



# OPTIMIZING PRINTER UTILIZATION AT BAPEKKO SURABAYA BY CONSIDERING LEASE OR BUY DECISION



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# Outline



# Outline



Introduction



Literature  
Review



Research  
Methodology



Analysis of  
Existing Condition



Solution Alternative for  
BAPPEKO Existing Utilization  
Problem



Proposed New Printer  
Management System



Conclusion and  
Suggestion



References



# Introduction

# Background



Has 72 SKPDs



IT based equipment



Printer as main focus

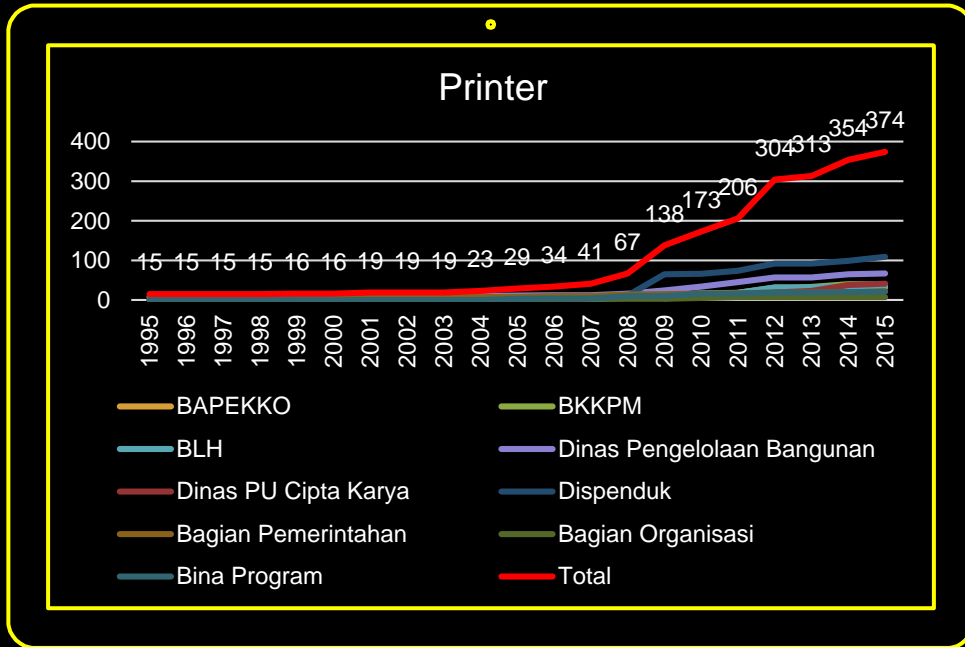


SKPD request to  
Procurement Division



Fast Developing  
Equipment





# Total Printer Growth

# Background



**BAPPEKO as  
observation object**



**Is the printer needs  
really that much?**



**Derived from BAPPEKO  
Historical Data**



**New Printer  
Management System**



## Problem Formulation








⊙ To generate general framework of Printer Management System in order to optimize printer utilization by considering lease and buy decision



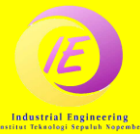
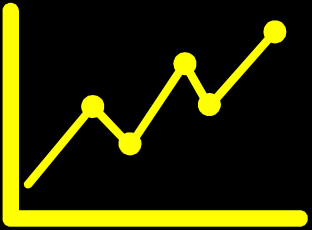


# Objectives



-  To develop printer management system based on three scenarios which are full buying, full leasing, and partial buying and leasing
-  To develop printer utilization mechanism in Surabaya City Government offices
-  To identify the consideration needs to be done before buying printer
-  To identify the consideration needs to be done before leasing printer
-  To calculate most beneficial scenario based on annual expense of each scenario

## Benefits



### ⊙ For Author:

- To understand Industrial Engineer's role in solving problem in real case
- To implement theoretical science got into practical situation
- To know the consideration needed in leasing and buying decision
- To be able to develop generic framework from one certain SKPD

### ⊙ For Government:

- To be used as consideration before printer procurement
- To save unnecessary expense in procuring asset
- To measure printer utilization level in SKPD



## Research Scope



### ⊙ Limitation:

- Survey and observation is limited on BAPPEKO.
- Leasing or buying decision framework is drawn from BAPPEKO existing condition.
- The evaluated printer procurement is limited from year 1995 until 2015.
- Time horizon for scenario made is limited to 16 years.

### ⊙ Assumption:

- Leasing policy is assumed to be permitted
- Lower bound of good utilization is 75%



# Literature Review



# Literature Review



1

## Printer

- Type
- Component function

## Economic Life and Service Life

2

- Consideration of buying scenario

3

## Taxonomy

- Breakdown of printer component

## Leasing and Buying Option

4

- Leasing Consideration
- Buying Consideration
- Lease vs Buy Decision Tree



# Literature Review



5

## Economic Alternative Selection

- Beneficial scenario or alternative in terms of economic

## Net Annual Worth (NAW)

6

- Beneficial decision

7

## Root Cause Analysis

- Detecting Root Cause of Problems
- RCA Tools



# Research Methodology

01

Problem  
Identification  
and Formulation  
Stage







# Research Methodology



1.

## Problem Identification and Formulation Stage

### Literature Review

- Printer
- Economical Life
- Service Life
- Taxonomy
- Leasing or Buying Option
- Net Annual Worth (NAW)
- Root Cause Analysis (RCA)
- Economic Alternative Selection

### Field Study

- Surabaya Procurement Division Observation
- BAPPEKO Observation
- BAPPEKO Stakeholder Interview



Data Collection  
Stage

02

01

Problem  
Identification  
and Formulation  
Stage





2.

## Data Collection Stage

# Research Methodology



### Direct Observation and Data Collection

- **Verification of Existing Asset**
- **Assets Existing Condition**
- **Experts Interview**
- **BAPPEKO Printer Utilization**
- **BAPPEKO printing frequency**

Data Collection  
Stage



Data Collection  
Stage

The icon shows a person standing next to a laptop and a briefcase, representing the initial data gathering phase.


02



Data Processing  
Stage

The icon depicts a hand pointing at a computer screen displaying data, with speech bubbles above it, symbolizing the analysis and cleaning of data.

01



Problem  
Identification  
and Formulation  
Stage

The icon features a magnifying glass over a bar chart and a smartphone, indicating the process of identifying a problem and formulating a research question.



### 3.

## Data Processing Stage

# Research Methodology



### Analysis of Existing Condition

- BAPPEKO Overview
- Verification of BAPPEKO Existing Asset
- BAPPEKO Existing Printer Utilization Calculation

### BAPPEKO Utilization Solution Alternative

- Asset Transfer
- Asset Elimination

Data Processing Stage

### PDCA Cycle


Plan	Do	Check	Action
<ul style="list-style-type: none"><li>• Printer Management Model</li><li>• Printer Management Model Simulation</li><li>• Asset Procurement Request Procedure</li></ul>	<ul style="list-style-type: none"><li>• Printer Usage Form</li><li>• Printer Failure Form</li><li>• Printer Maintenance Form</li><li>• SIMBADA database and interface changes</li></ul>	<ul style="list-style-type: none"><li>• Utilization Calculation</li><li>• Utilization Form</li><li>• Taxonomy</li></ul>	<ul style="list-style-type: none"><li>• Underutilized RCA</li><li>• Over Utilized RCA</li><li>• Asset Transfer Procedure</li><li>• Asset Elimination Procedure</li></ul>



Research  
Conclusions and  
Recommendation

04

Data Processing  
Stage



03



Data Collection  
Stage

02

Problem  
Identification  
and Formulation  
Stage



01



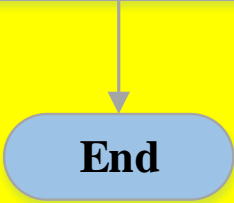
# Research Methodology



## 4.

## Research Conclusions and Recommendation

**Conclusions and Recommendation**



Research  
Conclusion and  
Recommendation



# Analysis of Existing Condition





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TEKNIK INDUSTRI - ITS



**Verification of Existing  
Printer Asset**



**Unclear Codification**



**Low Printer Utilization**



**No Printer Workload  
Data**



**No Printer  
Maintenance Data**

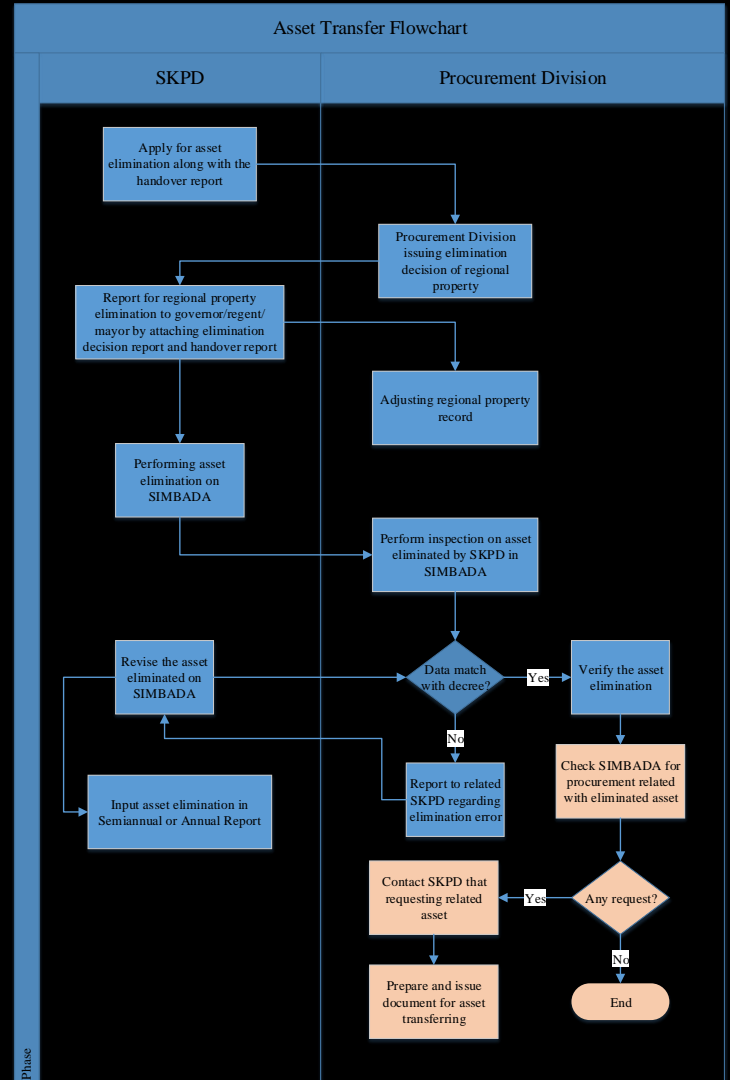
# Analysis of Existing Condition



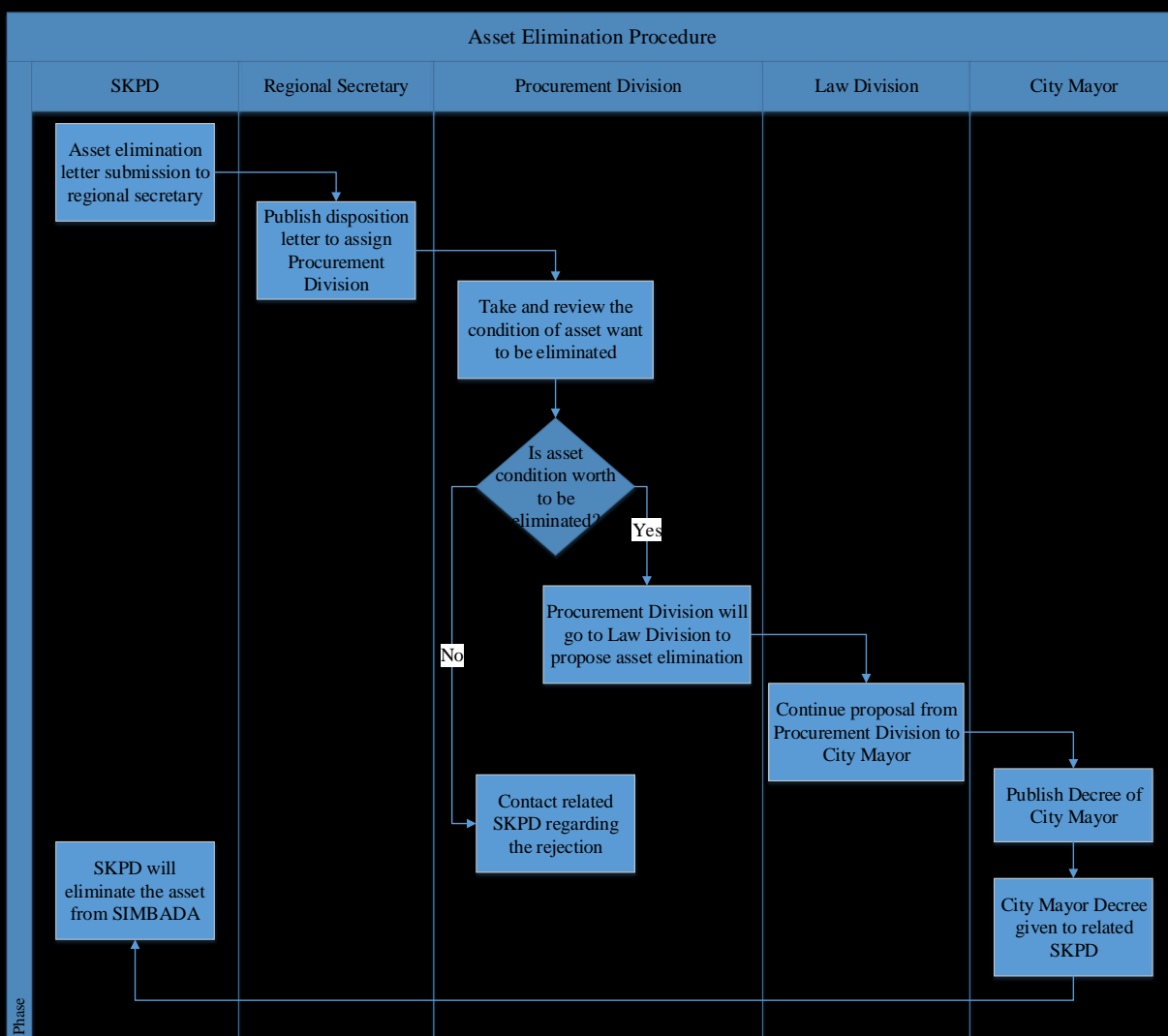


# **Solution Alternative for BAPPEKO Existing Utilization Problem**

# Asset Transfer



# Asset Elimination





# Proposed New Printer Management System

## PDCA Cycle

### Plan

- Printer Management Model
- Printer Management Model Simulation
- Asset Procurement Request Procedure

### Do

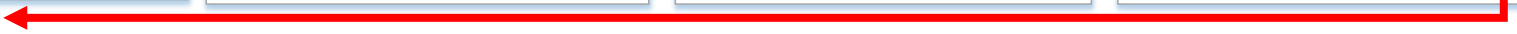
- Printer Usage Form
- Printer Failure Form
- Printer Maintenance Form
- SIMBADA database and interface changes

### Check

- Utilization Calculation
- Utilization Form
- Taxonomy

### Action

- Underutilized RCA
- Over Utilized RCA
- Asset Transfer Procedure
- Asset Elimination Procedure



## PDCA Cycle





# Utilization Calculation and Utilization Form

Check



No	Section	Printer Type and Brand	Total Daily Printing

$$\text{Utilization Level} = \frac{\text{uptime (hour)}}{\text{working hour}} * 100\%$$

$$\text{Printer Utilization} = \frac{\text{total printer printing (pages)}}{\text{printer printing speed (page per minutes)}} * \frac{1}{\text{total working minutes}}$$



# Taxonomy

Superordinate	Basic Level	Subordinate 1	Subordinate 2	
Printer	Function	Single Function		
		Multi-Function (All in one)	Print, Scan, Photocopy Print, Scan, Photocopy, Fax	
	Connection	Cable		
		Wireless		
	Type	Impact Printers		Dot Matrix Printer
				Daisy-Wheel Printer
				Line Printer
				Drum Printer
				Chain Printer
				Band Printer
		Non-Impact Printers		Ink-Jet Printer
				Laser Printer
				Electrostatic Printer
				Thermal Printer
	Wide Format Printer			
	Portable Printer			
	ID Card Printer			

**The codification is proposed to ease the asset maintaining and controlling, where it will be based on the taxonomy and later the codification made will be integrated with SIMBADA**

## Check







# Cause and Effect Diagram

## ⦿ Steps to construct Cause and Effect Diagram:

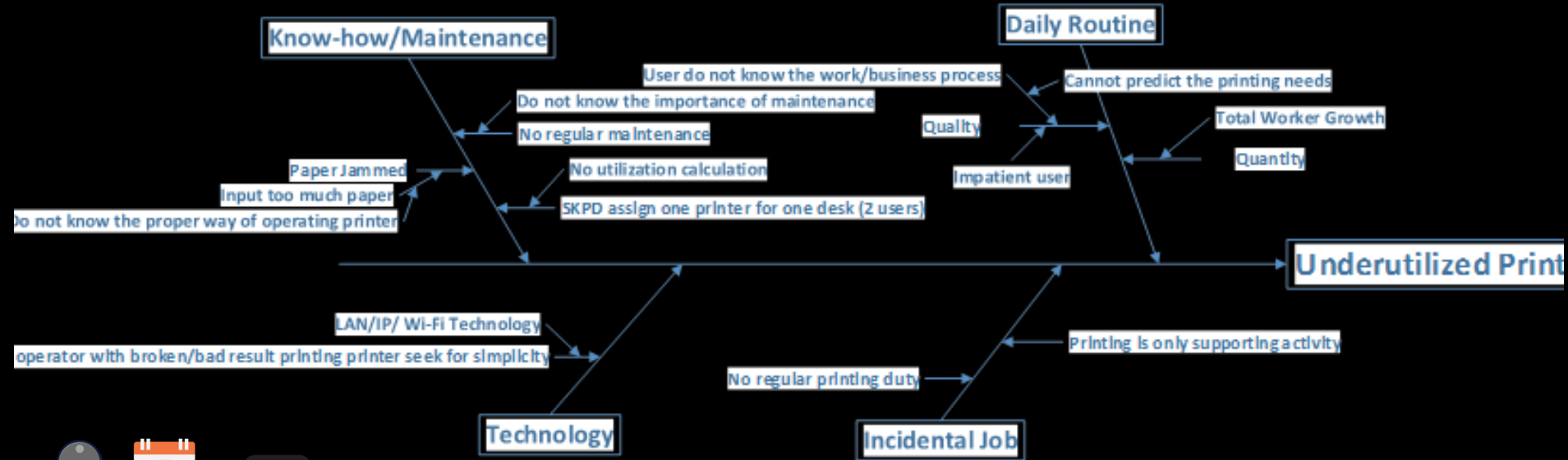
- Define the problem (effect) need to be solved.
- Identify the key causes of the problem or event.
- Identify the reasons behind the key causes.
- Identify the most likely causes.

- Kollengode, 2010

## Action



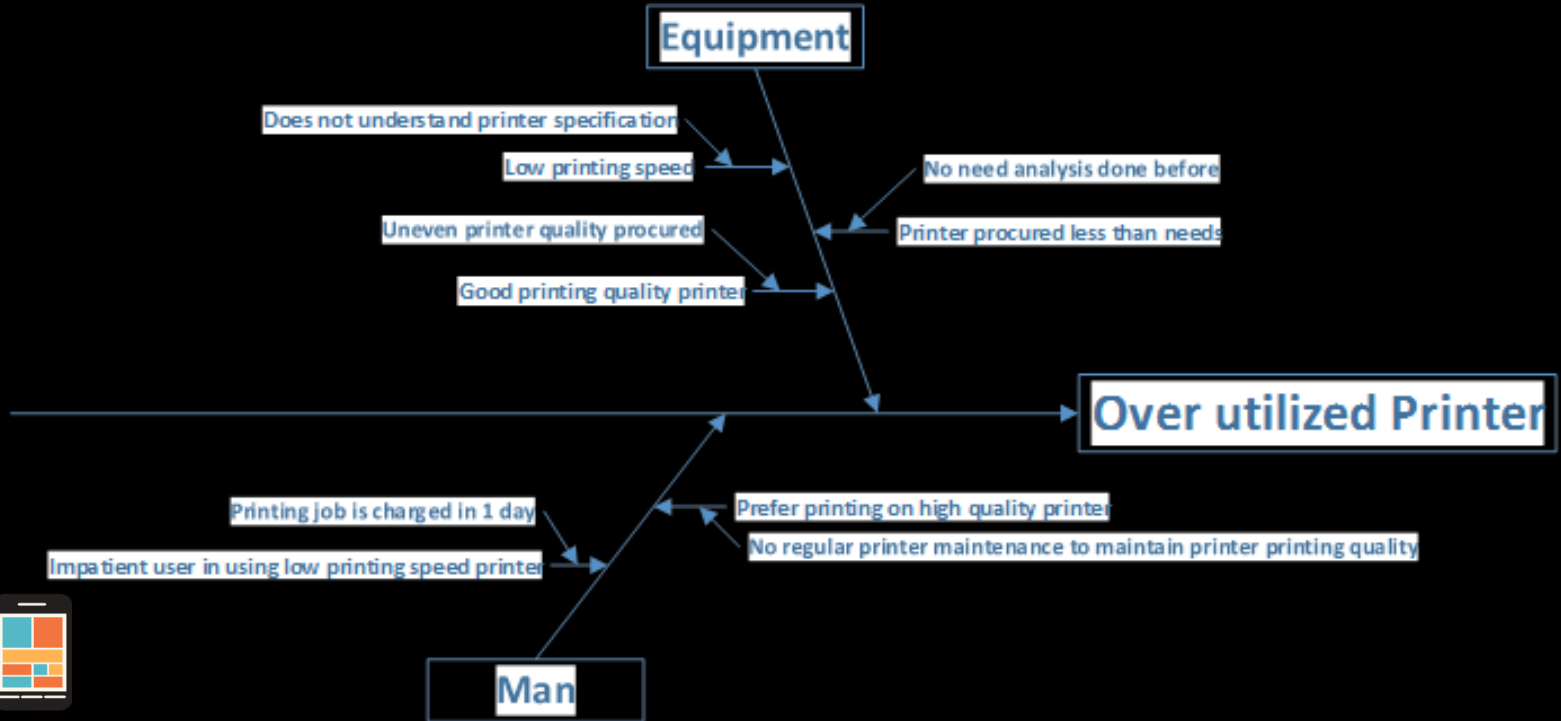
# Underutilized RCA



- Absence of needs analysis in SKPD
- Printer acts only as supporting tools
- Impatient user which leads to the desire to have printer for their own



# Over Utilized RCA



- No uniformity in printer procurement
- Impatient user

# Printer Management Model



## Printer Procurement System



## Plan



# Utilization



Working Time per day (minutes)				50							
No	Section	Printer Brand	Printer Type	Printing Speed(ppm)	Total Daily Printing	Total Monthly Printing	3-Month Printing	Daily Utilization	Monthly Utilization	3-Month Utilization	Decision
1				33	14	50	56	0.85%	3.03%	3.39%	Optimized current printer usage
2				21	12	34	788	1.14%	3.24%	75.05%	Can procure new printer
3								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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12								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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## Plan



Printer HP P1006 3 – month Utilization

$$= \left( \frac{\text{HP P1006 3 – Month printing frequency}}{\text{HP P1006 Printing Speed}} / \text{Working time in a day (minutes)} \right) * 100\%$$

$$\text{Printer HP P1006 3 – month Utilization} = \left( \frac{3,648}{17} / 480 \right) * 100\%$$

Printer HP P1006 3 – month Utilization = 45%





# Toner Cost

Assumptions	Working days in a	20	days
	Working days in a	235	days



Toner List

No	Year	Section	Printer Brand	Printer Type	Toner Type	Toner Price	Average Printing per day (pages)	Print Capacity per Toner	Length of Usage (days)	Toner needs per month	Toner needs per year	Toner expense per month	Toner expense per year	
1	2016					IDR 1,232,131	232	4123	17.77155172	1.13	13.22	IDR 1,386,633	IDR 16,232,938	
2	2016					IDR 12,412,414	124	1241	10.00806452	2.00	23.48	IDR 24,804,824	IDR 231,456,683	
3	2016					IDR 1,241,212	24	876	38.5	0.55	6.44	IDR 880,116	IDR 7,391,365	
4									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
5									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
6									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
7									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
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17									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
18									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
19									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
20									#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
<b>Total</b>													#DIV/0!	#DIV/0!



## Plan



$$\text{Length of usage (days)} = \frac{\text{Toner printing capacity}}{\text{Average printing in a day}}$$

$$\text{Toner needs per year} = \frac{\text{Working days in a year}}{\text{Length of usage (days)}}$$

$$\text{Toner expense per year} = \text{toner needs per year} * \text{toner price}$$

# Salvage Value



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## Plan



N	Printer Brand	Printer Type	Printer Procured Yes	Asset Elimination Year	Decision	Salvage Value
1					Asset cannot be eliminated	
2					Asset cannot be eliminated	
3					Asset cannot be eliminated	
4					Asset cannot be eliminated	
5					Asset cannot be eliminated	
6					Asset cannot be eliminated	
7					Asset cannot be eliminated	
8					Asset cannot be eliminated	
9					Asset cannot be eliminated	
10					Asset cannot be eliminated	
11					Asset cannot be eliminated	
12					Asset cannot be eliminated	
13					Asset cannot be eliminated	
14					Asset cannot be eliminated	
15					Asset cannot be eliminated	
16					Asset cannot be eliminated	
17					Asset cannot be eliminated	
18					Asset cannot be eliminated	
19					Asset cannot be eliminated	
20					Asset cannot be eliminated	







# Net Annual Worth

## Plan



Interest Rate		5.00%					
Cost	2016	2017	2018	2019	2020	2021	2022
Leasing Cost	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Buying Cost	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Maintenance	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Toner Cost	IDR 358,198,048	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Salvage Value	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV Buying Cost and Other Cost	IDR (341,140,998)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV Salvage Value	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
100% Buying Cost	IDR (83,213,647)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
100% Lease Cost	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV 100% Buying	IDR (79,251,092)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV 100% Lease	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
NAW Proportion	IDR (32,866,304)						
NAW 100% Buying	IDR (8,016,993)						
NAW 100% Leasing	IDR -						

# Alternative Comparison



## Plan



Net Annual Worth Proportion	IDR	-
Net Annual Worth Full Buy	IDR	-
Net Annual Worth Full Lease	IDR	-





# Model Simulation

## ⊙ Simulation Data Assumption:

- 20 Printer Procured on 2017
- Interest Rate 8.12%
- 10 printers procured on 2013 will be sold

## Plan



# Utilization

Working Time per day (minutes)		480									
No	Section	Printer Brand	Printer Type	Printing Speed(ppm)	Total Daily Printing	Total Monthly Printing	3-Month Printing	Daily Utilization	Monthly Utilization	3-Month Utilization	Decision
1	A	HP	P1006	17	114	2270	6809	1.40%	27.82%	83.44%	Can procure new printer
2	B	HP	P1102	18	125	2485	7454	1.45%	28.76%	86.27%	Can procure new printer
3	A	HP	P1102	18	110	2196	6589	1.27%	25.42%	76.26%	Can procure new printer
4	B	Xerox	Phaser 3435	33	76	1517	4550	0.48%	9.58%	28.72%	Optimized current printer usage
5	C	EPSON	L100	27	166	3328	9984	1.28%	25.68%	77.04%	Can procure new printer
6	C	Xerox	Phaser 3435	33	232	4640	13920	1.46%	29.29%	87.88%	Can procure new printer
7	D	HP	P1102	18	39	777	2330	0.45%	8.99%	26.97%	Optimized current printer usage
8	D	EPSON	L800	37	274	5477	16430	1.54%	30.84%	92.51%	Can procure new printer
9	A	EPSON	L220	27	196	3911	11732	1.51%	30.18%	90.52%	Can procure new printer
10	C	EPSON	L800	37	207	4145	12434	1.17%	23.34%	70.01%	Optimized current printer usage
11	B	HP	P1006	17	132	2631	7894	1.62%	32.24%	96.74%	Can procure new printer
12	D	Xerox	Phaser 3155	24	149	2986	8957	1.29%	25.92%	77.75%	Can procure new printer
13								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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19								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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# Toner

Assumptions	Working days in a month	20	days
	Working days in a year	235	days



*Toner List*

Buy Printer

No	Year	Section	Printer Brand	Printer Type	Toner Type	Toner Price	Average Printing per day (pages)	Print Capacity per Toner (pages)	Length of Usage (days)	Toner needs per month	Toner needs per year	Toner expense per month	Toner expense per year
1	2017	A	HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879	55	1600	29.09	0.69	8.08	IDR 574,667	IDR 6,752,335
2	2017	A	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	185	10000	54.05	0.37	4.35	IDR 264,570	IDR 3,108,697
3	2017	B	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	178	10000	56.18	0.36	4.18	IDR 254,559	IDR 2,991,071
4	2017	C	Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	120	2500	20.83	0.96	11.28	IDR 2,130,012	IDR 25,027,635
5	2017	A	Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	90	2500	27.78	0.72	8.46	IDR 1,597,509	IDR 18,770,727
6	2017	B	HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR 742,073	55	1500	27.27	0.73	8.62	IDR 544,187	IDR 6,394,196

# Toner Calculation



## Plan



$$\text{Length of usage (days)} = \frac{\text{print capacity per toner}}{\text{average printing per day (pages)}}$$

$$\text{Length of usage (days)} = \frac{1,600}{55} = 29.09 \text{ days}$$

$$\text{Toner needs per year} = \frac{\text{working days in a year}}{\text{length of usage (days)}}$$

$$\text{Toner needs per year} = \frac{235}{29.09} = 8.08 \text{ toner}$$

$$\text{Toner expense per year} = \text{toner needs per year} * \text{toner price}$$

$$\text{Toner expense per year} = 8.08 * \text{IDR } 835,879 = \text{IDR } 6,752,335$$

# Salvage Value

No	Printer Brand	Printer Type	Printer Procured Year	Asset Elimination Year	Decision	Salvage Value
1	HP	P1102	2012	2017	Asset can be eliminated	IDR 250,000
2	HP	P1006	2010	2017	Asset can be eliminated	IDR 300,000
3	Xerox	Phaser 3435	2001	2017	Asset can be eliminated	IDR 450,000
4	Xerox	WorkCenter 3119	2011	2017	Asset can be eliminated	IDR 400,000
5	EPSON	L800	2012	2017	Asset can be eliminated	IDR 150,000
6	EPSON	L100	2010	2017	Asset can be eliminated	IDR 100,000
7	Xerox	Phaser 3155	2010	2017	Asset can be eliminated	IDR 325,000
8	Xerox	Phaser 3435	2009	2017	Asset can be eliminated	IDR 425,000
9	EPSON	L220	2009	2017	Asset can be eliminated	IDR 125,000
10	Xerox	Phaser 3155	2011	2017	Asset can be eliminated	IDR 310,000
<b>Total Salvage Value</b>						<b>IDR 2,835,000</b>







# Alternative Comparison



Net Annual Worth Proportion	IDR	(12,581,720)
Net Annual Worth Full Buy	IDR	(2,984,525)
Net Annual Worth Full Lease	IDR	(956,500)





# Asset Procurement Request Procedure

## Plan



- ❑ SKPD filled asset request in e-budgeting
- ❑ Approval from Budgeting Team (Financial Department, BAPPEKO, Bina Program)
- ❑ If printer procured (buy) more than IDR 200,000,000 then SKPD will use auction method
- ❑ If less than IDR 200,000,000 then the procurement through e-catalogue
- ❑ If in case, printer want to be procured unavailable in e-catalogue then SKPD appoint 3<sup>rd</sup> party to do direct buying



# Printer Usage Form

Do



Month						
Section						
Printer Unit Code						
Printer Printing Speed (ppm)						
Working Time (minutes)						
Week	Total Daily Printing					
	Monday	Tuesday	Wednesday	Thursday	Friday	
1						
2						
3						
4						
Printer Monthly Utilization					0.00%	



# Printer Failure Form

No	Date	Section	Printer Unit Code	Printer Procured Year	Type of Failure	Part Replaced	Cost	Note

Do







# Conclusion and Suggestion

## Conclusion and Suggestion



## Conclusion

1. From the observed object, BAPPEKO, it can be seen that there are several problems occur, which are **low printer utilization**, **poor printer management**, and there is **no PDCA system** to control the management of printer procurement and evaluation. From the observation done, it is known that current printer utilization of BAPPEKO office is still very poor, as from 31 operating printers, the lowest utilization happened to be only **4% over 3-month printing data**, on the other hand, the **highest utilization is only 73% over 3-month printing data**, which is not even reached the lower bound of good utilization criteria. The management of the printer is also poor, as there are **no records related to the printer failure and maintenance data**. Result from the questionnaire distributed to the printer user also shows that **65% of the user never do regular printer maintenance** that is already provided by the printer manufacturer.





## Conclusion and Suggestion



## Conclusion

2. As the fact that printing is a supporting activities and cannot be predicted when it happened, then, a **good technology utilization by using IP/LAN/ Wi-Fi is recommended to prevent long queueing**. A **uniformity printer specification** is also needed to procure printer with same printing quality and speed to prevent tendency in using certain printer only. If the printer is being underutilized, it is then recommended to **combine several printers with low utilization** and **distribute printer with heavy printing load** evenly to the low utilization printer.



## Conclusion and Suggestion

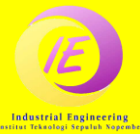


## Conclusion

3. Base on the interview and studies done, it can be known that the consideration in buying decision will be the **specification of printer** need to be procured/level of technology needed in existing condition, **toner or ink cost**, **utilization level of printer**, **maintenance cost**, and **printing frequency** in SKPD.
4. Base on the interview and studies done, it can be known that the consideration in leasing decision will be the **lease term and condition**, total number of **printer need and specification need**, and **cost of leasing**. Furthermore, due to limited number of printer leaser, SKPD should consider total printer need to be procured along with printer type and specification that available at the leaser.



## Conclusion and Suggestion



## Conclusion

5. By comparing NAW of full leasing and full buying scenario, it shows that **full leasing NAW** is only **32.04% of full buying NAW**, and by comparing **full leasing scenario** and **partial leasing and buying scenario**, it can be known that full leasing scenario NAW is only **7.6%** of partial leasing and buying scenario NAW. Thus, if comparing **full buying scenario** and **partial leasing and buying scenario**, it can be known that full buying scenario NAW is only **23.72%** of partial buying and leasing NAW.

## Conclusion and Suggestion



## Suggestion

1. Improvement to current model in terms of **utilization level calculation** that can **provide several ways of utilization calculation**
2. Checking mechanism is not only utilization, but **technical checking mechanism** to make sure that calculation from model can **represent SKPD ideal condition**
3. Finally, the suggestion related to the model which writer expect for further research can be developed more to be used not only as calculation model but can be **integrated with Surabaya City Government procurement system**





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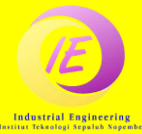


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Thank  
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