TUGAS AKHIR – TI 141501

OPTIMASI UTILISASI PRINTER DI BAPPEKO SURABAYA DENGAN MEMPERTIMBANGKAN KEPUTUSAN BELI/SEWA

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FINAL PROJECT – TI 141501

OPTIMIZING PRINTER UTILIZATION AT BAPPEKO SURABAYA BY CONSIDERING LEASE OR BUY DECISION

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ABSTRACT

Technology that keeps developing, require people to work side by side with office equipment to support its activities. Printer as one of the supporting equipment used in offices also keep developing. Many new type of printer being introduced by manufacturer. Technology that keeps changing should also go along with the good planning and good utilization of equipment. BAPPEKO as one of the busiest Surabaya City Government offices also require printer as the supporting tools to support their work activity. The procurement method during this time that only considers buying as the only method seems to be not appropriate anymore, as many developed industries nowadays choose to lease rather than buy. Good printer management should also be considered carefully in order to prevent underutilized or over utilized printer. Therefore, in this research, it proposes new printer management system which comes as user-friendly excel dashboard that propose three procurement scenarios, such as full buying, full leasing, and mixed decisions. In the dashboard made, there is also printer evaluation mechanism to measure the utilization level of existing printer in the office. The building logic of this research follows PDCA Cycle, in which this cycle will be a four iterative step that will control the printer management system and make continual improvement to the system. Thus, the output of this research will be displayed as excel dashboard that comparing Net Annual Worth of three scenarios proposed over 16-year planning horizon.

Keywords: Net Annual Worth, PDCA, Printer Management System, Utilization.

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ABSTRAK

Teknologi yang terus berkembang membuat orang bekerja secara berdampingan dengan peralatan kantor untuk mendukung pekerjaan mereka. Printer sebagai salah satu peralaan pendukung kantor juga terus berkembang. Banyak tipe printer baru yang diperkenalkan oleh pabrikan.Teknologi yang terus berkembang ini juga harus berjalan beriringan dengan perencanaan yang baik serta utilisasi peralatan yang baik. BAPPEKO sebagai salah satu kantor Pemerintah Kota Surabaya yang paling sibuk, juga membutuhkan printer sebagai alat bantu untuk mendukung pekerjaan mereka. Metode pengadaan barang yang selama ini berlangsung dengan hanya mempertimbangkan keputusan beli dirasa tidak tepat lagi, dimana banyak industry maju sekarang lebih memilih untuk menyewa daripada membeli. Manajemen printer yang baik juga harus dipertimbangkan dengan hati-hati untuk mencegah printer yang kurang dimanfaatkan atau digunakan berlebihan. Oleh karena itu, riset in akan mengusulkan sistem manajemen printer yang baru yang akan disampaikan dengan dasbor excel yang mudah digunakan, yang akan mengusulkan tiga skenario, yaitu, beli penuh, sewa penuh, dan keputusan campur. Pada dasbor yang dibuat, juga akan tersedia mekanisme evaluasi untuk mengukur tingkat utilisasi dari printer saat ini. Kerangka logika riset ini akan mengikuti siklus PDCA, dimana terdapat empat siklus berulang yang akan mengontrol sistem manajemen printer dan juga membuat perbaikan berkelanjutan terhadap sistem. Demikian, keluaran riset ini akan disampaikan melalui dasbor dengan membandingkan *Net Annual Worth* dari tiga skenario yang diusulkan selama 16 tahun horizon perencanaan.

Kata Kunci: *Net Annual Worth,* PDCA, Sistem Manajemen Printer, Utilisasi.

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CHAPTER I
INTRODUCTION

This research discusses about printer utilization evaluation in BAPPEKO Surabaya and printer management system. The printer management system will take BAPPEKO condition and draw general framework from BAPPEKO condition that applicable for all SKPD. Thus, in printer management system where the SKPD will procure printer, in this research will consider not only buying decision that has been done for all this time, but also leasing decision. The first chapter of research will explain about background, problem formulation, objectives, limitations and assumptions, as well as report writing methodology regarding this research.

1.1 Background

In this modern era, high technology equipment as a supporting tool is required to alleviate employees' workload and quicken the work. As the second largest city in Indonesia, Surabaya has 72 *Satuan Kerja Perangkat Daerah* (SKPDs). In *Rencana Pembangunan Jangka Menengah* (RPJM) 2010-2015, Surabaya's vision is to become a better Surabaya as Service City, smart trading, humane, dignified and environmental minded. Aligned with the vision, as a city that prioritizes high service level to its citizen, the necessity of high technology equipment in government offices to support its activities are expected to increase effectively and efficiently. Additionally, to increase the services of Surabaya City Government to the society, the existence of IT-based equipment is needed. IT based equipment in question is computer, laptop, and printer. Thus, from numerous IT based equipment exist, this research will focus on printer. The reason behind the selection is due to the total printer procured in SKPD is not followed by good utilization.

Noting that IT based equipment is urgently required by SKPD, good procurement system which is also followed by good printer utilization is needed by Surabaya City Government. Utilization which is defined in Merriam-Webster dictionary means that to make use of something. Procurement is the activities that

required in order to get the product from supplier to its final destination. Procurement activities includes purchasing function, stores, traffic and transportation, incoming inspection, and quality control and assurance, allowing companies to make supplier selection decisions based on total cost of ownership (TCO), rather than price (Weele, 2010). Weele (2010) also mention that procurement activities relate to the function of purchasing input used in the firm's value chain that may include raw materials, supplies, and other consumable items as well as assets such as machinery, laboratory equipment, office equipment, and buildings.

Above all numerous type of supporting office equipment, the demand of printer as one of office's supporting is also increasing. According to the International Data Corporation (IDC) Worldwide Quarterly Hardcopy Peripherals (HCP), business-inkjet printer and all-in-one shipments maintained their momentum in the third quarter of 2015 (3Q15) with 2.2 million units shipped and 16.3 percent year over year growth as presented in table 1.1 (Wirth, 2015).

Table 1. 1 Worldwide Hardcopy Peripherals Market Share and Year-Over-Year Growth for Q3 2015 (based on unit shipments)

Vendors	3Q14 Units Shipment	3Q15 Units Shipment
HP	10,840,722	9,983,710
Canon	5,659,586	5,293,411
EPSON	4,128,439	4,075,438
Brother	1,943,206	1,881,925
Samsung	1,315,456	1,039,723
Others	3,653,255	3,525,903
Total	27,540,664	25,800,110

(Source: IDC Worldwide Quarterly Hardcopy Peripherals Tracker, 2015)

Likewise, the needs of printer keep increasing, the cost of investment to have advanced-enough printer along with technology development is also increasing. Hence, each SKPD requests printer procurement to the Surabaya Procurement Division either for reasons such as outdated features, lagged technology, or un-optimal result. In its implementation, printer procurement request by each SKPD is done by specifying required printer specifications without

mentioning certain brand. The request will then be sent to Surabaya Procurement Division to be allocated based on the funds available. Historical data from Surabaya integrated asset recording system called as *Sistem Informasi Management Barang Daerah (SIMBADA)* shows that the procurement of IT based equipment is increasing. Figure 1.1 shows the data of 9 SKPD that has most significant printer increment data started from 1995 until 2015.

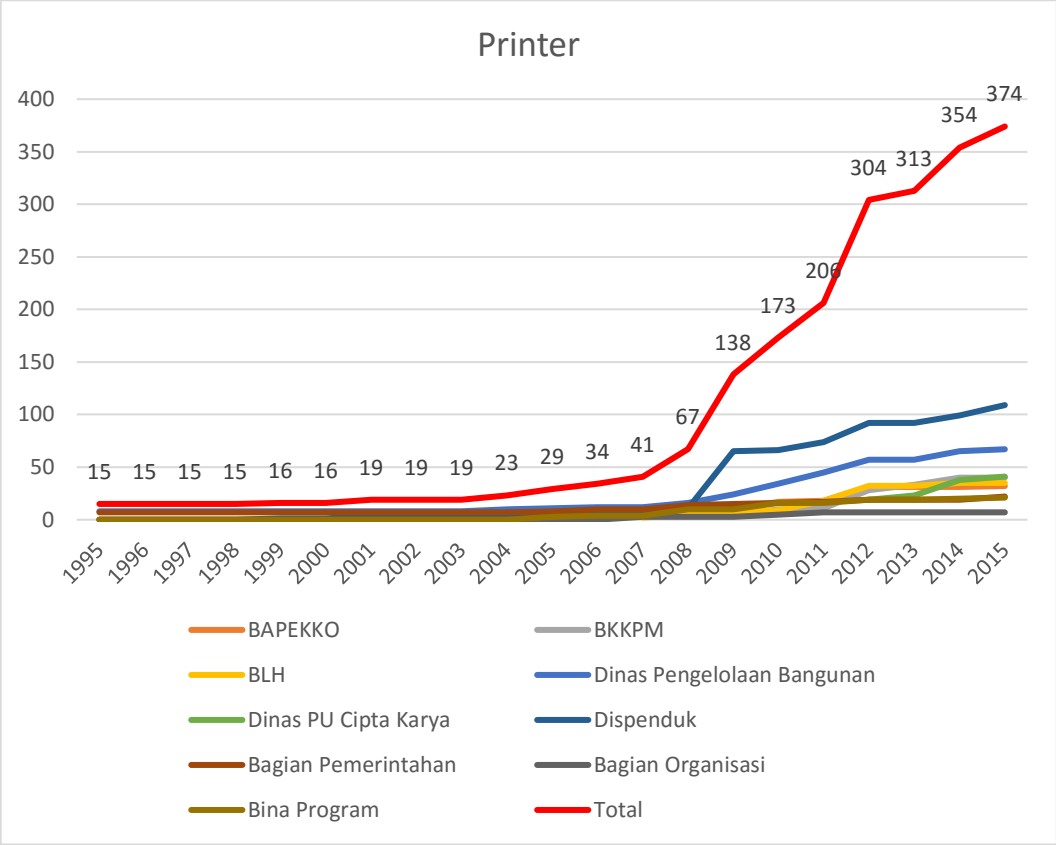

Figure 1. 1 Printer Procurement

Printer procurement request that keep increasing year by year raises a question, is it really need printer that much in the office. As it seems irrational if the procurement of printer which is only a supporting tool in an office keep increasing. Additionally, printer, as shows in table 1.2 and as we all know, is a fast-moving-development and an easily obsolete equipment, due to rapid new technology. This situation makes the increasing printer procurement more unreasonable, as it will be detrimental to Surabaya City Government.

Table 1. 2 Printer Evolution

Name	Introduction Time
Printing Press	1 January 1439
The Movable Type Press	1 January 1550
Steam Printing Press	1 January 1814
Rotary Printing Press	1 January 1847
Xerox	22 October 1938
First High Speed Printer	17 February 1953
Daisy Wheel Printer	1 January 1969
Dot Matrix Printer	1 January 1970
EARS	1 November 1971
IBM 3800	1 January 1976
The Xerox 9700	1 January 1977
HP LaserJet	1 March 1984
HP DeskJet	1 January 1988
HP DeskJet Color	1 January 1994
Xerox ColorQube - Solid Ink	6 May 2009

(Source: Timetoast, n.d.)

In relation to governance administration needs and governance finance institutions, Surabaya Procurement Division states the policy that all office equipment of Surabaya City Governance has economic life equal to five years. Service life of an equipment or asset can be smaller, equal, or longer than the economic life that has been stated in the policy. Generally, service life is defined as the expected lifetime of a product or a period usage of an equipment/tools, on the other hand, to avoid misinterpretation with economic life, it is a period where the assets fulfilled the required function (Asselbergs & Dijk, 2013). Service life span of a product itself might be longer or shorter than predicted as it is highly affected by the way of usage of the product.

Majority of printer in Surabaya Government Offices still considered as a new asset as from survey result shows that 78.14% of the printer is procured after 2009 (Bagian Perlengkapan Pemerintah Kota Surabaya, 2015). This means that actually if based on the regulation stated before, the procurement of some SKPD would not be done in the following year, yet in its implementation, there is still procurement request. This situation makes there is an urge to conduct utilization

analysis of printer as the evaluation method before SKPD proposing a procurement request. The utilization analysis will be then used as the basis to determine printer procurement activity. Aside from that, the focus of this research will be done in BAPPEKO because not only from the discussion with Procurement Division whom want to evaluate the existing condition of BAPPEKO, but also from interviews and surveys that have been done on several SKPD, BAPPEKO has the highest potential to become the research object as it provides data needed in conducting the research and has more cooperative stakeholder. Furthermore, from the analysis of BAPPEKO existing condition, it is expected to draw general model or framework that will be applicable for all SKPD.

In this research, it will first analyze the existing condition in BAPPEKO as the main focus and problem that currently happened in BAPPEKO. Verification of current asset is also done in the beginning of the research to make sure the condition of the printer and to match the data between SIMBADA and existing condition. However, as the asset inputted in SIMBADA cannot be traced in the real condition due to unclear codification, the asset will be matched with the KIR *(Kartu Inventaris Ruangan)* and it will be classified into the printer taxonomy made before. Questionnaire related to the printer usage will also be spread in order to measure the utilization level of current asset. Thus, after the RCA (Root Cause Analysis) of existing problem made, it will give solution alternatives regarding the problem in BAPPEKO.

Thereby, after evaluating the existing and analyzing the data, one question arises, why SKPD need such sophisticated feature and large number of procurement if the utilization itself is low and the function demanded is actually not necessarily so high. As an additional consideration, due to printer technology that keeps developing, a good printer management system, asset transfer option, and asset leasing concept seems need to be considered. Therefore, by using the historical data and trend along with the problems exist in BAPPEKO office which is generally also happened in all SKPD, it is thought to propose a new printer management system where it can be a general framework that is applicable for all SKPD in order to optimize the printer usage by considering lease and buy decision in the procuring system. As stated before, this new management system will not only consider

buying decision which has been applied for all this time, but also proposing leasing decision. Oxford Dictionaries define lease as a contract by which one party conveys land, property, services, etc. to another for a specified time, usually in return for a periodic payment. The leasing or buying decision will consider several factors, such as, investment cost of printer due to printer evolution that keeps developing which makes buying decision will be a risky decision, furthermore, due to printer's short life cycle, it will be a waste if the procurement of printer does not consider leasing decision.

Therefore, by conducting this study, it hopes that offices in Surabaya City Government will have a good printer utilization before proposing new procurement request. The generic framework made will be in the form of calculation dashboard that will show the annual payment should be made by SKPD base on 3 scenarios proposed. Finally, the output of the model will compare three alternatives which are full buying scenario, full leasing scenario, and mixed decisions scenario with respectively annual cost expensed.

1.2 Problem Formulation

The problem of this research is to generate general framework of printer management system in order to optimize printer utilization by considering lease and buy decision.

1.3 Objectives

The objectives aimed to be achieved through this research are:

1. To develop printer management system based on three scenarios which are full buying, full leasing, and mixed decisions.
2. To develop printer utilization mechanism in Surabaya City Government offices.
3. To identify the consideration needs to be done before buying printer
4. To identify the consideration needs to be done before leasing printer

5. To calculate most beneficial scenario based on annual expense of each scenario.

1.4 Benefits

The benefits can be achieved from this research for both author and government are:

1.4.1 For Author

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

1.4.2 For Government

1. To be used as consideration before printer procurement
2. To save unnecessary expense in procuring asset.
3. To measure printer utilization level in SKPD.

1.5 Scope of Study

In this subchapter it will explain about the scope of study used in writing this research. The scope of study will be divided into two parts, limitations and assumptions.

1.5.1 Limitations

In this subchapter it will explain about the limitations used in this research, limitations are set to narrow the scope and to make it focuses on key problem. The limitations are:

1. Survey and observation is limited on BAPPEKO.
2. Leasing or buying decision framework is drawn from BAPPEKO existing condition.

3. The evaluated printer procurement is limited from year 1995 until 2015.
4. Time horizon for scenario made is limited to 16 years.

1.5.2 Assumptions

The assumption used in this research is:

1. Leasing policy is assumed to be permitted.
2. Lower bound of good utilization is 75%.
3. High utilization has no effect on decrement of printer useful life.

1.6 Report Structure

The writing of this research is divided into several chapters. Each chapter in this research is written systematically and related to one another according to writer's sequence of events in analyzing and solving problems exist. The structure of the research will be explained as follows:

CHAPTER I: INTRODUCTION

This chapter will explain about the basis of this research writing, which will cover up background, problem formulation, objectives, benefits, scope of study, and the research report structure itself.

CHAPTER II: LITERATURE REVIEW

This chapter consists of theories got from literature review from several promising references to support this research. Literature used in this research will be mainly brief explanation about printer, taxonomy, service life, economic life, leasing or buying option, Net Annual Worth (NAW), Root Cause Analysis (RCA), and economic alternative selection.

CHAPTER III: METHODOLOGY

This chapter consists of research workflow or sequence start from beginning of literature review until the methodology used in order to solve the problem.

CHAPTER IV: ANALYSIS OF EXISTING CONDITION

This chapter will explain existing condition such as the validation of existing printer in observed SKPD along with the condition of the assets and continued with analysis of the assets according to its current condition. Collected data and analysis will be used as the evaluation of existing condition and will be used further in improvement suggestion.

CHAPTER V: SOLUTION ALTERNATIVE FOR BAPPEKO EXISTING UTILIZATION PROBLEM

This chapter will explain about the solution alternative that can be given to solve utilization problem in BAPPEKO existing condition. As has been known that printer procurement has been done before, so that the solution can be given only related on how to maximize the printer utilization that already exists.

CHAPTER VI: PROPOSED NEW PRINTER MANAGEMENT SYSTEM

In this chapter, it will explain about the new proposed printer management system. This chapter will be started on giving the solution of current asset management system. Then, continued by giving brief explanation to give basic overview of three scenarios that can be considered by SKPD in procuring printer. The scenarios that will be considered is full buying, full leasing, and mixed decisions scenario. The buying decision will consider several things such as operational cost, end of use and end of life treatment. Conversely, the leasing decision will consider several condition, such as, operator frequency in printing and several terms and condition offered by the third party. Last, it will explain about the generic framework of new printer management system that is drawn from BAPPEKO condition. The framework drawn will be made general in order to allow other SKPD to use it in optimizing its printer utilization.

CHAPTER VII: CONCLUSIONS AND SUGGESTION

This chapter will conclude the research done on printer management system in observed SKPD, BAPPEKO, and suggestion can be given to the research related to leasing and buying consideration in optimizing printer utilization.

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CHAPTER II
LITERATURE REVIEW

This chapter explore and explain theories and concepts used in this research which are gathered from several references such as published papers, books, journals, news, report, etc. The concepts and theories discussed and used as the base of this research are technical evolution of printer, economic life, service life, taxonomy, leasing or buying option, Net Annual Worth (NAW), Root Cause Analysis (RCA), and economic alternative selection.

2.1 Printer

Printer is an external output device that help human to represent graphic or text on paper or to generate data from computer into graphic/text form on paper. World's first known computer printer, as shown in Figure 2.1, was developed in the 19th century, which is still mechanically driven apparatus invented by Charles Babbage named difference engine (BBC News, 2000).

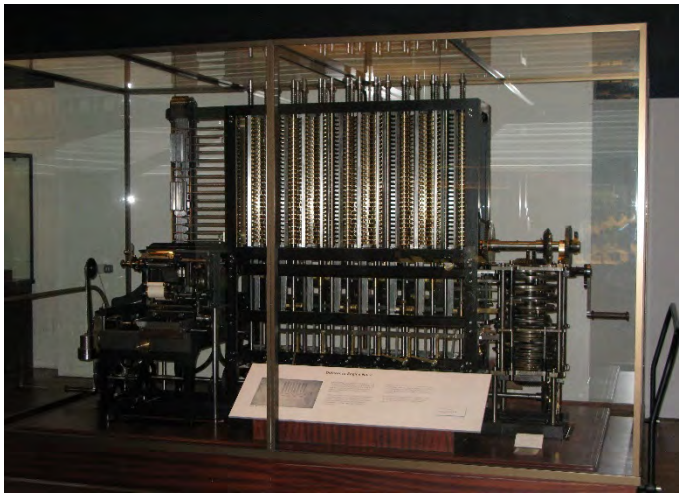

Figure 2. 1 Difference Engine
(Source: Wikimedia,n.d.)

2.1.1 Printer Types

As technology keep developing day by day, along with it, there exist several types of printer in the market produced by almost 110 printer

producer all around the world. The reason of printer development is due to its technology offered where it may have effects on the cost of the printer, cost of operation, printing speed, print-out quality, noise, durability, and etc.

Figure 2. 3 Dot Matrix Printer
(Source: Epson.com)

Figure 2. 2 Daisy Wheel Printer
(Source: trs-80.com, n.d.)

Figure 2. 4 Line Printer
(Source: enacademic.com, n.d.)

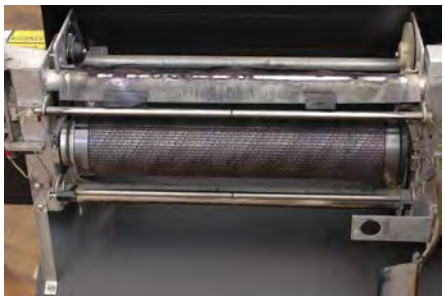

Figure 2. 5 Drum Printer
(Source: pcmag.com, n.d.)

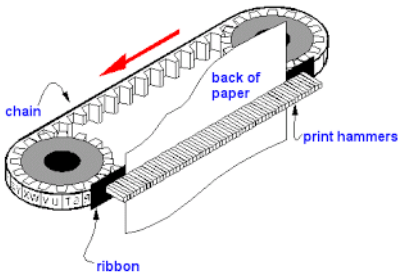

Figure 2. 7 Chain Printer
(Source: pcmag.com, n.d.)

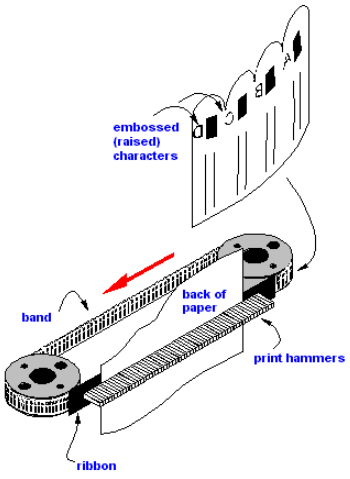

Figure 2. 6 Band Printer
(Source: pcmag.com, n.d.)

2.1.1.1 Impact Printers

Impact printer is a type of printer technology where it has to forcibly impact transfer ink to the media. Impact printer uses a print head that will either hit the printer ribbon to create characters or pressing the ink ribbon against the paper.

1. Dot Matrix Printers

   Dot matrix printer (figure 2.2) is one of the impact printer type that uses a print head consist of 9 to 24 pins to create characters on media. The pins on the print head will create patterns of dots on the paper/media to form an individual character. The difference between 24 and 9 pins is due to its quality of character where 24 pins will create better quality and clearer characters. On dot matrix printers, the pins will strike the ribbon individually as the printer mechanism will move across from left to right and vice versa. Dot matrix printer can produce black and color printing, as to create color printing, it has to change the ribbon manually to color-stripes ribbon. Dot matrix printer typically can print at speeds of 100-600 characters per second.

2. Daisy Wheel Printers

   Daisy wheel printer (figure 2.3) is usually used for user whom want to get typewriter quality. In order to print characters to the media, it used a printing mechanism that looks like daisy in which at the end of each “petal” is a fully formed character that produce solid line prints. The hammer on the printer strikes the “petal” that contain a character against the ribbon to be printed on media/paper. Daisy wheel printer itself has low speed which is typically 25-55 characters per second.

3. Line Printers

Line printer (figure 2.4) is used for a business that has a large amount of material to be printed. Line printer uses a special mechanism that can print the whole line at once. Line printer can typically print 1,200 to 1,600 lines per minute.

4. Drum Printers

Drum printer, as shown in figure 2.5, consists of a solid and cylindrical drum that has raised-band characters on its surface. The drum on the printer rotates at a rapid speed with 80-132 print positions which equals to the number available on the page. In each possible print position, the print hammer is located behind the paper. These hammers strike the paper along with the ink ribbon against the proper characters on the drum as it passes by. To be able to print each line, it needs one revolution of the drum, which means that all characters on the line are not printed on the same time. Drum printer typically has speeds range from 300 to 2,000 lines per minute.

5. Chain Printers

Chain printer (figure 2.6) which is also known as train printer, uses a chain of print characters wrapped around two pulley block in which it has one hammer for each print position. The mechanism of chain printer printing is the circuit inside the printer detect when the correct character appears at the specific print location and the hammer will then strike the page along with pressing the paper against

the ribbon with located character at specific point location. The chain will then keep rotating until all required print positions filled before moving to a new line. Speed of chain printer ranges from 400 to 2,500 characters per minute.

6. Band Printers

Generally, band printer (figure 2.7) operates similar to the chain printer except for this type of printer, it uses band instead of chain and it has fewer hammers. Band printer uses a steel band that divided into five sections with 48 characters each. The hammers are assembled on a cartridge that moves across the paper. Characters are rotated until meet the specify character before struck by the hammers. Band printers' font can also easily change by replacing the band.

Figure 2. 8 Ink Jet Printer (Source: letsgodigital.org, n.d.)

Figure 2. 9 LaserJet Printer (Source:amazon.com, n.d.)

2.1.1.2 Non-Impact Printers

Different form impact printers that use striking tools as hammer to create characters on media, non-impact printers do not require those striking tools. As a result, the printer work in much more quitter condition.

1. Ink Jet Printers

Ink jet printer (figure 2.8) works with the same logic as dot matrix printer, however the dots are made of tiny droplets of ink. If dot matrix printer creates character by hit through the hammer, then ink jet printer form character by spraying the ink from tiny nozzles through an electrical field that arranges charged ink particles into characters with speed approximately 250 characters per second. The ink sprayed to the paper will also dry instantly as it absorbed into the paper and various colors of ink is available. The nozzles in the print head emit a steady stream of ink drops, which are electrically charged after leaving the nozzles which are guided to the paper through deflecting plates. If a droplet is not needed for the character or image being formed or processed, it is recycled back to its input nozzle.

2. LaserJet Printers

LaserJet printer operates with the same logic as photocopy machine. LaserJet printer produces images on paper by directing a laser beam at a mirror which then bounces the beam onto a drum. The drum in LaserJet printer has a special coating where the toner or ink powder sticks onto it. Using small dot pattern, the laser beam conveys information got from computer to positively charged drum to become neutralized where from the neutralized drum areas, the toner detaches. As the drum rolls the paper, the toner is transferred to the paper in order to print text or graphic onto it. The hot roller bonds the toner to the paper.

Figure 2.9 shows LaserJet printers, which use buffers to store entire page at a time, as the whole page is loaded, it will be printed. LaserJet printer has a reliable high printing speed which approximately reach 21,000 lines per minute

or 437 pages per minute (with assumption each page contain 48 lines).

2.1.2 Printer Parts and Control Panel Functions

In order to support printer's function, printer is supported by its parts. Based on EPSON reference guide, the most general printer parts and function along with its control panel functions are as follows:

2.1.2.1 Printer Parts

Generally, printer is built of several components in order to support its function and operated. In the explanation of printer parts, it will be divided into front view parts and internal printer parts.

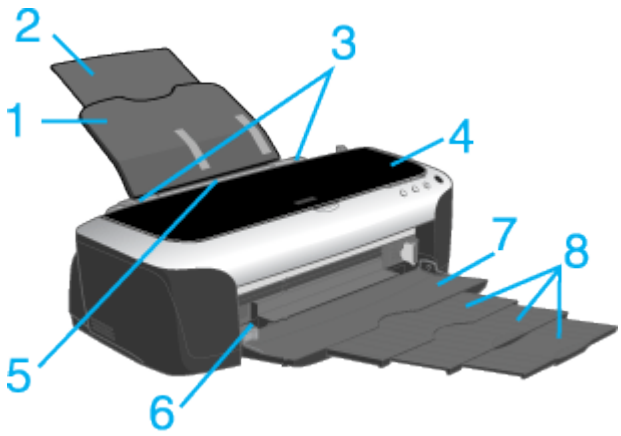

Figure 2. 10 Front View
(Source: Seiko Epson Corporation, 2001)

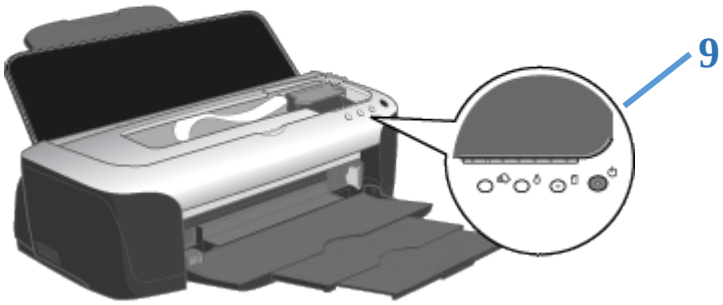

Figure 2. 11 Printer Control Panel
(Source: Seiko Epson Corporation, 2001)

Table 2. 1 Front View Parts Function

No	Parts Name	Function
1	Paper Support	Supports loaded paper
2	Paper Support Extension	Supports longer paper loaded in sheet feeder
3	Edge Guides	Help load paper straight. Can be adjusted on the left edge guide to fit paper width
4	Printer Cover	Covers printing mechanism. Open only when installing or replacing ink cartridges
5	Sheet Feeder	Hold blank paper and automatically feeds the paper during printing
6	Automatic Roll Paper Cutter Connector	Connect the automatic roll paper cutter
7	Output Tray	Receives ejected paper
8	Output Tray Extension	Supports ejected paper
9	Control Panel	Control various printer functions

(Source: Seiko Epson Corporation, 2001)

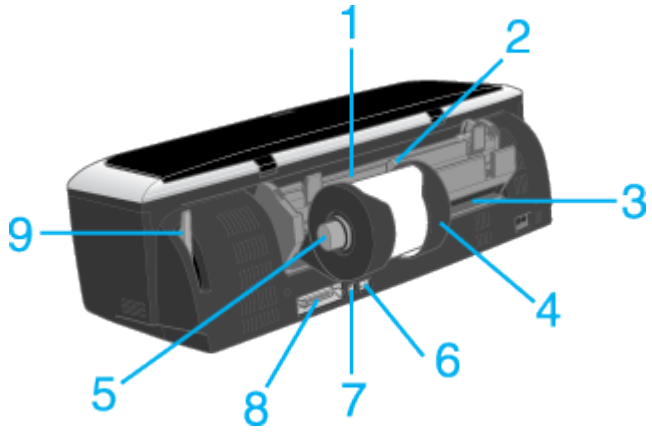

Figure 2. 12 Printer Internal Parts
(Source: Seiko Epson Corporation, 2001)

Table 2. 2 Printer Internal Parts

No	Parts Name	Function
1	Roll Paper Feeder	Holds the roll paper and automatically feeds it after holding the roll paper with hand for three seconds
2	Roll Paper Edge Guides	Helps load roll paper straight. Paper width can be adjusted by fitting it with edge guide
3	Manual Feed Slot	Feeds the thick paper
4	Roll Paper Holder	Attaches to printer and holds the roll paper
5	Roll Paper Knob	Use for rolling up the paper
6	IEEE 1394 Interface Cable Connector	Used to connect the IEEE cable to the computer and printer
7	USB Interface Cable Connector	Used to connect USB cable to computer and printer
8	Parallel Interface Cable Connector	Used to connect parallel cable to computer and printer
9	Adjust Lever	Used to adjust distance between print head and paper to prevent smearing

(Source: Seiko Epson Corporation, 2001)

2.1.2.2 Control Panel

Control panel on the printer is divided into buttons and light. The existence of control panel is for selecting the operation need to be executed by the printer, as for the light will show the alarm or warning or information regarding to process takes or error occurred. The function of printer's control panel will be explained in table 2.3.

Table 2. 3 Printer Control Panel Buttons Explanation

No	Button	Function
1	Power 	▪ Turn printer on/off ▪ Clear printer's memory if pressed twice while printer on ▪ To turn off power, hold the button until light goes out
2	Paper 	▪ Loads or ejects paper ▪ Resumes printing if pressed after paper out error occurred or double feed error
3	Ink 	▪ Moves the print head to ink cartridge replacement position ▪ Returns print head to its home position after ink cartridge replacement ▪ Performs print head cleaning if held down for three second when ink out light is off
4	Roll Paper (without cutter) 	▪ Prints a cutting guideline and feeds roll paper to a position where it can be easily removed from the sheet feeder if pressed after printing ▪ Feeds roll paper to the printing position if pressed after cutting the paper ▪ Feeds roll paper in reverse to a position where it can be easily removed from the roll paper feeder, if pressed for 3 seconds
5	Roll Paper (with cutter) 	With driver setting Paper-Saving Cut or Normal Cut ▪ Cuts roll paper at the position that is selected and ejects if it pressed after printing. Then feeds roll paper to the printing position automatically With driver setting Manual Cut ▪ Cuts roll paper with a margin and ejects it if pressed after printing. Then feeds roll paper to the printing position automatically

(Source: Seiko Epson Corporation, 2001)

Table 2. 4 Printer Light Panel Explanation

No	Button	Function
1	Power 	▪ On when printer is on ▪ Flashing when printer receiving data, printing, replacing an ink cartridge, charging ink, or cleaning the print head
2	Paper Out 	▪ On when printer is out of paper or when a double feed error detected. ▪ Flashing when paper jammed
3	Ink Out 	▪ Flashing when ink cartridge is nearly empty ▪ On when ink cartridge is empty ▪ Flashing when print head moves to the ink cartridge replacement position

(Source: Seiko Epson Corporation, 2001)

2.2 Economic Life and Service Life

Economic life can be simply addressed as a period of time where a fixed asset competitively produces goods or service of value, on the other hand, service life may be defined as a period over which an asset is expected to be usable, with normal repairs and maintenance, for the purpose it is acquired (Asselbergs & Dijk, 2013). Pujawan (2004) define economic life as juncture or point of time where yearly total cost (consist of the equivalent yearly cost of investment as well as operational and maintenance yearly cost) on minimum point, on the other hand, service life is defined as period where assets can be operated well. In a competitive industry nowadays, maintaining assets effectively will be the key success factors of competing with other industries. The life of an asset can be viewed in different perspective. The question is when to stop using existing asset. The economic life of an asset may lengthen or shorten depends on how one is prepared to spend enough money for it. Economic life of individual equipment depends fundamentally on the cash flows that can be associated with the asset like maintenance, repairs, utility consumption, and operating labor. Generally, assets economic life in a plant or business is influenced by a wide range of factors such as diseconomies of scale,

technology obsolesce, operating cost, product substitution, etc. (Asselbergs & Dijk, 2013).

Though, economic life term should be distinguished clearly with physical life. Physical life can be well defined by the illustration if a pump worn out beyond repair due to corrosion. In another case, a limit must be set on how long the company prepared to pay in order to keep the asset in service. Thus, the company should not incur losses when it keeps continuing operating the asset. Therefore, economic life can be defined as the money saved after the assets is abandoned.

Based on the illustration given above, it can be said that physical life is always greater than or equal to economic life. In order to calculate economic life, a financial analysis regarding the cash flows and market value of assets in future years should be made by using Discounted Cash Flow Analysis, whereas the cash flow can be simply defined as.

$$Cash\ Flow = earning\ after\ tax + depreciation - investment\ during\ the\ year$$

Commonly, discounted cash flow analyzed the cash flow generated by operating an asset over its service life and compared with the asset's initial investment outlay to see whether the money is brought in on an overall basis. In order to compare correctly time value of money, the so-called present values of future cash flows are computed by a process called discounting using formula below.

$$Present\ Value = Future\ Cash\ Flow * (1 + i)^{-n} \quad (2.1)$$

Where:

i: the discount rate

n: the year in which the cash flow is generated

2.3 Taxonomy

Roach (1978) mentions that taxonomy is a system by which categories are related to one another by means of class inclusion. Greater category inclusiveness within a taxonomy will have a higher level of abstraction, whereas each category

within a taxonomy is entirely included within one another category, but is not comprehensive of more inclusive category (Roach, 1978). Oxford Dictionaries define taxonomy as the branch of science concerned with classifications, especially of organism; a scheme of classification (Oxford Dictionaries, n.d.). Specific purpose object categorization is organized into taxonomies which are in turn organized into level of categorization. Roach (1978) also mentioned that one purpose of categorization is to reduce infinite differences among stimuli to behaviorally and cognitively usable proportions. Frey, et al. (2011) define categorization as a part of cognition and fundamental for the process of comprehension.

Categorization aims to group objects together into classes, based on similarities as it also plays a main role in perception, thinking, learning, and communication. In forming categories, there are two basic and general principles need to be met, first is the function and task of the categorization itself has to provide maximum information with the least cognitive effort; second has to do with information structure itself, whereas it should be provided as structural information rather than as arbitrary or unpredictable attributes (Roach, 1978). In categorization, new objects are associated with a category and it is then used to assume properties of the new object, without it every object or incidence would seems like inimitable.

In Categorization of Concerns, Frey, et al., (2011) mentioned a different theory of categorization, first is the classical view where it claims categories as a discrete entities characterized by a set of properties shared by all of their members; second is the prototype theory which claims that categories are represented by a bundle of characteristics that are typical for a certain category, but not sufficient or inevitable. Hence the prototype is a representation of amount of objects that share similar features; third the exemplary view which assumes that in contrary to prototype theory, single exemplar is engrained together with the category denotation, where each new exemplar represents its own category. Thus, Frey, et al., (2011) divide categories into three kinds, taxonomic categories which represent hierarchies of increasingly abstract categories; script categories which are used to group elements that has same role; and thematic categories that group objects which are associated or have a complementary relationship. Aside from that, it is also

possible in combining different categories and their object to create new categories (Murphy, 1988). Figure 2.13 shows that categories can also be structured hierarchically where subcategories have features of their superordinate for a certain probability.

Superordinate	*Basic Level*	*Subordinate*
Furniture	Chair	Kitchen chair
		Living-room chair
	Table	Kitchen table
		Dining-room table
	Lamp	Floor lamp
		Desk lamp
tree	Oak	White oak
		Red oak
	Maple	Silver maple
		Sugar maple
	Birch	River birch
		White birch

Figure 2. 13 Examples of Taxonomies used in Basic Object Research (Source: Roach, 1978)

Zilli, et al. (2009), mentions that there are actually four steps in process of building and using taxonomy, which are:

1. Developing a taxonomy
2. Defining models of rules for the taxonomy categories
3. Filling the taxonomy with documents
4. Navigating the taxonomy

Thus, Delphy Group, (2002) in Zilli, et al., (2009) mentions that it is possible to detail the four steps of building taxonomy in clearer way, such as:

- First, select the data to use as basis of taxonomy structure
- Transform the data into spider data to extract concepts of the domain representing by taxonomy
- Process concepts to develop cluster of related concepts or documents

- Develop taxonomy structures, a hierarchical organization of concepts
- Develop and submit training sets to the taxonomy structure, in order to define the rules that describe the taxonomy categories
- Classify body of data to fill the taxonomy structures and provide links and pointers to data
- Display hierarchical structure in an intuitive or graphical way
- Administration for modifying structure, renaming and linking to maintain the taxonomy and knowledge base

2.4 Leasing and Buying Option

Lease is a contract by which one party conveys land, property, services, etc. to another for a specified time, usually in return for a periodic payment (Oxford Dictionaries, n.d.). Ministry of Corporate Affairs (n.d.), specified that a lease is an agreement whereby the lessor conveys to the lessee in return for a payment or series of payments the right to use an asset for an agreed period of time. In printer leasing for example, there are several considerations have to be made clear before someone make a decision, such as:

1. Choosing the right style: plain (only printing) or all in one
2. Choose between ink jet or laser printer
3. Choose printer connected method: share without cables, print without a computer, print from anywhere
4. Ink costs
5. Decide how long the leasing should be made
6. Decide the type of printer whether black or color
7. Choose printer printing speed
8. Need finishing options (sorter, hole-punch, automatic stapler)?
9. Choose paper need to be load, whether need additional tray or not

When making a decision between leasing or buying, procurement division should consider comparative costs between each decision and other factors, in which at minimum should consist (Public Procurement Practice, 2012):

- Time period an equipment will be used and frequency of usage within the period
- Advantages of financial and operating of each alternatives
- Cumulative leasing payment for estimated period used
- Net purchase price
- Installation and transportation cost
- Maintenance cost
- Funds availability
- Equipment obsolescence potential as the effect of technology improvement

Furthermore, additional factors also need to be considered, as appropriate, stated by Public Procurement Practice in which depending on the type of the type, cost, complexity, and equipment usage period are as follows:

- Purchase options availability
- Potential utilization of equipment once its initial useful purpose has ended
- Salvage value at the end of lease term
- Imputed interest
- Fund or cost availability for equipment servicing

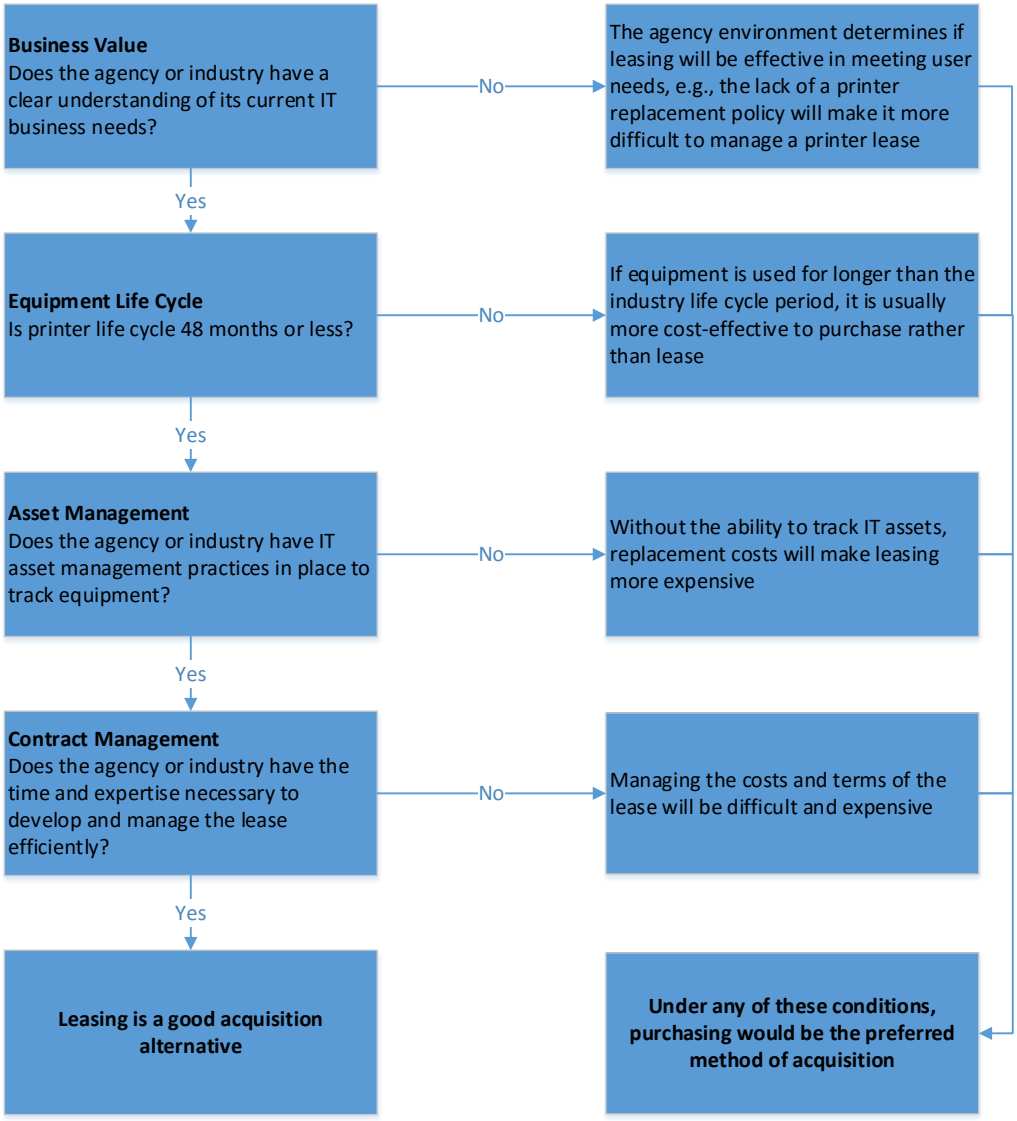

Figure 2. 14 Lease vs. Purchase Decision Tree
(Adapted from Department of Information Resources, 1998)

Figure 2.17 shows the decision tree between leasing and purchasing of equipment (in this case printer) that is adapted from Texas Department of Information Resources. In the decision tree proposed, it considers four things before the agency or industry decide to lease or purchase, such as business value, equipment life cycle, asset management, and contract management.

Table 2. 5 Contracting Comparison

Purchasing	Lease-Purchasing	Leasing
Equipment usage > 4 years	Equipment monetary value is substantial and equipment useful life > 4 years	Industry policy required periodical equipment replacement
No staff and systems to track assets and manage lease with supplier	Flexibility of spreading out payments will be beneficial for office	Rapid technology change affected industry business process
Uncertain funding		There is need for quick adoption of new technologies
		Flexibility of spreading out payments and using operating funds will be beneficial for office

(Source: Public Procurement Practice, 2012)

Table 2.8 shows the comparison between purchasing, lease-purchasing, and leasing contracting options. The listed consideration above should be taken into account and well considered before one determines the decision. Thus, in terms of cost need to be quantified, the consideration need to be quantified will be shown in table 2.9.

Table 2. 6 Cost and Benefits to Quantify

Purchasing	Lease-Purchasing	Leasing
Equipment Price	Equipment Price	Equipment Price
Equipment Salvage Value	Equipment Salvage Value	N/A
Maintenance Costs	Maintenance Costs	N/A
N/A	N/A	Contracted Maintenance Costs
Staff Costs	Staff Costs	Staff Costs
Procurement Costs	Procurement Costs	Procurement Costs
Disposal Costs	Disposal Costs	Disposal Costs

(Source: Public Procurement Practice, 2012)

In table 2.9 shows the cost and benefits need to be quantified before determining the decision between purchasing, lease-purchasing, or leasing of equipment. Staff costs include the time spent on equipment installation, maintenance, de-installation, and disposal cost. As for procurement costs including time spent on equipment procurement, purchase order processing cost, and equipment tracking cost.

2.5 Economic Alternative Selection

In facing economic alternative selection, both qualitative and quantitative criteria should be considered. To put it in an easy way, Pujawan (2004) defines 7 systematic steps in economic alternative selection:

1. Define several alternatives to be analyzed
2. Define planning horizon that will be used in comparing alternatives
3. Estimating cash flow of each alternative
4. Determine MARR value used
5. Comparing investment alternatives
6. Conducting supplementary analysis
7. Selecting best alternative

2.5.1 Defining Investment Alternatives

The first phase of investment decision making is defining investment alternatives decent to be considered in analysis. There will be three alternatives related to alternative decision making, such as, independent alternatives, mutually exclusive alternatives, and dependent alternatives.

1. Alternatives are categorized as independent if election or rejection of an alternative will not affect whether other alternatives are accepted/rejected.
2. Alternatives are categorized as mutually exclusive if election of an alternative lead to rejection of other alternatives or vice versa.

3. Alternatives are categorized as dependent (contingent or conditional) if the election of an alternative depends on one or more other alternatives that become precondition.

2.5.2 Determining Planning Horizon

In comparing investment alternatives, we need to determine period of study which called as planning horizon. Generally, it can be said that cash flow before and after planning horizon is not take into account, except the cash flow affect the cash flow along planning horizon. One should clearly differentiate between planning horizon with service life and depreciable life. Service life is an actual period of time where an asset still can be used economically, as depreciable life is time where an asset can be depreciated. Planning horizon might not be affected by two types of life above, as planning horizon is just a time frame used to comparing the alternatives and should realistically indicate the period of time that can provide cash flow estimation that fairly accurate (Pujawan, 2004).

In determining planning horizon, one may be faced with 1 out of 3 conditions, compared alternatives have same service life, different service life, or maybe perpetual life. There are several ways of determining planning horizon if the alternatives compared have different service life:

1. Using least common multiple of all alternatives life considered.
2. Using uniformity sequence of each alternative cash flows.
3. Using shorter alternative life by assuming salvage value of longer alternative life at the end of planning horizon as the salvage value.
4. Using longer alternative life.
5. Determining a generally used period lifetime which range between 5 to 10 years.

2.5.3 Estimating Cash Flow

In estimating cash flow of every alternative, then all cost and income over planning horizon along with its salvage value should be completely illustrated. In most economic evaluation, forecasting of cost and income is not necessarily done in detail. Expenses that always incurred with the same amount can be omitted. It is important to be noted that estimation of cash flow will not be accurate if it just considering historical data illustrated in accounting reports alone. Nevertheless, comprehensive, extensive, and thorough consideration is needed to estimate cash flow.

2.5.4 Determining MARR (Minimum Attractive Rate of Return)

Minimum Attractive Rate of Return (MARR) is a minimum rate of return or interest that is acceptable by investor. In another word, if an investment turns to have rate of return below MARR value, then the investment is considered not economically feasible to be done. There are several ways suggested by Pujawan (2004) in determining MARR value:

1. Adding a fixed percentage to company cost of capital
2. Average ROR for the past 5 years are used as this year MARR
3. Using different MARR value for different planning horizon of initial investment
4. Using different MARR value for different development of initial investment
5. Using different MARR value in new investment and investment in the form of cost reduction project
6. Using management tools to push or hamper investment, depends on company overall economic condition
7. Using shareowners average capital ROR in same industrial sector

MARR value is influenced by many factors, such as availability of capital, availability of investment opportunities, business condition, inflation rate, company cost of capital, tax rules, government regulations, courage to bear risk, risk level/uncertainty. MARR value can be expressed

both before and after tax, as the relationship between those two can be expressed as follow.

$$MARR\ (before\ tax) = \frac{MARR\ (after\ tax)}{1 - t} \quad (2.3)$$

Where t is combined income tax rate (both central and local government)

The cost of funding certain project is often stated as cost of capital, in which it can be expressed annual rate or percentage. The simplest way of calculating cost of capital is by determining cost of capital of each financing, followed by summing each of the cost of capital with a certain weight. Therefore, cost of capital can be formulated as follow.

$$i_c = r_d * i_d + (1 - r_d) i_e \quad (2.4)$$

Where:

r_d = ratio between debt and overall capital

$1 - r_d$ = ratio between owner's equity and overall capital

i_d = required rate of return on capital from loan

i_e = required rate of return on own capital

2.5.5 Comparing Investment Alternatives

Pujawan (2004) mentions that there are several techniques that can be used in comparing investment alternatives, such as:

1. Present Worth Analysis
2. Annual Worth Analysis
3. Future Worth Analysis
4. Rate of Return Analysis
5. Benefit Cost Ratio Analysis
6. Payback Period Analysis

The method stated above (1-5) gives result that can be compared to measure the effectiveness of an investment alternative. First, second, and third method covert all cash flow over planning horizon into a single value (P or F) or annual with predetermined MARR value.

2.5.6 Conducting Supplementary Analysis

In supplementary analysis, there are three types of analysis need to be done, Break Even Point (BEP) analysis, sensitivity analysis, and risk analysis. Break Even Point (BEP) analysis is done if the one or more parameter value is not certainly known, but the decision can be taken by knowing whether the parameter value is larger or smaller than a certain BEP value. Sensitivity analysis is needed in order to know how sensitive a decision made to changing variables that affecting the decision. Parameters that usually affected by economic condition are planning horizon, MARR, and cash flow. Therefore, sensitivity analysis is done to know how much the effect will be if one of the parameter changes. Last, risk analysis is done explicitly to get the range of possible value of certain parameter in the form of probability distribution. Thus, to get the range, it can be done through analytical models or simulation by treating parameters as random variable.

2.5.7 Selecting Best Alternative

In selecting best alternative, it is not necessarily to be done just form economic perspective. In selecting the best alternative, one often considered compound criteria, including risk and uncertainty that might happen in the future. Thus, there is several techniques can be used to make decision on compound criteria, which one of it is goal programming.

2.6 Net Annual Worth

Net Annual Worth (NAW) is a method where all cash flows occur over the planning horizon are converted to their respective equal end of period amounts with interest rate of MARR (Pujawan, 2004). It is usually considered easier to calculate annual cash flow if it is done from Present Worth, so that it will apply the relation:

$$A(i) = p(i)(A/P\,, i\%, N) \tag{2.5}$$

or

$$A(i) = \left[\sum_{t=0}^{N} A_t(P/F, i\%, t)\right](A/P, i\%, N) \quad (2.6)$$

If the alternatives compared are mutually exclusive, then the chosen alternative is the one with the highest annual net cash flow. In another word, if the cash flow only consists of costs, then the chosen alternative is the one with lowest annual cost.

If the alternatives compared are independent, then all alternatives that produce annual net cash flow larger than zero will be accepted, as it means that the alternatives produce rate of return larger than MARR (Minimum Rate of Return). Alternatives for do nothing will have A value equal to 0.

2.7 Root Cause Analysis (RCA)

Root Cause Analysis (RCA) is a way to identify root cause so that the action taken can prevent the problem to occur again in the future. Mahto, et al. (2013) mention that RCA is a process of identifying causal factors by using a structured approach with techniques designed to provide a focus for identifying and resolving problems which is known as Root Cause Analysis Tools. RCA also identifies the root and contributing factors, the determination of risk reduction strategies, and the development of action plans along with measurement strategies to evaluate the effectiveness of the plan.

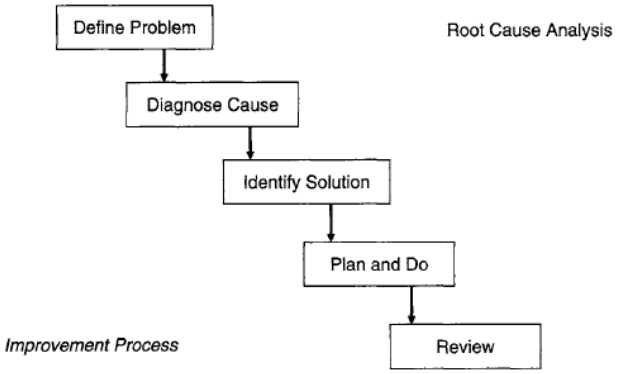

Figure 2. 15 RCA Logic Graph
(Source: Moore, 2006)

Figure 2.15 provides the RCA logic graph, in which RCA acts in defining the problem exist, followed by diagnosing the cause, identifying the solution regarding problems happened, plan and do the solution, and last, review the solution given. Wilson et al. (1993) mentions that root cause is a basic reason for unwanted condition or problem. As long as the root cause of the problem is not identified, then the symptoms and problems will always appear. According to Duggett (2004), several tools in identifying root cause has been developed, some of which are, 5 whys, Multi Vari Analysis, Cause and Effect Diagram, Interrelationship Diagram, and Current Reality Tree (CRT). Dalgobind (2008) mentions several analysis methods can be used in analyzing RCA result, such as, event and causal factor analysis, change analysis, barrier analysis, and human performance evaluation. DOE Guideline Root Cause Analysis Guidance Document February (1992) mentions that soon after identifying the problem, it is important to start data collection phase of root cause found by using several tools to ensure data is not loss.

There are several basic terminologies that is frequently used to address several problems happened in industry, such as (Mahto & Kumar, 2008):

- Facility : facility may be defined as any equipment, structure, system, activity, or process that fulfills a specific purpose. Some of the examples include production or processing plants, coal conversion plants, disposal system, etc.
- Condition : may be defined as state, whether it is resulting from an event or not, that may have adverse safety, health, quality assurance, security, environmental implications, or operational.
- Root Cause : the cause, in which if corrected would prevent recurrence of this and similar occurrences. The root cause does not apply only to this occurrence, but has generic implications to a broad group of possible occurrences, and it is the most fundamental aspect of the cause that can logically be identified and corrected.
- Causal Factor: a condition or an event that results in an effect. In the context of DOE, there are seven major causal factor categories, which are, equipment/material problem, personnel

error, procedure problem, management problem, design problem, training deficiency, and external phenomenon.

Identifying root cause should be the one thing that is embedded in the culture of a company. Unfortunately, many company more focused on the symptoms rather than focusing on the root cause of the problem and resolved it. As has been mentioned before, there are several tools in identifying root cause that has been developed which are, 5 Whys, Cause and Effect Diagram, Apollo RCA, Interrelationship Diagram, and Current Reality Tree (CRT) (Duggett, 2004).

- 5 Whys

  5 Whys method is a method that is easy to understand and straight to the root of the problem. This method is applied in Toyota Production System. The main factor of 5 whys method is never accepted the causes which first obtained for an event. We should always question the causes of the incident until at least 5 times "why?" before setting on the root cause. In the end, if there is double root cause over an incident, then the next approach used is a more complicated approach.

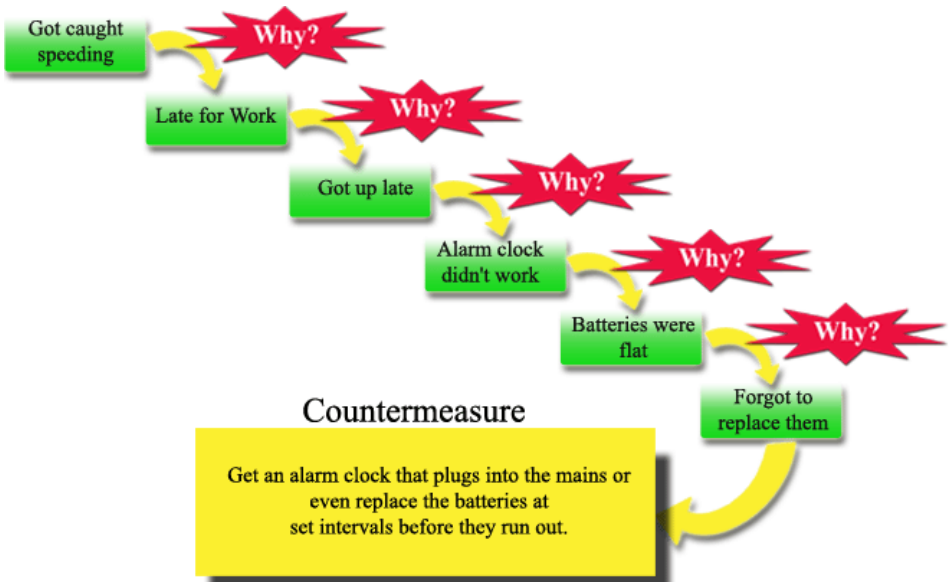

Figure 2. 16 5Whys Example
(Source: Educational Business Articles, n.d.)

- Cause and Effect Diagram

  Cause and effect diagram is a diagram based on the fishbone diagram created by Ishikawa. This approach is very suitable to be applied to the problems that are chronic problems and have some solutions. This approach has a cause and effect that includes objectives and problems. Then, the causes and best solution will be identified. Furthermore, from some of the solution given, the best solution is selected to overcome the problem.

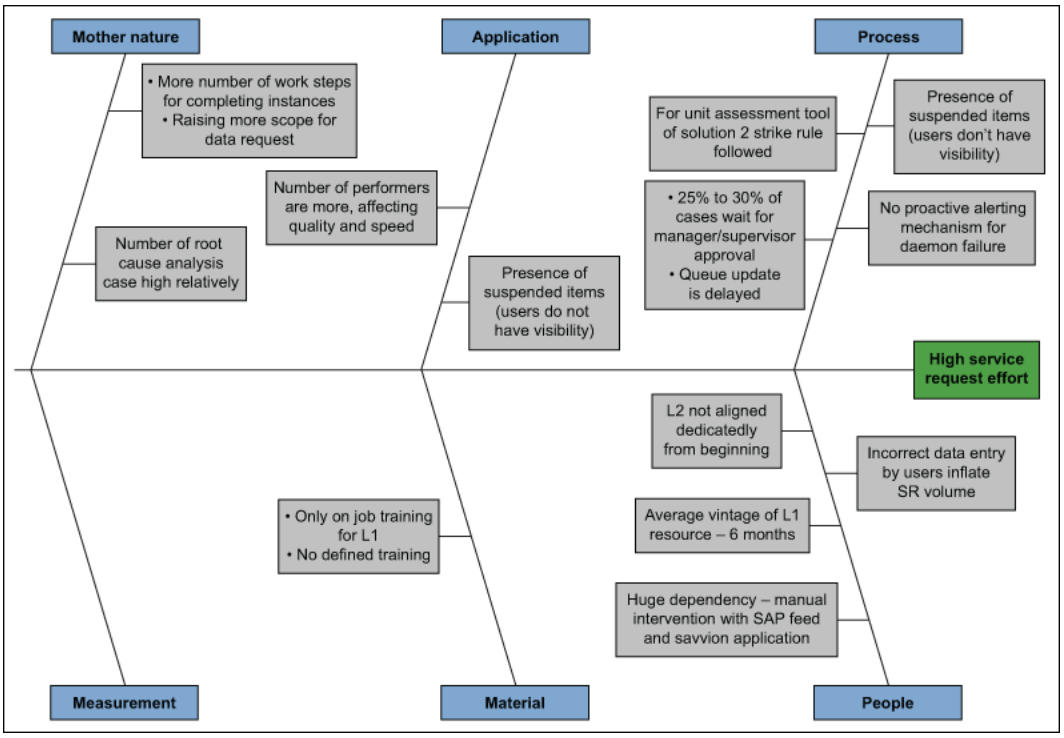

Figure 2. 17 Cause and Effect Diagram
(Source: Priyadarshi, n,d)

- Apollo RCA

  The other commonly used tool is Apollo RCA. This approach is similar to cause and effect diagram that identifies the causes and effects of an event. This approach can be used for all kinds of events, especially single event. The program is believed to improve the effectiveness of problem solving and effective approach to identify creative problem solving and complex

problem. There are 4 steps in identifying problems in this approach such as, what, where, when, and significance. Significance is problem influence to several factors. Factors that influence are safety, environment, income, customer service, cost, frequency, and etc. Finally, the cause and effect chart is made to identify problem and determine best solution.

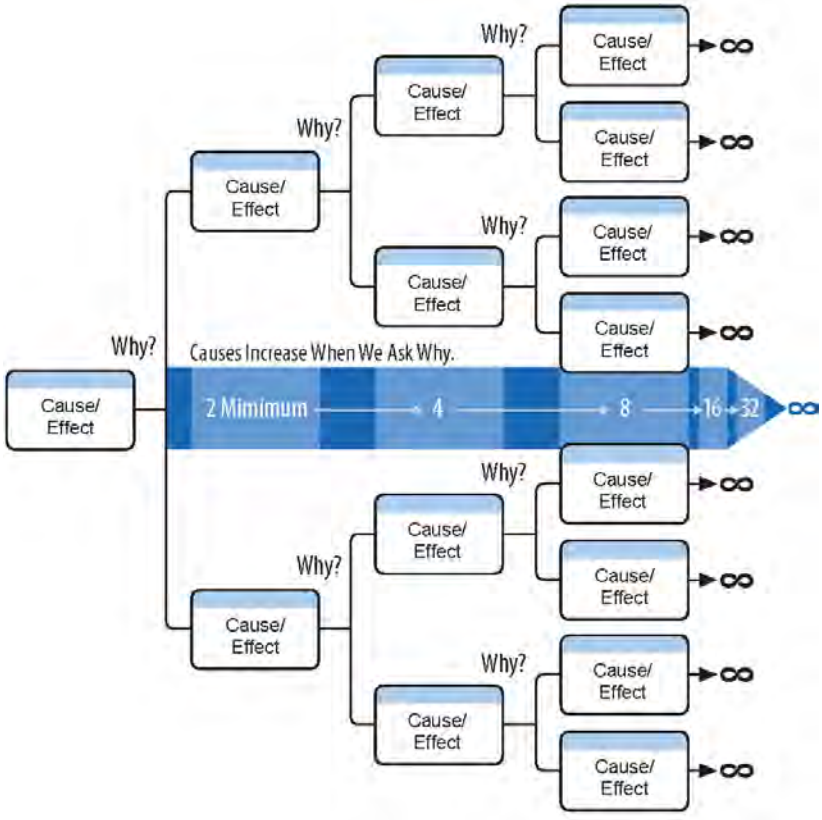

Figure 2. 18 Apollo RCA
(Source: Effective Problem Solving, 2014)

- Interrelationship Diagram

  Interrelationship Diagram shows relationship between cause and effect. Most importantly, the process of making interrelationship diagram helps the group to analyze the natural relationship between different aspects of a complex situation. There are some appropriate conditions for the implementation of this diagram, such as:

a. When trying to understand the interrelationship between ideas produced or causal relationship. For example, in the case to identify areas that have the greatest impact in improving productivity.
b. When doing an analysis of a complex issue
c. When implementing a complex issue
d. After completing an affinity diagram, a causal diagram, or a tree diagram that is useful to explore the relationship of the ideas that have been generated.

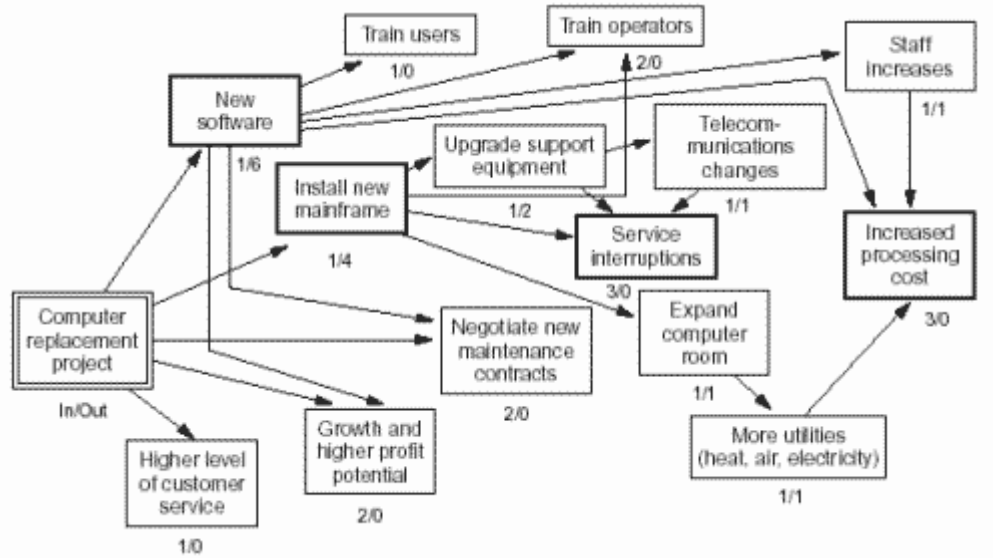

Figure 2. 19 Interrelationship Diagram
(Source: ASQ, n.d.)

After the diagram is completed to be formulated, analysis of the diagram needs to be done to determine the relationship in it. To identify the key point of ideas formulated, it can be done by counting the number of arrows going in or out for each idea. Idea that has the most arrow going in or out, then the idea is the key idea of the diagram made. Furthermore, to identify the main cause of the diagram created can be done by calculating the number of arrows going out of an idea. Idea with most arrows going out is the main cause. Finally, idea with the most arrows going in is the most cause resulted from the diagram made.

- Current Reality Tree (CRT)

  Current Reality Tree is one of the tools for process logic thinking. This tool illustrates a series of causal relationships. Starting from unwanted impact turn into one or several root causes. Root cause can also be said as a major problem or major driver. Current reality is something that is not right in particular that leads to negative results and that prevent company for reaching the goal of solving the problem and improve the condition of company. From some problem solving tools, CRT has its own functions and intended use. Thus, CRT cannot be used for all kinds of problem. CRT is devoted to solve complex, multi-factor, and the problems that include wide-system.

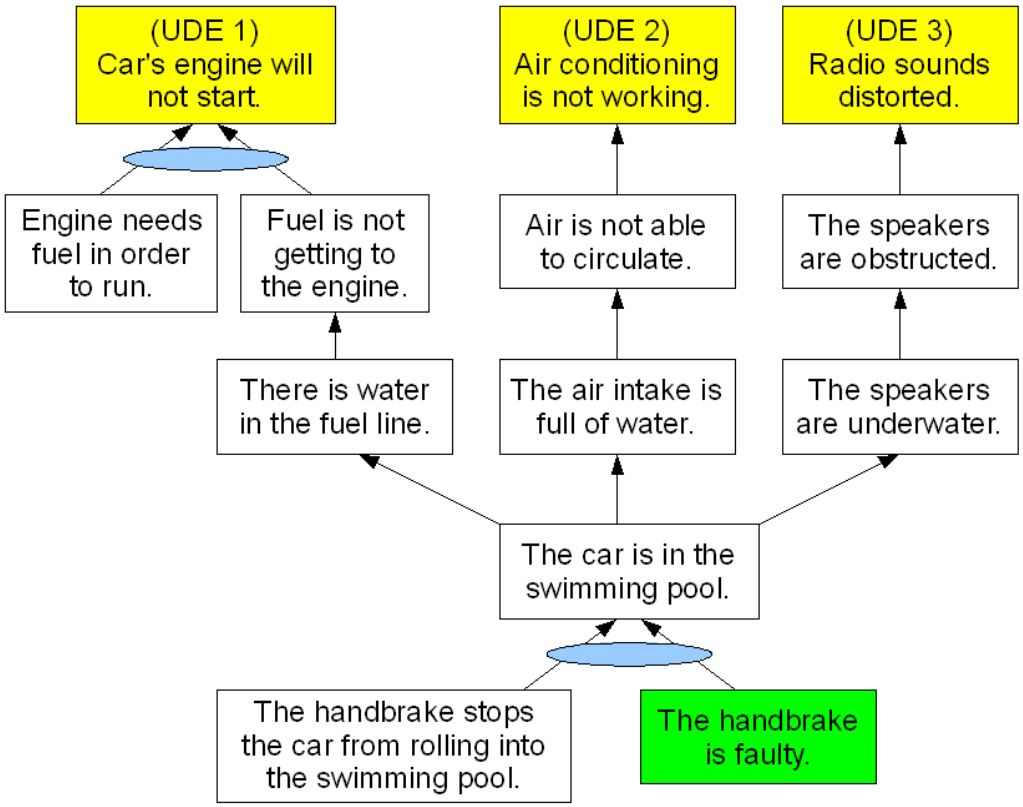

Figure 2. 20 Current Reality Tree Example
(Source: Wikimedia, n.d.)

2.8 Review of Previous Research

This subchapter will give review of previous research done that related to current research done by writer. Review of previous research is done also to know current research position compared to similar researches done before. Current research done by writer is related to optimization of printer utilization by considering lease or buy decision in Surabaya City Government. Thus, below table will present relevant previous research.

Table 2. 7 Review of Previous Research

Title	Author	Year	Methods
Cost Assessment and Benefits of using RFID in Reverse Logistics of Waste Electrical & Electronic Equipment (WEEE)	Marcus Vinicius F. de Araujo, Uanderson R. de Oliveira, Fernando A. S. Marins, Jorge Muiz Jr.	2015	NPV; RFID
A Heuristic Approach to Logistics Network Design for End-of-Lease Computer Products Recovery	Lee Der-Horng, Dong Meng	2008	Tabu Search Algorithm
Capacity Utilization: Concept, Measurement, and Recent Estimates	Lawrence R. Klein, Virginia Long	1973	Capacity Utilization
Utilization Efficiency of Electrical Equipment within Life Cycle Assessment: Indexes, analysis and a case	Zhuangli Hu, Yongjun Zhang, Canbing Li, Jing Li, Yijia Cao, Diansheng Luo, Huazhen Cao	2015	Life Cycle Assessment; Power Distribution Network; Utilization Evaluation
Stochastic Models and Numerical Solutions for Manufacturing/Remanufacturing Systems with Applications to the Printer Cartridge Industry	Kouedeu Annie Francie, Kenne Jean-Pierre, Dejax Pierre, Songmene Victor, Polotski Vladimir	2015	Sensitivity Analysis

Table 2. 7 Review of Previous Research (cont.)

Title	Author	Year	Methods
Purchasing vs Leasing: A Benefit-Cost Analysis of Residential Solar PV Panel use in California	Xiaohui Liu, Eric G. O'Rear, Wallace E. Tyner, Joseph F. Pekny	2014	Modified Accelerated Cost Recovery System (MACRS), Benefit-Cost Analysis, Sensitivity Analysis
Overall Equipment Effectiveness (OEE) Calculation-Automation through Hardware & Software Development	Ranteshwar Singh, Dhaval B Shah, Ashish M Gohil, Milesh H. Shah	2013	OEE; Availability; Performance Efficiency; Quality Rate; Total Productive Maintenance

CHAPTER III
METHODOLOGY

In this chapter, it will explain about the methodology in conducting the research. The methodology will inform about the sequence of this research. This chapter will also provide the explanation about the flowchart.

3.1 Flowchart

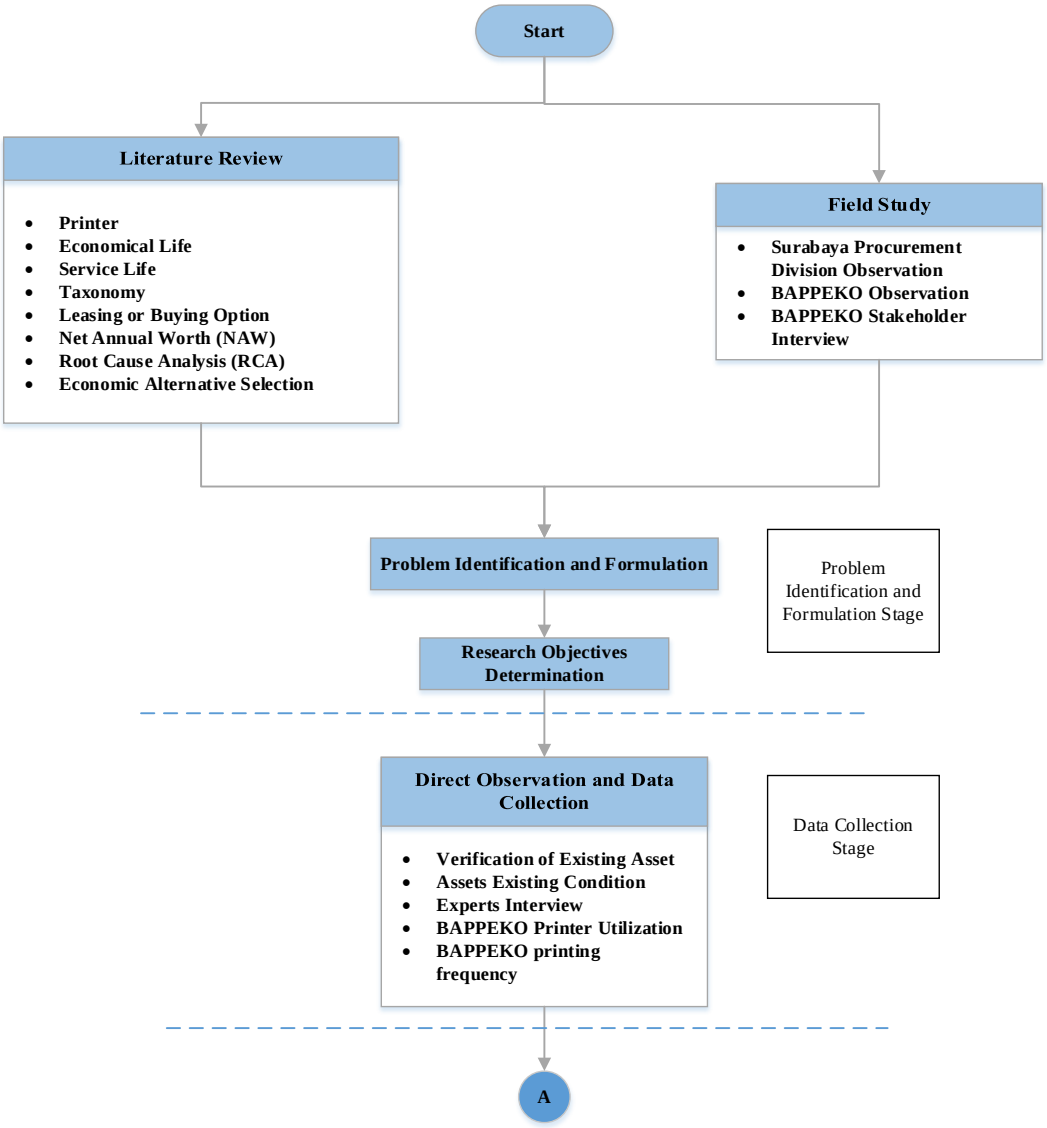

Figure 3. 1 Research Methodology Flowchart

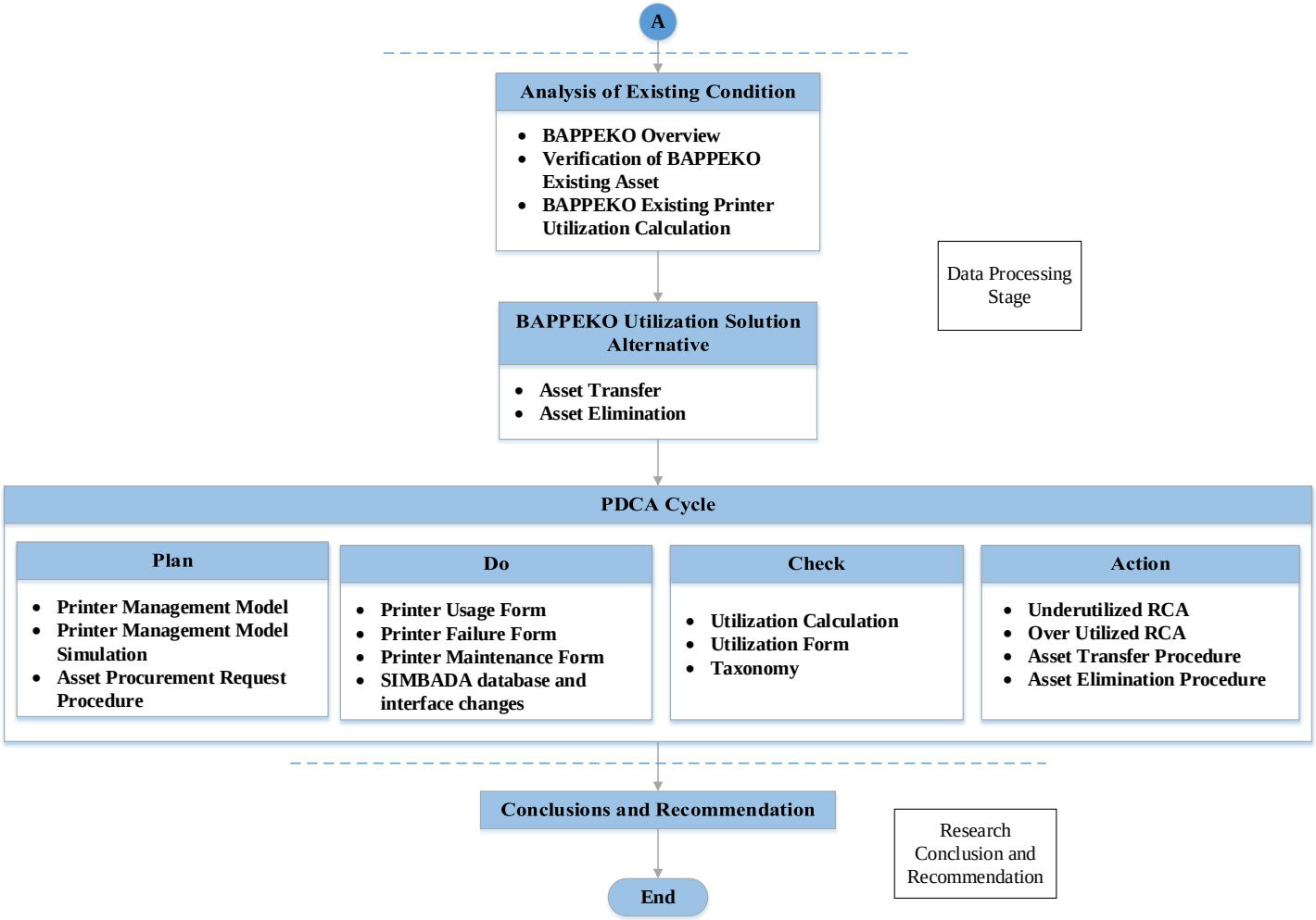

Figure 3. 1 Research Methodology Flowchart (cont.)

3.2 Flowchart Description

There are four stages in proposed research methodology, which are problem identification and formulation stage, data collection stage, data processing stage, and research conclusion and recommendation.

3.2.1 Problem Identification and Formulation Stage

In problem identification and formulation stage, it divided into two parts which is literature review and field study. Problem identification and formulation stage aim to get the basic concept/idea of existing condition in observed SKPD.

3.2.1.1 Literature Review

In literature review phase, it will collect theories and/or concepts from several references got from published papers, books, journals, news, report, etc. This phase will give a basic overview of what the research is about in order to support the knowledge and understanding regarding research topic. The literature collected from the references will mostly related to economic life and service life, taxonomy, and leasing or buying option, Net Annual Worth, Root Cause Analysis, and economic alternative selection.

3.2.1.2 Field Study

In this phase, writer conducts field study to BAPPEKO as the observed SKPD and Surabaya Procurement Division. The activity is done in order to gain preliminary condition of observed object. In this phase, writer will also do some interviews to the related stakeholders.

3.2.2 Data Collection Stage

Secondary data got from Surabaya Procurement Division about total assets from BAPPEKO seems to be insufficient and uncompleted. Direct observation is needed in order to validate the existing condition in order to get a clearer vision of the assets, especially printer which becomes the main focus in this research. Direct observation will be done by

conducting interviews with the experts, direct survey and will cover up the validation of the existing data and the existing condition of the assets itself in BAPPEKO.

Data collection phase is done to gather and know the existing condition. Data gathered in this research will be about experts' interview regarding to the asset observed, historical data and validation data of asset in BAPPEKO. Historical data of the asset acquired by accessing SIMBADA system that shows the data from 1995 until 2015. As the information from the secondary data is unreliable, direct observation is carried out in order to validate and compare data from secondary data with the existing condition in the field based on the questionnaire made.

Table 3. 1 BAPPEKO Printer Validation Form

Room	Object Name	Brand	Type	Total	Year	Function	Connection	Printer Type	Status

Table 3.1 shows the validation form used in data collection in BAPPEKO. The form which consists of room, object name, brand, type, total, year, function, connection, printer type, and status will be filled by interviewing each user/worker in BAPPEKO office. This form is needed not only to check the existence of asset but also checking the condition and specification of printer procured. Printer validation form made has also integrated with the taxonomy of printer made before, so that it can ease the asset tracking, maintenance, and management.

Table 3. 2 Printer Utilization Form

No	Section	Printer Type and Brand	Total Daily Printing

Another form used in data collection is printer utilization form. This form consists of section, printer type and brand, and total daily printing. In the process of data collection, writer interviewed one by one the user/worker in BAPPEKO office to obtain the data about the printing frequency in a day starting from Monday until Friday. Aside from it, writer also conduct a deep interview related on specific printer being used in their printing activity in order to get representative calculation of printer utilization.

3.2.3 Data Processing Stage

In this phase, data got from interview done before will be processed further. The problem exist in BAPPEKO will be discussed and find the root cause behind the problem exist. After the root cause has been defined using fish bone diagram, it will suggest alternative regarding the problem exist. Base on the fact in the field, it is then suggested a new printer management system. The management system will follow the PDCA cycle.

3.2.3.1 Check

The first cycle will be started from check, as printer procurement has been established before. In the check cycle, it will present the utilization calculation of from the data that has been collected before. Printing frequency used in this calculation is decided to be 3-month printing frequency, as it is the most representative time in calculating the printer utilization. The utilization calculation is done by dividing total 3 months-printing (pages) by printing speed of each printer, which is then the result is divided again by total work minutes in a day. The utilization of each printer should at least reach 75% before it can procure another printer. This utilization calculation will also act as the evaluation method that should be done by SKPD before requesting new printer. If existing printer utilization has not reach 75%, then the procurement cannot be done by related SKPD as the existing printer still be adequate to fulfill current needs.

In this cycle will also present the most common printer failure that happened based on the questionnaire distributed before. Last, the taxonomy that has

been made will also be included here as in the existing condition, there is no clear codification which make the asset condition cannot be traced accurately.

3.2.3.2 Action

Action cycle which is indirectly become follow-up action of problem exist in the check cycle, consists of RCA of underutilized and over utilized, also asset transfer and elimination procedure. This cycle will give the solution regarding the problem exists in the check cycle. Once the proposed printer management system has run, any problem that has been detected on the check cycle will be solved in the action cycle.

3.2.3.3 Plan

Third cycle is plan cycle in which in this cycle will explain about the proposed printer management model along with the simulation of the model using dummy data. In the proposed printer management model, it will evaluate the decision of printer procurement under three scenarios made, full buying scenario, full leasing scenario, and mixed decisions scenario. The evaluation of full leasing scenario will first need the data about term and conditions of printer leasing, contract about leasing, printer specification or requirement need by SKPD. On the other hand, for full buying scenario it will need the data about printer critical part that usually need to be maintained, cost of maintenance and/or replacement, and also operational cost such as ink or toner replacement cost. Finally, for mixed decisions scenario, data needed will be mainly same as full buying and full leasing scenario but the difference is that in this scenario it will need both scenario data.

3.2.3.4 Do

Finally, in the do cycle, it will present printer usage form, printer failure form, printer maintenance form, and also SIMBADA database and interface changes. The forms presented in this cycle will be filled by related SKPD, so that it can be used as evaluation method in the check cycle. The printer usage form is used for knowing the utilization level of printer exist in the SKPD, it will detect whether existing total printer is already adequate to support its business process or not.

While if the printer failure and maintenance is high, then it means that current condition need to be evaluated. It will be checked later whether the failure/error happened is due to human/operator error or printer procured is a low quality printer. Finally, the analyzed data will be used as evaluation method for the next procurement or evaluation of how the user operated the equipment.

3.2.4 Research Conclusions and Recommendation

In this phase, it will first analyze the scenario implementation of three scenarios proposed. The scenario will include full leasing decision, full buying decision, and mixed decisions in accordance to the needs of technology and/or frequency of printer usage. The scenario will be analyzed and evaluated based on most beneficial decision using Net Annual Worth and Economic Alternative Selection. However, this scenario is not only limited to beneficial decision only, but also optimization of printer utilization. Therefore, the important points in the research will be pointed out and concluded to answer the objectives of the research. Matters that have not been answered in this research will be suggested for further research to enrich and enhance the usefulness of this research.

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CHAPTER IV
ANALYSIS OF EXISTING CONDITION

This chapter will explain about the existing condition of observed object and the problematics that occurred in the existing condition. The data and analysis are used as the evaluation of existing condition and later will be compared with the improvement suggestion.

4.1 BAPPEKO Overview

BAPPEKO which stand for *Badan Perencanaan Pembangunan Kota Surabaya* is one of Surabaya City Government offices that help Surabaya in composing and executing regional policy regarding development planning. BAPPEKO has vision to have participatory planning, innovative and qualified to become a better Surabaya, where the mission is improving the quality of implementation and control system for regional development planning.

As coordinator of development planning, BAPPEKO arranges stages of activities that involving various stakeholders, in order to use and allocate resources exist to help improving social welfare. BAPPEKO itself has function such as:

1. Planning technical policy formulation
2. Coordinating the development planning
3. Coaching and execution of tasks in the field of development planning
4. Administrative management
5. Execution of other tasks given by Head of Region in accordance with the duties and functions

In executing the duties and functions given, BAPPEKO carries out part of government affairs in the field of public works, housing, spatial planning, development planning, regional autonomy, general government, region financial administration, regional instrument, staffing and coding.

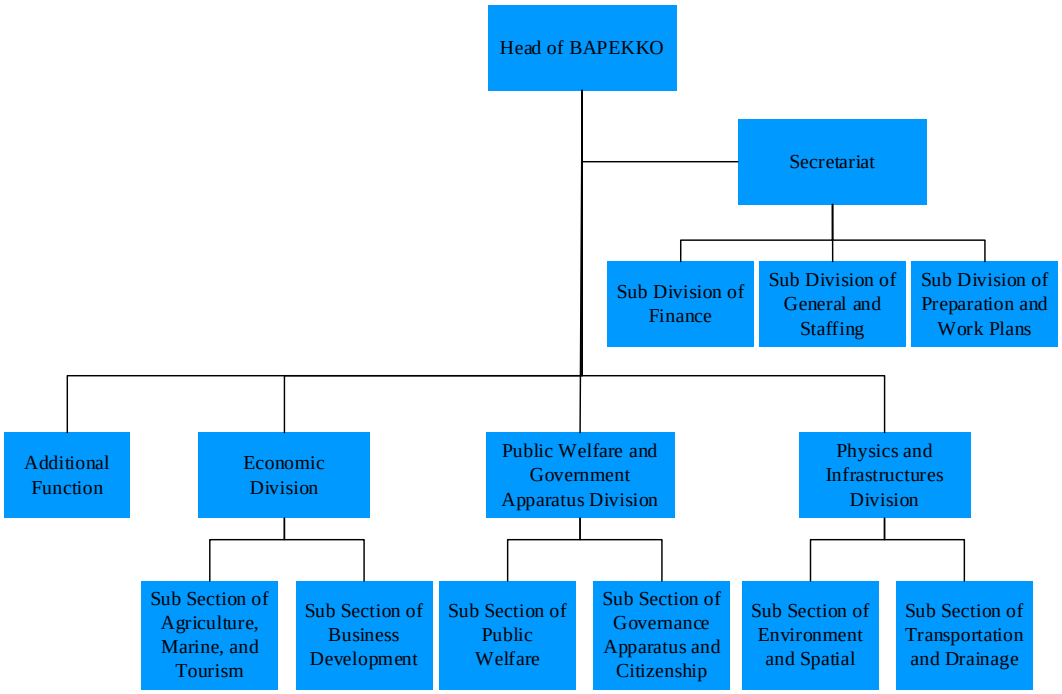

Figure 4. 1 BAPPEKO Organization Chart

In doing such complex tasks, BAPPEKO, as shown in figure 4.1, divides the staff into 4 different sections, which are, economic division, secretariat division, public welfare and government apparatus division, and physics and infrastructures division. Additionally, each division is supplied with office supporting equipment including printer. Historical data shows that BAPPEKO procurement on asset keep increasing year by year especially in 2008 which increased drastically. Each printer in BAPPEKO office is arranged to be used by 2 people. Printer procured in BAPPEKO office is ranged from EPSON, HP, Fuji Xerox, and Canon brand. The procurement is done by proposing procurement request to Surabaya Procurement Division which only include the specification of printer need without specifying the brand. Printer procurement request that has entered Surabaya Procurement Division will be proceed and given to BAPPEKO.

4.2 BAPPEKO Existing Condition

In the existing condition of BAPPEKO office, the total number of printer is not followed by the utilization of the printer. From the interview and observation done on the related stakeholder in the BAPPEKO office, it is known that the printer

is only used frequently, where the utilization reaches its highest point only in the end of period (monthly, quarterly, or yearly). Thus, in the daily operation, the utility of printer is very low, as it is only being used for several document printing, and if it is summed up, it only has total average usage of 2 hours per day.

4.2.1 Verification of Existing Printer Asset

In the existing condition, the asset procured, in this case printer, has been inputted to SIMBADA software, where it stored all asset being procured through Surabaya Procurement Division. When in fact, in its implementation, the procurement is not only done through Surabaya Procurement Division, but some of it also procured using its own funding. This condition lead to invalid asset verification where the asset in the existing condition might be more or less than the total asset inputted to the software. Therefore, an asset verification form that has been elaborated with taxonomy is made in order to make sure and check the existence of printer in BAPPEKO office.

Table 4. 1 Example of BAPPEKO Printer Verification Form

Room	Object Name	Brand	Type	Total	Year	Function	Connection	Printer Type	Status
Staf Kesra	Printer	HP Laser Jet	P1006	1	2007	Single Function	Cable	Laser Jet	Exist
Staf Sekretariat	Printer	HP Laser Jet	1300	1	2007	Single Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	HP Laser Jet	1010	1	2008	Single Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	HP Laser Jet	P1006	3	2008	Single Function	Cable	Laser Jet	Exist
Staf Fisik & Prasa	Printer	HP Laser Jet	P1006	1	2008	Single Function	Cable	Laser Jet	Exist
Staf Fisik & Prasa	Printer	HP Laser Jet	1020	1	2008	Single Function	Cable	Laser Jet	Not operated
Staf Fisik & Prasa	Printer	HP Laser Jet	1010	1	2008	Single Function	Cable	Laser Jet	Returned
Staf Kesra	Printer	XEROX	3119	2	2009	Multi-Function	Cable	Laser Jet	Exist

Table 4.1 shows 11 printers out of 49 printers verification done on all printer asset in BAPPEKO office, where the total of printer asset verification will be presented in attachment. The form made is slightly different from SIMBADA system, where it does not pay attention to the registration number of the asset itself, but more on the room it is placed. In the verification form made, it also considers the status of the printer, where it states the condition of the printer, whether it exist

or not, operated or not, and also if it has been returned/eliminated. By comparing the total printer from SIMBADA and existing condition, it is known that there is deviation as much as 12 printers. The deviation exists due to not update SIMBADA software once the asset returned to or eliminated by Surabaya Procurement Division. In addition, the asset that is not physically exist is still included in SIMBADA software, which makes the data more unreliable.

4.2.2 Unclear Codification

In existing asset controlling system, the procured asset is inputted into SIMBADA software in which the data inputted consist of location, register number, equipment code, equipment name, brand, type, total asset, unit, value, procured year, acquired year, and information. Thus, as a matter of fact, current system cannot fully track the asset including the condition. The codification of equipment is also not specific, where one type of product can have different codification. This situation makes the asset's condition harder to be tracked and checked. Thus, a unique code of each asset is needed in order to make the data collection of asset regarding its condition easier. In addition, the codification has to be specific so that it can ease the maintenance procedure if there is any failure happened.

4.2.3 Low Utilization of Printer

Based on the observation facts exposed before, it is known that the total printer procured is not followed by its utility. In the existing condition, if the printer is broken or the print result is not good, user/employee tends to print document by using other printer through Internet Protocol (IP) of another user/employee. The employee prefers entrusting document printing to service the printer as it saves more time. Thus, in the daily operational, the printer is not necessarily procured that much. In the attachment, it shows the mapping of printer in BAPPEKO office.

Table 4. 2 Existing Printer Utilization

No	Section	Printer Type and Brand	Printing Speed (ppm)**	Total Daily Printing*	Total Monthly Printing*	3-Month Printing*	Daily Utilization***	Monthly Utilization***	3-month Utilization***
1	Economics	HP P1006	17	66	1219	3648	0.81%	14.94%	45%
2	Economics	HP P1006	17	106	1834	5472	1.30%	22.48%	67%
3	Economics	HP 1010	12	80	1380	4200	1.39%	23.96%	73%
4	Economics	EPSON L800	37	40	830	2560	0.23%	4.67%	14%
5	Economics	HP LaserJet P1566	22	63	933	2478	0.60%	8.84%	23%
6	Secretariat	HP LaserJet P1102	18	75	1265	3747	0.87%	14.64%	43%
7	Secretariat	EPSON L100	27	40	873	2653	0.31%	6.74%	20%
8	Secretariat	HP LaserJet P1102	18	30	674	1966	0.35%	7.80%	23%
9	Secretariat	EPSON L100	27	70	1160	3402	0.54%	8.95%	26%
10	Secretariat	Xerox Phaser 3435	33	20	624	1910	0.13%	3.94%	12%
11	Secretariat	Xerox Phaser 3160N	24	60	1128	3378	0.52%	9.79%	29%
12	Secretariat	Xerox Phaser 3435	33	147	2853	8384	0.93%	18.01%	53%
13	Secretariat	HP LaserJet P1102	18	7	246	775	0.08%	2.85%	9%
14	Physics and Infrastructures Division	Xerox WorkCenter 3119	19	20	445	1309	0.22%	4.88%	14%
15	Physics and Infrastructures Division	EPSON L100	27	45	817	2525	0.35%	6.30%	19%
16	Physics and Infrastructures Division	EPSON L220	27	100	1925	5960	0.77%	14.85%	46%
17	Physics and Infrastructures Division	HP LaserJet P1006	17	16	265	943	0.20%	3.25%	12%
18	Physics and Infrastructures Division	Brother MFC J3520	33	99	2241	6519	0.63%	14.15%	41%
19	Physics and Infrastructures Division	EPSON L210	27	10	234	799	0.08%	1.81%	6%

Table 4. 3 Existing Printer Utilization (cont.)

No	Section	Printer Type and Brand	Printing Speed (ppm)**	Total Daily Printing*	Total Monthly Printing*	3-Month Printing*	Daily Utilization***	Monthly Utilization***	3-month Utilization***
20	Physics and Infrastructures Division	EPSON Office Stylus T1100	30	64	1761	4947	0.44%	12.23%	34%
21	Physics and Infrastructures Division	Brother DCP J125	33	10	345	998	0.06%	2.18%	6%
22	Physics and Infrastructures Division	EPSON L800	37	36	815	2439	0.20%	4.59%	14%
23	Public Welfare and Government Apparatus Division	Xerox WorkCenter 3119	19	28	770	2436	0.30%	8.44%	27%
24	Public Welfare and Government Apparatus Division	EPSON L800	37	30	781	2462	0.17%	4.40%	14%
25	Public Welfare and Government Apparatus Division	EPSON L800	37	58	1141	3474	0.32%	6.42%	20%
26	Public Welfare and Government Apparatus Division	Xerox Phaser 3155	24	2	139	421	0.02%	1.21%	4%
27	Public Welfare and Government Apparatus Division	HP LaserJet P1006	17	57	1396	4023	0.70%	17.11%	49%
28	Public Welfare and Government Apparatus Division	Xerox Phaser 3160N	24	35	872	2627	0.30%	7.57%	23%
29	Public Welfare and Government Apparatus Division	Xerox Phaser 3155	24	10	418	1244	0.09%	3.63%	11%
30	Public Welfare and Government Apparatus Division	Xerox Phaser 3155	24	20	519	1574	0.17%	4.51%	14%
31	Public Welfare and Government Apparatus Division	HP P1100	8	30	851	2499	0.78%	22.16%	65%

*Primary Data
**Secondary Data
***Calculation Data

Table 4.2 shows the data of existing printer utilization based on the calculation of printing speed and assumption of daily working time is 480 minutes or equal to 8 hours. The table provides the utilization of each printer brand exist in BAPPEKO office, both daily, monthly, and 3-month utilization. The number of daily printing is got from the questionnaire and validated again by interviewing each worker in BAPPEKO office that is using printer in their work. The total number of printing has already considered the document that other user entrusted into it by using IP/LAN network/Wi-Fi technology. As for the monthly and 3-month printing data is got from Monte Carlo simulation (shown in attachment) by using one week printing data and also has considered routine printing needs assigned to each printer.

In the attachment shows the fact that employees do not really require that much of printer, where in BAPPEKO, printer is used for printing general document under normal usage. Table 4.2 will show printer usage, printing frequency, and printer specification required in each sector.

Table 4. 4 Printer Usage and Specification per User

No	User	Frequency (daily)	Usage	Specification Required
1.	Secretariat Division	Average 57 pages per day, per person, per division	General document printing	Color and Monochrome, single function printer
2.	Economic Division	Average 71 pages per day, per person, per division	General document printing	Color and Monochrome, single function printer
3.	Public Welfare and Government Apparatus Division	Average 30 pages per day, per person, per division	General document printing	Color and Monochrome, single function printer
4.	Physics and Infrastructures Division	Average 45 pages per day, per person, per division	General document printing and Layout (image) printing	Color and Monochrome, single function printer

Furthermore, table 4.3 shows the average printing frequency in a day that is specified further into printing per person and per division. The table also shows the usage of the printer itself for what it is being used per division, along with the specification of printer required, in which the data is got from interviewing user and distributing questionnaire for all staff in BAPPEKO office. From the interview with inventory person in charge, Mr. Irfan, it is also known that the needs of color and monochrome printer is proportioned into 40% for color printer and 60% for monochrome printer. The utilization of printer that is so low compared to the total number of printer makes it become source of waste. Therefore, in order to know the cause of the waste, it is using fishbone diagram to present the cause of waste which is presented in figure 4.2.

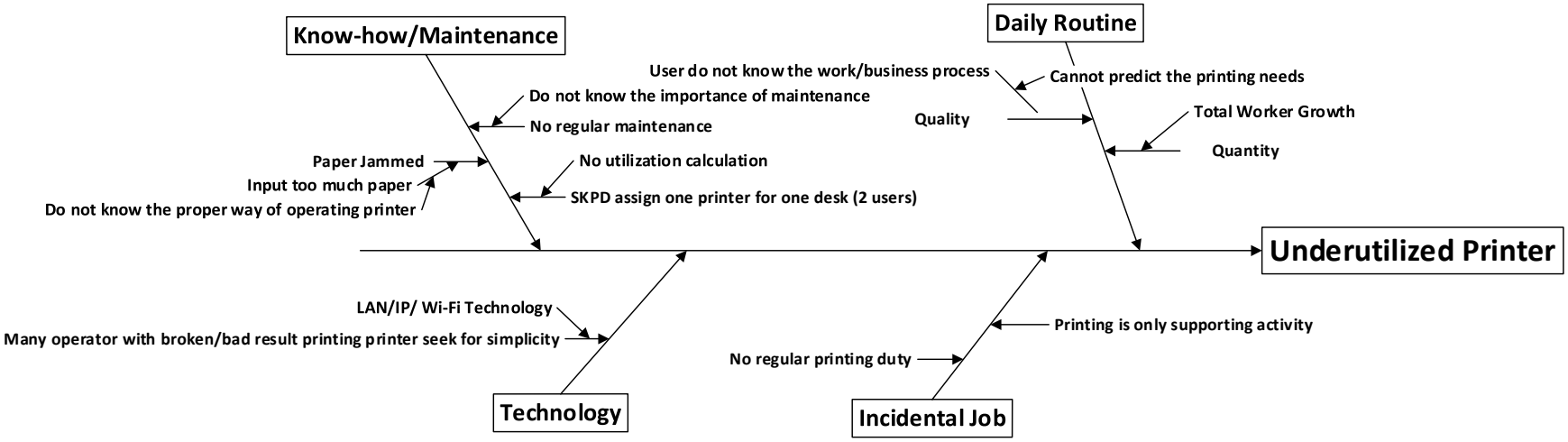

Figure 4. 2 Fishbone of Waste Exist

The waste exist in the current condition is underutilized printer, where the printer in BAPPEKO office is not used in its full potential. After the fishbone been developed, it can be concluded that three main reasons/main causes of the waste are unknown importance of needs analysis determination, printing is only a supporting activity rather than main activity, and the idealism that thinking existing condition is the ideal condition. The recommended action regarding the waste exist is conducting thorough utilization calculation in which will lead to ideal number of printer need to be procured so that the printer utilization will not be so low and the suggestion given will not prevent the user from doing its daily printing activities.

4.2.4 No Printer Workload Data

In existing condition of BAPPEKO office, the workload of printer tends to be fluctuated. From 31 printers available in BAPPEKO office, the workload of each printer is different. In example there is printer in Public Welfare and Government Apparatus Division that has daily printing frequency of 2 pages only. As in Secretariat Division, there is printer that has daily printing frequency reaches 147 pages. Most of the printer workload is not distributed evenly, in example in secretariat section, monthly report or annual 5-year report is charged into 1 printer. The main reason is because the quality of the printer is the best of all.

The absence of printer workload data is also due to printer is not a primary need, but supporting tools. This means that the usage of each printer is not fix and cannot be determined, as it will be fluctuating. Another reason of no printer workload data is that the printer is not dedicated for one user, but it is dedicated for one desk consist of two users. Furthermore, if other user's printer is broken down, then printing job is charged to another printer.

4.2.5 No Maintenance Data

In the existing condition of BAPPEKO, none of the staff or printer user realized the importance of regular maintenance. The regular maintenance can be done by the user itself by using the software provided by printer manufacturer, with purpose to lengthen the life span of the printer and to ensure the quality of printer itself. Besides it does not occur any cost, it also requires some time that is not longer

than 30 minutes. Another type of maintenance that is also not being done in the existing condition is preventive maintenance, albeit, this alternative needs quite expensive cost. The preventive maintenance can be done by contacting third party that provides printer maintenance service.

BAPPEKO existing condition does not have clear record regarding to printer maintenance. Once printer is broken or error, the maintenance will be done by Mr. Irfan as the person in charge for inventory, and if the error occurred cannot be solved, it will be then brought to partner service center. In the current condition, the maintenance record of asset is combined into one record without specific type of maintenance and equipment being maintained. Unspecific record of maintenance data might be because it is troublesome to specify the maintenance done, as the fund allocated is also accumulated for all equipment maintenance. Thus, in the existing condition, if the maintenance cost of a printer nearly same as the price of the printer, the decision is to buy a new one as it turns out be the same.

CHAPTER V
SOLUTION ALTERNATIVE FOR BAPPEKO EXISTING UTILIZATION PROBLEM

This chapter will explain about the procedure of asset elimination, where from the chapter before there are many printers underutilized. The underutilized printers that still can be used under normal usage, actually can be transferred to other SKPD that needs printer, rather than retain the printer in the SKPD. Underutilized printers can be transferred to 72 SKPD in Surabaya based on printer request in the SIMBADA system. Thus, in this chapter, it will include the printer transfer, printer utilization assessment, and printer elimination.

5.1 Printer Transfer

As mentioned before, the underutilized printer and several unused printers exist in the SKPD is better to be transferred to SKPD that need printer procurement. Existing asset transfer system involving two parties, which are related SKPD and Procurement Division. Figure 5.1 will present the asset transfer flowchart which is based on Ministerial Regulation no 19 year 2016 chapter XII.

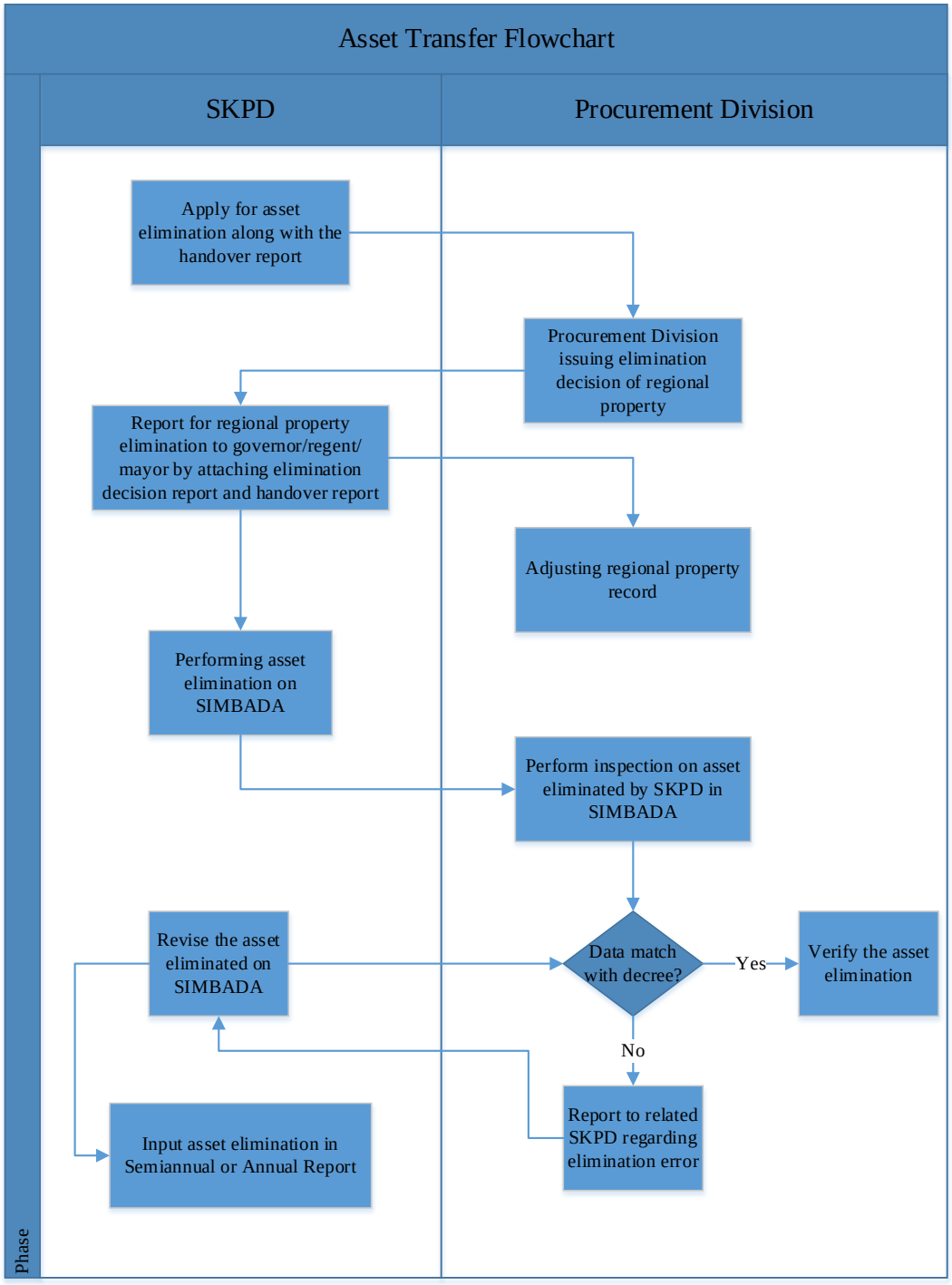

Figure 5. 1 Existing Asset Transfer Flowchart

In the existing asset transfer process, it only involves two parties with final goal is to eliminate the data from SIMBADA system. As can be seen in figure 5.1, the flow of existing asset elimination is only proposing asset elimination report to Procurement Division, Procurement Division will issue elimination decision that

will be continued to Governor/Regent/Mayor along with the handover report. The process continued to data verification and elimination on SIMBADA system and end up with SKPD eliminated asset, but, this mechanism is not really solving the problem exist in Surabaya City Government. Thus, it is proposed new asset transfer scheme with several addition process.

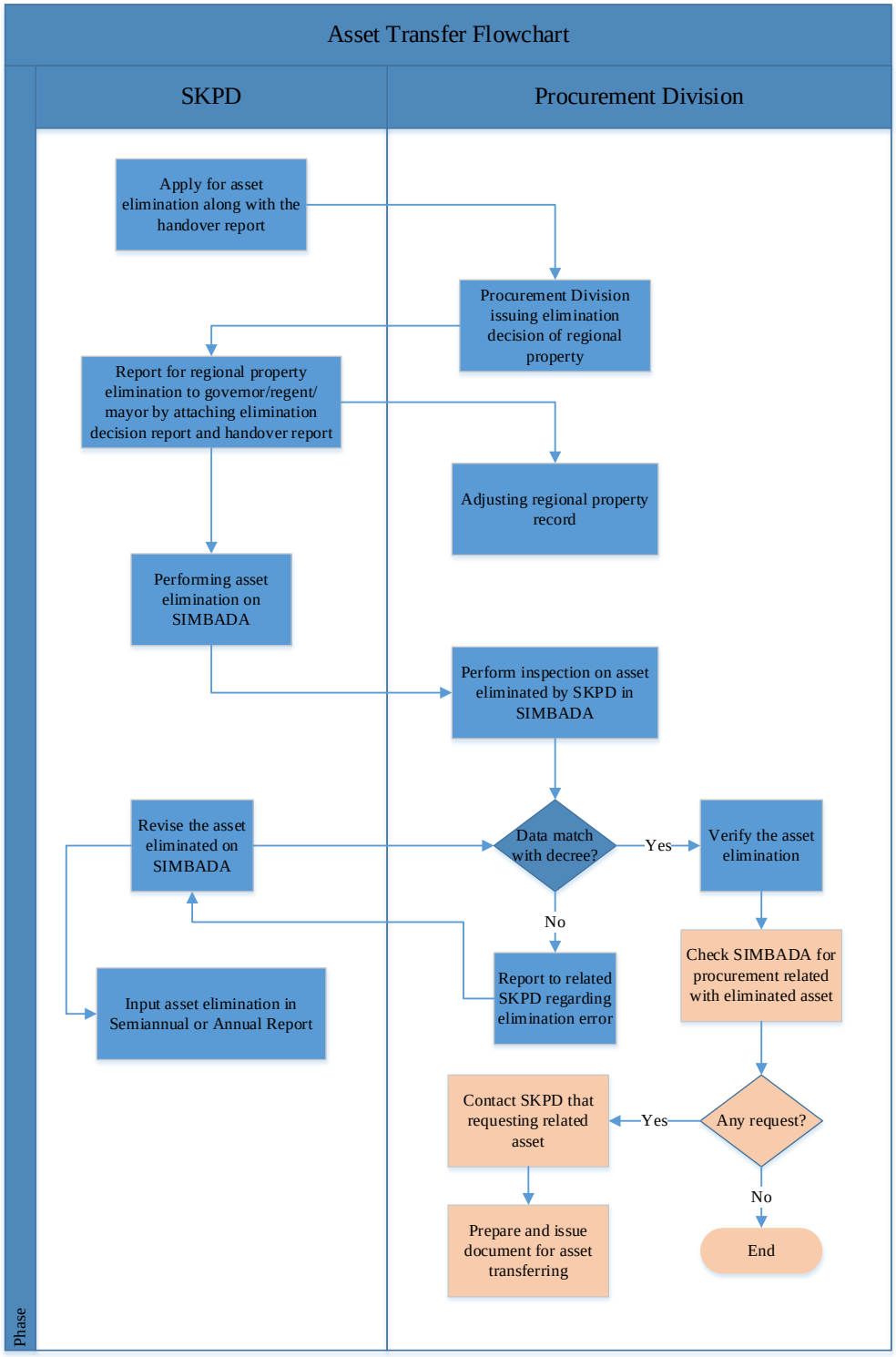

Figure 5. 2 Proposed Asset Transferring Flowchart

As can be seen in figure 5.2 of new asset transferring scheme, after Procurement Division has verified that the data eliminated by SKPD in SIMBADA system has matched with decree, then it checks on SIMBADA system again

whether there is any request or not. If the requests from SKPD matched with the asset eliminated, then Procurement Division will contact related SKPD to check whether the asset conform to the request. Once the eliminated asset accepted by the SKPD, then Procurement Division will prepare and issue the document for asset transferring.

5.2 Asset Elimination

Aside from asset transfer, if the asset, in this case printer, not worth using, it cannot be transferred to other SKPD, they must be eliminated, in order to prevent stack-up assets in the warehouse itself, aside from that also help updating data on SIMBADA related asset in SKPD. Thus, figure 5.3 presents the asset elimination flowchart in the existing condition.

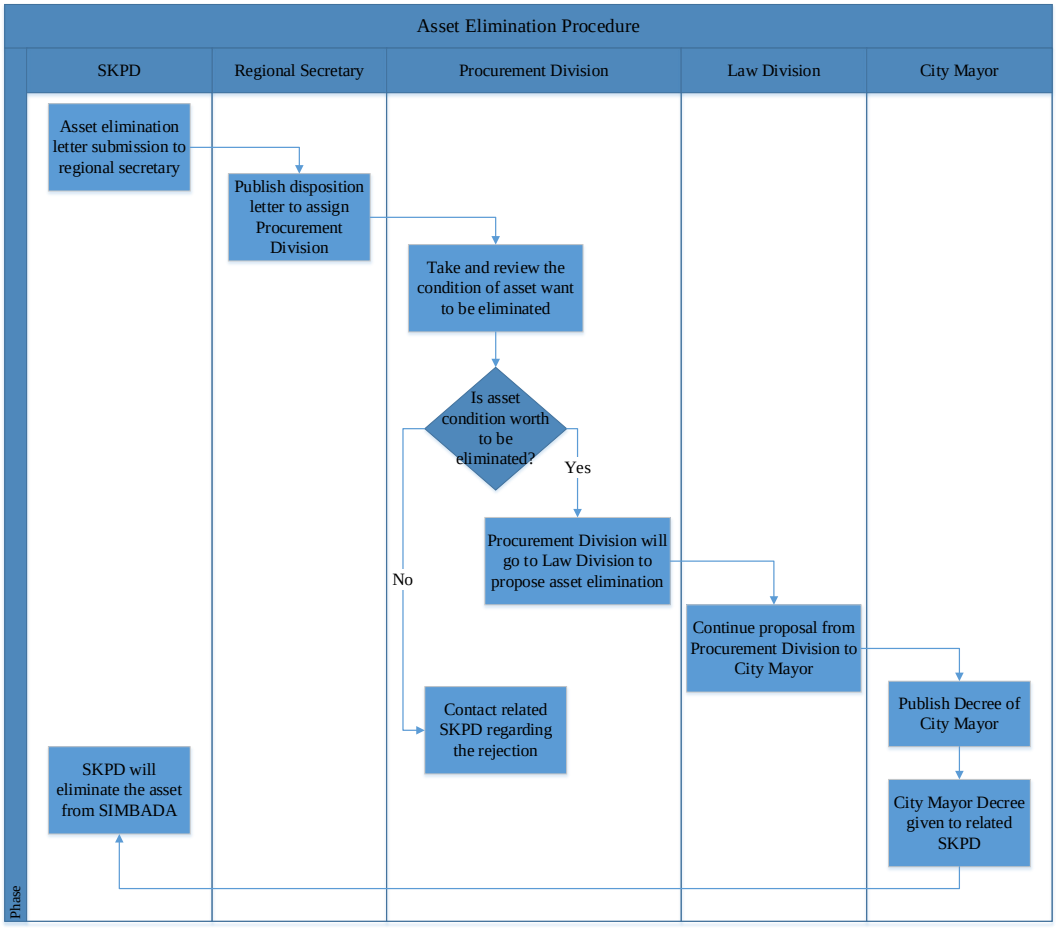

Figure 5. 3 Asset Elimination Procedure

Figure 5.3 shows the existing condition of asset elimination based on the interview did on Mr. Irfan as inventory person in charge in BAPPEKO office. One of the deficiency in the existing scheme is that there is no thorough asset evaluation regarding its condition. Asset elimination will require interference from 5 parties, related SKPD, regional secretary, procurement division, law division, and City Mayor. In this asset elimination procedure presents in figure 5.3, it will adopt BAPPEKO ways in proposing asset elimination.

5.2.1 Related SKPD

Related SKPD mentioned in this subchapter means that SKPD who wants to eliminate the asset. The role of related SKPD in asset elimination is pooling the assets want to be eliminated. Asset that has been collected will be listed in one asset elimination letter by the inventory person in charge. Asset elimination letter will be delivered to regional secretary in order to get the disposition letter.

5.2.2 Regional Secretary

Regional Secretary role in asset elimination will be as the receiver and reviewer about the asset elimination proposal from each SKPD. Each SKPD that proposing asset elimination will have to get disposition letter from regional secretary first before the asset can be eliminated. The disposition letter published by regional secretary will be given to Procurement Division to be proceed further.

5.2.3 Procurement Division

Procurement Division tasks as one of Surabaya City Government apparatus is not only procuring asset but it also dealing with asset elimination. In this situation, once procurement division has the disposition letter published by regional secretary, it will go to related SKPD to check and review the asset condition. Thus, after checking the asset, it takes the asset to the warehouse located on Jl. Margomulyo. Moreover, after the asset taken from related SKPD, procurement division goes to law division to give the asset elimination proposal.

5.2.4 Law Division

Law Division in asset elimination will review the proposal given by Procurement Division regarding asset elimination. Thus, after the proposal been reviewed, it will be continued to Surabaya City Mayor.

5.2.5 Surabaya City Mayor

After the proposal got from Procurement Division is given to Surabaya City Mayor by Law Division, it will publish the Decree of City Mayor. It is after the decree is published, then the asset can be eliminated from SIMBADA. Decree that has been published will be given respectively to the related SKPD that proposing asset elimination. The decree will be given to each SKPD's inventory person in charge. The inventory PIC in related SKPD will then eliminated the asset from SIMBADA.

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CHAPTER VI
PROPOSED NEW PRINTER MANAGEMENT SYSTEM

The urge to the existence of a valuation system seems to be important, that issues rise from the facts in the field that there is problem in procuring asset that took a long time, troublesome in asset elimination, and over procuring asset without proper utilization. In addition, for a long time, asset procurement system only sees buying as a rigid way of asset procurement. In developed industries, leasing has high interest. Compare to buying which has to spend a lot of money, leasing become more favorable in this era, as user has only need to pay for the annual leasing cost without thinking about maintenance and the other cost. Thus, to answer the problems exist, this chapter will propose different alternatives of asset procurement, which will compare between those alternatives to see most favorable option.

Seeing the problem in the field that many problems occur due to bad management system, it is thought to develop a new printer management system. The printer management system build is taken from existing condition of BAPPEKO, which is then drawn into general framework which is applicable for all SKPD. Printer Management System builds will provide three scenarios to be compared, which are full buying scenario, full leasing scenario, and mixed decisions scenario. This generic framework of new printer management system made will follow the PDCA (Plan-Do-Check-Action) cycle system.

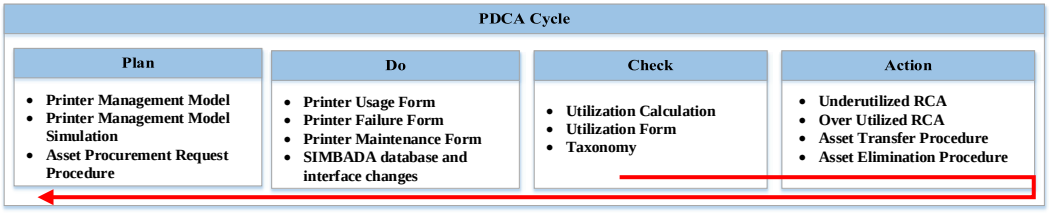


Figure 6. 1 PDCA Cycle

6.1 Check

As has been noted before that printer procurement mechanism is already existed in all SKPD, this cycle will be started from check, which is evaluation of existing printer. In the check cycle, SKPD need to check the utilization of existing

printer in the SKPD itself. For this Printer Management System, it is set that the bottom limit that is considered as good printer utilization is 75% over 3 months' printing usage. The limit is set due to the consideration that printing is only a supporting activities and the usage is fluctuating. Hence, after considering the average daily, weekly, and monthly printing, it is concluded that 3-months printing usage will be the effective time to calculate the printer utilization. Therefore, in check cycle, SKPD need to do following action before filling up the procurement request.

a. Fill in questionnaire of each user regarding their printing activities

In this step, SKPD need to develop a questionnaire about user printing activities. It should be made clear which printer is being used in their printing activities and how many pages are being printed in their daily, weekly, and monthly activity.

b. Total printing per printer

The next thing should be done is to recapitulate and classify the printing activities from interview result into each printer. The recapitulated data should be separated between daily and 3 months printing data.

c. Printer utilization level

Finally, after the total printed paper per printer has been defined and input into the system made, it will tell the utilization level of existing printer. The utilization level of each printer should reach minimum 75% to be classified as good utilization of printer. Once the printer has reached 75% utilization, then SKPD can proposed a new printer procurement request.

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					

Figure 6. 2 Monthly Printer Utilization Form

Figure 6.2 shows the printer utilization form that should be filled by SKPD before it wants to calculate the utilization level of the printer. Generally, utilization level of an equipment can be calculated using this formula:

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

Thus, for this case, printer utilization level can be simply calculated by following this formula:

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

As the matter of fact that asset can be eliminated and transferred, codification seems to be important. A code that attached to an asset accurately can help asset evaluation to know the condition precisely. Codification in the existing system is not properly managed, in which the existence of the asset cannot be traced precisely. Based on the existing condition, the taxonomy of printer is established. Printer taxonomy is made based on the taxonomic categories which represent hierarchies of increasingly abstract categories. The taxonomy developed is

important to help codification of asset, especially printer in this case. The taxonomy is made based on 3 differentiators, function, connection, and type of printer.

Table 6. 1 Printer 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

Based on table 6.1, the codification is proposed to ease the asset maintaining and controlling, where it will be based on the taxonomy above and later the codification made will be integrated with SIMBADA. In the proposed codification, the asset can be differentiated between its function, connection, and type. The differentiation will help the inventory PIC in each SKPD to procure the require spare part and maintenance if there is any error. Thus, to ease knowing the most failure happened in printer critical parts, the FMEA (Failure Mode and Effect Analysis) is made.

Table 6. 2 Printer FMEA

Printer Component	Component Figure	Function	Failure Mode	Failure Effect	Effect Cause	Recommended Action	Repair Impact	Severity	Probability	Detectability	RPN	Maintenance Procedure
Cartridge		Ink Container	Dried ink	Print output is not perfect; There is stripe on printed output	Usage errors; lack of heating performed on cartridge causing the ink dried; ink used for refill is not compatible; low quality of ink used	Replace component if broken	Perfect Repair	7	6	1	42	Regular turn on once every 3 days if not being used to clean dried ink on cartridge; using original ink from printer manufacturer
			Dried sponge	Print output is not perfect; There is stripe on printed output; Color printed is not same as desired	Has been used for too long; Too long not being used	Replace component if broken	Perfect Repair					Regular printer warming up once every 3 days if not used; cartridge replacement if it shows any error
Head Print		Character and picture printing media from ink	Dried ink	Print output is not perfect; There is stripe on printed output; Color printed is not same as desired	Usage errors; low quality of ink; printer is left unused for a long time which leads to dried ink	Replace component if broken	Perfect Repair	7	7	1	49	Use original ink from printer manufacturer; do regular warming up every 3 days if not used

Table 6. 2 Printer FMEA (cont.)

Printer Component	Component Figure	Function	Failure Mode	Failure Effect	Effect Cause	Recommended Action	Repair Impact	Severity	Probability	Detectability	RPN	Maintenance Procedure
Mainboard		Circuit board that combine the main component of printer (memory card, processor, chipset). Functioned as the main controller of printer	Inoperable	Printer cannot be operated/turned on	Unstable power voltage	Replace component if broken	Perfect Repair	7	3	9	189	Using UPS (Uninterruptible Power Supply) to prevent unstable power supply
Roller		Tool used for pulling the printed paper	Paper cannot be pulled by roller; Paper pulled too much	Printer cannot pull the paper	Inputted paper too thick; too much paper in the paper support	Replace component if broken	Perfect Repair	6	3	1	18	Prevent high document printing frequency with different paper thickness; Feed paper inputted limited to tolerable quantity

Table 6. 2 Printer FMEA (cont.)

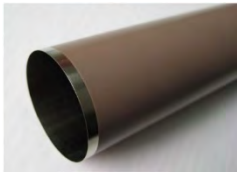
Printer Component	Component Figure	Function	Failure Mode	Failure Effect	Effect Cause	Recommended Action	Repair Impact	Severity	Probability	Detectability	RPN	Maintenance Procedure
Film Fuser		Protect the paper from fuser heat while printing so that the paper will not damaged	Print output is wavy and/or wrinkle; torn film	Printed paper will be damaged because of direct exposure of the fuser heat	Usage errors where user pull the paper by force when it jammed; frequently change the paper thickness	Replace component if broken	Perfect Repair	4	3	3	36	Prevent high document printing frequency with different paper thickness; Feed paper inputted limited to tolerable quantity; prevent using wrinkle paper to prevent paper jammed
Pin		Character or images printing media on paper	Untidy print output	Printed output is not soft; Some characters are not clear	Pin has been used for a long time; usage errors where the paper is pulled by force which make the pin broken; broken transistor which make the pin cannot back to its initial position and lead to broken pin	Replace component if broken	Perfect Repair	4	4	2	32	Pin replacement after certain period of usage; do not pull paper by force while paper jammed, but open the component to take out the jammed paper; UPS usage to prevent short circuit and damaged transistor

Table 6.2 shows the critical printer part that build up the printer, critical parts of printer that usually occurred error are cartridge, head print, mainboard, roller, film fuser (for laser jet printer), and pin (for dot matrix printer). Next, after knowing the critical parts, the severity, probability, and detectability of each critical part is determined using expert judgement to get the RPN (Risk Priority Number) value. Highest RPN value means that it is the critical part that need most attention, as if the error occurred to related part, it has high impact to the whole system.

6.2 Action

In action cycle, it will provide guide to SKPD regarding action need to be taken if either existing printer is underutilized or over utilized. In action cycle also will include the Root Cause Analysis (RCA) of each situation that might happen, so that it can be known the root cause of the problem and action need to be taken in each situation. In this cycle, it will introduce one of RCA tools, which is Cause and Effect Diagram, also known as Fishbone Diagram. Kollengode (2010) mentions step by step how to construct cause and effect diagram.

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

As we know that cause and effect diagram is an easy yet powerful tool commonly used in a cross functional setting to visually describe the potential root causes for a specific problem in question, it seems to be the most appropriate way to draw the problem regarding this printer management system that has cross functional cause. To ease the understanding of Cause and Effect Diagram, then in Figure 6.3 and 6.4 will show the example of underutilized and over utilized Cause and Effect Diagram in BAPPEKO office.

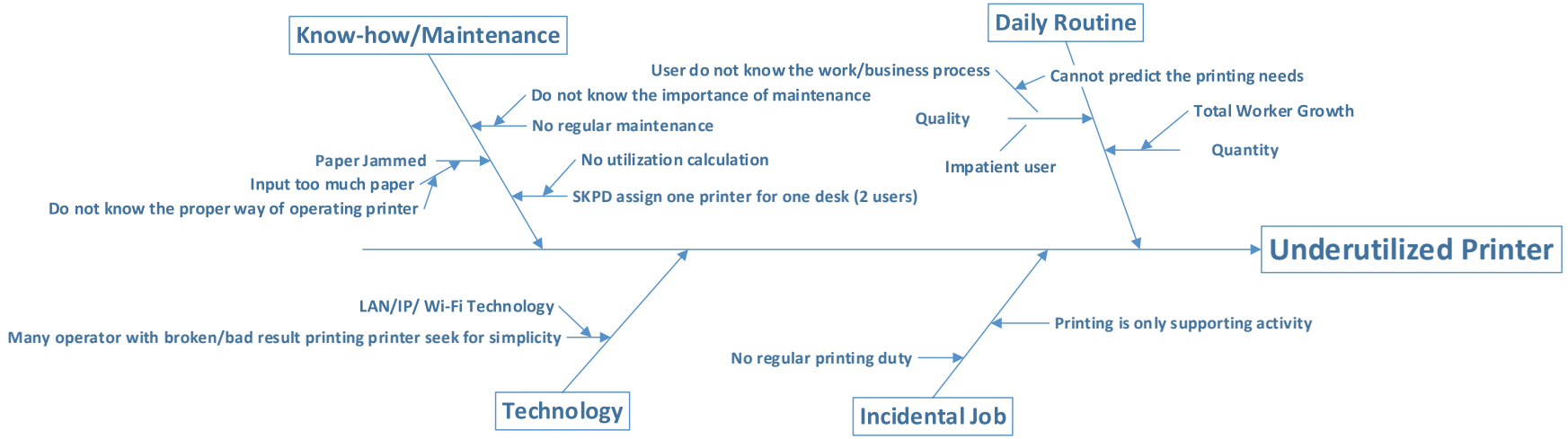


Figure 6. 3 RCA of Underutilized Printer

After the fishbone been developed, it can be concluded that three main reasons/main causes of underutilized printer are the absence of needs analysis in SKPD, printer acts only as supporting tools, and impatient user which leads to the desire to have printer for their own. Mainly the reason of over procurement is impatient, in which as realized, printer is not a main equipment need in the office which make the printing activities are only done frequently, but when there are several users that need to print at a same time, the users tend not to wait/queue, users want to have their document printed as soon as they need it. The recommended action regarding the waste exist is conducting thorough utilization calculation in which will lead to ideal number of printer need to be procured so that the printer utilization will not be so low and the suggestion given will not prevent the user from doing its daily printing activities.

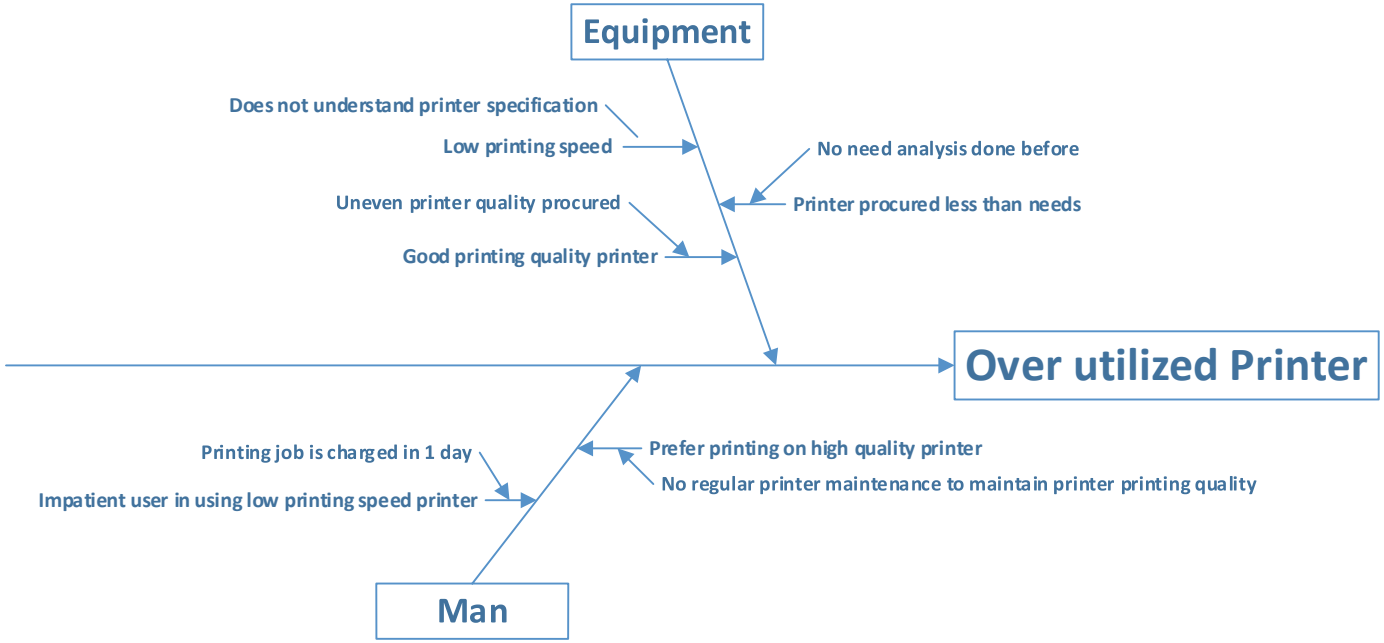


Figure 6. 4 RCA of Over Utilized Printer

In case of over utilized printer, figure 6.4 shows the root cause of the problem exist. Basically, good utilization of equipment is good, but if it is over utilized then it may cause problem. In this case, if printer in SKPD is over utilized, this can mean two things, first that the printer being over utilized is good in terms of printing quality and it is reliable. On the other hand, if most of the printing duty is charged on the over utilized printer, then it will make the other printer become low in terms of utilization and it may also cause queuing in printing as many of the worker wants to have good quality printing. As can be seen in the fishbone made, the main reason of over utilized printer is that there is no uniformity in printer procurement which make the printer printing quality different and make the user tends to choose better printer printing quality. Thus, another minor reason might cause the problem is that the worker/user is impatient to wait the printing result to be done so that they tend to choose on printing with quicker printer. The recommended action regarding the problem exist is the related SKPD is better to procure another printer with notes that it should perform uniformity printer specification procured, besides it will make the printing quality same, it also eases the maintenance procedure and toner or ink procurement.

6.3 Plan

In new management of printer procurement proposed, if SKPD wants to do procurement, first it needs to check the utilization of existing asset. As what has been discussed before, the utilization level need to be equal or higher than 75% before it can propose a new procurement request. In the new printer management system, it will propose three scenarios, which are full buying, full leasing, and mixed decisions. Thus, from the three scenarios provided, it will be compared to see which alternative is more beneficial and favorable. Apart from knowing the total printer need to be procured, it also has to know the way of procurement, whether it will be procured through buying all the needs, leasing, or mixed decisions. The decision of procurement can be known through the form provided in table 6.3 and the decision tree provided in figure 2.17. Once the printer needs and way of procurement have been decided, it can be continued by filling up the Printer

Procurement System where it will act as guide to make best decision of procurement from financial side.

6.3.1 Procurement Planning Scenario

By having codification ready, then asset monitoring and tracing is not a problem anymore. The codification that has been made can be used for the next asset procurement. In the existing condition of asset procurement especially printer, SKPD only sees buying as the only option, whereas actually there is another option such as leasing. Current condition of procurement that only consider buying decision is not followed by the utility level of the asset itself.

As mentioned in the chapter before regarding the utility level of printer, it can be seen that from total procured printer, the utility is very low. Low utility level which due to fluctuate and unpredictable document printing makes the buying option is not the only option to procure an asset. SKPD can also lease the asset, where in the lease decision, related SKPD only needs to pay for annual leasing payment without considering other cost such as maintenance cost and operational cost such as toner or ink payment as it has been covered by the 3rd party that provide the service. Compared to buy decision, SKPD still has to consider the maintenance cost and toner or ink expenses as it may cost more. Thus, in the improvement system, it proposes three types of scenario can be chosen, full printer leasing, full printer buying, or mixed decisions. The system framework made will be using Microsoft Excel dashboard to make it more user friendly.

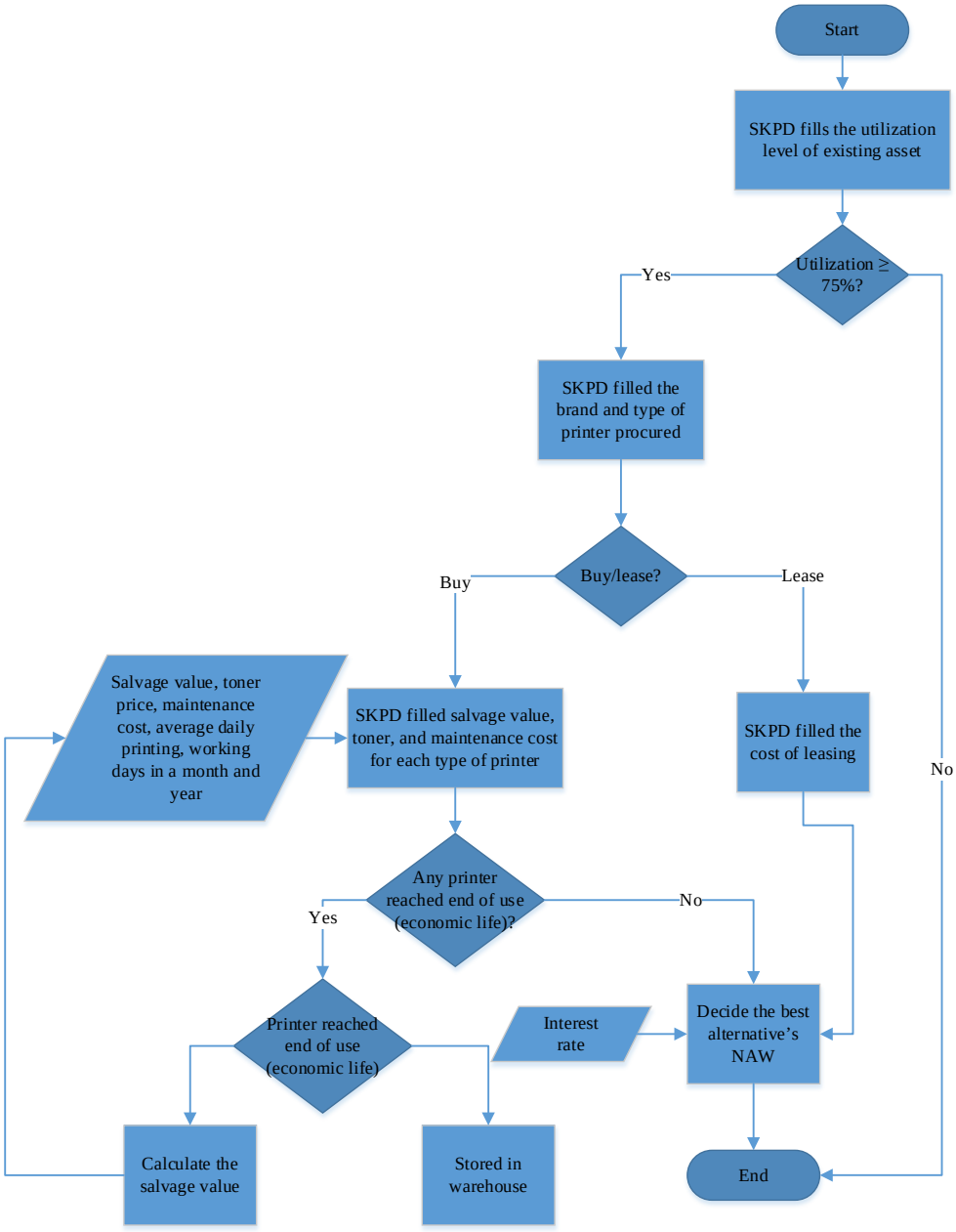


Figure 6. 5 Procurement Methodology

Figure 6.5 shows the procurement methodology where the user can determine how much printer they want to buy or lease or even mixed decisions scheme. The first step is to fill the utilization of existing printer, where the lower bound threshold can be flexibly changed by related SKPD, if the utilization of existing condition is not greater or equal to the limit determined then the SKPD cannot procure the printer. Next, if the utilization is greater or equal to the limit determined, then the user has to determine how many printers need to be procured

by filling up the brand and type of printer along with the decision whether to buy or lease. Then, if user decides to buy the printer, it needs to input salvage value, toner or ink expense, maintenance cost, average daily printing, working days in a month, while if the decision is leasing, then user only need to input the cost of leasing. After the framework filled, then it will show the NAW of 3 scenarios over 16 years planning horizon, to be then determined which decision to be taken.

a. Full Buying Scenario

Speaking about procurement using buying scenario, it seems to be familiar as it has been done by SKPD throughout the time. In full buying scenario, the procurement of printer is only considering buying as the only option. Though, SKPD should realize that in buying scenario, even though there will be warranty regarding failure happened over certain period of time given by manufacturer, there will be also operational cost should be expensed. The operational cost included into this decision will be toner or ink expenses, and also regular printer preventive maintenance cost, additionally if the printer warranty has ended, it also has to consider breakdown maintenance, if in case the printer troubled.

Though the cost of printer buying scenario is costly and require a lot of expense, printer buying has double-edged knife advantage, where in one side it saves leasing cost if printer usage is low but used for a long time, while in another side it also cause the utilization of printer low. In this scenario, each cost must be carefully calculated, where it is also not a few data that need to be converted before it can be known the total expense.

b. Full Leasing Scenario

Next, second scenario will be explained about the leasing scenario. Leasing which has been a new printer procurement system to the SKPD has less expense than buying decision. Regardless it costs less money, SKPD should not rush to make the choice. Recalling Figure 2.17 about lease vs purchase decision tree, SKPD should follow through the question before deciding in leasing printer.

Table 6. 3 Lease or Buy Decision Form

Lease or Buy Decision Form			
No	**Question**	**Criteria**	
		Lease	**Buy**
1	Does SKPD have a clear understanding of its current printer needs?	Yes	No
2	How long does the printer lifecycle being used?	≤ 48 months	≥ 48 months
3	Does the SKPD have IT asset management practices in place to track equipment?	Yes	No
4	Does the SKPD has the time and expertise necessary to develop and manage the lease efficiently?	Yes	No
Decision		**Leasing is a good acquisition alternative**	**Under any of these conditions, purchasing would be the preferred method of acquisition**

Table 6.3 shows the guide form for lease or buy decision which is derived from the decision tree in chapter 2 (Figure 2.17). If all the criteria in the lease decision match with the printer want to be procured, then the printer should be leased, contrarily, if one of the criteria is not matched, then it is considerably better to buy the printer. Additionally, though printer leasing seems to be favorable and interesting promotion due to its less expense than buying decision, there are several considerations have to be made clear in leasing certain type of printer, such as:

1. What kind of printer do you need? Is it plain (only printing) or all in one printer?
2. What type of printer do you need? Is it ink jet or laser printer?
3. What kind of printer connection do you need? Do you need printer that can share without cables, printer that can print without a computer, or printer that can print from anywhere?
4. How much is the ink costs you budgeted?
5. How long the leasing should be made?
6. Is it black or color printer?

7. How fast does it need to be?
8. Do you need any finishing options (sorter, hole-punch, automatic stapler)?
9. How much paper need to load? Need additional tray?
10. Etc.

In leasing evaluation, printer is procured through 3rd party service. Based on the interview done on printer leasing service providers, it is then taken an example of printer leasing evaluation of printer HP P1102 for monochrome printer and HP LaserJet Pro CP1025 for color printer.

Table 6. 4 Monochrome and Color Printer Cost Comparison

No	Factors	Price	
		Monochrome	Color
1	Daily	Rp 50,000.00	-
2	Monthly	Rp 250,000.00	Rp 250,000.00
3	Paper Based Leasing	-	Rp 1,000.00 per page
4	Toner	Rp 250,000.00	Rp 250,000.00 per color
5	Multi-Function	Rp 350,000.00	Rp 450,000.00

In this scenario/decision, if SKPD decided to lease the printer, it does not need to bother the maintenance and toner/ink as it has been covered by the service provider. The only cost need to be considered in the leasing decision is only the cost of leasing in each period. Furthermore, the benefit of leasing printer is that if there is any error occurred during leasing period, the printer can be directly replaced with a new one if the maintenance or repair cannot be done in a day. Thus, from several benefit provided, it has to be made clear that printer leasing service is still a limited service, so large scale leasing is not possible; different type of printer procurement may also cost different. Therefore, procurement needs have to be calculated carefully to prevent any loss.

c. Mixed Decisions Scenario

The last scenario in the printer procurement system is mixed procurement between leasing and buying. In this scenario, SKPD is required to calculate carefully the need of printing, is it urgent and frequently use or not. If printing become primary activity which means it is being used a lot, then more printer leasing will be more favorable and beneficial. On the other hand, if printing is not a primary activity and it is only being used frequently, then more printer buying may be more favorable.

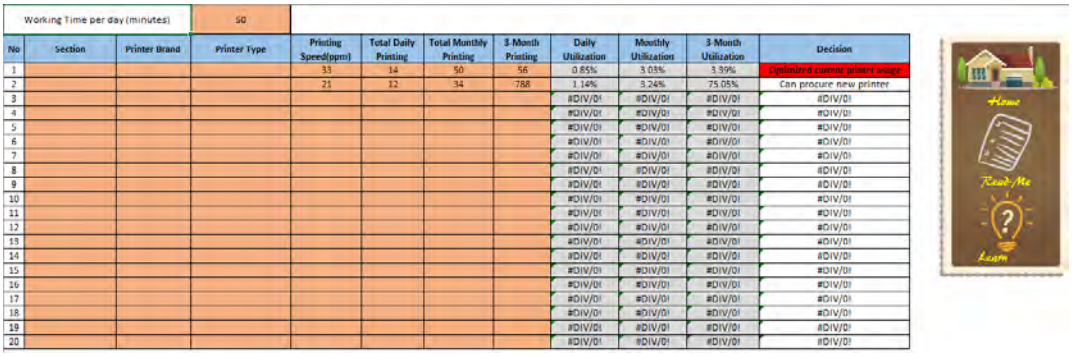
Even though printing activity is not a primary activity and only act as a supporting activity, it does not mean that regular maintenance is neglected. Regular maintenance still need to be done in order to prevent obsolete printer and to keep the printing quality good.

6.3.2 Printer Management Model

As subchapter before has briefly explaining scenarios proposed, full leasing scenario, full buying scenario, and mixed decisions scenario, in here, it will be explained further about each document in the system made. In the proposed system, namely Printer Procurement System (shown in figure 6.6), there are six documents exist, such as, utilization, procurement, toner cost, salvage value, net annual worth, and alternative comparison. In these documents, SKPD require to input several data regarding the specification of printer procured and other minor data, in order for this system can be run. Thus, the role of each document will be explained further below.

Figure 6. 6 Printer Procurement System User Interface

a. 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!
8								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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18								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20								#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Figure 6. 7 Utilization User Interface

First document (shown in figure 6.7) that need to be filled before determining printer procurement is utilization data. In utilization data, SKPD is required to fill the existing printer and other data, such as working time per day, section, printer brand, printer type, printing speed, total daily printing, total monthly printing, and total of 3-month printing one by one. The document shown in Figure 6.7 is an automatic generating system that will calculate the utilization level of printer once the user input the printing frequency, in which the category of utilization is divided into three, over utilized, optimum, or underutilized.

Thus, for manual utilization calculation, by taking the example from BAPPEKO, based on the interview done on each staff in BAPPEKO office regarding 1-week printing frequency, it is then being used as the reference point for Monte Carlo Simulation to simulate the printing frequency in 3 months. Monte Carlo simulation is used only as framework of thinking to simulate the 3-month printing data as there is no printing frequency data in the current condition. The Monte Carlo simulation is done by taking the historical one-week printing frequency data and calculate the probability of printing distribution. After the probability being developed, it is then being used to generate the lower limit and upper limit. Next, the random interval number is generated by taking the range between the lower limit and upper limit. Finally, a random number of 54 data is generated by using excel (green shaded cell), then, if the random number is fall between certain random interval number determine before, then it will be the result of printing frequency simulation generated from Monte Carlo.

Table 6. 5 Printer Printing Frequency using Monte Carlo Simulation

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	66	0.17	0.00	0.17	0-17
2	61	0.17	0.17	0.33	18-32
3	58	0.17	0.33	0.50	33-49
4	59	0.17	0.50	0.67	50-66
5	69	0.17	0.67	0.83	67-82
6	45	0.17	0.83	1.00	83-99
7	66	0.14			
8	45	0.91			
9	61	0.27			
10	61	0.17			
11	66	0.03			
12	69	0.79			
13	66	0.01			
14	69	0.75			
15	69	0.67			
16	58	0.43			
17	66	0.14			
18	61	0.30			
19	45	0.96			
20	59	0.54			
21	69	0.81			
22	59	0.62			
23	66	0.03			

Table 6. 5 Printer Printing Frequency using Monte Carlo Simulation (cont.)

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
24	45	0.86			
25	61	0.33			
26	58	0.37			
27	66	0.07			
28	69	0.80			
29	45	0.89			
30	69	0.73			
31	61	0.21			
32	45	0.87			
33	69	0.83			
34	66	0.16			
35	45	0.93			
36	59	0.64			
37	66	0.15			
38	59	0.53			
39	69	0.72			
40	58	0.49			
41	45	0.86			
42	59	0.62			
43	61	0.32			
44	61	0.29			
45	66	0.12			
46	66	0.01			

Table 6. 5 Printer Printing Frequency using Monte Carlo Simulation (cont.)

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
47	69	0.73			
48	58	0.35			
49	69	0.70			
50	66	0.02			
51	61	0.25			
52	59	0.51			
53	61	0.23			
54	58	0.47			
55	59	0.60			
56	66	0.01			
57	58	0.36			
58	69	0.80			
59	45	0.96			
60	69	0.78			

The first way in conducting Monte Carlo simulation is inputting the historical data of printing frequency, next, in 6 historical data, find the probability printing distribution by following the formula $\frac{Same\ printing\ frequency\ data}{total\ data}$ if there is no same historical printing frequency data, then the value is 1 which result $\frac{1}{6} = 0.17$. Then, calculate the lower limit and upper limit of the frequency data range to be used as random interval number. Finally, generate random number in order to get the simulation result, which is then the number generated randomly will be trace from the random interval number to know how many printing frequencies done over 3 months' period. After the printing frequency have been determined, it is then calculated the utility of the printer, which is shown in table 6.6.

Table 6. 6 Example of Printer Utilization Calculation

No	Section	Printer Type and Brand	Printing Speed (ppm)	Total Daily Printing	Total Monthly Printing	3-Month Printing	Daily Utilization	Monthly Utilization	3-month Utilization
1	Economics	HP P1006	17	66	1219	3648	0.81%	14.94%	45%
2	Economics	HP P1006	17	106	1834	5472	1.30%	22.48%	67%
3	Economics	HP 1010	12	80	1380	4200	1.39%	23.96%	73%
4	Economics	EPSON L800	37	40	830	2560	0.23%	4.67%	14%
5	Economics	HP LaserJet P1566	22	63	933	2478	0.60%	8.84%	23%

Table 6.6 shows the example of printer utilization calculation in economics section, where the logic of this calculation will be implemented in the utilization document in Printer Procurement System. The example of printer utilization calculation will be shown below.

$$Printer\ HP\ P1006\ 3-month\ Utilization =$$

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

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

$$Printer\ HP\ P1006\ 3-month\ Utilization = 45\%$$

Then, from the example calculation above, it is known that from 3-month printing frequency, the utilization of printer HP P1006 is 45%. The existing utilization of printer HP P1006 is classified as low utility as it is still being used half of its full utilization. In the Printer Procurement System made, the utilization threshold can be flexibly changed, if the utilization of existing printer is lower than or equal to the threshold determined, then in the decision column will state that related SKPD should optimize current printer usage.

b. Procurement

Figure 6. 8 Procurement User Interface

Next, the document that should be completed by the user is the procurement document. In procurement document, user need to input procurement year, printer brand, printer type, total buy and lease printer, cost of each printer buying and leasing, and maintenance cost. In this procurement document, it will calculate both full buying scenario, full leasing scenario, and mixed decisions. Last, for maintenance cost, the user will input the monthly preventive maintenance cost provided by 3rd party. For full buying and full leasing scenario, the total printer needs are being sum up and multiplied to each buying and leasing cost per printer type and brand.

c. Toner Cost

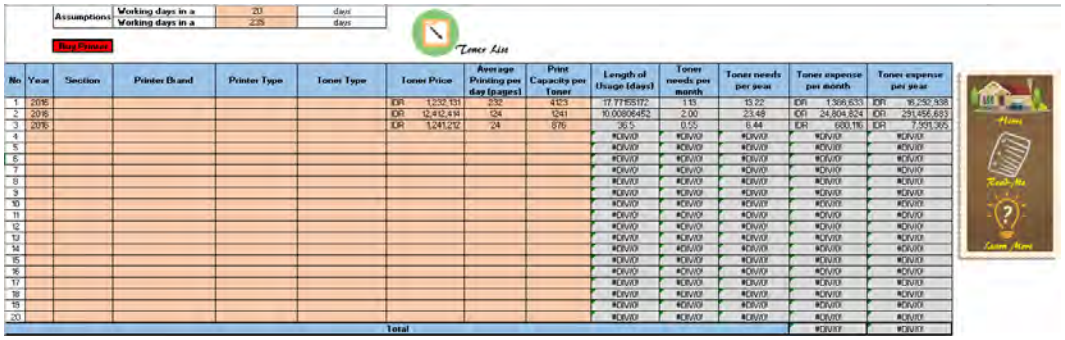

Figure 6. 9 Toner User Interface

Toner cost document is made with purpose to track the expense for printer that is bought. User first need to input working days in a month and year, which is then followed by inputting year of toner buying, section, printer brand, printer type, toner type, toner price, average printing per day, and print capacity per toner. The toner list is already provided above where it included all printer that is usually being procured, based on historical data. If in any case the toner type is not provided in the document, then user can update the data manually by inputting the data required.

In toner cost calculation, it will convert the average printing value in a day and the toner printing capacity into the needs of toner per month and year. The illustration of toner cost calculation will be provided below.

Assumption: working days in a month= 20 days; working days in a year= 235 days; toner price= 1,500,000; average printing in a day= 50 pages; toner print capacity= 300 pages.

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

$$Length\ of\ usage\ (days) = \frac{300}{50} = 6\ days$$

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

$$Toner\ needs\ per\ month = \frac{20}{6} = 3.33$$

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

$$Toner\ needs\ per\ month = \frac{235}{6} = 39.17$$

$$Toner\ expense\ per\ month = toner\ needs\ per\ month * toner\ price$$

$$Toner\ expense\ per\ month = 3.33 * 1{,}500{,}000 = 5{,}000{,}000$$

$$Toner\ expense\ per\ year = toner\ needs\ per\ year * toner\ price$$

$$Toner\ expense\ per\ month = 39.17 * 1{,}500{,}000 = 58{,}750{,}000$$

In the document, SKPD is required to input both toner cost for printer that is bought and leased. Toner cost input in leased printer is required for the calculation of full printer buying scenario.

d. Salvage Value

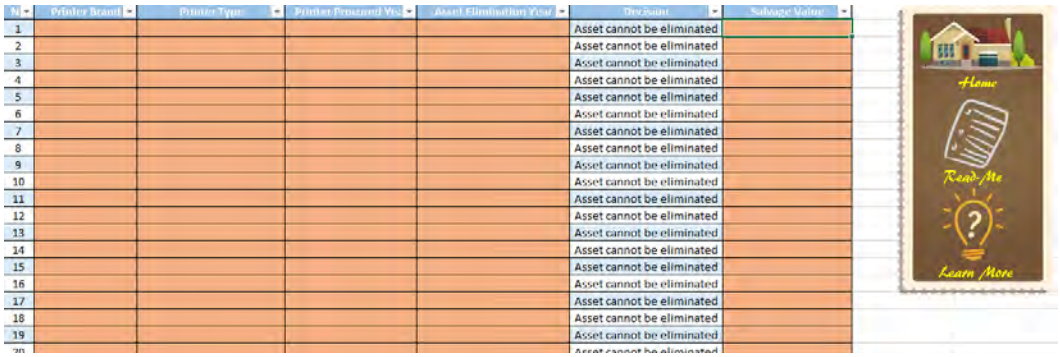

Figure 6. 10 Salvage Value User Interface

Salvage value document is not a compulsory document need to be filled by SKPD. This document is only filled if SKPD want to eliminated the asset, but the asset elimination should follow *Minister of Finance Regulation No 96/PMK.03/2009* which stated the economic life of printer that is included into office equipment that has economic life of 4 years. If the asset eliminated is not being used at least for 4 years, then in the decision column, it will state that the asset cannot be eliminated and in the salvage value will be written in red-colored font. The printer that is procured less than 4 years can be eliminated only if the printer is broken or it is not being used. The printer that is eliminated will be then become the income to Surabaya City Government as there is other parties that want to buy the broken printer.

e. Net Annual Worth (NAW)

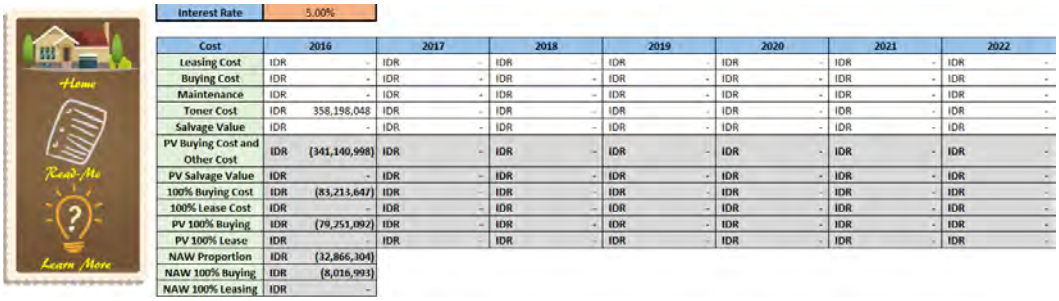

Figure 6. 11 Net Annual Worth User Interface

In net annual worth document, it distributes all cost into an equivalent value series of cash flow. In this document, all of the cost is first transformed into present value which is then it will be calculated annually over 16 years of planning horizon. The planning horizon is set at 16 years as this Printer Procurement System can cover multiple investment, so that based on the Minister of Finance Regulation that stated printer which is included on asset group 1, has economic life equal to 4 years and to provide multiple investment, then the planning horizon is set at 16 years. Leasing cost, buying cost, maintenance cost, toner cost, and salvage value from the document before will be recapitulated in this document. The costs will

then be used as the data of calculating net annual worth of scenarios. The example of NAW calculation will take mixed decisions printer procurement scenario.

First, the buying cost, leasing cost, maintenance, and toner cost in the same year is being sum up, and if there happened to be multiple investment in different years, them the cost is first brought from Future Value (FV) into Present Value (PV), which is then after that being sum up with the other cost in the same year. Next, if there is salvage value, which means that there will be asset elimination in the year, the salvage value will be transformed into present value also. Finally, in NAW calculation, it will sum up all cost over 16 years planning horizon into annual cost. Below will be given illustration of transforming costs into present value if the cost is happened to be expensed in different years.

Example of transforming cost from different years into Present Value and transformed into equivalent uniform annual cost

The expensed of printer maintenance cost for five years are as follows: $8,250, $12,600, $9,750, $11,400, and $14,500. If the value of money is 12%, what is the equivalent uniform annual cost for the five-year period?

PW= 8,250 (P/F, 12%, 1) + 12,600 (P/F, 12%, 2) + 9,750 (P/F, 12%, 3) + 11,400 (P/F, 12%, 4) + 14,500 (P/F, 12%, 5)

PW= $39,823

EUAC= 39,823 (A/P, 12%, 5) = $11,047

Therefore, based on the illustration calculation shown above, the calculation of Net Annual Worth (NAW) in Printer Procurement System will follow that logic. In the Printer Procurement System, it allows user to input multiple investment, where the cost in the future will be brought into present value. All the costs that have been brought into present will be sum up and be distributed into its equivalent uniform annual cost.

f. Alternative Comparison

Figure 6. 12 Alternative Comparison User Interface

The last document in the Printer Procurement System will be the Alternative Comparison document. In this document it will show the comparison between predetermined scenarios. The scenario that will be compared is net annual worth mixed decisions, net annual worth full buy, and net annual worth full lease. Thus, as the scenarios made is mutually exclusive, where the selection of one alternative resulting in rejection of other alternatives. The alternative is mutually exclusive due to the limited resources, in this case is financial resource. Although there is more than one alternative qualified, it should only choose one alternative which is thought to be the best.

6.3.3 Printer Procurement System Model Simulation

This subchapter will provide simulation of the Printer Procurement System Model that has been developed before. The simulation model made will be divided into 2 sections, the first simulation is only acts as an illustration of how the model made works, on the other hand, the second simulation made will be using existing data of BAPPEKO printer in order to know cost of existing procurement and what is the optimum printer should actually be procured.

6.3.3.1 First Simulation

As stated above, in the first simulation it only acts as an illustration of how the model will be and not representing existing condition. In this model, it will simulate the procurement of 20 printers on 2017 by using assumption that existing utilization is above 75%. The interest rate used in the model will follow the BI (Bank Indonesia) rate which is 8.12%. As for the salvage value, it will sell 10 printers that has been procured before 2013.

Figure 6. 13 Front User Interface

Figure 6.13 shows the front user interface use as the guide of Printer Procurement System, there are 6 documents which are, utilization, procurement, toner cost, salvage value, net annual worth, and alternative comparison. The first document need to be filled will be utilization document, in the utilization document, user need to input existing printer in the SKPD before can decide procure new printer.

Working Time per day (minutes)			480		Lowest Utilization Threshold		75%					
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**	**Current Utilization Level**	**Decision**
1	A	HP	P1006	17	114	2270	6809	1.40%	27.82%	83.44%	Overutilized Printer	Can procure new printer
2	B	HP	P1102	18	125	2485	7454	1.45%	28.76%	86.27%	Overutilized Printer	Can procure new printer
3	A	HP	P1102	18	110	2196	6589	1.27%	25.42%	76.26%	Overutilized Printer	Can procure new printer
4	B	Xerox	Phaser 3435	33	76	1517	4550	0.48%	9.58%	28.72%	Underutilized Printer	Optimized current printer usage
5	C	EPSON	L100	27	166	3328	9984	1.28%	25.68%	77.04%	Overutilized Printer	Can procure new printer
6	C	Xerox	Phaser 3435	33	232	4640	13920	1.46%	29.29%	87.88%	Overutilized Printer	Can procure new printer
7	D	HP	P1102	18	39	777	2330	0.45%	8.99%	26.97%	Underutilized Printer	Optimized current printer usage
8	D	EPSON	L800	37	274	5477	16430	1.54%	30.84%	92.51%	Overutilized Printer	Can procure new printer
9	A	EPSON	L220	27	196	3911	11732	1.51%	30.18%	90.52%	Overutilized Printer	Can procure new printer
10	C	EPSON	L800	37	207	4145	12434	1.17%	23.34%	70.01%	Underutilized Printer	Optimized current printer usage
11	B	HP	P1006	17	132	2631	7894	1.62%	32.24%	96.74%	Overutilized Printer	Can procure new printer
12	D	Xerox	Phaser 3155	24	149	2986	8957	1.29%	25.92%	77.75%	Overutilized Printer	Can procure new printer

Figure 6. 14 Utilization Form

Figure 6.14 shows the utilization level of existing printer, it can be seen that in the related SKPD, most of the printer utilization level is above 75%, thus the decision column shows the decision that the SKPD can procure a new printer as it has reached minimum level of good utilization. As has been discussed before, the utilization level of printer will be measured from 3-month printing data in the SKPD. Because the utilization of the printer has been over utilized, which means good, but on the other side can hamper the workers' work also, so it will be wise to decide on procuring new printer.

Total Printer Brand Procured						Cost								
			Procured Printer											
Procurement Year	Brand	Type	Buy	Lease	Total	Printer Buy Cost	Buy Cost	Maintenance Cost (per printer, monthly)	Total Maintenance Cost (all printer, yearly)	Buy 100% Cost	Total Maintenance Cost (all printer, yearly) (for 100% buy	Monthly Leasing Cost	Lease Cost (yearly)	Lease 100% Cost
2017	HP	P1102	1	3	4	IDR 1,475,000	IDR 1,475,000	IDR 75,000	IDR 75,000	IDR 5,900,000	IDR 300,000	IDR 250,000	IDR 9,000,000	IDR 12,000,000
2017	Xerox	Phaser 3435	2	5	7	IDR 3,144,000	IDR 6,288,000	IDR 75,000	IDR 150,000	IDR 22,008,000	IDR 525,000	IDR 350,000	IDR 21,000,000	IDR 29,400,000
2017	Xerox	Phaser 3155	2	3	5	IDR 1,050,000	IDR 2,100,000	IDR 75,000	IDR 150,000	IDR 5,250,000	IDR 375,000	IDR 300,000	IDR 10,800,000	IDR 18,000,000
2017	HP	P1006	1	3	4	IDR 1,400,000	IDR 1,400,000	IDR 75,000	IDR 75,000	IDR 5,600,000	IDR 300,000	IDR 300,000	IDR 10,800,000	IDR 14,400,000
Total Printer Procured			6	14	20		IDR 11,263,000	IDR 300,000	IDR 450,000	IDR 38,758,000	IDR 1,500,000		IDR 51,600,000	IDR 73,800,000
			20											

Figure 6. 15 Procurement Form

After the SKPD makes sure the utilization level above 75%, then SKPD needs to determine how many additional printers needed and which brand need to be procured. In this model, it procures 20 printers with detail of printer procured presented below. The proportion of 40% buy and 60% lease is determined from the consideration of monthly printing frequency that is low and the expense of toner and also maintenance cost is high.

Table 6. 7 Detail of Printer Procured

Brand	Type	Buy	Lease	Total
HP	P1102	1	3	4
Xerox	Phaser 3435	2	5	7
Xerox	Phaser 3155	2	3	5
HP	P1006	1	3	4
Total		**6**	**14**	**20**

Total 20 printer needs are broken down into detail presented in table 6.7, the procurement of certain brand is based on the needs and specification of printer need by the SKPD. In this form, SKPD who fills the form should make sure that the cost of printer, maintenance cost, and monthly leasing cost have been filled base on the real condition.

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

Buy Printer

Toner List

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

Figure 6. 16 Toner Cost for Buy Printer

Next, the form need to be filled is the toner cost form, this form is needed to know and forecast the cost needed to be expensed by the SKPD if they want to procure printer. First, the assumption of working days in a month is 20 days and 235 working days in a year. Next, SKPD need to fill the year of procurement, section where the printer placed, printer brand, printer type, toner type, toner price, average printing per day (pages), and print capacity per toner. Some toner detail of common printer procured has been provided in toner list form. After the data needed has been inputted, the form will automatically generate the length of toner usage and the toner needs and cost per month and year. Below will be illustrated the step of calculating the toner needs and costs per year of printer HP P1102 procures in 2017 placed on section A. The toner type for printer HP P1102 is Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge) with capacity printing 1,600 pages and cost per toner IDR 835,879 and the average printing per day is 55 pages.

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

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

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

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

$$Toner\ expense\ per\ year = toner\ needs\ per\ year * toner\ price$$

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

Thus, SKPD not only have to input the toner detail of buy printer, but for leased printer, it also has to input the toner detail as it will be used as the consideration for full buying scenario (shown in figure 6.17).

Leased Printer

Toner List

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	D	HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879	28	1600	57.14	0.35	4.11	IDR 292,558	IDR 3,437,552
2	2017	A	HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879	57	1600	28.07	0.71	8.37	IDR 595,564	IDR 6,997,875
3	2017	D	HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879	43	1600	37.21	0.54	6.32	IDR 449,285	IDR 5,279,098
4	2017	C	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	128	10000	78.13	0.26	3.01	IDR 183,054	IDR 2,150,882
5	2017	C	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	115	10000	86.96	0.23	2.70	IDR 164,462	IDR 1,932,433
6	2017	C	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	175	10000	57.14	0.35	4.11	IDR 250,269	IDR 2,940,660
7	2017	A	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	215	10000	46.51	0.43	5.05	IDR 307,473	IDR 3,612,810
8	2017	B	Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	243	10000	41.15	0.49	5.71	IDR 347,516	IDR 4,083,316
9	2017	B	Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	89	2500	28.09	0.71	8.37	IDR 1,579,759	IDR 18,562,163
10	2017	D	Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	75	2500	33.33	0.60	7.05	IDR 1,331,257	IDR 15,642,272
11	2017	C	Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	78	2500	32.05	0.62	7.33	IDR 1,384,507	IDR 16,267,963
12	2017	D	HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR 742,073	68	1500	22.06	0.91	10.65	IDR 672,813	IDR 7,905,551
13	2017	D	HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR 742,073	76	1500	19.74	1.01	11.91	IDR 751,967	IDR 8,835,616
14	2017	C	HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR 742,073	69	1500	21.74	0.92	10.81	IDR 682,707	IDR 8,021,809

Figure 6. 17 Lease Printer Toner Cost

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
Total Salvage Value						**IDR**	**2,835,000**

Figure 6. 18 Salvage Value Form

One of the six forms that is not compulsory to be filled is salvage value cost. This form is intended only if SKPD wants to eliminate the printer exist in the SKPD. Thus, not all printer can be eliminated by the SKPD, the requirement need to be met is that the printer has been procured for at least 4 years or if it is only being used less than 4 years, it can only be eliminated only if the printer is broken down. The salvage value font will turn red and decision column will be written “Asset cannot be eliminated” if the printer is used below 4 years.

Interest Rate	8.12%

Cost	2016	2017	2018	2019	2020	2021	2022	2023	2024
Leasing Cost	IDR -	IDR 51,600,000	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Buying Cost	IDR -	IDR 11,263,000	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Maintenance	IDR -	IDR 450,000	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Toner Cost	IDR -	IDR 63,044,661	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
Salvage Value	IDR -	IDR 2,835,000	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV Buying Cost and Other Cost	IDR -	IDR (108,090,992)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV Salvage Value	IDR -	IDR (2,425,163)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
100% Buying Cost	IDR -	IDR (23,790,508)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
100% Lease Cost	IDR -	IDR (8,401,766)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV 100% Buying	IDR -	IDR (20,351,276)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
PV 100% Lease	IDR -	IDR (7,187,180)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -

NAW Proportion	IDR (12,581,720)
NAW 100% Buying	IDR (2,984,525)
NAW 100% Leasing	IDR (956,500)

2025	2026	2027	2028	2029	2030	2031	2032
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -
IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -

Figure 6. 19 Net Annual Worth

Finally, the last form need to be filled by SKPD is Net Annual Worth, in which SKPD only needs to fill the interest rate. The rest of the data will be automatically recapitulated from the document before that has been linked through formula. In this form, it will show all data starting from leasing cost, buying cost, maintenance, toner cost, and salvage value. Additionally, it will show the NAW of 3 scenarios, full buying scenario, full leasing scenario, and mixed decisions scenario. This NAW form will provide recapitulation column up to 16-year horizon planning. All the cost shows in the NAW form will be distributed annually over 16-year horizon planning.

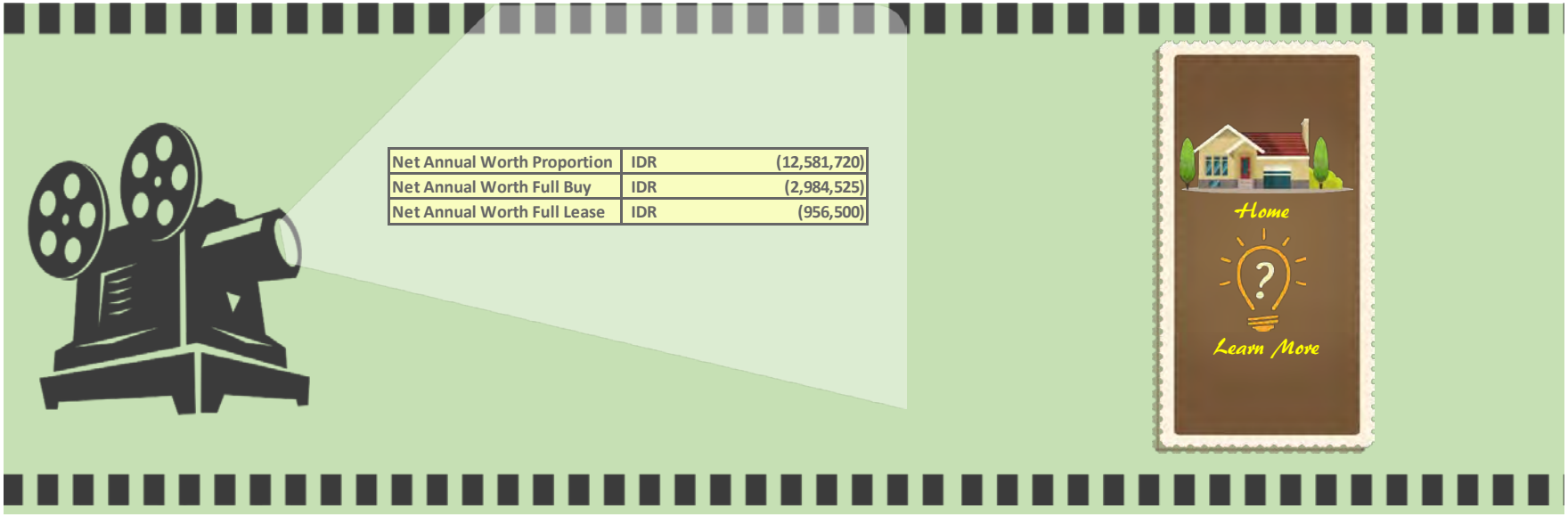

Figure 6. 20 Alternative Comparison Form

In conclusion, to ease SKPD in comparing 3 scenarios given, then all the cost will be provided in Alternative Comparison form. This form will show the cost from 3 scenarios which is distributed annually over 16-year horizon planning. It can be seen in figure 6.20, the cost is all in negative value, this happened as a result that in the scenarios most of the data is outflow data, and the only inflow is salvage value, which resulted negative value. Therefore, as has been said before that the scenarios are mutually exclusive, then SKPD can only select one scenario as the procurement decision.

6.3.3.2 Second Simulation

For the second simulation will be based on BAPPEKO existing condition, in which from the observation done, there are 49 printers exist, but it is only 31 printer operating. Thus, in second simulation will simulate the expense of BAPPEKO if buy 49 printers, lease 49 printers, buy 31 and lease 17 printers, and last is lease 31 printers and buy 17 printers. Last, the assumption used is the interest rate is 8.12%.

Working Time per day (minutes)			480		Lowest Utilization Threshold		75%					
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**	**Current Utilization Level**	**Decision**
1	Economics	HP	P1006	17	66	1219	3648	1%	15%	45%	Underutilized Printer	**Optimized current printer usage**
2	Economics	HP	P1006	17	106	1834	5472	1%	22%	67%	Underutilized Printer	**Optimized current printer usage**
3	Economics	HP	1010	12	80	1380	4200	1%	24%	73%	Underutilized Printer	**Optimized current printer usage**
4	Economics	EPSON	L800	37	40	830	2560	0%	5%	14%	Underutilized Printer	**Optimized current printer usage**
5	Economics	HP	P1566	22	63	933	2478	1%	9%	23%	Underutilized Printer	**Optimized current printer usage**
6	Secretariat	HP	P1102	18	75	1265	3747	1%	15%	43%	Underutilized Printer	**Optimized current printer usage**
7	Secretariat	EPSON	L100	27	40	873	2653	0%	7%	20%	Underutilized Printer	**Optimized current printer usage**
8	Secretariat	HP	P1102	18	30	674	1966	0%	8%	23%	Underutilized Printer	**Optimized current printer usage**
9	Secretariat	EPSON	L100	27	70	1160	3402	1%	9%	26%	Underutilized Printer	**Optimized current printer usage**
10	Secretariat	Xerox	Phaser 3435	33	20	624	1910	0%	4%	12%	Underutilized Printer	**Optimized current printer usage**
11	Secretariat	Xerox	Phaser 3160N	24	60	1128	3378	1%	10%	29%	Underutilized Printer	**Optimized current printer usage**
12	Secretariat	Xerox	Phaser 3435	33	147	2853	8384	1%	18%	53%	Underutilized Printer	**Optimized current printer usage**
13	Secretariat	HP	P1102	18	7	246	775	0%	3%	9%	Underutilized Printer	**Optimized current printer usage**
14	Physics and Infrastructures Division	Xerox	WorkCenter 3119	19	20	445	1309	0%	5%	14%	Underutilized Printer	**Optimized current printer usage**
15	Physics and Infrastructures Division	EPSON	L100	27	45	817	2525	0%	6%	19%	Underutilized Printer	**Optimized current printer usage**
16	Physics and Infrastructures Division	EPSON	L220	27	100	1925	5960	1%	15%	46%	Underutilized Printer	**Optimized current printer usage**
17	Physics and Infrastructures Division	HP	P1006	17	16	265	943	0%	3%	12%	Underutilized Printer	**Optimized current printer usage**
18	Physics and Infrastructures Division	Brother	MFC J3520	33	99	2241	6519	1%	14%	41%	Underutilized Printer	**Optimized current printer usage**
19	Physics and	EPSON	L210	27	10	234	799	0%	2%	6%	Underutilized Printer	**Optimized current printer usage**
20	Physics and Infrastructures Division	EPSON	Office Stylus T1100	30	64	1761	4947	0%	12%	34%	Underutilized Printer	**Optimized current printer usage**
21	Physics and	Brother	DCP J125	33	10	345	998	0%	2%	6%	Underutilized Printer	**Optimized current printer usage**

Figure 6. 21 Existing Printer Utilization Level

22	Physics and Infrastructures Division	EPSON	L800	37	36	815	2439	0%	5%	14%	Underutilized Printer	**Optimized current printer usage**
23	Public Welfare and Government Apparatus Division	Xerox	WorkCenter 3119	19	27.5	770	2436	0%	8%	27%	Underutilized Printer	**Optimized current printer usage**
24	Public Welfare and Government Apparatus Division	EPSON	L800	37	30	781	2462	0%	4%	14%	Underutilized Printer	**Optimized current printer usage**
25	Public Welfare and Government Apparatus Division	EPSON	L800	37	57.5	1141	3474	0%	6%	20%	Underutilized Printer	**Optimized current printer usage**
26	Public Welfare and	Xerox	Phaser 3155	24	2	139	421	0%	1%	4%	Underutilized Printer	**Optimized current printer usage**
27	Public Welfare and	HP	P1006	17	57	1396	4023	1%	17%	49%	Underutilized Printer	**Optimized current printer usage**
28	Public Welfare and Government Apparatus Division	Xerox	Phaser 3160N	24	35	872	2627	0%	8%	23%	Underutilized Printer	**Optimized current printer usage**
29	Public Welfare and Government Apparatus Division	Xerox	Phaser 3155	24	10	418	1244	0%	4%	11%	Underutilized Printer	**Optimized current printer usage**
30	Public Welfare and Government Apparatus Division	Xerox	Phaser 3155	24	20	519	1574	0%	5%	14%	Underutilized Printer	**Optimized current printer usage**
31	Public Welfare and Government Apparatus Division	HP	P1100	8	30	851	2499	1%	22%	65%	Underutilized Printer	**Optimized current printer usage**

Figure 6. 21 Existing Printer Utilization Level (cont.)

After simulating the existing printer usage in the current condition, it is known that from 31 operating printers, it is still underutilized, thus, the conclusion can be drawn from this form is that BAPPEKO cannot procure anymore additional printer for the next year. On the other hand, BAPPEKO should optimize more the printer by distributing the printing workload throughout all printers in BAPPEKO and not only focusing on several printers due to its specification. For other underutilized printer, it is suggested that BAPPEKO should proposing asset transferring, not only it can save more unimportant expense but also it can utilize more the printers. Thus, the lower bound good utilization used in the simulation is 75% following the assumption used before, but in the next simulation, the utilization threshold can be changed according to SKPD assumption, as it is being made flexible to be changed.

The checking of utilization form here is done only for alerting purpose, hoping that BAPPEKO can know the utilization level of its printers. Next, in the procurement form, it will simulate the expense of buying 41 printers, leasing, and mixed decisions.

Total Printer Brand Procured						Cost								
			Procured Printer											
Procurement Year	Brand	Type	Buy	Lease	Total	Printer Buy Cost	Buy Cost	Maintenance Cost (per printer, monthly)	Total Maintenance Cost (all printer, yearly)	Buy 100% Cost	Total Maintenance Cost (all printer, yearly) (for 100% buy decision)	Monthly Leasing Cost	Lease Cost (yearly)	Lease 100% Cost
2016	HP	LaserJet 1010	1		1	IDR 467,000	IDR 467,000	IDR 75,000	IDR 75,000	IDR 467,000	IDR 75,000	IDR 250,000	IDR -	IDR 3,000,000
2016	HP	LaserJet 1100	1		1	IDR 472,000	IDR 472,000	IDR 75,000	IDR 75,000	IDR 472,000	IDR 75,000	IDR 250,000	IDR -	IDR 3,000,000
2016	Xerox	3119	2	2	4	IDR 995,000	IDR 1,990,000	IDR 75,000	IDR 150,000	IDR 3,980,000	IDR 300,000	IDR 350,000	IDR 8,400,000	IDR 16,800,000
2016	Xerox	Phaser 3155	3		3	IDR 1,050,000	IDR 3,150,000	IDR 75,000	IDR 225,000	IDR 3,150,000	IDR 225,000	IDR 300,000	IDR -	IDR 10,800,000
2016	Xerox	Phaser 3435	2		2	IDR 3,144,000	IDR 6,288,000	IDR 75,000	IDR 150,000	IDR 6,288,000	IDR 150,000	IDR 350,000	IDR -	IDR 8,400,000
2016	Xerox	Phaser 3160N	2		2	IDR 1,545,000	IDR 3,090,000	IDR 75,000	IDR 150,000	IDR 3,090,000	IDR 150,000	IDR 350,000	IDR -	IDR 8,400,000
2016	Brother	DCP J125	1	1	2	IDR 980,000	IDR 980,000	IDR 75,000	IDR 75,000	IDR 1,960,000	IDR 150,000	IDR 450,000	IDR 5,400,000	IDR 10,800,000
2016	Brother	J3520	1		1	IDR 5,500,000	IDR 5,500,000	IDR 75,000	IDR 75,000	IDR 5,500,000	IDR 75,000	IDR 650,000	IDR -	IDR 7,800,000
2016	EPSON	L100	1		1	IDR 1,185,000	IDR 1,185,000	IDR 75,000	IDR 75,000	IDR 1,185,000	IDR 75,000	IDR 550,000	IDR -	IDR 6,600,000
2016	EPSON	L210	1		1	IDR 2,750,000	IDR 2,750,000	IDR 75,000	IDR 75,000	IDR 2,750,000	IDR 75,000	IDR 550,000	IDR -	IDR 6,600,000
2016	EPSON	L220	1	2	3	IDR 2,459,000	IDR 2,459,000	IDR 75,000	IDR 75,000	IDR 7,377,000	IDR 225,000	IDR 650,000	IDR 15,600,000	IDR 23,400,000
2016	EPSON	L800	4		4	IDR 4,650,000	IDR 18,600,000	IDR 75,000	IDR 300,000	IDR 18,600,000	IDR 300,000	IDR 550,000	IDR -	IDR 26,400,000
2016	HP	P1006	3	1	4	IDR 1,420,000	IDR 4,260,000	IDR 75,000	IDR 225,000	IDR 5,680,000	IDR 300,000	IDR 350,000	IDR 4,200,000	IDR 16,800,000
2016	HP	P1006		1	1	IDR 1,420,000	IDR -	IDR 75,000	IDR -	IDR 1,420,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	HP	P1102	1		1	IDR 1,550,000	IDR 1,550,000	IDR 75,000	IDR 75,000	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	HP	P1102	1		1	IDR 1,550,000	IDR 1,550,000	IDR 75,000	IDR 75,000	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	HP	P1102	1		1	IDR 1,550,000	IDR 1,550,000	IDR 75,000	IDR 75,000	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	HP	P1566	1		1	IDR 1,980,000	IDR 1,980,000	IDR 75,000	IDR 75,000	IDR 1,980,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	EPSON	T1100	1		1	IDR 3,500,000	IDR 3,500,000	IDR 75,000	IDR 75,000	IDR 3,500,000	IDR 75,000	IDR 750,000	IDR -	IDR 9,000,000
2016	HP	Design Jet 510	1		1	IDR 38,500,000	IDR 38,500,000	IDR 75,000	IDR 75,000	IDR 38,500,000	IDR 75,000	IDR 5,000,000	IDR -	IDR 60,000,000
2016	HP	LaserJet 1020		1	1	IDR 1,300,000	IDR -	IDR 75,000	IDR -	IDR 1,300,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	HP	DeskJet 4515		1	1	IDR 1,540,000	IDR -	IDR 75,000	IDR -	IDR 1,540,000	IDR 75,000	IDR 800,000	IDR 9,600,000	IDR 9,600,000
2016	HP	LasetJet 1102W		1	1	IDR 1,140,000	IDR -	IDR 75,000	IDR -	IDR 1,140,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	Brother	MFC 9330CDW		1	1	IDR 7,339,000	IDR -	IDR 75,000	IDR -	IDR 7,339,000	IDR 75,000	IDR 600,000	IDR 7,200,000	IDR 7,200,000
2016	EPSON	L100	2	1	3	IDR 1,185,000	IDR 2,370,000	IDR 75,000	IDR 150,000	IDR 3,555,000	IDR 225,000	IDR 550,000	IDR 6,600,000	IDR 19,800,000
2016	EPSON	LQ2180		2	2	IDR 780,000	IDR -	IDR 75,000	IDR -	IDR 1,560,000	IDR 150,000	IDR 210,000	IDR 5,040,000	IDR 5,040,000
2016	HP	P1102		1	1	IDR 1,550,000	IDR -	IDR 75,000	IDR -	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	EPSON	T1100		1	1	IDR 3,500,000	IDR -	IDR 75,000	IDR -	IDR 3,500,000	IDR 75,000	IDR 600,000	IDR 7,200,000	IDR 7,200,000
2016	EPSON	TX111		2	2	IDR 713,000	IDR -	IDR 75,000	IDR -	IDR 1,426,000	IDR 150,000	IDR 350,000	IDR 8,400,000	IDR 8,400,000
Total Printer Procured			31	18	49		IDR 102,191,000	IDR 2,175,000	IDR 2,325,000	IDR 133,459,000	IDR 3,675,000		IDR 94,440,000	IDR 308,640,000
			49											

Figure 6. 22 Printer Procurement (31 Buy and 18 Lease Scenario)

Total Printer Brand Procured						Cost								
			Procured Printer											
Procurement Year	Brand	Type	Buy	Lease	Total	Printer Buy Cost	Buy Cost	Maintenance Cost (per printer, monthly)	Total Maintenance Cost (all printer, yearly)	Buy 100% Cost	Total Maintenance Cost (all printer, yearly) (for 100% buy decision)	Monthly Leasing Cost	Lease Cost (yearly)	Lease 100% Cost
2016	HP	LaserJet 1010		1	1	IDR 467,000	IDR -	IDR 75,000	IDR -	IDR 467,000	IDR 75,000	IDR 250,000	IDR 3,000,000	IDR 3,000,000
2016	HP	LaserJet 1100		1	1	IDR 472,000	IDR -	IDR 75,000	IDR -	IDR 472,000	IDR 75,000	IDR 250,000	IDR 3,000,000	IDR 3,000,000
2016	Xerox	3119	2	2	4	IDR 995,000	IDR 1,990,000	IDR 75,000	IDR 150,000	IDR 3,980,000	IDR 300,000	IDR 350,000	IDR 8,400,000	IDR 16,800,000
2016	Xerox	Phaser 3155		3	3	IDR 1,050,000	IDR -	IDR 75,000	IDR -	IDR 3,150,000	IDR 225,000	IDR 300,000	IDR 10,800,000	IDR 10,800,000
2016	Xerox	Phaser 3435		2	2	IDR 3,144,000	IDR -	IDR 75,000	IDR -	IDR 6,288,000	IDR 150,000	IDR 350,000	IDR 8,400,000	IDR 8,400,000
2016	Xerox	Phaser 3160N		2	2	IDR 1,545,000	IDR -	IDR 75,000	IDR -	IDR 3,090,000	IDR 150,000	IDR 350,000	IDR 8,400,000	IDR 8,400,000
2016	Brother	DCP J125	1	1	2	IDR 980,000	IDR 980,000	IDR 75,000	IDR 75,000	IDR 1,960,000	IDR 150,000	IDR 450,000	IDR 5,400,000	IDR 10,800,000
2016	Brother	J3520		1	1	IDR 5,500,000	IDR -	IDR 75,000	IDR -	IDR 5,500,000	IDR 75,000	IDR 650,000	IDR 7,800,000	IDR 7,800,000
2016	EPSON	L100		1	1	IDR 1,185,000	IDR -	IDR 75,000	IDR -	IDR 1,185,000	IDR 75,000	IDR 550,000	IDR 6,600,000	IDR 6,600,000
2016	EPSON	L210		1	1	IDR 2,750,000	IDR -	IDR 75,000	IDR -	IDR 2,750,000	IDR 75,000	IDR 550,000	IDR 6,600,000	IDR 6,600,000
2016	EPSON	L220	2	1	3	IDR 2,459,000	IDR 4,918,000	IDR 75,000	IDR 150,000	IDR 7,377,000	IDR 225,000	IDR 650,000	IDR 7,800,000	IDR 23,400,000
2016	EPSON	L800		4	4	IDR 4,650,000	IDR -	IDR 75,000	IDR -	IDR 18,600,000	IDR 300,000	IDR 550,000	IDR 26,400,000	IDR 26,400,000
2016	HP	P1006	1	3	4	IDR 1,420,000	IDR 1,420,000	IDR 75,000	IDR 75,000	IDR 5,680,000	IDR 300,000	IDR 350,000	IDR 12,600,000	IDR 16,800,000
2016	HP	P1006	1		1	IDR 1,420,000	IDR 1,420,000	IDR 75,000	IDR 75,000	IDR 1,420,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	HP	P1102		1	1	IDR 1,550,000	IDR -	IDR 75,000	IDR -	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	HP	P1102		1	1	IDR 1,550,000	IDR -	IDR 75,000	IDR -	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	HP	P1102		1	1	IDR 1,550,000	IDR -	IDR 75,000	IDR -	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	HP	P1566		1	1	IDR 1,980,000	IDR -	IDR 75,000	IDR -	IDR 1,980,000	IDR 75,000	IDR 350,000	IDR 4,200,000	IDR 4,200,000
2016	EPSON	T1100		1	1	IDR 3,500,000	IDR -	IDR 75,000	IDR -	IDR 3,500,000	IDR 75,000	IDR 750,000	IDR 9,000,000	IDR 9,000,000
2016	HP	Design Jet 510		1	1	IDR 38,500,000	IDR -	IDR 75,000	IDR -	IDR 38,500,000	IDR 75,000	IDR 5,000,000	IDR 60,000,000	IDR 60,000,000
2016	HP	LaserJet 1020	1		1	IDR 1,300,000	IDR 1,300,000	IDR 75,000	IDR 75,000	IDR 1,300,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	HP	DeskJet 4515	1		1	IDR 1,540,000	IDR 1,540,000	IDR 75,000	IDR 75,000	IDR 1,540,000	IDR 75,000	IDR 800,000	IDR -	IDR 9,600,000
2016	HP	LasetJet 1102W	1		1	IDR 1,140,000	IDR 1,140,000	IDR 75,000	IDR 75,000	IDR 1,140,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	Brother	MFC 9330CDW	1		1	IDR 7,339,000	IDR 7,339,000	IDR 75,000	IDR 75,000	IDR 7,339,000	IDR 75,000	IDR 600,000	IDR -	IDR 7,200,000
2016	EPSON	L100	1	2	3	IDR 1,185,000	IDR 1,185,000	IDR 75,000	IDR 75,000	IDR 3,555,000	IDR 225,000	IDR 550,000	IDR 13,200,000	IDR 19,800,000
2016	EPSON	LQ2180	2		2	IDR 780,000	IDR 1,560,000	IDR 75,000	IDR 150,000	IDR 1,560,000	IDR 150,000	IDR 210,000	IDR -	IDR 5,040,000
2016	HP	P1102	1		1	IDR 1,550,000	IDR 1,550,000	IDR 75,000	IDR 75,000	IDR 1,550,000	IDR 75,000	IDR 350,000	IDR -	IDR 4,200,000
2016	EPSON	T1100	1		1	IDR 3,500,000	IDR 3,500,000	IDR 75,000	IDR 75,000	IDR 3,500,000	IDR 75,000	IDR 600,000	IDR -	IDR 7,200,000
2016	EPSON	TX111	2		2	IDR 713,000	IDR 1,426,000	IDR 75,000	IDR 150,000	IDR 1,426,000	IDR 150,000	IDR 350,000	IDR -	IDR 8,400,000
Total Printer Procured			18	31	49		IDR 31,268,000	IDR 2,175,000	IDR 1,350,000	IDR 133,459,000	IDR 3,675,000		IDR 214,200,000	IDR 308,640,000
			49											

Figure 6. 23 Printer Procurement (18 Buy and 31 Lease Scenario)

Figure 6.22 and 6.23 shows the procurement form that simulating the existing printers in BAPPEKO. The simulation is made for 49 printers, for Figure 6.22 it is simulating if the decision made for buying 31 printers and leasing 18 printers. In this scenario, the needs of 31 printers are fully procured by buying as 18 printers is an idle printer that will be leased by BAPPEKO. On the other hand, in Figure 6.23, the needs of 31 printers are fully procured by leasing as there will be 18 printers that are idle. The determination of 31 operating printers and 18 printers in this simulation is based on the interview and observation done in the real condition of BAPPEKO.

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	2016		HP	LaserJet 1010	Genuine Black HP 12A Toner Cartridge - (Q2612A)	IDR 925,879	80	2000	25	0.80	9.40	IDR 740,703	IDR 8,703,263
2	2016		HP	LaserJet 1100	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879	30	1600	53.33333333	0.38	4.41	IDR 313,455	IDR 3,683,092
3	2016		Xerox	3119	Black Xerox 013R00625 Toner Cartridge	IDR 524,779	20	3000	150	0.13	1.57	IDR 69,971	IDR 822,154
4	2016		Xerox	3119	Black Xerox 013R00625 Toner Cartridge	IDR 524,779	28	3000	107.1428571	0.19	2.19	IDR 97,959	IDR 1,151,015
5	2016		Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	2	2500	1250	0.02	0.19	IDR 35,500	IDR 417,127
6	2016		Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	10	2500	250	0.08	0.94	IDR 177,501	IDR 2,085,636
7	2016		Xerox	Phaser 3155	Fuji Xerox 108R00909	IDR 2,218,762	20	2500	125	0.16	1.88	IDR 355,002	IDR 4,171,273
8	2016		Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	20	10000	500	0.04	0.47	IDR 28,602	IDR 336,075
9	2016		Xerox	Phaser 3435	High Capacity Black Xerox 106R01415 Toner Cartridge	IDR 715,054	147	10000	68.02721088	0.29	3.45	IDR 210,226	IDR 2,470,154
10	2016		Xerox	Phaser 3160N	Fuji Xerox 108R00909	IDR 2,218,762	60	2500	41.66666667	0.48	5.64	IDR 1,065,006	IDR 12,513,818
11	2016		Xerox	Phaser 3160N	Fuji Xerox 108R00909	IDR 2,218,762	35	2500	71.42857143	0.28	3.29	IDR 621,253	IDR 7,299,727
12	2016		Brother	DCP J125	Black Brother LC985BK Ink Cartridge (LC-985BK Inkjet Printer Cartridge)	IDR 81,628	10	300	30	0.67	7.83	IDR 54,419	IDR 639,419
13	2016		Brother	J3520	Brother LC-569XL High Yield Black Ink Cartridge	IDR 1,779,524	99	2400	24.24242424	0.83	9.69	IDR 1,468,107	IDR 17,250,261
14	2016		EPSON	L100	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR 75,000	40	4000	100	0.20	2.35	IDR 15,000	IDR 176,250
15	2016		EPSON	L210	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR 75,000	10	4000	400	0.05	0.59	IDR 3,750	IDR 44,063
16	2016		EPSON	L220	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR 75,000	100	4000	40	0.50	5.88	IDR 37,500	IDR 440,625
17	2016		EPSON	L800	C13T673199 (Black L800 Ink Bottle)	IDR 134,000	40	9900	247.5	0.08	0.95	IDR 10,828	IDR 127,232

Figure 6. 24 Toner Cost for 31 Utilized Printer

18	2016		EPSON	L800	C13T673199 (Black L800 Ink Bottle)	IDR	134,000	36	9900	275	0.07	0.85	IDR	9,745	IDR	114,509
19	2016		EPSON	L800	C13T673199 (Black L800 Ink Bottle)	IDR	134,000	30	9900	330	0.06	0.71	IDR	8,121	IDR	95,424
20	2016		EPSON	L800	C13T673199 (Black L800 Ink Bottle)	IDR	134,000	58	9900	170.6896552	0.12	1.38	IDR	15,701	IDR	184,487
21	2016		HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR	742,073	66	1500	22.72727273	0.88	10.34	IDR	653,024	IDR	7,673,035
22	2016		HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR	742,073	106	1500	14.1509434	1.41	16.61	IDR	1,048,797	IDR	12,323,359
23	2016		HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR	742,073	16	1500	93.75	0.21	2.51	IDR	158,309	IDR	1,860,130
24	2016		HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR	742,073	57	1500	26.31578947	0.76	8.93	IDR	563,975	IDR	6,626,712
25	2016		HP	P1006	Genuine Black HP 35A Toner Cartridge - (HP CB435A)	IDR	742,073		1500							
26	2016		HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR	835,879	75	1600	21.33333333	0.94	11.02	IDR	783,637	IDR	9,207,730
27	2016		HP	P1102	Genuine Black HP 85A	IDR	835,879	30	1600	53.33333333	0.38	4.41	IDR	313,455	IDR	3,683,092
28	2016		HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR	835,879	7	1600	228.5714286	0.09	1.03	IDR	73,139	IDR	859,388
29	2016		HP	P1566	Genuine Black HP 78A Toner Cartridge - (CE278A Laser Printer Cartridge)	IDR	948,141	63	2100	33.33333333	0.60	7.05	IDR	568,885	IDR	6,684,394
30	2016		EPSON	T1100	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR	835,879	64	1600	25	0.80	9.40	IDR	668,703	IDR	7,857,263
31	2016		EPSON	L100	C13T664100 (Black 70ml	IDR	75,000	70	4000	57.14285714	0.35	4.11	IDR	26,250	IDR	308,438
32	2016		EPSON	L100	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR	75,000	45	4000	88.88888889	0.23	2.64	IDR	16,875	IDR	198,281
Total													IDR	10,213,398	IDR	120,007,424

Figure 6. 24 Toner Cost for 31 Utilized Printer (cont.)

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	2016		Xerox	3119	Black Xerox 013R00625 Toner Cartridge	IDR 524,779		3000					
2	2016		Xerox	3119	Black Xerox 013R00625 Toner Cartridge	IDR 524,779		3000					
3	2016		Brother	DCP J125	Black Brother LC985BK Ink Cartridge (LC-985BK Inkjet Printer Cartridge)	IDR 81,628		300					
4	2016		EPSON	L220	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR 75,000		4000					
5	2016		EPSON	L220	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR 75,000		4000					
6	2016		HP	LaserJet 1020	Genuine Black HP 12A Toner Cartridge - (Q2612A)	IDR 925,879		2000					
7	2016		HP	DeskJet 4515	HP 678 Black Ink Cartridge CZ107AA	IDR 169,264		235					
8	2016		HP	LasetJet 1102W	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879		1600					
9	2016		Brother	MFC 9330CDW	Black Brother TN-241BK Toner Cartridge (Replaces TN241BK Laser Printer Cartridge)	IDR 417,273		2500					
10	2016		EPSON	L100	C13T664100 (Black 70ml Genuine Ink Bottle)	IDR 75,000		4000					
11	2016		HP	P1102	Genuine Black HP 85A Toner Cartridge - (CE285A Laser Printer Cartridge)	IDR 835,879		1600					
12	2016		EPSON	T1100	Black Cartridge (T1051)	IDR 115,000		255					
13	2016		EPSON	TX111	Black Cartridge (T1051)	IDR 115,000		255					
14	2016		EPSON	TX111	Black Cartridge (T1051)	IDR 115,000		255					
Total												IDR -	IDR -

Figure 6. 25 Toner Cost for 18 Idle Printer

Next, is the toner form, in this form, both 31 buy or 31 lease printers and will have the same form, as the scenario is differentiated by using operating and idle criteria. The cost of toner will only be filled for the operating printer whether it is buy or lease. In case the printers are idle, the toner cost of the printers will be left blank because it has no utilization of the printers itself, which make there will be also no expense for the scenario.

Interest Rate	8.12%

Cost	2016	2017	2018	2019	2020
Leasing Cost	IDR 94,440,000	IDR -	IDR -	IDR -	IDR -
Buying Cost	IDR 102,191,000	IDR -	IDR -	IDR -	IDR -
Maintenance	IDR 2,325,000	IDR -	IDR -	IDR -	IDR -
Toner Cost	IDR 120,007,424	IDR -	IDR -	IDR -	IDR -
Salvage Value	IDR -	IDR -	IDR -	IDR -	IDR -
PV Buying Cost and Other Cost	IDR (295,008,716)	IDR -	IDR -	IDR -	IDR -
PV Salvage Value	IDR -	IDR -	IDR -	IDR -	IDR -
100% Buying Cost	IDR (29,274,284)	IDR -	IDR -	IDR -	IDR -
100% Lease Cost	IDR (35,137,143)	IDR -	IDR -	IDR -	IDR -
PV 100% Buying	IDR (27,075,735)	IDR -	IDR -	IDR -	IDR -
PV 100% Lease	IDR (32,498,283)	IDR -	IDR -	IDR -	IDR -
NAW Mixed Decision	IDR (33,585,289)				
NAW 100% Buying	IDR (3,332,733)				
NAW 100% Leasing	IDR (4,000,191)				

Figure 6. 26 Net Annual Worth of 31 Buy and 18 Lease Printers

Interest Rate	8.12%

Cost	2016	2017	2018	2019	2020
Leasing Cost	IDR 214,200,000	IDR -	IDR -	IDR -	IDR -
Buying Cost	IDR 31,268,000	IDR -	IDR -	IDR -	IDR -
Maintenance	IDR 1,350,000	IDR -	IDR -	IDR -	IDR -
Toner Cost	IDR -	IDR -	IDR -	IDR -	IDR -
Salvage Value	IDR -	IDR -	IDR -	IDR -	IDR -
PV Buying Cost and Other Cost	IDR (228,281,539)	IDR -	IDR -	IDR -	IDR -
PV Salvage Value	IDR -	IDR -	IDR -	IDR -	IDR -
100% Buying Cost	IDR (29,274,284)	IDR -	IDR -	IDR -	IDR -
100% Lease Cost	IDR (35,137,143)	IDR -	IDR -	IDR -	IDR -
PV 100% Buying	IDR (27,075,735)	IDR -	IDR -	IDR -	IDR -
PV 100% Lease	IDR (32,498,283)	IDR -	IDR -	IDR -	IDR -
NAW Mixed Decision	IDR (25,988,729)				
NAW 100% Buying	IDR (3,332,733)				
NAW 100% Leasing	IDR (4,000,191)				

Figure 6. 27 Net Annual Worth of 18 Buy and 31 Lease Printers

Net Annual Worth form will recapitulate the data inputted in the form before, the only data need to be inputted manually is the interest rate. In this simulation, the interest rate will be used is 8.12% following the BI Rate. As stated before, this simulation of existing condition will consider four scenarios, which are, full leasing of 49 printers, full buying, 31 buy and 18 lease, and 18 buy and 31 lease. From figure 6.26 and 6.27, it can be seen that there is no changes of NAW between full buying and full leasing expense with each value respectively IDR 3,332,733 and IDR 4,000,191. The only changes are only in the mixed decisions, in which the analysis of the alternatives will be discussed deeper in the alternative comparisons form.

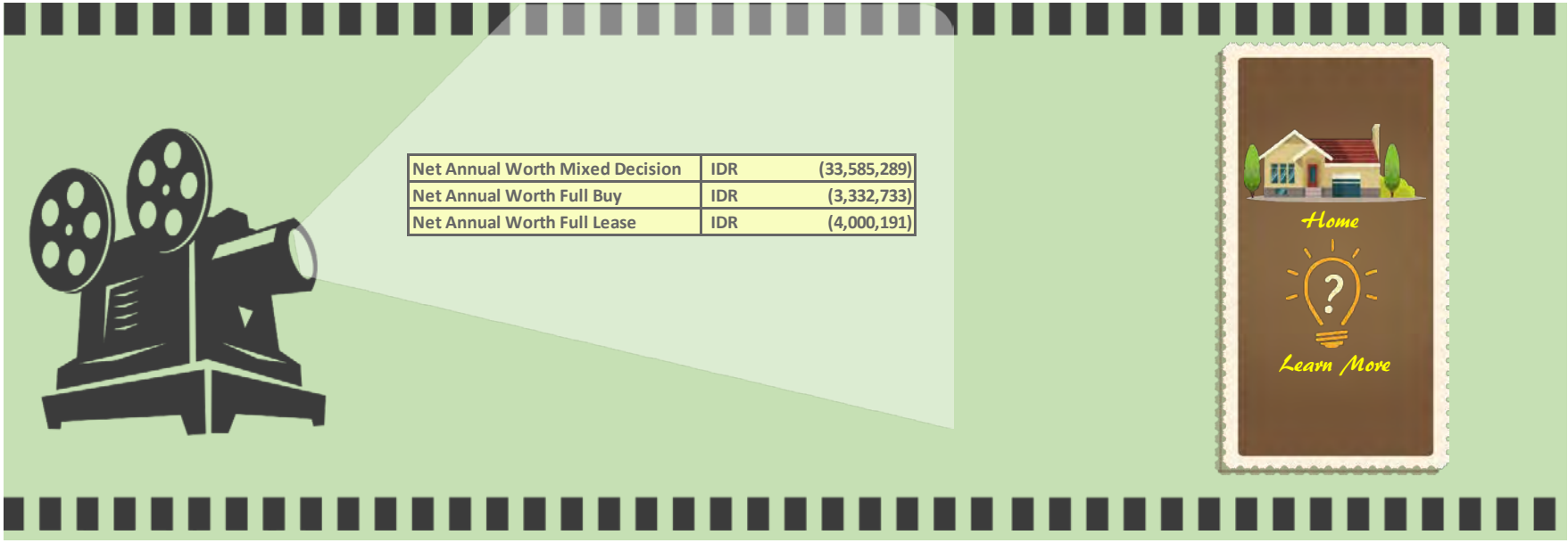

Figure 6. 28 Alternative Comparisons for 31 Buy and 18 Lease Printers

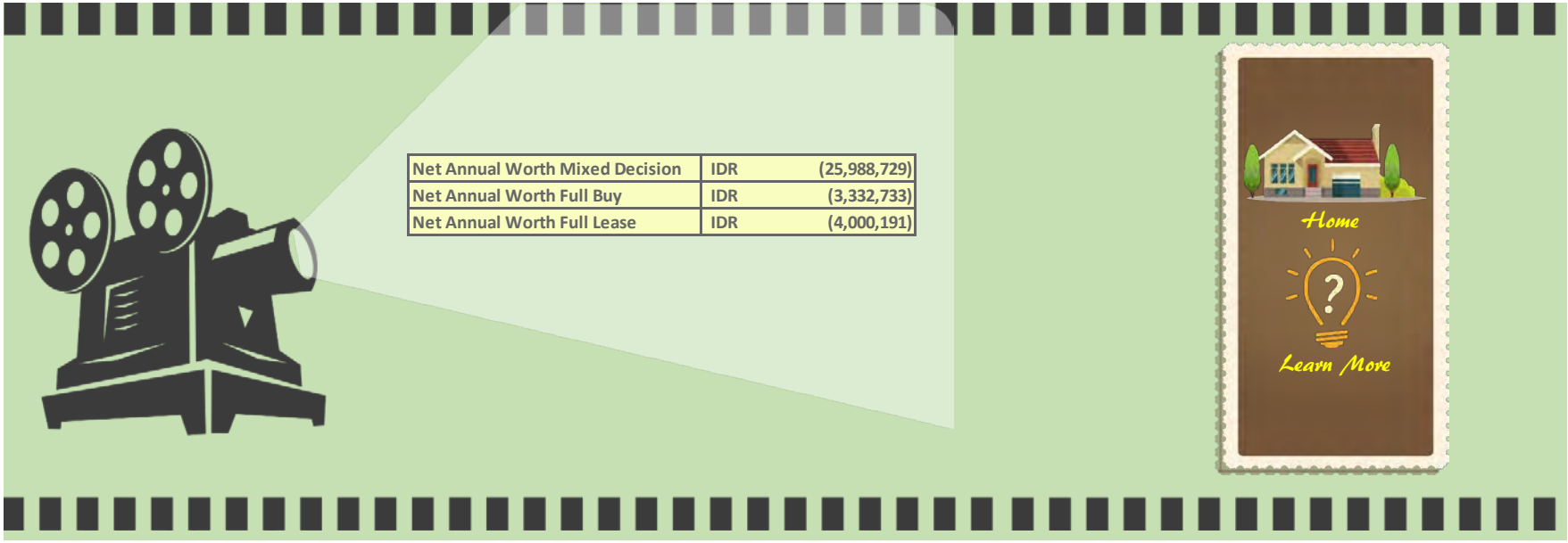

Figure 6. 29 Alternative Comparisons for 18 Buy and 31 Lease Printers

Last, in the Printer Management Model, it shows the comparison between mixed decisions, full buying, and full leasing decision. From what has been discussed before, it shows no difference of full leasing and full buying NAW between 31 buy printers scenario and 31 lease printers scenario. The scenario only affected in mixed decisions. It can be seen in figure 6.28 and 6.29 that there is a deviation of IDR 7,596,560 in which the more beneficial scenario is by buying 18 printers and leasing 31 printers. This results happened as the effect of the toner or ink cost that is expensed in buying 31 printers. Because if BAPPEKO buy more printers, then it will expense more for buying the toner replacement and doing maintenance, but if they lease more, then BAPPEKO does not have to worry about the toner and maintenance cost, as it has been covered by 3rd party that providing the service. From overall scenario, the most beneficial scenario is full buying for existing BAPPEKO condition. Full buying become the most beneficial scenario as the result of expensive plotter monthly leasing cost compared to buying plotter. Thus, the result got from the simulation is not an exact decision, it only acts as one of the consideration and calculation of the cost, the procurement is once again returned to the related SKPD by adjusting with the condition in the SKPD.

6.3.4 Asset Procurement Request Procedure

Printer Procurement System made which is used for managing the asset in Surabaya City Government offices, hopefully will then be integrated with SIMBADA system for the asset procurement. Thus, after the printer needs has been simulated through the Printer Procurement System made, then SKPD will input the procurement request to SIMBADA following the flowchart of asset procurement request shows in Figure 6.30.

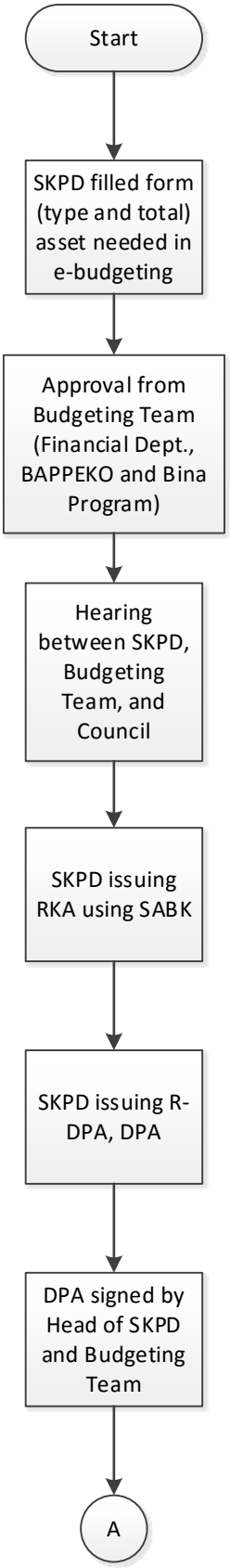

Figure 6. 30 Asset Procurement Procedure

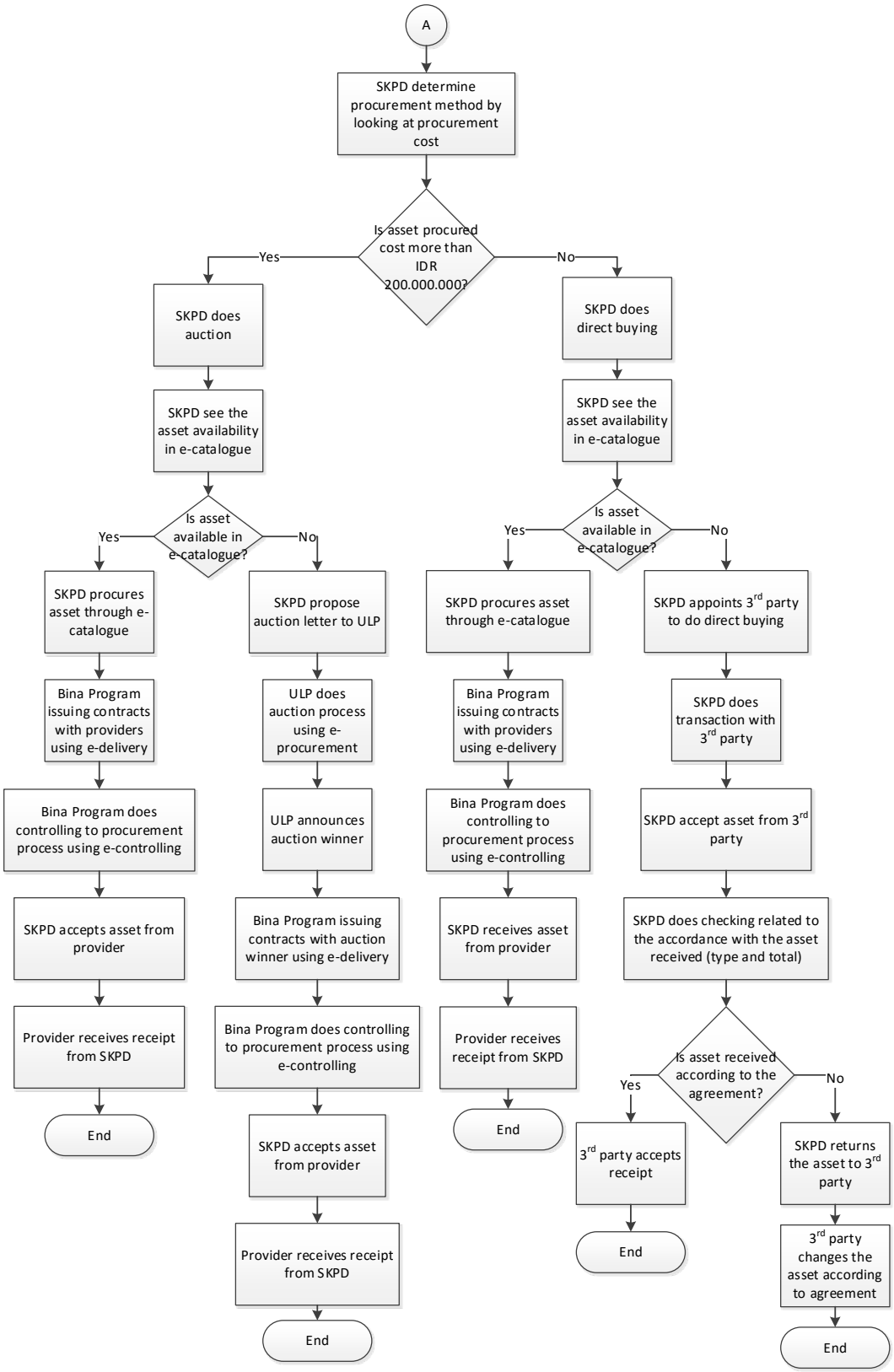

Figure 6. 30 Asset Procurement Procedure (cont.)

Figure 6.30 shows the existing asset procurement request procedure in which as stated before, it will be filled once the needs of printer has been run in Printer Procurement System. The needs of printer that has been simulated through the system will be filled in e-budgeting form in SIMBADA system. Then, after the approval of asset procuring has been issued, it is then decided how the printer procurement being done. If the procurement cost (in this case is buying) is more than IDR 200,000,000 then SKPD will use auction method, but if it is less than IDR 200,000,000 then SKPD will do direct buying from e-catalogue. If in case, the asset wants to be procured is not available in e-catalogue, then SKPD will appoint 3rd party to do direct buying according to the agreement made.

6.4 Do

According to the PDCA Cycle, do cycle will provide the form related to the printer usage, printer failure form, printer maintenance form, and SIMBADA database and interface design. The form made which is related to the usage is important in order for SKPD to check the printer utilization in the SKPD itself. The checking made is meant to check the utilization level of the printer whether it is being underutilized or over utilized. The form is also important as the evaluation method for SKPD before it wants to procure new printer, as if the utilization is still underutilized, then the procurement cannot be made. The failure and maintenance form is also important to support the good procurement system in Surabaya City Government offices, where it can be used as evaluation of printer usage. If certain type of printer always occur failure, then it can be concluded that the type of printer is not reliable and better not to be procured in the next procurement. Aside from it, from the form also can be known how user operated the printer, whether it has been operated properly or not.

Table 6. 8 Printer Usage Form

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%

Table 6.8 shows the printer usage form, in which this form will be used by SKPD to measure the utilization level of the printer usage. In calculating the printer utilization, user only needs to input the printer printing speed, working time, and total daily printing. After the data needed is inputted to the form, it will automatically calculate the printer utilization level of evaluated printer.

Table 6. 9 Printer Failure Form

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

Table 6. 10 Printer Maintenance Form

No	Date	Section	Printer Unit Code	Printer Procured Year	Maintained Part	Cost	Note

Table 6.9 shows the printer failure form and table 6.10 shows printer maintenance form, where in this form it will recapitulate the failure occurs in certain type of printer and how many time does the maintenance done in order to maintain the quality of printer. The historical data collected from this form is important to be used as evaluation method of the printer. The evaluation can be made regarding the data collected is related to the printer reliability and user operation method. In the printer failure form, if certain printer always occur failure although it has been regularly maintained, then it means that the printer is not reliable enough to be used in the SKPD to do the printing activities charged upon it. Next, the other conclusion can be made is that, if the printer is regularly maintained and yet occurs many same failures over the time, it can be concluded that there is error/mistake on the human/operator who operated the printer.

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ATTACHMENTS

BAPPEKO Printer Validation Form

Room	Object Name	Brand	Type	Total	Year	Function	Connection	Printer Type	Status
Staf Kesra	Printer	HP Laser Jet	P1006	1	2007	Single Function	Cable	Laser Jet	Exist
Staf Sekretariat	Printer	HP Laser Jet	1300	1	2007	Single Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	HP Laser Jet	1010	1	2008	Single Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	HP Laser Jet	P1006	3	2008	Single Function	Cable	Laser Jet	Exist
Staf Fisik & Prasa	Printer	HP Laser Jet	P1006	1	2008	Single Function	Cable	Laser Jet	Exist
Staf Fisik & Prasa	Printer	HP Laser Jet	1020	1	2008	Single Function	Cable	Laser Jet	Not operated
Staf Fisik & Prasa	Printer	HP Laser Jet	1010	1	2008				Returned
Staf Kesra	Printer	XEROX	3119	2	2009	Multi Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	XEROX	3119	1	2009	Multi Function	Cable	Laser Jet	Only Scan
Staf Ekonomi	Printer	HP Color	CP1215	1	2009				Returned
Staf Fisik & Prasa	Printer	XEROX	3119	1	2009	Single Function	Cable	Laser Jet	Exist
Staf Sekretariat	Printer	EPSON	LQ2180	2	2010	Single Function	Cable	Dot Matrix	Exist
Staf Ekonomi	Printer	HP Laser Jet	P1566	1	2010	Single Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	EPSON	L100	1	2010	Single Function	Cable	Ink Jet	Brokedown (2 month)
Staf Fisik & Prasa	Printer	EPSON Stylus	TX III	1	2010	Multi Function	Cable	Ink Jet	Not operated

Room	Object Name	Brand	Type	Total	Year	Function	Connection	Printer Type	Status
Staf Fisik & Prasa	Printer	EPSON Stylus	TX III	1	2010	Multi Function	Cable	Ink Jet	Exist
Staf Fisik & Prasa	Printer	EPSON Stylus	T1100	1	2010	Single Function	Cable	Ink Jet	Exist
Staf Kesra	Printer	EPSON	L800	1	2011	Single Function	Cable	Ink Jet	Exist
Staf Sekretariat	Printer	Brother DCP	J125	2	2011	Multi Function	Cable	Ink Jet	1 printer eliminated
Staf Sekretariat	Printer	Xerox Phaser	3435	2	2011	Single Function	Cable	Laser Jet	Exist
Staf Sekretariat	Printer	Canon IP	2770	1	2011				Returned
Staf Sekretariat	Printer	HP Laser Jet	P1102	1	2011	Single Function	Cable	Laser Jet	Exist
Staf Ekonomi	Printer	EPSON	L800	1	2011	Single Function	Cable	Ink Jet	Exist
Staf Fisik & Prasa	Printer	EPSON	L210	1	2011	Multi Function	Cable	Ink Jet	Exist
Staf Fisik & Prasa	Printer	EPSON	L800	2	2011	Single Function	Cable	Ink Jet	Exist
Staf Fisik & Prasa	Printer	Brother DCP	J125	1	2011	Multi Function	Cable	Ink Jet	Exist
Staf Kesra	Printer	XEROX Phaser	3160N	1	2012	Single Function	Cable	Laser Jet	Exist
R.Klinik + Rapat	Printer	HP Laser Jet	P1102	1	2012	Single Function	Cable	Laser Jet	Exist
Staf Sekretariat	Printer	EPSON	L100	2	2012	Single Function	Cable	Ink Jet	Exist
Staf Sekretariat	Printer	EPSON	L100	1	2012	Single Function	Cable	Ink Jet	Eliminated on period Oct 2015
Staf Sekretariat	Printer	XEROX	3160N	1	2012	Single Function	Cable	Laser Jet	Exist

Room	Object Name	Brand	Type	Total	Year	Function	Connection	Printer Type	Status
Staf Ekonomi	Printer	EPSON	L100	1	2012	Single Function	Cable	Ink Jet	Eliminated on period Feb 2016
Staf Fisik & Prasa	Printer	EPSON	L100	1	2012	Single Function	Cable	Ink Jet	Exist
Staf Kesra	Printer	XEROX Phaser	3155	3	2013	Single Function	Cable	Laser Jet	Exist
Staf Sekretariat	Printer	HP Laser Jet	P1102	1	2014	Single Function	Cable	Laser Jet	Exist
Staf Kesra	Printer	HP Laser Jet	P1102	1	2015	Single Function	Cable	Laser Jet	Exist
Staf Kesra	Printer	HP Deskjet	4515	1	2015	Multi Function	Wireless	Laser Jet	Exist
Staf Sekretariat	Printer	Brother MFC	9330CDW	1	2015	Multi Function	Wireless	Laser Jet	Exist
Staf Fisik & Prasa	Printer	EPSON	L220	3	2015	Multi Function	Cable	Ink Jet	Exist
Staf Fisik & Prasa	Printer	Brother MFC	J3520	1		Multi Function	Wireless	Ink Jet	Exist
Staf Fisik & Prasa	Printer	HP Laser Jet	1102W	1		Single Function	Cable	Laser Jet	Exist
Staf Fisik & Prasa	Printer	HP Design Jet	510	1		Single Function	Cable	Ink Jet	Exist
Kasubid LH	Printer	Epson Stylus	T1100	1		Single Function	Cable	Ink Jet	Exist

Illustration of Printer Layout on 1st Floor

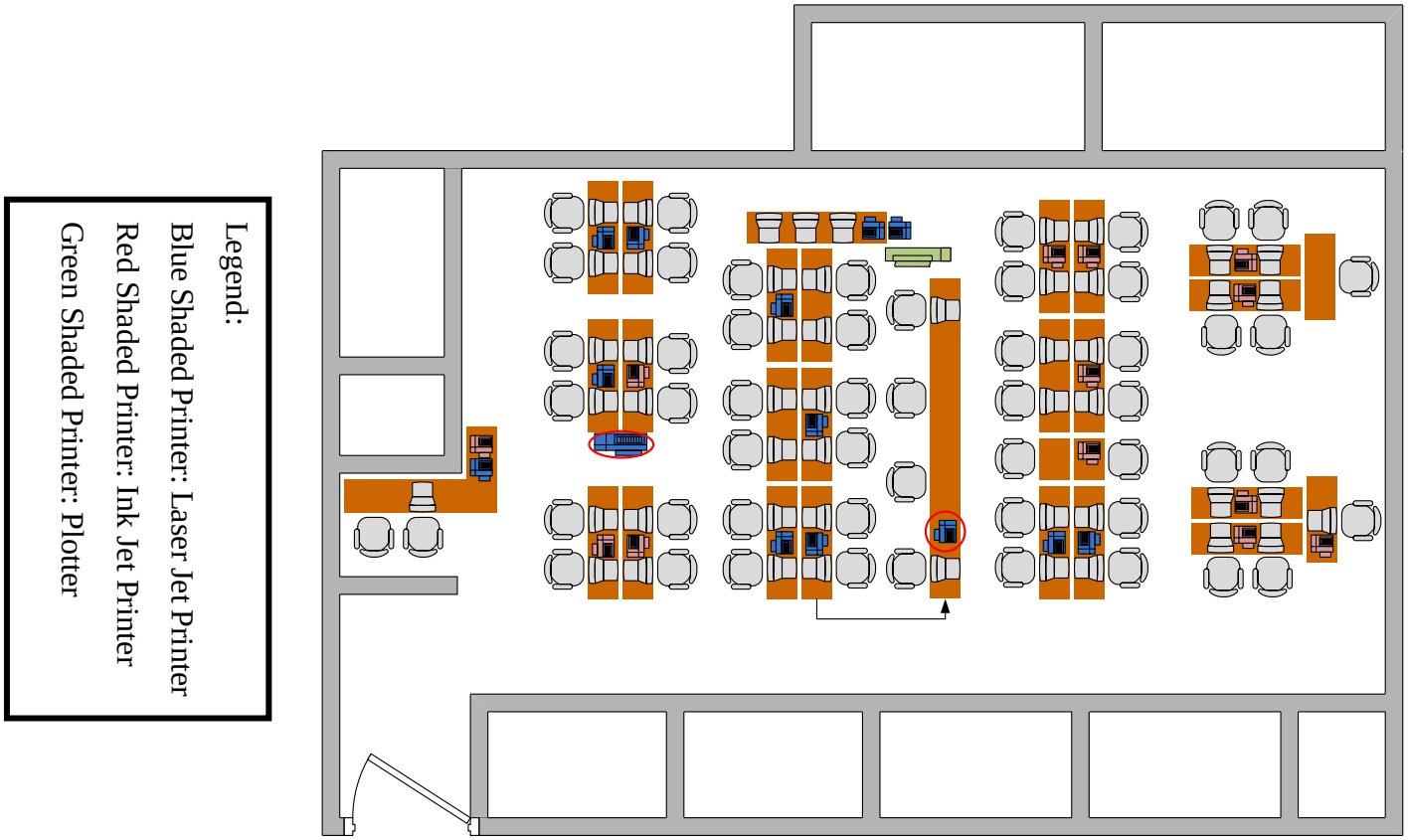
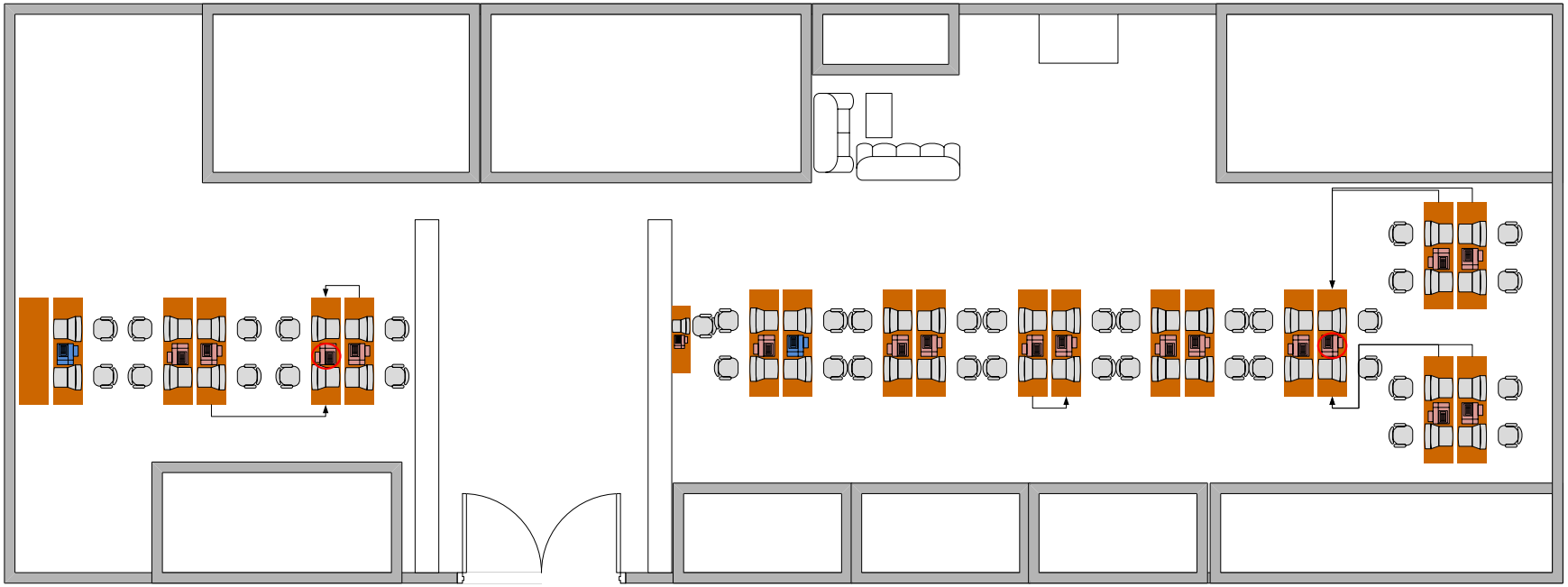


Illustration of Printer Layout on 2nd Floor



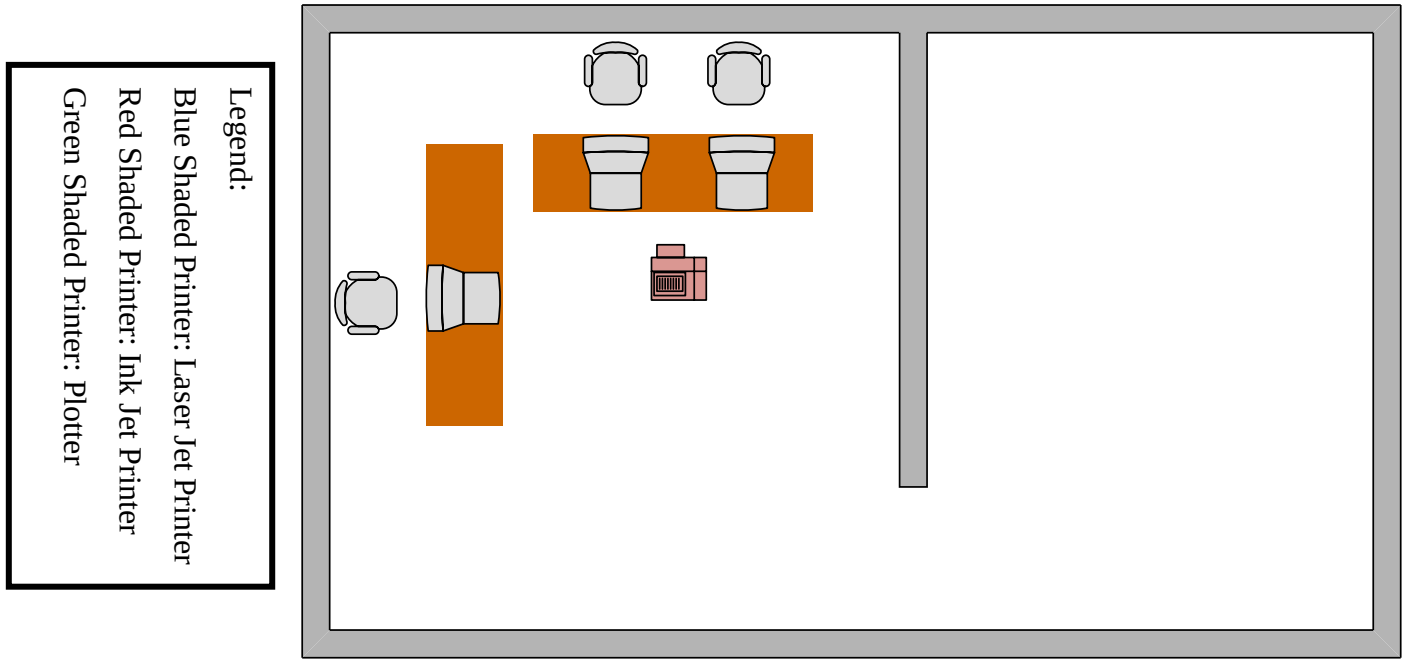
Legend:

Blue Shaded Printer: Laser Jet Printer

Red Shaded Printer: Ink Jet Printer

Green Shaded Printer: Plotter

Illustration of Printer Layout on 3rd Floor



Monte Carlo Simulation of Printer Printing Frequency

*Note: Green shaded cell shows random number generated based on historical data

Orange shaded cell shows printing frequency based on the result of Monte Carlo Simulation

Economics Division

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	66	0.17	0.00	0.17	0-17
2	61	0.17	0.17	0.33	18-32
3	58	0.17	0.33	0.50	33-49
4	59	0.17	0.50	0.67	50-66
5	69	0.17	0.67	0.83	67-82
6	45	0.17	0.83	1.00	83-99
7	66	0.141973011			
8	45	0.908582764			
9	61	0.266309559			
10	61	0.173924626			
11	66	0.026236057			
12	69	0.786838982			
13	66	0.001197137			
14	69	0.747133995			
15	69	0.672130236			
16	58	0.429536086			
17	66	0.137643443			
18	61	0.298570731			
19	45	0.957669252			

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
20	59	0.535649918			
21	69	0.807168226			
22	59	0.619699659			
23	66	0.027744543			
24	45	0.86386573			
25	61	0.329498564			
26	58	0.369812587			
27	66	0.069332627			
28	69	0.80337794			
29	45	0.894792463			
30	69	0.729218693			
31	61	0.206910799			
32	45	0.866534255			
33	69	0.830039655			
34	66	0.162986145			
35	45	0.927355158			
36	59	0.639445181			
37	66	0.153957141			
38	59	0.528557944			
39	69	0.724836585			
40	58	0.491519327			
41	45	0.857347394			
42	59	0.619509572			
43	61	0.318872394			

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
44	61	0.293648455			
45	66	0.124899809			
46	66	0.007166493			
47	69	0.73410703			
48	58	0.3534262			
49	69	0.703855841			
50	66	0.020676351			
51	61	0.245297574			
52	59	0.507851798			
53	61	0.232140505			
54	58	0.467865013			
55	59	0.603361081			
56	66	0.002359594			
57	58	0.364897603			
58	69	0.797058808			
59	45	0.97581486			
60	69	0.775302625			

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	106	0.17	0.00	0.17	0-17
2	100	0.17	0.17	0.33	18-32
3	90	0.17	0.33	0.50	33-49
4	86	0.17	0.50	0.67	50-66
5	115	0.17	0.67	0.83	67-82

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
6	60	0.17	0.83	1.00	83-99
7	60	0.909896271			
8	86	0.50313838			
9	100	0.252608961			
10	60	0.870962283			
11	100	0.250901377			
12	90	0.357598759			
13	60	0.898603815			
14	86	0.536471397			
15	60	0.971662786			
16	86	0.654836639			
17	106	0.154885183			
18	106	0.028177131			
19	86	0.616498625			
20	60	0.865042942			
21	100	0.323403006			
22	60	0.986201901			
23	86	0.649974419			
24	86	0.661689963			
25	86	0.507306685			
26	115	0.771626415			
27	115	0.811844882			
28	106	0.118201075			
29	100	0.295569806			

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
30	86	0.643653232			
31	106	0.084062963			
32	60	0.913709163			
33	106	0.068865615			
34	115	0.748274701			
35	90	0.347316275			
36	115	0.813498974			
37	115	0.701711001			
38	60	0.855469721			
39	106	0.111027271			
40	106	0.116631304			
41	90	0.38647065			
42	115	0.713618152			
43	86	0.541132606			
44	90	0.483994112			
45	90	0.342621322			
46	100	0.323759872			
47	115	0.745773847			
48	60	0.954588009			
49	90	0.410182813			
50	115	0.816381482			
51	106	0.124523491			
52	60	0.929577209			
53	86	0.520439066			

HP P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
54	90	0.43455964			
55	100	0.282625951			
56	90	0.408172823			
57	115	0.756564115			
58	106	0.074498854			
59	86	0.594873845			
60	60	0.947584997			

HP 1010	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	80	0.17	0.00	0.17	0-17
2	75	0.17	0.17	0.33	18-32
3	85	0.17	0.33	0.50	33-49
4	90	0.17	0.50	0.67	50-66
5	60	0.17	0.67	0.83	67-82
6	45	0.17	0.83	1.00	83-99
7	90	0.504548377			
8	80	0.122663697			
9	85	0.423873413			
10	80	0.157235882			
11	60	0.675741985			
12	75	0.262694168			
13	45	0.859021572			
14	90	0.625568201			
15	60	0.678803654			

HP 1010	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
16	45	0.925814134			
17	45	0.919279874			
18	85	0.495884778			
19	45	0.91944604			
20	60	0.699993563			
21	45	0.935221531			
22	60	0.777693238			
23	80	0.09213999			
24	45	0.834921676			
25	45	0.994391491			
26	80	0.125123378			
27	75	0.276164454			
28	45	0.903845193			
29	45	0.868008703			
30	45	0.979233165			
31	80	0.051806557			
32	80	0.041710868			
33	80	0.051651475			
34	80	0.099163433			
35	75	0.287822517			
36	90	0.509845847			
37	85	0.382522814			
38	75	0.179255629			
39	45	0.926056239			

HP 1010	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
40	90	0.63486853			
41	80	0.005716155			
42	75	0.327700431			
43	60	0.686534103			
44	85	0.442522606			
45	90	0.632211851			
46	80	0.082270833			
47	45	0.896387944			
48	45	0.848830281			
49	75	0.31468874			
50	85	0.448245345			
51	85	0.337879219			
52	85	0.493852062			
53	90	0.564213366			
54	90	0.565047279			
55	45	0.891055633			
56	90	0.52147961			
57	60	0.803445441			
58	75	0.333010789			
59	45	0.90148042			
60	90	0.650156061			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	40	0.17	0.00	0.17	0-17
2	45	0.17	0.17	0.33	18-32
3	50	0.17	0.33	0.50	33-49
4	55	0.17	0.50	0.67	50-66
5	25	0.17	0.67	0.83	67-82
6	30	0.17	0.83	1.00	83-99
7	50	0.470606149			
8	25	0.724480299			
9	55	0.589641699			
10	40	0.045205914			
11	50	0.457872609			
12	40	0.151669638			
13	40	0.072367458			
14	45	0.262200064			
15	55	0.577890178			
16	45	0.282561573			
17	40	0.007366388			
18	30	0.870013967			
19	30	0.909219423			
20	40	0.02548568			
21	45	0.299861123			
22	45	0.170584915			
23	45	0.294592318			
24	30	0.947709769			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
25	45	0.217767606			
26	40	0.023079062			
27	30	0.985553426			
28	30	0.98914081			
29	50	0.468713101			
30	55	0.564186858			
31	40	0.081821017			
32	45	0.180909365			
33	40	0.086180148			
34	50	0.408019019			
35	55	0.51914871			
36	25	0.795556747			
37	40	0.01257624			
38	45	0.316106104			
39	55	0.602015986			
40	45	0.229902904			
41	50	0.416507994			
42	45	0.327038702			
43	30	0.93600429			
44	30	0.859151056			
45	45	0.270046275			
46	55	0.61200411			
47	30	0.900326938			
48	30	0.901605215			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
49	50	0.467593395			
50	30	0.833470034			
51	55	0.533320527			
52	55	0.60585309			
53	25	0.727949206			
54	45	0.262047305			
55	55	0.646723836			
56	45	0.181607245			
57	55	0.649771708			
58	50	0.447558247			
59	50	0.39604917			
60	45	0.21847022			

HP LaserJet P1566	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	63	0.17	0.00	0.17	0-17
2	75	0.17	0.17	0.33	18-32
3	50	0.17	0.33	0.50	33-49
4	45	0.17	0.50	0.67	50-66
5	55	0.17	0.67	0.83	67-82
6	35	0.17	0.83	1.00	83-99
7	75	0.186288841			
8	40	0.089995193			
9	25	0.735059929			
10	50	0.378715877			

HP LaserJet P1566	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
11	50	0.476152511			
12	40	0.063235826			
13	55	0.587525211			
14	55	0.64164258			
15	40	0.071580992			
16	50	0.405087817			
17	25	0.757640588			
18	45	0.288648961			
19	30	0.981185008			
20	30	0.986475233			
21	30	0.96021262			
22	40	0.083404293			
23	50	0.485428459			
24	40	0.012558501			
25	25	0.683870214			
26	25	0.753236094			
27	50	0.343869028			
28	55	0.603984192			
29	25	0.787474083			
30	25	0.770748936			
31	25	0.667348543			
32	40	0.032853777			
33	40	0.151345375			
34	30	0.968928748			

HP LaserJet P1566	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
35	50	0.375691316			
36	30	0.952810597			
37	45	0.290453177			
38	55	0.657527108			
39	50	0.431917532			
40	45	0.267783681			
41	30	0.856178284			
42	45	0.324074228			
43	25	0.743215281			
44	45	0.210167832			
45	45	0.286109849			
46	25	0.776338011			
47	40	0.076599475			
48	50	0.418400006			
49	25	0.770625958			
50	45	0.220355331			
51	55	0.525535162			
52	50	0.367965872			
53	45	0.264171497			
54	30	0.918277364			
55	40	0.002392828			
56	45	0.18278961			
57	50	0.445834593			
58	25	0.821444233			

HP LaserJet P1566	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
59	25	0.700390981			
60	30	0.882286947			

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HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	75	0.17	0.00	0.17	0-17
2	60	0.17	0.17	0.33	18-32
3	55	0.17	0.33	0.50	33-49
4	45	0.17	0.50	0.67	50-66
5	83	0.17	0.67	0.83	67-82
6	58	0.17	0.83	1.00	83-99
7	55	0.46956047			
8	75	0.041563587			
9	55	0.462767776			
10	83	0.779028471			
11	58	0.979906909			
12	83	0.753808764			
13	60	0.213432955			
14	75	0.084626958			
15	60	0.196541846			
16	45	0.606810406			
17	75	0.141071198			
18	55	0.343470124			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
19	55	0.4918234			
20	55	0.345097123			
21	45	0.605582157			
22	45	0.565180394			
23	60	0.312854688			
24	58	0.933656073			
25	55	0.437177523			
26	58	0.917868208			
27	83	0.732634692			
28	60	0.285614859			
29	83	0.812074859			
30	75	0.135760009			
31	58	0.954373587			
32	60	0.189621217			
33	83	0.810768374			
34	83	0.734143707			
35	58	0.950310915			
36	60	0.225919256			
37	58	0.875378823			
38	55	0.402189841			
39	55	0.409112507			
40	58	0.890312911			
41	75	0.024569146			
42	45	0.605579102			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
43	83	0.800752607			
44	55	0.428125829			
45	55	0.396398863			
46	58	0.986780199			
47	83	0.696616883			
48	45	0.534794235			
49	75	0.076589262			
50	45	0.601509817			
51	83	0.792274416			
52	58	0.874411545			
53	45	0.594723293			
54	55	0.383723673			
55	83	0.782533875			
56	45	0.592571901			
57	58	0.898798408			
58	58	0.912935059			
59	45	0.540350455			
60	83	0.738183294			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	40	0.17	0.00	0.17	0-17
2	28	0.17	0.17	0.33	18-32
3	35	0.17	0.33	0.50	33-49
4	45	0.17	0.50	0.67	50-66

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
5	55	0.17	0.67	0.83	67-82
6	58	0.17	0.83	1.00	83-99
7	58	0.874972213			
8	40	0.13489278			
9	35	0.409386476			
10	35	0.401540462			
11	58	0.942836996			
12	35	0.483530351			
13	40	0.053870563			
14	28	0.214235967			
15	28	0.324671739			
16	45	0.54440306			
17	45	0.588374175			
18	55	0.667519611			
19	55	0.798991216			
20	55	0.774783538			
21	55	0.816088755			
22	45	0.510886085			
23	28	0.303940438			
24	55	0.709492707			
25	45	0.504694473			
26	55	0.681999472			
27	55	0.799293974			
28	40	0.017211607			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
29	58	0.993584634			
30	35	0.398501776			
31	28	0.167906277			
32	58	0.922894698			
33	45	0.54384568			
34	35	0.396327515			
35	55	0.715987198			
36	45	0.51786006			
37	35	0.340239572			
38	35	0.472925788			
39	55	0.819783645			
40	28	0.281778242			
41	40	0.144925618			
42	28	0.185208685			
43	55	0.794274024			
44	45	0.607770266			
45	28	0.254326358			
46	45	0.66377959			
47	40	0.039799834			
48	45	0.639370632			
49	55	0.743537475			
50	58	0.969923419			
51	45	0.636820678			
52	40	0.064099348			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
53	58	0.850080737			
54	55	0.734152167			
55	28	0.210315202			
56	35	0.419503225			
57	45	0.522753375			
58	45	0.616521862			
59	45	0.514110346			
60	55	0.775609331			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	30	0.17	0.00	0.17	0-17
2	24	0.17	0.17	0.33	18-32
3	35	0.17	0.33	0.50	33-49
4	40	0.17	0.50	0.67	50-66
5	48	0.17	0.67	0.83	67-82
6	18	0.17	0.83	1.00	83-99
7	24	0.301155841			
8	30	0.013702121			
9	40	0.50315422			
10	48	0.827696889			
11	18	0.85872847			
12	18	0.915708479			
13	30	0.016082052			
14	35	0.447095588			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
15	48	0.720109032			
16	30	0.131172293			
17	30	0.137946689			
18	40	0.526396145			
19	40	0.566322593			
20	48	0.820992065			
21	35	0.379633509			
22	30	0.042565248			
23	48	0.785087321			
24	18	0.926210251			
25	35	0.443454464			
26	18	0.841463262			
27	24	0.219458079			
28	24	0.178981173			
29	48	0.792655978			
30	30	0.077774832			
31	24	0.169654656			
32	35	0.335776034			
33	30	0.154996353			
34	40	0.601633793			
35	18	0.86622133			
36	18	0.935378068			
37	30	0.165244793			
38	48	0.676871956			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
39	40	0.566457339			
40	35	0.481349215			
41	48	0.753677111			
42	48	0.686256155			
43	48	0.756846222			
44	24	0.297793764			
45	30	0.098048429			
46	40	0.62524054			
47	40	0.501655723			
48	30	0.079326502			
49	18	0.907909178			
50	48	0.669460516			
51	24	0.225228447			
52	24	0.28759217			
53	40	0.515620436			
54	30	0.148506012			
55	40	0.583555167			
56	48	0.812547649			
57	18	0.881518161			
58	18	0.938554719			
59	24	0.283598492			
60	24	0.208042834			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	70	0.17	0.00	0.17	0-17
2	55	0.17	0.17	0.33	18-32
3	75	0.17	0.33	0.50	33-49
4	80	0.17	0.50	0.67	50-66
5	45	0.17	0.67	0.83	67-82
6	43	0.17	0.83	1.00	83-99
7	70	0.068352929			
8	43	0.89628486			
9	70	0.064517671			
10	55	0.322532453			
11	45	0.711968429			
12	43	0.996253334			
13	45	0.756022851			
14	43	0.852624622			
15	70	0.000294164			
16	75	0.353241452			
17	45	0.670447265			
18	75	0.393643958			
19	70	0.157669011			
20	43	0.903837938			
21	70	0.095325231			
22	55	0.178762995			
23	43	0.998813227			
24	45	0.804136994			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
25	70	0.015629733			
26	43	0.99908443			
27	43	0.97368841			
28	70	0.087080411			
29	45	0.790227024			
30	55	0.185936963			
31	70	0.062118218			
32	80	0.546642037			
33	75	0.423816252			
34	55	0.281438808			
35	70	0.041358658			
36	43	0.947180696			
37	70	0.165661248			
38	75	0.397049169			
39	55	0.317575699			
40	45	0.809318817			
41	55	0.289852656			
42	45	0.823188159			
43	45	0.67336698			
44	70	0.010928484			
45	43	0.861907691			
46	45	0.760725422			
47	55	0.184423063			
48	45	0.779345047			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
49	45	0.762898065			
50	43	0.994448561			
51	55	0.267165078			
52	55	0.226865041			
53	43	0.899148688			
54	70	0.008844943			
55	55	0.287946625			
56	43	0.973519543			
57	43	0.944822806			
58	70	0.108777154			
59	70	0.091238707			
60	70	0.133855947			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	20	0.17	0.00	0.17	0-17
2	8	0.17	0.17	0.33	18-32
3	10	0.17	0.33	0.50	33-49
4	15	0.17	0.50	0.67	50-66
5	25	0.17	0.67	0.83	67-82
6	30	0.17	0.83	1.00	83-99
7	8	0.206834407			
8	25	0.667311228			
9	30	0.887610222			
10	20	0.143719904			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
11	30	0.905795277			
12	8	0.251988038			
13	10	0.409639908			
14	20	0.11586383			
15	10	0.35941399			
16	20	0.015185544			
17	30	0.97927126			
18	20	0.041062884			
19	15	0.611481095			
20	270	0.165768146			
21	25	0.701328428			
22	15	0.651694571			
23	20	0.134269461			
24	30	0.908694682			
25	25	0.678553082			
26	30	0.981140771			
27	25	0.739809041			
28	15	0.502416449			
29	30	0.876910747			
30	30	0.996608079			
31	8	0.25675974			
32	30	0.893740247			
33	20	0.161500377			
34	15	0.656436386			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
35	25	0.672716039			
36	30	0.891713793			
37	15	0.588751658			
38	15	0.614149671			
39	25	0.754655476			
40	275	0.736591272			
41	15	0.511332397			
42	30	0.897064382			
43	8	0.172723251			
44	15	0.594082228			
45	25	0.731562288			
46	8	0.230710907			
47	25	0.817266048			
48	15	0.564543138			
49	8	0.278213174			
50	20	0.018208051			
51	20	0.074239309			
52	8	0.268030721			
53	8	0.272044721			
54	8	0.215758585			
55	30	0.920732019			
56	25	0.770289104			
57	15	0.628154626			
58	10	0.493651186			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
59	25	0.730862889			
60	265	0.587891697			

Xerox Phaser 3160N	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	60	0.17	0.00	0.17	0-17
2	55	0.17	0.17	0.33	18-32
3	45	0.17	0.33	0.50	33-49
4	68	0.17	0.50	0.67	50-66
5	58	0.17	0.67	0.83	67-82
6	46	0.17	0.83	1.00	83-99
7	46	0.926592364			
8	68	0.511217728			
9	68	0.564214396			
10	45	0.428280899			
11	60	0.14897879			
12	68	0.573398064			
13	45	0.351977079			
14	45	0.405691672			
15	45	0.403862072			
16	55	0.222884402			
17	55	0.233779711			
18	68	0.620238552			
19	60	0.1606484			
20	68	0.642634518			

Xerox Phaser 3160N	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
21	45	0.45257831			
22	60	0.114347742			
23	55	0.224937201			
24	60	0.00587626			
25	46	0.973225069			
26	46	0.90543182			
27	55	0.306594063			
28	68	0.519447606			
29	46	0.912246574			
30	45	0.419524963			
31	45	0.339593113			
32	68	0.599913151			
33	55	0.321256541			
34	55	0.1929951			
35	45	0.341998244			
36	68	0.656442136			
37	46	0.972909098			
38	68	0.659638799			
39	45	0.407897648			
40	60	0.073847416			
41	68	0.514594942			
42	68	0.517516786			
43	55	0.300990088			
44	68	0.535330808			

Xerox Phaser 3160N	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
45	55	0.170014001			
46	58	0.678148611			
47	46	0.956422434			
48	68	0.646602658			
49	55	0.233547084			
50	58	0.735286962			
51	45	0.429149669			
52	46	0.884457166			
53	55	0.331797708			
54	68	0.594457969			
55	68	0.635941801			
56	60	0.019359566			
57	55	0.278115268			
58	45	0.441924982			
59	68	0.662785455			
60	60	0.156593406			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	147	0.17	0.00	0.17	0-17
2	135	0.17	0.17	0.33	18-32
3	128	0.17	0.33	0.50	33-49
4	168	0.17	0.50	0.67	50-66
5	136	0.17	0.67	0.83	67-82
6	110	0.17	0.83	1.00	83-99

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
7	168	0.579086552			
8	135	0.314173316			
9	147	0.101754979			
10	136	0.740053244			
11	136	0.764536095			
12	168	0.531437857			
13	128	0.339333532			
14	168	0.658299982			
15	136	0.738707243			
16	168	0.620642447			
17	135	0.246540148			
18	147	0.109080008			
19	147	0.146302597			
20	110	0.9382334			
21	128	0.443361252			
22	110	0.999496817			
23	110	0.89718254			
24	135	0.315099309			
25	147	0.007767154			
26	110	0.839245794			
27	168	0.642318218			
28	135	0.175081798			
29	110	0.894288607			
30	135	0.170342936			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
31	135	0.284071841			
32	135	0.270282157			
33	147	0.091694351			
34	136	0.680429054			
35	168	0.624051688			
36	110	0.86354718			
37	136	0.710446913			
38	128	0.44438636			
39	147	0.09317602			
40	147	0.084682528			
41	128	0.475978471			
42	168	0.51613012			
43	136	0.773373593			
44	147	0.026436186			
45	136	0.730114129			
46	168	0.665525358			
47	110	0.856015105			
48	135	0.288982233			
49	128	0.446793927			
50	168	0.540961163			
51	168	0.616570223			
52	168	0.552211284			
53	136	0.817507867			
54	135	0.29524688			

Xerox Phaser 3435	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
55	168	0.524447916			
56	147	0.147869101			
57	135	0.314766514			
58	110	0.877479169			
59	128	0.335400356			
60	135	0.311007			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	7	0.17	0.00	0.17	0-17
2	3	0.17	0.17	0.33	18-32
3	10	0.17	0.33	0.50	33-49
4	15	0.17	0.50	0.67	50-66
5	8	0.17	0.67	0.83	67-82
6	25	0.17	0.83	1.00	83-99
7	3	0.259939959			
8	8	0.748634116			
9	15	0.638128413			
10	25	0.9712681			
11	15	0.6181507			
12	7	0.070650223			
13	25	0.85521498			
14	7	0.038250991			
15	8	0.80467981			
16	15	0.56582734			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
17	15	0.589325577			
18	10	0.425283471			
19	15	0.540874148			
20	10	0.420474513			
21	3	0.240627357			
22	8	0.725405232			
23	25	0.928922938			
24	3	0.178173023			
25	15	0.560780091			
26	10	0.404029962			
27	15	0.600470411			
28	25	0.945536955			
29	10	0.494711744			
30	25	0.974828105			
31	8	0.807569929			
32	25	0.895063479			
33	3	0.188017191			
34	15	0.554179158			
35	15	0.50780498			
36	25	0.875547869			
37	8	0.749677203			
38	25	0.924469647			
39	7	0.022699071			
40	25	0.893625165			

HP LaserJet P1102	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
41	8	0.790241983			
42	10	0.430916895			
43	10	0.413059242			
44	8	0.765735086			
45	25	0.981629413			
46	25	0.937639571			
47	3	0.247816935			
48	25	0.987183065			
49	3	0.255350627			
50	15	0.542953393			
51	25	0.915807926			
52	3	0.323412923			
53	7	0.110751595			
54	8	0.731202431			
55	3	0.297605687			
56	3	0.247575249			
57	25	0.849409905			
58	8	0.691688441			
59	10	0.395161905			
60	10	0.391611108			

Physical and Infrastructure Division

Xerox WorkCenter 3119	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	20	0.17	0.00	0.17	0-17
2	14	0.17	0.17	0.33	18-32
3	10	0.17	0.33	0.50	33-49
4	27	0.17	0.50	0.67	50-66
5	34	0.17	0.67	0.83	67-82
6	18	0.17	0.83	1.00	83-99
7	20	0.041405856			
8	34	0.630048643			
9	34	0.9390601			
10	18	0.369598607			
11	18	0.901759341			
12	18	0.126654061			
13	20	0.212677622			
14	18	0.849208585			
15	34	0.598421999			
16	18	0.737648897			
17	18	0.804648388			
18	18	0.721634416			
19	34	0.609859749			
20	20	0.195921993			
21	18	0.915947684			
22	18	0.158548255			
23	18	0.800720849			

Xerox WorkCenter 3119	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
24	18	0.123411165			
25	20	0.170387168			
26	34	0.440866627			
27	18	0.988083791			
28	20	0.292237734			
29	18	0.805529231			
30	18	0.998114925			
31	34	0.463709152			
32	18	0.911562061			
33	18	0.72182136			
34	20	0.246673698			
35	18	0.747879052			
36	18	0.872483367			
37	18	0.673784755			
38	34	0.522825317			
39	18	0.78066218			
40	34	0.474482274			
41	34	0.613208858			
42	34	0.522409874			
43	18	0.751160821			
44	18	0.872578664			
45	18	0.74878121			
46	34	0.540637798			
47	18	0.968319739			

Xerox WorkCenter 3119	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
48	18	0.972657993			
49	20	0.182613055			
50	18	0.055359813			
51	20	0.199303856			
52	18	0.835093496			
53	18	0.680783323			
54	20	0.200586992			
55	34	0.393349056			
56	18	0.695574777			
57	20	0.213054081			
58	18	0.036605191			
59	18	0.676389397			
60	20	0.3011735			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	45	0.17	0.00	0.17	0-17
2	32	0.17	0.17	0.33	18-32
3	40	0.17	0.33	0.50	33-49
4	28	0.17	0.50	0.67	50-66
5	57	0.17	0.67	0.83	67-82
6	50	0.17	0.83	1.00	83-99
7	28	0.508671105			
8	40	0.443572799			
9	50	0.990289056			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
10	45	0.160054701			
11	45	0.135253604			
12	32	0.287296364			
13	40	0.468097069			
14	28	0.525790384			
15	50	0.957866064			
16	40	0.420183637			
17	32	0.237343383			
18	57	0.69270754			
19	28	0.616278038			
20	50	0.968407298			
21	50	0.996738192			
22	40	0.345717179			
23	40	0.370968747			
24	50	0.991870137			
25	45	0.081939659			
26	32	0.175332195			
27	57	0.678891665			
28	50	0.988611591			
29	40	0.416945706			
30	40	0.384669457			
31	50	0.841798303			
32	45	0.110641134			
33	32	0.308570743			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
34	57	0.725150662			
35	32	0.248641502			
36	45	0.135539654			
37	28	0.612009845			
38	32	0.296083608			
39	50	0.930155463			
40	57	0.808996469			
41	28	0.580361188			
42	50	0.928548854			
43	50	0.869316959			
44	40	0.337403386			
45	50	0.851883145			
46	28	0.634110117			
47	45	0.088284857			
48	50	0.957310605			
49	45	0.142778868			
50	50	0.840366025			
51	50	0.919814533			
52	45	0.081931149			
53	32	0.264131986			
54	32	0.229431779			
55	50	0.997706735			
56	28	0.622580399			
57	40	0.378194354			

EPSON L100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
58	45	0.147899987			
59	28	0.651631072			
60	50	0.884870887			

EPSON L220	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	100	0.17	0.00	0.17	0-17
2	85	0.17	0.17	0.33	18-32
3	92	0.17	0.33	0.50	33-49
4	115	0.17	0.50	0.67	50-66
5	120	0.17	0.67	0.83	67-82
6	79	0.17	0.83	1.00	83-99
7	120	0.800982667			
8	79	0.956245732			
9	115	0.553217941			
10	100	0.136314279			
11	100	0.010087121			
12	92	0.393975544			
13	79	0.947650167			
14	92	0.431337623			
15	79	0.898933469			
16	79	0.975991881			
17	100	0.02170907			
18	120	0.686885943			
19	79	0.995296339			

EPSON L220	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
20	100	0.137746652			
21	100	0.153105697			
22	100	0.072464473			
23	120	0.738533712			
24	115	0.524051642			
25	115	0.656522918			
26	115	0.658062329			
27	100	0.069632936			
28	92	0.336040626			
29	120	0.753422563			
30	120	0.79710053			
31	79	0.984318396			
32	85	0.268485536			
33	115	0.638594089			
34	115	0.618707243			
35	120	0.734337804			
36	92	0.491808867			
37	100	0.049580154			
38	92	0.466348683			
39	85	0.241146332			
40	100	0.155320873			
41	85	0.18585193			
42	92	0.451400822			
43	115	0.545777916			

EPSON L220	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
44	79	0.978806152			
45	100	0.159535518			
46	85	0.329399785			
47	100	0.093048966			
48	100	0.040482377			
49	92	0.400354284			
50	120	0.718922826			
51	92	0.436543399			
52	115	0.535982554			
53	100	0.125502294			
54	100	0.157969931			
55	79	0.999289418			
56	115	0.5080491			
57	115	0.591241206			
58	100	0.031127205			
59	92	0.384725726			
60	79	0.976000401			

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	16	0.17	0.00	0.17	0-17
2	7	0.17	0.17	0.33	18-32
3	24	0.17	0.33	0.50	33-49
4	20	0.17	0.50	0.67	50-66
5	13	0.17	0.67	0.83	67-82

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
6	10	0.17	0.83	1.00	83-99
7	10	0.898945522			
8	10	0.961064035			
9	10	0.849799763			
10	7	0.268561087			
11	13	0.740385251			
12	24	0.427368873			
13	16	0.091024749			
14	10	0.93030067			
15	10	0.86295242			
16	10	0.905255822			
17	16	0.141423989			
18	16	0.076275734			
19	7	0.321113016			
20	16	0.129663385			
21	20	0.665128648			
22	10	0.92992268			
23	24	0.485928113			
24	24	0.438803117			
25	24	0.421016186			
26	20	0.599954691			
27	20	0.516758058			
28	7	0.217253044			
29	7	0.314890625			

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
30	7	0.255123048			
31	16	0.064540597			
32	24	0.389697254			
33	24	0.409854151			
34	24	0.459837103			
35	16	0.159026875			
36	10	0.9364036			
37	16	0.108694727			
38	16	0.105519401			
39	20	0.581768788			
40	10	0.936234491			
41	20	0.507908951			
42	24	0.467572747			
43	16	0.099467977			
44	13	0.69356719			
45	16	0.12534895			
46	13	0.737078234			
47	24	0.44140532			
48	24	0.460441721			
49	10	0.878185818			
50	16	0.147933977			
51	10	0.981764839			
52	24	0.414143745			
53	13	0.7585901			

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
54	10	0.93482312			
55	24	0.490224286			
56	7	0.167715801			
57	24	0.335318286			
58	20	0.65585609			
59	7	0.286639319			
60	24	0.368530798			

Brother MFC J3520	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	99	0.17	0.00	0.17	0-17
2	118	0.17	0.17	0.33	18-32
3	78	0.17	0.33	0.50	33-49
4	83	0.17	0.50	0.67	50-66
5	135	0.17	0.67	0.83	67-82
6	123	0.17	0.83	1.00	83-99
7	78	0.435709897			
8	135	0.688044537			
9	135	0.743427825			
10	123	0.923012101			
11	83	0.54075461			
12	135	0.815545978			
13	83	0.609243565			
14	135	0.800908951			
15	123	0.941839184			

Brother MFC J3520	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
16	99	0.070717446			
17	135	0.79808899			
18	135	0.801733796			
19	83	0.503314388			
20	123	0.96507709			
21	123	0.959041598			
22	135	0.66973433			
23	135	0.738192482			
24	99	0.02504094			
25	123	0.99162851			
26	123	0.894219641			
27	123	0.937435682			
28	83	0.516883607			
29	118	0.20788764			
30	118	0.187847724			
31	99	0.027989238			
32	78	0.365242083			
33	135	0.700129865			
34	78	0.427908096			
35	83	0.610676164			
36	123	0.853848898			
37	123	0.936858615			
38	83	0.642574003			
39	78	0.495693618			

Brother MFC J3520	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
40	135	0.673308168			
41	123	0.914037184			
42	99	0.118545315			
43	78	0.352018809			
44	118	0.327133217			
45	135	0.759665717			
46	118	0.180110333			
47	135	0.728559609			
48	83	0.643119016			
49	83	0.633852575			
50	123	0.928816992			
51	78	0.477197656			
52	99	0.068990215			
53	78	0.388729433			
54	83	0.530824858			
55	118	0.290200392			
56	78	0.481749669			
57	118	0.259617826			
58	83	0.513306384			
59	118	0.17826377			
60	135	0.71329221			

EPSON L210	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	10	0.17	0.00	0.17	0-17
2	3	0.17	0.17	0.33	18-32
3	17	0.17	0.33	0.50	33-49
4	24	0.17	0.50	0.67	50-66
5	15	0.17	0.67	0.83	67-82
6	7	0.17	0.83	1.00	83-99
7	15	0.666982175			
8	3	0.243256624			
9	10	0.116354059			
10	17	0.342272827			
11	17	0.460894082			
12	7	0.888620091			
13	10	0.03216799			
14	7	0.838518566			
15	3	0.220037018			
16	17	0.353410665			
17	15	0.677298399			
18	15	0.722809896			
19	7	0.980546043			
20	15	0.730731822			
21	24	0.625211591			
22	24	0.507806555			
23	15	0.721151938			
24	3	0.320890897			

EPSON L210	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
25	17	0.494914083			
26	7	0.997574064			
27	17	0.358549924			
28	17	0.372493283			
29	15	0.785594445			
30	3	0.186055676			
31	3	0.244172902			
32	15	0.79482157			
33	24	0.633388036			
34	24	0.543932319			
35	7	0.899670164			
36	24	0.562191083			
37	7	0.97421401			
38	17	0.35359111			
39	17	0.454060781			
40	3	0.315599566			
41	17	0.472026916			
42	7	0.879759656			
43	24	0.511036582			
44	24	0.544327701			
45	15	0.726921103			
46	7	0.982508193			
47	10	0.006831605			
48	17	0.422900904			

EPSON L210	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
49	24	0.650778039			
50	3	0.219232493			
51	3	0.21662176			
52	24	0.612824627			
53	7	0.920621569			
54	10	0.018857903			
55	24	0.517947496			
56	7	0.869599203			
57	15	0.712133688			
58	10	0.001404671			
59	17	0.472239446			
60	17	0.389382925			

EPSON Office Stylus T1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	64	0.17	0.00	0.17	0-17
2	78	0.17	0.17	0.33	18-32
3	59	0.17	0.33	0.50	33-49
4	87	0.17	0.50	0.67	50-66
5	94	0.17	0.67	0.83	67-82
6	116	0.17	0.83	1.00	83-99
7	94	0.721882403			
8	64	0.156966844			
9	94	0.731694825			
10	116	0.922778726			

EPSON Office Stylus T1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
11	59	0.423510523			
12	78	0.31876558			
13	116	0.941036668			
14	64	0.020050316			
15	78	0.180880699			
16	116	0.897375117			
17	94	0.751245458			
18	87	0.616032931			
19	87	0.581594359			
20	116	0.862045599			
21	59	0.449051052			
22	59	0.467634499			
23	116	0.979892278			
24	59	0.370146074			
25	59	0.484478859			
26	78	0.209204503			
27	78	0.259437316			
28	87	0.56481142			
29	64	0.109789465			
30	87	0.535092377			
31	59	0.443120772			
32	64	0.016657432			
33	78	0.183903675			
34	59	0.488977242			

EPSON Office Stylus T1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
35	64	0.01358774			
36	116	0.961431466			
37	116	0.83395803			
38	94	0.782504642			
39	59	0.485976053			
40	94	0.818436336			
41	78	0.251901537			
42	78	0.170724939			
43	78	0.19601221			
44	116	0.878419024			
45	94	0.805312835			
46	116	0.92480747			
47	59	0.484110945			
48	94	0.816356921			
49	64	0.073825916			
50	64	0.147250664			
51	78	0.24971503			
52	94	0.684558481			
53	87	0.625942449			
54	78	0.178684583			
55	78	0.18090143			
56	116	0.978678884			
57	64	0.143074458			
58	64	0.060711409			

EPSON Office Stylus T1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
59	59	0.446819881			
60	78	0.26061691			

Brother DCP J125	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	10	0.17	0.00	0.17	0-17
2	17	0.17	0.17	0.33	18-32
3	8	0.17	0.33	0.50	33-49
4	15	0.17	0.50	0.67	50-66
5	6	0.17	0.67	0.83	67-82
6	25	0.17	0.83	1.00	83-99
7	10	0.084918296			
8	17	0.237693338			
9	25	0.99788899			
10	17	0.17771716			
11	6	0.718498926			
12	25	0.968223871			
13	8	0.459517537			
14	10	0.053522185			
15	17	0.271232505			
16	6	0.7586368			
17	25	0.874437844			
18	25	0.900039959			
19	6	0.818477785			
20	67	0.274152978			

Brother DCP J125	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
21	25	0.944678326			
22	10	0.116482847			
23	25	0.886306111			
24	6	0.822632004			
25	25	0.936647372			
26	10	0.132174179			
27	8	0.466882101			
28	15	0.608839607			
29	25	0.838108595			
30	25	0.867363688			
31	17	0.32013597			
32	25	0.888639812			
33	10	0.086899018			
34	6	0.706379766			
35	6	0.672429869			
36	17	0.323040797			
37	17	0.211283304			
38	6	0.729778588			
39	17	0.212011656			
40	65	0.542618884			
41	15	0.602094007			
42	15	0.591782177			
43	8	0.334761944			
44	15	0.567061982			

Brother DCP J125	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
45	10	0.161149346			
46	6	0.683407006			
47	15	0.596551062			
48	10	0.133641393			
49	8	0.394438059			
50	6	0.749940457			
51	25	0.863493321			
52	17	0.303370889			
53	10	0.144424771			
54	10	0.056232592			
55	15	0.518913188			
56	17	0.19294978			
57	6	0.816411747			
58	8	0.497827881			
59	17	0.272097158			
60	60	0.069228162			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	36	0.17	0.00	0.17	0-17
2	25	0.17	0.17	0.33	18-32
3	43	0.17	0.33	0.50	33-49
4	57	0.17	0.50	0.67	50-66
5	39	0.17	0.67	0.83	67-82
6	49	0.17	0.83	1.00	83-99

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
7	39	0.668173531			
8	39	0.823788965			
9	57	0.5034971			
10	43	0.474301651			
11	57	0.516932267			
12	39	0.78381946			
13	25	0.214486067			
14	39	0.799005366			
15	36	0.014458127			
16	25	0.166903793			
17	49	0.937757465			
18	39	0.754518175			
19	43	0.451938006			
20	36	0.009736741			
21	36	0.001580337			
22	43	0.413542365			
23	57	0.638083964			
24	36	0.14476196			
25	36	0.150302954			
26	43	0.369373007			
27	57	0.643318822			
28	43	0.436285726			
29	25	0.261056822			
30	25	0.208367717			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
31	49	0.915097144			
32	57	0.66074672			
33	43	0.413306718			
34	36	0.088490166			
35	25	0.200340444			
36	49	0.883226106			
37	25	0.241904335			
38	25	0.171780834			
39	43	0.377920646			
40	36	0.155104872			
41	49	0.929194929			
42	49	0.981273392			
43	57	0.568076618			
44	43	0.34638122			
45	43	0.339448651			
46	25	0.301290186			
47	25	0.327782333			
48	36	0.14706227			
49	36	0.109775035			
50	57	0.54567714			
51	43	0.440746803			
52	36	0.102586722			
53	57	0.537844954			
54	49	0.951710074			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
55	25	0.230258674			
56	49	0.886997488			
57	25	0.244554687			
58	49	0.875009135			
59	25	0.258478856			
60	57	0.603816091			

Public Welfare and Government Apparatus Division

Xerox WorkCenter 3119	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	28	0.17	0.00	0.17	0-17
2	37	0.17	0.17	0.33	18-32
3	19	0.17	0.33	0.50	33-49
4	47	0.17	0.50	0.67	50-66
5	52	0.17	0.67	0.83	67-82
6	39	0.17	0.83	1.00	83-99
7	28	0.130168424			
8	39	0.889504744			
9	37	0.271772686			
10	47	0.568446491			
11	19	0.339163319			
12	28	0.165331647			
13	28	0.052846746			
14	39	0.968930435			

Xerox WorkCenter 3119	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
15	39	0.948461803			
16	52	0.673402282			
17	39	0.925771022			
18	19	0.442792677			
19	39	0.870905306			
20	95	0.962434638			
21	47	0.601530492			
22	52	0.672630982			
23	52	0.700039142			
24	52	0.811283049			
25	19	0.336284474			
26	39	0.888572435			
27	19	0.432848303			
28	37	0.256498962			
29	52	0.785047817			
30	52	0.816921658			
31	28	0.114442345			
32	39	0.938226128			
33	37	0.308277484			
34	39	0.846479956			
35	28	0.105940313			
36	19	0.495280116			
37	47	0.511719562			
38	52	0.688792673			

Xerox WorkCenter 3119	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
39	19	0.373517019			
40	95	0.942772031			
41	47	0.508636588			
42	47	0.53395903			
43	37	0.196660596			
44	52	0.764867055			
45	52	0.67200035			
46	52	0.739484503			
47	19	0.3775185			
48	47	0.619996392			
49	52	0.81799043			
50	37	0.185868131			
51	47	0.617480328			
52	39	0.983422912			
53	19	0.420801185			
54	47	0.655380772			
55	19	0.350562333			
56	37	0.19450753			
57	19	0.466435315			
58	37	0.245648321			
59	28	0.092857045			
60	108	0.771434922			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	30	0.17	0.00	0.17	0-17
2	39	0.17	0.17	0.33	18-32
3	27	0.17	0.33	0.50	33-49
4	48	0.17	0.50	0.67	50-66
5	33	0.17	0.67	0.83	67-82
6	53	0.17	0.83	1.00	83-99
7	33	0.79650625			
8	39	0.249211473			
9	48	0.532860365			
10	27	0.477737171			
11	30	0.004278087			
12	39	0.186297813			
13	33	0.666850788			
14	48	0.61177644			
15	27	0.355486812			
16	33	0.755674968			
17	27	0.486943788			
18	33	0.726248538			
19	48	0.66643068			
20	86	0.065186273			
21	33	0.6736139			
22	30	0.019145184			
23	33	0.71711354			
24	30	0.015314498			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
25	30	0.065236649			
26	53	0.980270276			
27	48	0.61422917			
28	30	0.094077172			
29	39	0.284029832			
30	48	0.649098919			
31	27	0.358138975			
32	33	0.833302847			
33	53	0.870352357			
34	30	0.154471927			
35	30	0.113826342			
36	27	0.472098743			
37	53	0.960275742			
38	48	0.583119459			
39	27	0.397110523			
40	86	0.034560032			
41	33	0.704696879			
42	48	0.663235873			
43	39	0.170483816			
44	53	0.987687091			
45	33	0.765760663			
46	53	0.958133017			
47	27	0.498378141			
48	48	0.606665216			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
49	53	0.924510973			
50	53	0.850468542			
51	33	0.668504187			
52	27	0.461937227			
53	33	0.767815859			
54	39	0.294129477			
55	53	0.998564226			
56	48	0.502241704			
57	48	0.562092393			
58	33	0.705986566			
59	53	0.952700242			
60	86	0.062284301			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	58	0.17	0.00	0.17	0-17
2	77	0.17	0.17	0.33	18-32
3	49	0.17	0.33	0.50	33-49
4	43	0.17	0.50	0.67	50-66
5	55	0.17	0.67	0.83	67-82
6	69	0.17	0.83	1.00	83-99
7	77	0.254127964			
8	55	0.729093769			
9	43	0.531421049			
10	43	0.657744461			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
11	43	0.57829705			
12	55	0.675146059			
13	55	0.810018187			
14	49	0.498586143			
15	49	0.388511057			
16	43	0.558519841			
17	55	0.823936173			
18	69	0.906874005			
19	49	0.414165489			
20	105	0.3352364			
21	69	0.932444977			
22	49	0.452561311			
23	58	0.102049516			
24	77	0.246004177			
25	77	0.236639292			
26	69	0.88567044			
27	49	0.478659144			
28	58	0.011501559			
29	58	0.094572824			
30	58	0.062439644			
31	43	0.529326621			
32	49	0.489189855			
33	58	0.08547389			
34	49	0.498312696			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
35	58	0.136879404			
36	43	0.610320215			
37	43	0.56031433			
38	43	0.598604644			
39	43	0.532626589			
40	111	0.797923325			
41	58	0.125574996			
42	77	0.237264555			
43	43	0.515772985			
44	43	0.516476942			
45	58	0.132074264			
46	49	0.475631228			
47	49	0.395593862			
48	49	0.337104805			
49	43	0.542638721			
50	43	0.62866859			
51	55	0.762943781			
52	77	0.299452632			
53	77	0.214221941			
54	69	0.881478522			
55	49	0.489161658			
56	43	0.59426775			
57	58	0.055768403			
58	49	0.424603567			

EPSON L800	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
59	49	0.394442919			
60	133	0.289601945			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	2	0.17	0.00	0.17	0-17
2	5	0.17	0.17	0.33	18-32
3	3	0.17	0.33	0.50	33-49
4	7	0.17	0.50	0.67	50-66
5	4	0.17	0.67	0.83	67-82
6	6	0.17	0.83	1.00	83-99
7	2	0.008365461			
8	3	0.339918474			
9	4	0.731808713			
10	5	0.227321723			
11	2	0.073236907			
12	3	0.365299983			
13	4	0.812984006			
14	4	0.777287455			
15	7	0.65073297			
16	2	0.107033487			
17	5	0.326703349			
18	7	0.526601955			
19	2	0.044666198			
20	62	0.942416115			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
21	3	0.474763612			
22	7	0.504113987			
23	5	0.317201445			
24	2	0.042833158			
25	2	0.116030263			
26	4	0.744535734			
27	4	0.772476286			
28	5	0.171484806			
29	7	0.517494189			
30	5	0.180873995			
31	2	0.011581235			
32	3	0.393295362			
33	3	0.412338547			
34	7	0.540658328			
35	3	0.432596952			
36	3	0.414676033			
37	7	0.533059742			
38	4	0.806192339			
39	7	0.630274726			
40	58	0.151562153			
41	7	0.642146108			
42	5	0.214848638			
43	3	0.461133064			
44	5	0.313191536			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
45	6	0.876459901			
46	6	0.904972015			
47	4	0.732801515			
48	5	0.195333574			
49	3	0.446900939			
50	3	0.40097377			
51	5	0.250152187			
52	4	0.770384415			
53	3	0.438389014			
54	3	0.462178625			
55	3	0.481249655			
56	7	0.618708692			
57	6	0.981651874			
58	2	0.091147888			
59	2	0.140753554			
60	59	0.359499396			

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	57	0.17	0.00	0.17	0-17
2	68	0.17	0.17	0.33	18-32
3	46	0.17	0.33	0.50	33-49
4	54	0.17	0.50	0.67	50-66
5	77	0.17	0.67	0.83	67-82
6	83	0.17	0.83	1.00	83-99

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
7	68	0.244079685			
8	54	0.516616794			
9	83	0.906226191			
10	83	0.833630255			
11	54	0.633655661			
12	68	0.310396544			
13	68	0.314720443			
14	77	0.754234325			
15	46	0.480307431			
16	54	0.617133543			
17	83	0.970117379			
18	83	0.935730767			
19	57	0.120205636			
20	133	0.768043685			
21	68	0.257182994			
22	68	0.319149095			
23	46	0.492136226			
24	57	0.073291058			
25	57	0.097716692			
26	46	0.48235771			
27	46	0.359261612			
28	68	0.189874196			
29	77	0.673851957			
30	83	0.978779176			

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
31	57	0.027676383			
32	77	0.676851761			
33	46	0.397471817			
34	68	0.231899091			
35	46	0.404348044			
36	54	0.651034171			
37	57	0.110814371			
38	77	0.816644514			
39	68	0.211260041			
40	124	0.212282968			
41	68	0.261076728			
42	77	0.720891572			
43	46	0.41297404			
44	54	0.600580663			
45	54	0.555736127			
46	83	0.86105922			
47	77	0.704391497			
48	68	0.300086036			
49	54	0.600163195			
50	83	0.97628421			
51	68	0.32225323			
52	54	0.573594134			
53	68	0.330093807			
54	68	0.252719417			

HP LaserJet P1006	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
55	57	0.14058072			
56	46	0.379298106			
57	54	0.596798048			
58	77	0.783821447			
59	68	0.283980064			
60	113	0.056789842			

Xerox Phaser 3160N	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	35	0.17	0.00	0.17	0-17
2	27	0.17	0.17	0.33	18-32
3	48	0.17	0.33	0.50	33-49
4	52	0.17	0.50	0.67	50-66
5	45	0.17	0.67	0.83	67-82
6	39	0.17	0.83	1.00	83-99
7	45	0.731152067			
8	45	0.773797675			
9	52	0.530066654			
10	39	0.946658208			
11	52	0.615474947			
12	39	0.959671297			
13	39	0.892877943			
14	39	0.904350566			

Xerox Phaser 3160N	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
15	48	0.404744588			
16	39	0.98249333			
17	27	0.286036675			
18	27	0.197809306			
19	27	0.210906305			
20	108	0.645173966			
21	27	0.237563347			
22	27	0.215841792			
23	27	0.212353507			
24	48	0.471540388			
25	48	0.422279776			
26	45	0.686217785			
27	48	0.493381881			
28	27	0.170210645			
29	52	0.604946082			
30	48	0.479681588			
31	45	0.754346402			
32	35	0.045107745			
33	45	0.791440638			
34	52	0.569881201			
35	27	0.235847371			
36	35	0.060175797			
37	45	0.759905213			
38	48	0.37281179			

Xerox Phaser 3160N	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
39	48	0.430098918			
40	101	0.797138146			
41	45	0.744323472			
42	35	0.145545268			
43	27	0.306047449			
44	39	0.970348671			
45	27	0.211256239			
46	52	0.549951556			
47	45	0.753185816			
48	45	0.690665353			
49	39	0.980758508			
50	45	0.814784097			
51	39	0.864436235			
52	48	0.40273355			
53	35	0.165537001			
54	48	0.484156965			
55	52	0.517106374			
56	27	0.265904736			
57	45	0.727018818			
58	48	0.337319571			
59	45	0.744597155			
60	91	0.114170316			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	10	0.17	0.00	0.17	0-17
2	4	0.17	0.17	0.33	18-32
3	17	0.17	0.33	0.50	33-49
4	29	0.17	0.50	0.67	50-66
5	13	0.17	0.67	0.83	67-82
6	31	0.17	0.83	1.00	83-99
7	10	0.124459605			
8	29	0.558321615			
9	29	0.570389842			
10	17	0.365887747			
11	13	0.670225152			
12	17	0.434218229			
13	13	0.723782411			
14	31	0.908985539			
15	31	0.93157836			
16	10	0.056758921			
17	10	0.080876168			
18	4	0.331919806			
19	13	0.750215044			
20	87	0.853518261			
21	31	0.87336667			
22	29	0.502476415			
23	17	0.351540761			
24	17	0.376036646			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
25	13	0.678320186			
26	13	0.777969038			
27	31	0.949922863			
28	10	0.102565181			
29	4	0.276399506			
30	4	0.171718679			
31	10	0.057122797			
32	31	0.854735558			
33	17	0.498053987			
34	10	0.01992328			
35	13	0.677186084			
36	4	0.276077236			
37	17	0.391500592			
38	4	0.214105744			
39	17	0.413688259			
40	73	0.406898751			
41	13	0.747174611			
42	10	0.076061328			
43	31	0.865653149			
44	13	0.69087945			
45	31	0.928077637			
46	29	0.614369886			
47	29	0.574589279			
48	13	0.76605552			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
49	4	0.254555619			
50	13	0.762975			
51	29	0.529172553			
52	10	0.072293197			
53	13	0.791102351			
54	29	0.654097665			
55	10	0.148533841			
56	31	0.869502473			
57	29	0.625753138			
58	29	0.61754082			
59	29	0.548539217			
60	66	0.076343864			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	20	0.17	0.00	0.17	0-17
2	14	0.17	0.17	0.33	18-32
3	34	0.17	0.33	0.50	33-49
4	27	0.17	0.50	0.67	50-66
5	19	0.17	0.67	0.83	67-82
6	32	0.17	0.83	1.00	83-99
7	19	0.668945342			
8	19	0.750945062			
9	34	0.453815774			
10	27	0.601578937			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
11	20	0.051759433			
12	14	0.21019709			
13	19	0.723952774			
14	14	0.261645762			
15	20	0.021408829			
16	19	0.676180734			
17	34	0.351989601			
18	32	0.927186525			
19	19	0.707105027			
20	83	0.588383492			
21	34	0.388450051			
22	19	0.819437501			
23	32	0.958896588			
24	19	0.734644753			
25	34	0.333644925			
26	20	0.15703623			
27	20	0.030381484			
28	34	0.42797869			
29	32	0.880701825			
30	19	0.751835653			
31	19	0.73092737			
32	20	0.027780261			
33	19	0.708058846			
34	14	0.286099355			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
35	34	0.448925491			
36	19	0.81529754			
37	20	0.0377819			
38	34	0.366126889			
39	19	0.789641499			
40	83	0.601880565			
41	34	0.39521841			
42	32	0.943120879			
43	20	0.126668028			
44	19	0.832317511			
45	19	0.723134379			
46	19	0.778584007			
47	14	0.204085544			
48	34	0.43268591			
49	14	0.184403572			
50	34	0.473925343			
51	32	0.846357613			
52	19	0.702990561			
53	32	0.983347724			
54	19	0.764295469			
55	14	0.218225594			
56	20	0.068265914			
57	20	0.122222793			
58	27	0.584296539			

Xerox Phaser 3155	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
59	14	0.30501841			
60	75	0.831705581			

HP P1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
1	30	0.17	0.00	0.17	0-17
2	21	0.17	0.17	0.33	18-32
3	36	0.17	0.33	0.50	33-49
4	47	0.17	0.50	0.67	50-66
5	58	0.17	0.67	0.83	67-82
6	37	0.17	0.83	1.00	83-99
7	47	0.579131326			
8	30	0.070027476			
9	47	0.618383445			
10	30	0.009758461			
11	58	0.820062514			
12	58	0.830090989			
13	58	0.787891407			
14	47	0.621119501			
15	21	0.315020589			
16	30	0.039209201			
17	21	0.269143294			
18	36	0.380298324			
19	47	0.521810233			
20	92	0.466954704			

HP P1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
21	36	0.373737312			
22	30	0.030633001			
23	58	0.725957327			
24	37	0.924442845			
25	21	0.18257902			
26	30	0.138259907			
27	47	0.503186103			
28	21	0.2592977			
29	37	0.94666269			
30	58	0.79030971			
31	58	0.790630574			
32	21	0.269748465			
33	58	0.68200329			
34	37	0.959761966			
35	36	0.432659478			
36	47	0.601912671			
37	47	0.595867759			
38	30	0.16245752			
39	36	0.417360946			
40	77	0.286902743			
41	30	0.149267594			
42	37	0.957490999			
43	47	0.627156765			
44	37	0.969786304			

HP P1100	Printing Frequency	Probability Printing Distribution	Lower Limit	Upper Limit	Random Interval Number
45	30	0.152868829			
46	30	0.071156914			
47	37	0.866184743			
48	58	0.802606238			
49	21	0.170489458			
50	58	0.831398707			
51	58	0.788787513			
52	47	0.553570354			
53	30	0.008912624			
54	58	0.690159696			
55	37	0.872814396			
56	36	0.391746231			
57	21	0.32984236			
58	30	0.047396744			
59	47	0.564999766			
60	77	0.209591489			

CHAPTER VII
CONCLUSION AND SUGGESTION

This chapter consists of conclusion of the research done based on the data analysis and calculation done. Furthermore, it will give the suggestion for the future research to enrich and enhance this research topic.

7.1 Conclusion

After conducting research about optimizing printer utilization using BAPPEKO data to draw generic framework that can be applied for all SKPD, it can be concluded that:

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.
2. Printer utilization of SKPD in Surabaya Government Office can be optimized by proper usage of the printer. 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. By conducting this research, printer needs in Surabaya City Government can be known by using the printer utilization in the existing condition. By knowing historical printing data each day, week, and month, it can be known whether current condition has been ideal or not. 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. Additionally, 75% lowest utilization limit will also help in measuring whether SKPD need to procure printer or not.

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.
5. In this research which provides 3 scenarios, such as, full buying scenario, full leasing scenario, mixed decisions scenario that is distributed annually over 16-year of horizon planning and base on the simulated model, it can be known that the most beneficial decision is full leasing scenario. 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 mixed decisions scenario, it can be known

that full leasing scenario NAW is only 7.6% of mixed decisions scenario NAW. Thus, if comparing full buying scenario and mixed decisions scenario, it can be known that full buying scenario NAW is only 23.72% of mixed decisions NAW. Therefore, from the first simulation did using dummy data, it can be concluded that the most beneficial decision is full leasing, as it only need to pay monthly leasing cost without considering maintenance and toner cost. Thus, the result got from the simulation is not an exact decision, it only acts as one of the consideration and calculation of the cost, the procurement is once again returned to the related SKPD by adjusting with the condition in the SKPD.

7.2 Suggestion

The suggestion that can be given for further research is doing improvement to current model in terms of interface that is hoped to be developed more using information system or programming to accommodate large data processing and utilization level calculation that can provide several ways of utilization calculation, not only by total paper printing but other factors. Next, the suggestion is also related to existing condition checking, writer suggests that the checking mechanism is not only utilization, but technical checking mechanism to make sure that calculation from model can represent the ideal condition for SKPD and be implemented in SKPD without interrupt the operational. 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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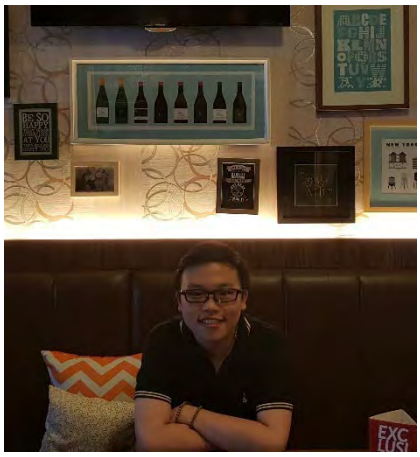
BIOGRAPHY



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