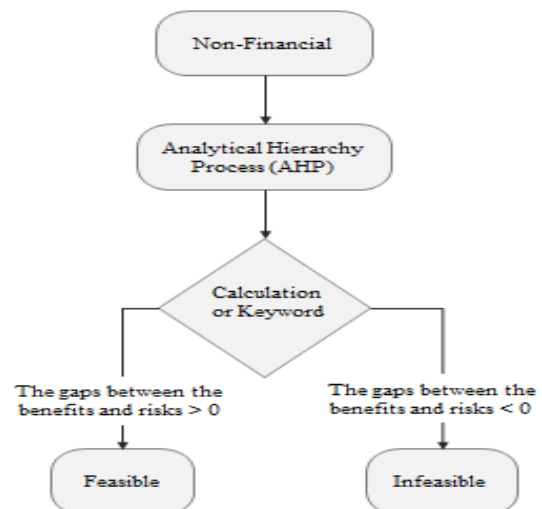


Figure 4. The Flowchart of Non-Financial Feasibility Method



## RESULTS

### Financial Feasibility Results

By bear on mind those components of costs, risks and benefits of each investment option, the results that obtained could be served according to these

following table. The investment value which becomes the benchmark for the assessment of investment feasibility in this research was the total amount of investment that the company has spent for four years.

Table 2. Summary on the components of costs, risks, benefits and other costs

Initial Cost Components					
Cost Component	Year	Initial server purchase	License software virtualisasi	Server Installation	Sub Total
Data Center On-Premise	Year 1	770.675.000	139.193.750	5.000.000	914.868.750
	Year 2	-	139.193.750	-	139.193.750
	Year 3	-	139.193.750	-	139.193.750
	Year 4	-	139.193.750	-	139.193.750
Data Center Colocation	Year 1	770.675.000	139.193.750	-	909.868.750
	Year 2	-	139.193.750	-	139.193.750
	Year 3	-	139.193.750	-	139.193.750
	Year 4	-	139.193.750	-	139.193.750
Data Center Private Cloud	Year 1	-	-	-	-
	Year 2	-	-	-	-
	Year 3	-	-	-	-
	Year 4	-	-	-	-

Table 3. Summary on the components of costs, risks, benefits and other costs (continued)

Operational Cost Components					
Investment Option	Year	Rent of Place	Maintenance	Manage Service	Total
Data Center On-Premise	Year 1	60.600.000	373.000.000	-	1.348.468.750
	Year 2	60.600.000	373.000.000	-	572.793.750
	Year 3	60.600.000	373.000.000	-	572.793.750
	Year 4	60.600.000	373.000.000	-	572.793.750
Data Center Colocation	Year 1	-	-	58.080.000	967.948.750
	Year 2	-	139.193.750	58.080.000	336.467.500
	Year 3	-	139.193.750	58.080.000	336.467.500
	Year 4	-	139.193.750	58.080.000	336.467.500
Data Center Private Cloud	Year 1	-	-	1.005.400.000	1.005.400.000
	Year 2	-	-	1.005.400.000	1.005.400.000
	Year 3	-	-	1.005.400.000	1.005.400.000
	Year 4	-	-	1.005.400.000	1.005.400.000

Table 4. Summary on the components of costs, risks, benefits and other costs (continued)

Risk Potential Cost						
Investment Option	Year	Cyber Security Attack	Outage	Vendor Lock-in	Vendor Failure	Total
Data Center On-Premise	Year 1	204.375.000	175.500.000	-	-	379.875.000
	Year 2	204.375.000	175.500.000	-	-	379.875.000
	Year 3	204.375.000	175.500.000	-	-	379.875.000
	Year 4	204.375.000	175.500.000	-	-	379.875.000
Data Center Colocation	Year 1	204.375.000	263.250	-	67.500.000	272.138.250
	Year 2	204.375.000	263.250	-	67.500.000	272.138.250
	Year 3	204.375.000	263.250	-	67.500.000	272.138.250
	Year 4	204.375.000	263.250	-	67.500.000	272.138.250
Data Center Private Cloud	Year 1	408.750.000	263.250	67.500.000	67.500.000	544.013.250
	Year 2	408.750.000	263.250	67.500.000	67.500.000	544.013.250
	Year 3	408.750.000	263.250	67.500.000	67.500.000	544.013.250
	Year 4	408.750.000	263.250	67.500.000	67.500.000	544.013.250

Table 5. Summary on the components of costs, risks, benefits and other costs (continued)

Potential Cost Benefit component					
Investment Option	Year	Ownership of Data	Data Security	Flexibility	Total
Data Center On-Premise	Year 1	1.635.000.000	270.000.000	136.250.000	-
	Year 2	1.635.000.000	270.000.000	136.250.000	-
	Year 3	1.635.000.000	270.000.000	136.250.000	-
	Year 4	1.635.000.000	270.000.000	136.250.000	-
Data Center Colocation	Year 1	1.635.000.000	-	136.250.000	-
	Year 2	1.635.000.000	-	136.250.000	-
	Year 3	1.635.000.000	-	136.250.000	-
	Year 4	1.635.000.000	-	136.250.000	-
Data Center Private Cloud	Year 1	1.635.000.000	-	-	770.675.000
	Year 2	1.635.000.000	-	-	-
	Year 3	1.635.000.000	-	-	-
	Year 4	1.635.000.000	-	-	-

Table 6. Summary on the components of costs, risks, benefits and other costs (continued)

Investment Option	Year	Initial Purchase	Virtualization License Fee	IT Management Efficiency	Technology
Data Center On-Premise	Year 1	-	-	-	2.041.250.000
	Year 2	-	-	-	2.041.250.000
	Year 3	-	-	-	2.041.250.000
	Year 4	-	-	-	2.041.250.000
Data Center Colocation	Year 1	-	-	-	1.771.250.000
	Year 2	-	-	-	1.771.250.000
	Year 3	-	-	-	1.771.250.000
	Year 4	-	-	-	1.771.250.000
Data Center Private Cloud	Year 1	139.193.750	394.816.000	545.000.000	3.484.684.750
	Year 2	139.193.750	394.816.000	545.000.000	2.714.009.750
	Year 3	139.193.750	394.816.000	545.000.000	2.714.009.750
	Year 4	139.193.750	394.816.000	545.000.000	2.714.009.750

All costs, risks and benefits that should be discounted in advance with Bank Indonesia discount rate. Based on data

from [www.bi.go.id](http://www.bi.go.id), the discount rate for July 2020 was 4.00%.

Table 7. Net incomes of each investment option

Cost Component		First Year	Second Year	Third Year	Fourth Year
Cost	On Premise	2.172.804.000	526.970.250	504.058.500	481.146.750
	Colocation	1.802.704.800	309.550.100	296.091.400	282.632.700
	Private Cloud	965.184.000	924.968.000	884.752.000	844.536.000
Risk	On Premise	364.680.000	349.485.000	334.290.000	319.095.000
	Colocation	261.252.720	250.367.190	239.481.660	228.596.130
	Private Cloud	522.252.720	500.492.190	478.731.660	456.971.130
Benefit	On Premise	1.959.600.000	1.877.950.000	1.796.300.000	1.714.650.000
	Colocation	1.700.400.000	1.629.550.000	1.558.700.000	1.487.850.000
	Private Cloud	3.345.297.360	2.496.888.970	2.388.328.580	2.279.768.190
Net Benefit	On Premise	(577.884.000)	1.001.494.750	957.951.500	914.408.250
	Colocation	(363.557.520)	1.069.632.710	1.023.126.940	976.621.170
	Private Cloud	1.857.860.640	1.071.428.780	1.024.844.920	978.261.060

Table 8. Summary from financial feasibility analysis results

Investment Analysis Method	Data Center Option		
	On-Premise	Colocation	Private Cloud
PP	1 Year 11 Months 12 Days	1 Year 7 Months 16 Months	1 Year 2 Months 11 Months
NPV	Rp 3.724.544.127	Rp 3.738.472.916	Rp 6.973.164.684
IRR	45,45%	57,30%	78,69%
PI	0,62	1,01	1,36

The payback period analysis result for the private cloud data center option was 1 year 2 months 11 days. Meaning that private cloud data center options could pay off the capital in a relatively short of time. The payback value from this private cloud data center option was faster other than the two options left.

NPV value for the private cloud data center option was Rp. 6,973,164,684. The NPV value is the amount of benefits that Telkominfra will received during these for 4 years periods. NPV value of the private cloud data center option was greater other than the two options left. So, Telkominfra will get greater benefits if they invested with a private cloud option based on the NPV method.

On this IRR method, the acceptance or rejection of an investment decision would be decided after the results from the IRR analysis of investment options and compared to the required interest rate. In the on-premise data center option, the IRR obtained was 45.45%, colocation with an IRR was 57.30%, while the IRR of a private cloud data center option was 78.69%. According to these results it could be concluded that the three investment options are acceptable. However, the private cloud

data center option provides greater value so it will be profitable for the company to implement the private cloud data center option compared to the other two options.

PI values of the on-premise, colocation and private cloud data center options were 0.62, 1.01, and 1.36, respectively. An investment option would be feasible to be implemented if the value of  $PI > 1$ . Because the on-premise data center option has a value of  $PI < 1$ , so this option was declared infeasible. Meanwhile, the colocation data center and private cloud data center options were considered feasible, as for the PI method option goes to private cloud data center because it has a greater value.

From these financial investment feasibility analysis results, it could be said that the investment option which provide lots of benefits for Telkominfra over the next 4 years is a private cloud data center.

### Non-Financial Feasibility Result Analysis of Investment Benefit

The hierarchy of criteria and alternative categories of investment benefits using the AHP method is as shown in Figure 5.

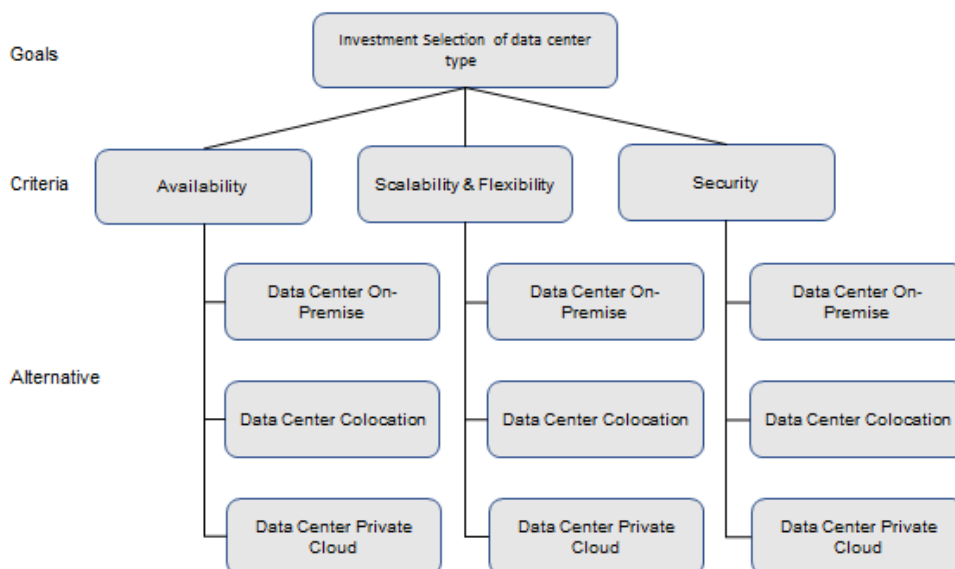


Figure 5. Hierarchy of criteria and alternatives in benefit categories

The next process is to reveal the priority of the elements by making a

pairwise comparison and pairwise comparison matrix. As well as the synthesis



process, namely sum up the values of each column of the matrix, dividing each value from the column by the total column in question by obtaining normalized matrix

and sum up the values of each row and dividing by the number of elements to get the average value as it shown in the table. 4.2.

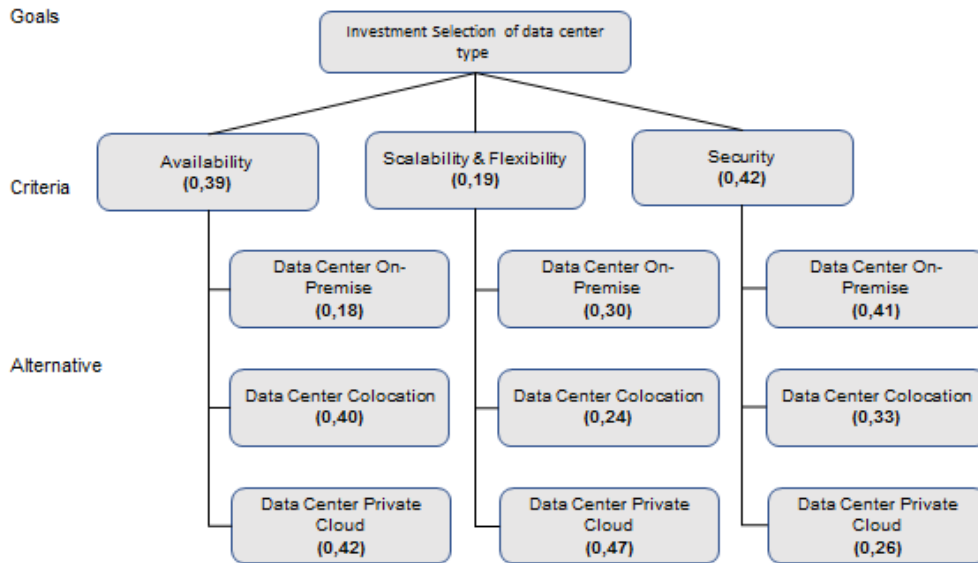


Figure 6. The results from processing criteria and alternatives in benefit categories

Table 9. Results from rating of benefit categories

No	Investasi Option of Data Center	Value
1	On-Premise	0,36
2	Colocation	0,33
3	Private Cloud	0,31

From these calculation results, it was found that the option of investment from these three options according to Telkominfra's needs it is recommended to choose a private cloud investment. This is in accordance with the value obtained fr the

private cloud data center option which is higher amongst all.

### Investment Risk Analysis

Similar to the non-financial benefit category analysis, the first stages that should be done by evaluating the risk of each investment option that the company will earn. Table 4.3 below is a hierarchy of criteria and alternatives using the Analytical Hierarchy Process (AHP).

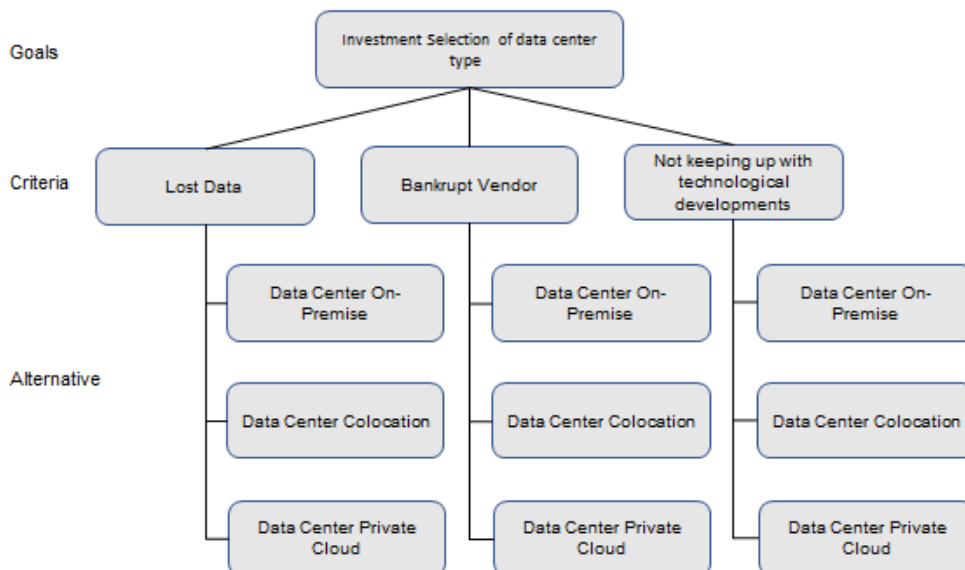


Figure 7. Hierarchy of criteria and alternatives in risk categories

The next process is to find out the priority of the elements by making a pairwise comparison and pairwise comparison matrix. As well as the synthesis process, namely sum up the values of each column of the matrix, dividing each value

from the column by the total column in question by obtaining a normalization matrix and sum up the values of each row and dividing by the number of elements to get the average value as it shown in the Figure 8.

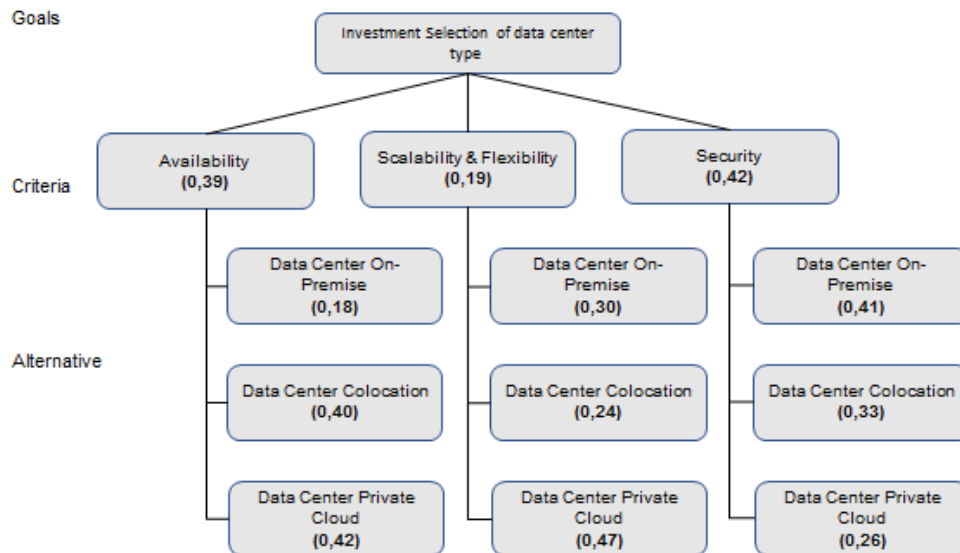


Figure 8. The outcomes from processing criteria and alternatives in risk categories

Table 10. The results from rating risk categories

No	Investasi Option of Data Center	Value
1	On-Premise	0,36
2	Colocation	0,33
3	Private Cloud	0,31

## DISCUSSION

From these calculation results, it was found that the investment options between on-premise, colocation and private cloud data center options based on Telkominfra's needs through risk category analysis is recommended to choose investment with private cloud. This is in accordance with the

value obtained by private cloud data center which has the smallest risk compared to the two options.

## Decision of Investment Feasibility Based on Non-Financial

The decision on non-financial investment feasibility in data center types could be obtained by calculating the gaps between the value of benefits and risks. The difference between benefits and risks which could be shown in Table 11.

Table 11. The gaps between benefits and risks.

Investment Option of Data Center	Benefit Value	Risk Value	Gap	Benefits of the risks Appeal
On-Premise	0,30	0,36	-0,06	0,83
Colocation	0,34	0,33	0,01	1,03
Private Cloud	0,36	0,31	0,05	1,17

From the Table 11, it is obtained an analysis which has the most suitable of information technology data center investment for PT Telkominfra's non-financial needs is the use of the private

cloud data center. Based on the gaps between the benefits and risks, the appropriate types of investment are colocation data center and private cloud,

while on-premise data centers were considered as non-financially infeasibility.

## CONCLUSION

### Conclusion

- 1) On-premise data center option was declared to be financially feasible through the PP, NPV and IRR methods but declared inadequate by the PI method. While Colocation Data center and private cloud data center options were declared financially feasible both PP, NPV, IRR and PI methods.
- 2) On-premise data center option was declared non-financially infeasible, while Colocation data center and Private cloud data center options were declared non-financially feasible based on Analytical Hierarchy Process (AHP) methods.
- 3) The results from data processing comparisons between on-premise data centers, colocation data centers, and private cloud data centers both financially and non-financially, that could be concluded if the investment option chosen which is recommended is a private cloud data center because it has good financial benefits and non-financially at best.

### Recommendations

Companies were advised to use the private cloud data center investment option because this investment option would provide the best financial and non-financial benefits for the company. This option will also provide the benefits in the form of system availability, scalability, and flexibility therefore you could easily catch up with the rapid growth of information technology.

If the company chooses the private cloud data center option, it suggests increasing the ability to control data security, for example by adding special software related to cyber security.

Due to the limited time and place for the research, it is expected for the next further researchers should be conduct this

research by adding the reference to the costs of users, companies and different types of investment options.

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