CHAPTER I
INTRODUCTION

This chapter is discussed the final project's background, problem formulation, objectives, scope, and final project's outline.

1. 1 Background

PT Semen Padang is one of the oldest and largest cement companies in Indonesia, located in Padang City, West Sumatra. PT Semen Padang produces cement with a production capacity reaching 8,900,000 tons per year(www.semenpadang.com). To meet its production targets, PT Semen Padang performs its production process at Indarung II, III, IV, V, and VI factories.

PT Semen Padang's workshop is one of the units under the production department. The workshop plays an essential role as a unit that manufactures and repairs equipment at PT. Semen Padang. Managing asset becomes a required course of action in the production of PT Semen Padang.

Based on an interview with the manager of Workshop PT Semen Padang, Mr. Efrizal Zain, the asset is divided into: production machine asset, machine tool asset, and measuring instrument. In 2020, 38 assets are still being operated, and more than 30 assets are no longer being utilized in the Workshop of PT Semen Padang.

The breakdown Workshop PT Semen Padang often experiences for instance repairs and replacement of components. The component that frequently breakdowns are compressor hydraulic oil and gearbox. From 38 operating assets, seven assets are suggested to get replaced for 2021. These assets are plasma cutting machine, hydraulic punch machine, beyeler cutting machine, milling lathe machine, roll davi 3041 machine, roll davi 4095 machine, and mincang MCD press machine. They are suggested because of their frequent breakdowns

and components replacement the frequency of oil replacement and maintenance in 2019 in each of these assets can be seen in **Tabel 1.1**

Tabel 1. 1 Frequent of Maintaining and Oil Replacing 2019

Name	Quantity											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Des
Mincang MCD Press Machine	35	35	35	35	35	35	35	35	35	35	35	33
Hydraulic Punch Machine	14	0	0	14	0	0	14	0	0	14	0	0
Milling Lathe	0	12	22	22	12	0	0	12	0	0	12	0
Plasma Cutting Machine	0	0	0	105	0	0	0	0	0	0	0	0
Beyeler Cutting Machine	0	0	0	22	0	0	0	0	0	22	0	0
Roll Davi 3041	0	418	0	0	0	0	0	0	0	0	0	0
Roll Dabi 4095	0	0	0	418	0	0	0	0	0	0	0	0

(Source: Workshop PT Semen Padang)

Because of frequent of maintaining and breakdown shown in **Table 1.1**, workshop manager suggested to head of unit to replacing the following asset. The replacement decision should be based on the head of the workshop unit's permission, linked on the data report of the asset's breakdown from the manager workshop. **Table 1.2** shows in previous years, the manager applied the suggestion of replacement assets based on breakdown data, but the many proposal was denied because the breakdown data is not strong enough. Proven by, few assets have been suggested to get replaced but still be operated in 2020 because it hasn't received a total breakdown yet.

Tabel 1. 2 Historical Data of Replacement Submission

Year	Machine	Submission	Head Unit Decision	Operational Status
2017	Forklift Mitshubisi FD50	Replacing an asset because it frequent component replacement	Not replace	Still Operated
2018	Heatting Electroda	Fully breakdown	Replace asset	Asset no longer operated
2018	Roll Davi 3041	Replacing because of replacement in hidraulic component	Not replace	Still Operated
2018	Forklift Mitshubisi FD79	Replacing asset because of its frequent of repairment in coolant	Not replace	Asset no longer operated
2019	Bayer Shearing	Replacing asset because of its breakdown in vital component	Not replace	Asset no longer operated
2019	Kjellberg Plasma Cutting Machine	Replacing asset because breakdown in nozzle highsensing	Not replace	Still Operated
2019	Plasma Cutting Messer PHC 95	Replacing asset because PH95 is replaced	Not replace	Still Operated
2019	FLS-Smith Milling Lathe	Replacing asset because Spare part feeder is broken	Not replace	Still Operated

(Source: Workshop PT Semen Padang)

The unit's head decides to an asset won't get replaced until the asset receives a full breakdown. The asset's breakdown report from manager isn't considered as a strong excuse to replace the asset by the head of unit. That's because the asset replacement suggestion from the manager has not been supported yet with strong calculation, head of unit consider that frequent of breakdown is not strong justification for making the replacement. Thus, the head of unit needs a specific calculation approach to determine when the right time the asset should be replaced. If the assets are not replaced at the right time through an economic approach, the workshop will have the incremental cost in replacing assets will be the following year.

Therefore, the calculation of replacement analysis is needed. However, in industrial engineering, a scientific study discusses when an asset should be replaced based on the machine's economic life, namely replacement analysis (Newnan, 1988). Based on economic replacement analysis calculations, the asset is recommended to get replaced when it reached the year with the lowest total equivalent annual cost.

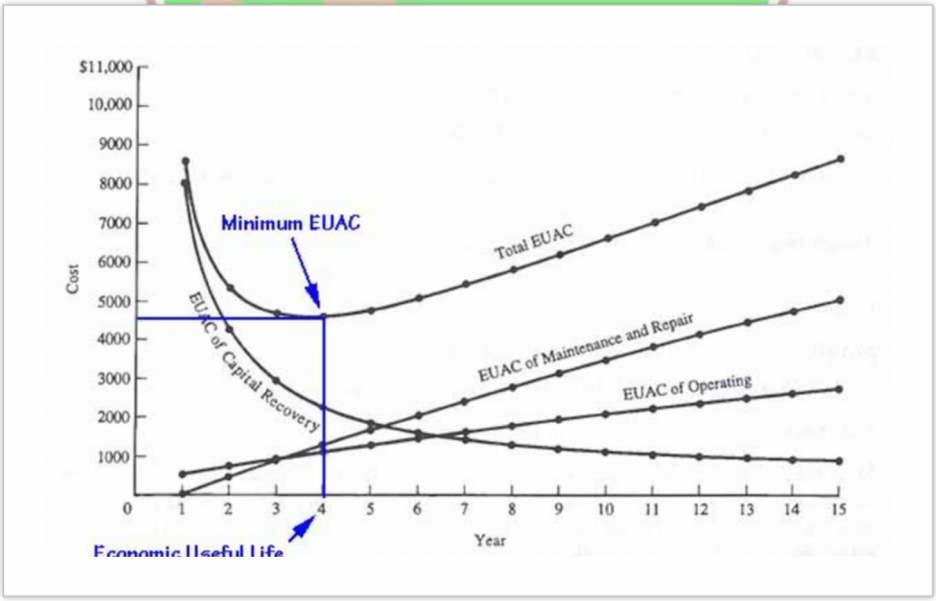

Figure 1. 1 Annual Equivalent Cost (Newnan, 1988)

In the graph above the 4th year, the equivalent total annual cost has reached its lowest point. Based on economic calculations, the machine is suggested to replace it with a new machine because, in the 4th year has the most minimal cost to the company to do a replacement (Newnan, 1988). The total equivalent annual cost is the annual cost of owning and maintaining an asset determined by dividing the net present value of the asset purchase, operations, and maintenance cost by the present value of the annuity factor(Thausen, 1977).

The following table is previous research on asset replacement analysis. In previous studies, many have developed new models in the application of determining asset replacement. With the available development models, it is possible to develop new models in several case studies on different asset replacement problems.

Tabel 1. 3 Previous Research on Asset Replacement

No	Author	Title	Method	Conclusion
1	Joseph C. Hartman a & Alison Murphy (2006)	Finite-horizon equipment replacement analysis	Integer-Knapsack of Dinamic Equivalent Annual Cost	Facilitated through a new dynamic-programming formulation to the problem based on the integer-knapsack problem with nonlinear costs.
2	Jack W. POSEY Jane M. FRASER (1998)	A framework for replacement analysis	finite-horizon models and infinite-horizon models replacement analysis	Unified framework for replacement analysis is presented. The framework consists of a four-step method appropriate for engineering economics decisions and a classification of some traditional and current replacement models and analysis techniques.
3	Joseph C. Hartman (2003)	Multiple asset replacement analysis under variable utilization and stochastic demand	Dynamic programming formulation	Provide an efficient optimal solution procedure through the use of stochastic dynamic programming, illustrate a threshold optimal policy under common cost assumptions and provide a method to easily examine
4	Pinar Keles a & Joseph C. Hartman a (2014)	A Journal Devoted to the Problems of Capital Investment Case Study : Buss Fleet Replacment	finite-horizon models and infinite-horizon models replacement analysis	Analyze the impact of various parameters on decisions, in terms of the choice of replacement assets, as well as the optimal time to retain assets
5	Feri Afrinaldi TaufikaAndrea MartaTasmana Hong-ChaoZhang AlizarHasana (2004)	Minimizing economic and environmental impacts through an optimal preventive **replacement** schedule: Model and application Equipment replacement analysis with an uncertain finite horizon	Age Replacement	Presents a mathematical model to determine the optimal schedule of preventive replacement of a component such that the economic and environmental impacts of the component are minimized. For the economic dimension, the model minimizes the operation, failure and replacement costs of the component.
6	Chin Hon Tan a & Joseph C. Hartman (2010)	Equipment replacement analysis with an uncertain finite horizon	Stochastic dynamic programming formulations	presented and solutions that minimize either expected costs ormaximumregret are explored

So far, proposals for asset replacement of workshop PT Semen Padang are only provided data of asset's breakdown, and often this reason is not be accepted. Therefore, managers need strong scientific calculations, namely the replacement analysis method, to support asset replacement suggestions. The result of asset replacement calculation will give the manager a strong consideration to propose a replacement asset in the recommended year. Therefore, a justification calculation is needed to determine the right decision when the asset should be replaced.

A software of asset replacement is needed to make a manager's task easier to determine an asset's useful life and make reports to replace the asset. An asset replacement software is needed as software that can analyze very quickly and precisely. Therefore, it is necessary to design a software that can integrate data and assist decisions in asset replacement at PT Semen Padang Workshop. A software will help to run the process repeatedly and produce correct asset replacement decisions to solve problems.

The asset replacement software has a role for the PT Semen Padang Workshop in helping make a decision. This software is executed using various information about the required assets, which is processed to become new decision. This new information is an option or solution in making decisions in the form of asset replacement calculations.

Based on the above statement, the asset replacement analysis software has an important role in assisting managers in determining when the asset is replaced. Accuracy in determining and calculating when assets should be replaced is important for the workshop. The workshop can avoid increment in asset replacement costs and overcoming human error in determining and calculating when assets should be replaced. Asset replacement software are also specially created to maintain communication in decision between managers and unit leaders. There is no misunderstanding and perception of each other.

Therefore, this research will discuss asset replacement analysis software expected to assist the PT Semen Padang Workshop management in calculating and determining the appropriate time for an asset should be replaced. The results provided by the software as application whose can provide alternative management of existing problems so that replacement decisions are made to be better with scientific calculation included.

1. 2 Problem Formulation

The asset replacement suggestion from the workshop's manager has not been supported yet with strong consideration. The head of the workshop unit decides to refuse asset replacement because there is no strong justification for making the replacement. Therefore, software in asset replacement analysis is needed to facilitating an automatic calculation to manager.

1. 3 Research Objectives

Design a asset replacement software as an application to help the manager to generate replacement analysis calculations as a strong consideration in asset replacement suggestion.

1. 4 Research Scope

1. The research is only focusing on replacement defender without selection in challenger.
2. The software will be applied for Workshop PT Semen Padang only
3. The result application is only until testing, not the implementation.

1. 5 Outline of Research

The outline of this final project consists of five chapters with the system as follows:

CHAPTER 1 INTRODUCTION

This chapter will discuss the final project's background, problem formulation, objectives, scope, and final project outline.

CHAPTER 2 LITERATURE REVIEW

This chapter will cover some theories and literature related to Replacement Analysis and Database Software.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter will discuss the final project methodology is used in this final project. Final Project methodology describes the systematic step to solve this research problem, from the beginning until the end of the study.

CHAPTER 4 RESULT AND DISCUSSION

The result will be presented the result of the research with the data collected Discussion will be presented with the analysis of the software results in asset replacement.

CHAPTER 5 CONCLUSION AND RECOMMENDATION

This chapter contains the conclusion of the final project and the recommendation for the next research.