

# CHAPTER I

## INTRODUCTION

### 1.1 Background

Cement is one of the main basic ingredients in building construction, thus making cement a strategic commodity (Purnawan and Prabowo, 2017). In 2017 the total national cement production capacity reached 68.7 million tons with a production capability of 59.9 million tons, this shows that the capability of national production has not yet reached its maximum point. In Indonesia, there are several companies that produce cement, one of which is PT. Semen Padang.

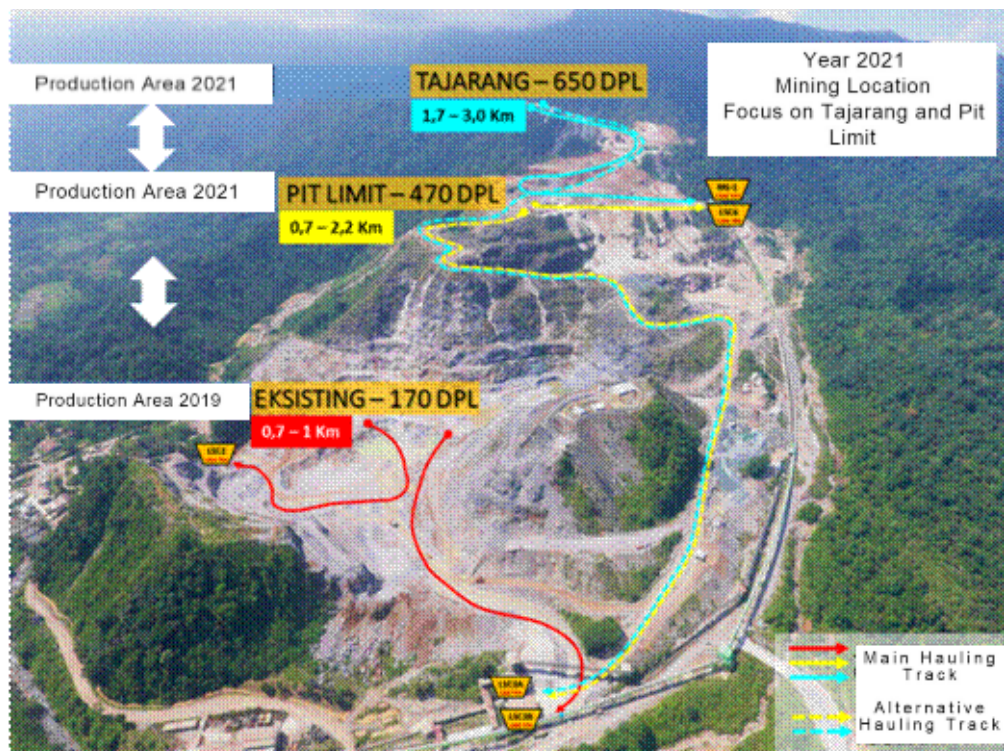
PT. Semen Padang is a subsidiary of PT. Semen Indonesia (Persero) Tbk, which is involved in the production and trade of cement (Handoko et al, 2017). Limestone is a type of non-metal quarrying material which is the primary raw material in making cement (Sari and Wanggai, 2019). Limestone can be used in industrial and commercial use in the form of white limestone and cement. Also, limestone can be used for building stones, building materials, road building materials, and ceramic materials. **Table 1.1** shows the limestone production of PT. Semen Padang in the last five years and production plans for 2020:

**Table 1.1.** Realization of 2015-2019 Limestone Production and 2020 Production Plan (Source: Mining Department of PT Semen Padang 2020)

Year	Limestone Production (Tons)
2015	8.078.077
2016	7.525.328
2017	9.575.904
2018	9.325.634
2019	9.171.943
Company Plan of 2020	10,213,316

Based on the data above, in general, the production of limestone PT. Semen Padang is increasing from year to year. However, limestone is included as a non-

renewable natural resource, so the availability of resources is limited. Currently, PT. Semen Padang conducts limestone mining in three locations. The first area is the Existing Area with Level 170 ASL (above sea level) which is 700-1000 m from Limestone Crusher LSC2, LSC 3A, and LSC 3B. The second area is the Pit Limit Area with Level 470 ASL is 0.7-2.2 km from Limestone Crusher LSC2, LSC 3A, and LSC 3B. The third area is the Tajarang Area with Level 650 ASL is 1.7-3.0 km from Limestone Crusher LSC2, LSC 3A, and LSC 3B. The current mining conditions of PT. Semen Padang is described in **Figure 1.1**. The limestone mining plan for each area is presented in **Table 1.2**.



**Figure 1.1.** PT Semen Padang Mining Conditions (Source: Mining Department of PT Semen Padang 2020)

**Table 1.2.** Limestone Mining Plan (Source: Mining Department of PT Semen Padang 2020)

Area	2019	2020	2021	2022	2023
Existing	60%	60%	-	-	-
Pit Limit	10%	10%	40%	40%	40%
Tजारang	30%	30%	60%	60%	60%

Based on the limestone mining plan data above, the Existing Area in 2021 can no longer be used, due to the depleted resources, even though the Existing Area has the closest distance to the Limestone Crusher compared to other areas.

The limestone mining process itself consists of several stages of the process that begins with the process of blasting, breaking chunks (Breaking), taking material (Loading), loading material (Hauling) and disposal of material (Dumping) into the crusher. The main mining equipment used by PT. Semen Padang is a Dumb Truck and an excavator. **Table 1.3** shows the heavy equipments of limestone mining in PT. Semen Padang:

**Table 1.3.** Heavy Equipment in the Mining Department PT. Semen Padang

No	Unit Code	Type	Equipment Life (Years)	Year of Purchase	End Year	Capacity	Unit	Variety	Brand
1	DC09	777D	19	1999	2025	100	tons	Dumprtruck	Caterpillar
2	DC10	777D	19	1999	2025	100	tons	Dumprtruck	Caterpillar
3	DK 15	HD-784-7	10	2008	2022	100	tons	Dumprtruck	Komatsu
4	DK 16	HD-784-7	7	2011	2025	100	tons	Dumprtruck	Komatsu
5	DK 17	HD-784-7	7	2011	2021	100	tons	Dumprtruck	Komatsu
6	DK 18	HD-784-7	6	2012	2021	100	tons	Dumprtruck	Komatsu
7	DK 19	HD-784-7	6	2012	2021	100	tons	Dumprtruck	Komatsu
8	EC03	6030BH	1	2017	2022	15	m3	Excavator	Caterpillar
9	EH06	EX-2500-6	7	2011	2025	15	m3	Excavator	Hitachi
10	EK04	PC 1800-6	12	2006	2019	15	m3	Excavator	Komatsu

Based on the data above, PT. Semen Padang has already eight units of Dump Trucks and three units of excavators. The limestone mining process has been going well for the last few years. However, due to the Existing Area can no longer be used in 2021, and the target of cement production tends to increase that causing the demand for limestone is also increasing, thus the need for heavy equipment in PT. Semen Padang is also increased. Based on **Table 1.2** the mining process of PT. Semen Padang in 2021 is focused on 2 areas (usually done in 3 areas), causing PT. Semen Padang lacks the resources to fulfill production needs.

In 2021 PT. Semen Padang will carry out mining activities in 2 areas which are usually carried out in 3 areas, one of the things that PT. Semen Padang to keep fulfilling the production target is to increase the number of heavy mining equipment used, namely excavators and dump trucks. Therefore, PT. Semen Padang should determine the optimal amount of additional Dump Trucks and Excavators to fulfill the limestone production plan. Determination of the correct amount of additional heavy equipment is needed by PT. Semen Padang because in 2021 the required distance to the limestone quarrying area will be further than before, and the heavy equipment transports the limestone in tons. Thus, it is vital to determine the optimal amount of heavy equipment to use in mining the limestone.

Efforts to achieve certain goals can not be separated from economic principles, that is, do not let the costs incurred too high (Niaro et al, 2016). The supply of equipment that is too much, or too little will cause an increase in inventory costs. If there is too much equipment, there will be costs called carrying costs, which are costs incurred because the company has a lot of inventory. Otherwise, if too little equipment inventory will incur costs due to lack of inventory which is commonly called a stock out cost such as disruption of the production process. Determination of the addition of an appropriate amount for these two machines is also urgent because the limestone material itself cannot be stored in the storage. The quality of the limestone will be reduced if stored for a long time.

There are many ways that can be done in solving the problem to get the best results (Chandra, 2015). The way to achieve the best results is called optimization techniques. Optimization technique is a method used to provide the best-desired results. Optimization system usually refers to a mathematical program technique that usually discusses the course of a research program, and is used to provide the best results for the problem at hand.

The mining system of PT. Semen Padang is influenced by various factors such as the determination of the excavation location, the distance between locations, the location for detonating/ blasting limestone, the type of heavy equipment used, the number of heavy equipment to be used, the type and capacity of heavy equipment used, and other things. Mining activities at PT. Semen Padang must also always be alert to uncertainty problem that can occur in mining such as accidents by heavy equipment, breakdown to the equipment while operating, the influence of weather, and also quite steep roads, because the mining process can be said to be a dangerous process and can create a big risk if not careful. Therefore, it is recommended that the optimization technique is not used in solving the problem of determining the number of heavy equipment at PT. Semen Padang, due to the mining system of PT. Semen Padang is a complex system and there are many factors that influence this system, so it will be difficult to get the "best results" if using optimization techniques. And also optimization must first be demonstrated rigidly as it can be formally described mathematically and can be solved (Munirah and Subanar, 2017).

Based on the problems described above, it is necessary to conduct a detailed study on how to determine the number of Dump Trucks and Excavators needed for the supply of limestone in PT. Semen Padang. The simulation technique is applied in this research. Simulation is a process of imitating by designing a model of a real-world system, to evaluate a model numerically, and the data gathered in order to estimate the desired true characteristics of the model (Law and Kelton, 1991). As a technique, simulation is one of the most widely used in operations research and management science. Application areas for simulation are numerous and diverse, consist of designing and analyzing manufacturing systems, evaluating hardware and software requirements for a computer system, determining ordering policies for a inventory system, and evaluating a new military weapons system or tactic.

Based on the explanation above, one of the functions of simulation is to evaluate a system. In this research, the simulation technique is used and the

scenarios are developed to determine the optimal number of Dump Trucks and Excavators needed to fulfill the production plan in PT. Semen Padang.

## 1.2 Problem Formulation

Based on the background described, the problem of this research is how to determine the number of Dump Trucks and Excavators needed to fulfill the limestone production plan in PT. Semen Padang.

## 1.3 Research Objective

The objective of this research is to determine the number of Dump Trucks and Excavators needed to fulfill the limestone production plan in PT. Semen Padang.

## 1.4 Research Scopes

The scopes of this research are:

1. The study is conducted in the Mining Area of PT. Semen Padang.
2. The research is analyzed based on the historical production data 2015-2019 and the production plan 2020.
3. Cost was not considered in this study.

## 1.5 Outline of Report

The outline of this final project report are as follows:

### CHAPTER I INTRODUCTION

This chapter contains the background of research, problem formulation, research objectives, research scopes, and outline of report.

## CHAPTER II LITERATURE REVIEW

This chapter presents theories related to research, such as cement, limestone, excavator, dump truck, system modeling, simulation and arena software.

## CHAPTER III RESEARCH METHODOLOGY

This chapter describes the stages in problem-solving, which starts from the preliminary study, literature study, problem identification, problem formulation, data collection, data processing, discussions, and conclusions.

## CHAPTER IV DEVELOPMENT OF SIMULATION MODEL FOR MINING ACTIVITIES IN PT. SEMEN PADANG

This chapter presents the development of simulation model for mining activities in PT. Semen Padang. It consist of system description, collecting the data, computing the data, development of simulation model, verification, validation, replication of simulation model, simulation output analysis and development of scenarios.

## CHAPTER V DISCUSSIONS

This chapter contains the discussion of the result consist of simulation model and scenarios of simulation model.

## CHAPTER V CONCLUSIONS

This chapter contains conclusions based on research objectives and suggestions for future research.

