CHAPTER I
INTRODUCTION

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

1.1 Background

One of the supporting factors for the success of the manufacturing industry is determined by the smooth production process. If the production process is smooth, then the effective use of machinery and production equipment will produce the quality products, the right time to complete manufacturing, and the low production costs (Rinawati and Dewi, 2014). One of the things that affect the smoothness of the production process is the state of the machine. The machine has an economical age in its use, thus it needs proper handling of maintenance so that the machine can work optimally (Said and Susetyo, 2008). According to Said and Susetyo (2008), the maintenance problems are the implementation of machine maintenance that has not been implemented properly so that the machine is damaged, the machine downtime is long, and wasteful because it does not know the root causes. The problems that usually occur in maintenance are machine failure, machine downtime and product defects (Rinawati and Dewi, 2014). Whereas according to Nursubiyantoro *et al* (2016), the maintenance problems are a breakdown, defective products, and rework products. From the description above, it is necessary to have proper maintenance measures to achieve equipment effectiveness and low production costs.

Effective maintenance is critical to many operations. It extends equipment life improves equipment availability and retains equipment in proper condition. Conversely, poorly maintained equipment may lead to more frequent equipment failures, poor utilization of equipment and delayed production schedules.

Misaligned or malfunctioned equipment may result in scrap or products of questionable quality. Finally, poor maintenance may mean more frequent equipment replacement because of shorter life that affected to high production and maintenance cost (Swanson, 2001).

In response to the maintenance problems encountered in manufacturing environments, the Japanese developed and introduced the concept of total productive maintenance (TPM), a form of the productive maintenance that involving all employees in 1971. TPM is a maintenance system developed by Nakajima (1988) in Japan, which covers the entire life of equipment in every division including planning, manufacturing, and maintenance. It describes a synergistic relationship among all organizational functions, but particularly between production and maintenance, for continuous improvement of product quality, operational efficiency, capacity assurance and safety (Suzuki, 1994). TPM is an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns, and promotes autonomous operator maintenance through day-to-day activities involving the total workforce (Singh et al., 2013).

Through TPM, the involvement of non-technical staff, especially production operators, is required to perform simple maintenance activities. This practice can indirectly prevent unexpected breakdowns, which can reduce the maintenance cost that may amount to millions a year. The practice known as autonomous maintenance (AM), which is also called Jitshu-Hosen in Japanese, is the key to TPM success. Through AM practice, operators can inspect, clean, lubricate, adjust and even perform simple countermeasures in their respective equipment to prevent unplanned machine downtime. AM ascertains the roles and tasks of production operators so they can perform easy daily maintenance activities aside planned maintenance. In other words, AM is designed to oblige production operators to maintain their equipment independently without notice or instruction from the maintenance department. The goal of AM is to achieve a high degree of cleanliness, excellent lubrication, and proper fastening to inhibit deterioration and prevent machine breakdown (Min et al, 2011).

TPM has spread rapidly in Japanese Industry and thus, the companies outside Japan are becoming interested are because of some reasons (Suzuki, 1994). First, implementing TPM has significant results in reducing equipment breakdowns, minimizing idling and minor stops, fewer quality defects, and claims, increasing productivity, decreasing labor and cost, shrinking inventory, minimizing accidents, and promoting employee involvement. Second, by implementing TPM, the working environment becomes cleaner. Third, implementing TPM makes transforming the plant worker because it begins to yield the concrete results in improving the working environment, minimizing breakdowns, improving quality, reducing change over time and so on, the workers become motivated, involvement increases, and improvement suggestion develop. The workers are beginning to think of TPM as part of their job.

The maintenance system in PT Semen Padang is the maintenance in terms of mechanical and electrical. The maintenance department is under the directorate of operations. So that those responsible for maintenance related issues in PT Semen Padang are the operation director of PT Semen Padang. The maintenance program conducted in PT Semen Padang is an autonomous maintenance program, planned maintenance, and quality maintenance. These three programs have actually been implemented. However, for some programs, there has never been an evaluation based on actual conditions in the factory to determine the level of success of the program. Especially for an autonomous maintenance program, the results are presented in qualitative based on conditions in the factory. In terms of planned maintenance and quality maintenance, PT Semen Padang has its own working unit to handle the programs and conducted quantitative measurements for the definite results. It is different from autonomous maintenance which does not have its own working unit. The autonomous maintenance programs require operators to understand their equipment and can carry out basic maintenance actions such as cleaning, inspection, lubrication, and tightening.

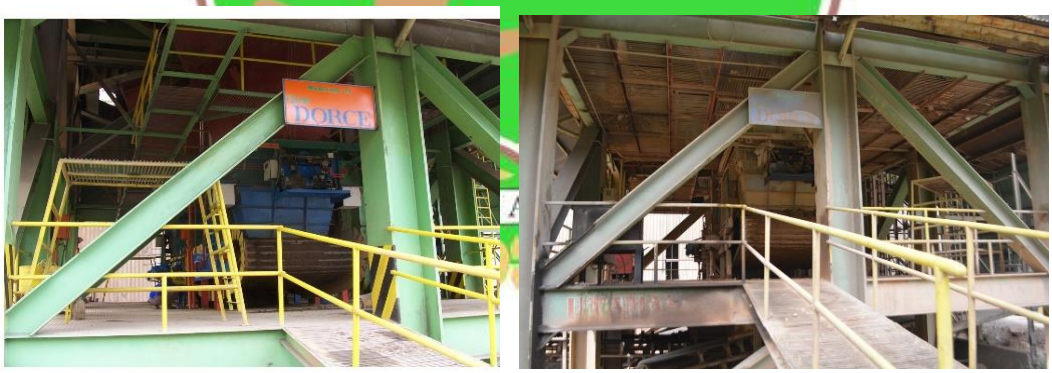
PT Semen Padang has a vision "Being a reliable, superior and environmentally sound cement company in Western Indonesia and Southeast Asia". It illustrated that PT. Semen Padang has responsibility to advance the company's position in Southeast Asia, competition seizes and retains market share in Southeast Asia not only to cement companies that are in one group of companies such as Thang Long Cement in Vietnam, but also with cement companies that are outside the company group such as Siam Cement in Thailand, and Lafarge Malaysia. Therefore, in order to win the competition, more advanced and consistent methods and actions are needed to face the competitors (TPM Officer of PT Semen Padang, 2019).

One of the opportunities to win the competition is to reduce the Cost of Goods Manufactured (COGM). Many strategies have been taken by PT. Semen Padang, one strategy is by applying the TPM (Total Productive Maintenance) work culture in the production line. However, since the TPM program was launched at PT. Semen Padang in 2004, it has not been conducted a comprehensive measurement to the level of success of the program and the evaluation of the implementation of TPM (TPM Officer of PT Semen Padang, 2019). If the implementation of TPM is not evaluated, PT Semen Padang will not know whether the TPM implementation has been successful and well-running for each TPM pillar. If this continues, then PT Semen Padang cannot determine the right steps as a follow up to the results of the TPM implementation. Because it is unknown whether there are problems in the TPM implementation. If there is a problem, it is not known exactly what problems occur in the TPM pillar because there is no proper evaluation. Therefore, PT Semen Padang needs to evaluate the implementation of TPM in order to conduct improvements from the results of the evaluation.

Actually, in the beginning of 2019, PT Semen Padang has conducted a TPM implementation assessment system using an instrument called the TPM control board. TPM control board is applied to all production floors and working groups in PT Semen Padang. This system is based on the instruction from Semen Indonesia Group which was adapted from PT Astra. The control board is designed for all

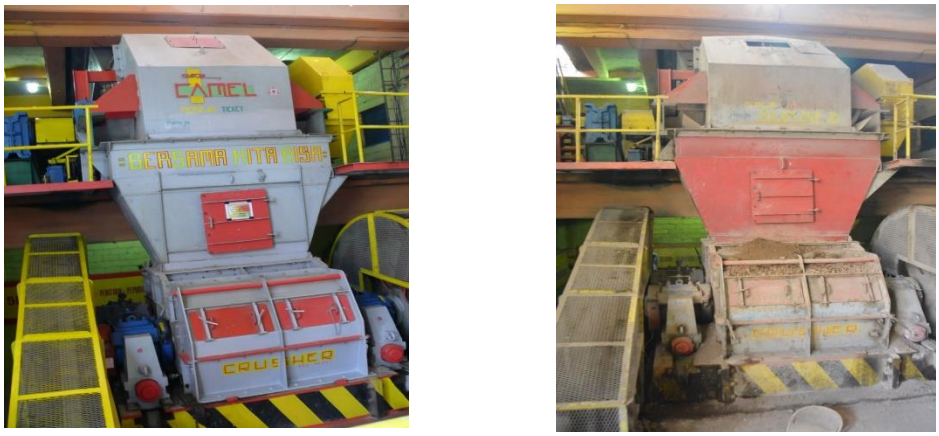
workers and working groups based on some pillars of TPM consists of autonomous maintenance, planned maintenance, focus improvement, quality management and safety health environment. The results of TPM control board is present the value of key performance index of employees. But this system is considered not fully suitable to be applied at PT Semen Padang because PT Astra and PT Semen Padang are different companies in the production process and the main products produced (TPM Officer of PT Semen Padang, 2019). In addition, assessment indicators in this system do not fulfill all TPM activities carried out based on the literature. For example, the activities on the Autonomous Maintenance pillar. While actually, PT Semen Padang has implemented AM activities, but there is evaluation yet in accordance with the implementation that has been carried out by PT Semen Padang.

Implementation of TPM has a significant impact on the performance of PT Semen Padang. **Figure 1.1** and **Figure 1.2** show the comparison condition of PT Semen Padang with and without TPM implementation. **Figure 1.1** presents the condition in Feeder Silika of the Indarung IV plant. **Figure 1.2** presents the condition in Clay crusher of the Indarung IV plant.



i. With TPM (2009) ii. Without TPM (2018)

Figure 1.1 Comparison condition with TPM and without TPM (TPM Officer of PT Semen Padang, 2019)



i. With TPM (2009) ii. Without TPM (2018)

Figure 1.2 Comparison condition with TPM and without TPM (TPM Officer of PT Semen Padang, 2019)

Currently, besides the assessment system using TPM control board, in order to evaluate the TPM implementation, PT Semen Padang has calculated the OEE value. If the actual OEE bigger than the target OEE, then it can be concluded that TPM has well implemented. The value of OEE from 2018-May 2019 is presented in **Table 1.1**. The OEE calculation conducted to three main machines of the production process in PT Semen Padang consist of raw mill, kiln and cement mill.

Table 1.1 Value of OEE from January 2018 until May 2019 in PT Semen Padang (Maintenance Planning and Evaluation of PT Semen Padang, 2019)

OEE (%)	2018												2019				
Wilayah	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nov	Des	Jan	Feb	Mar	Apr	Mei
2R1	87.90%	100.08%	68.02%	88.95%	66.50%	74.84%	80.40%	85.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	79.06%	98.33%	105.51%
3R2	86.85%	97.23%	0.00%	0.00%	0.00%	0.00%	0.00%	81.21%	87.62%	78.89%	103.97%	82.94%	71.86%	47.51%	48.99%	0.00%	0.00%
4R1	107.30%	96.25%	76.94%	92.34%	70.02%	71.77%	59.96%	72.94%	80.99%	75.73%	70.88%	87.08%	68.45%	8.66%	59.27%	60.40%	65.13%
4R2	105.12%	105.77%	98.50%	96.61%	84.86%	81.12%	83.20%	90.19%	99.75%	90.84%	83.59%	90.22%	70.10%	9.26%	66.41%	91.07%	86.82%
5R1	96.14%	74.00%	84.83%	78.15%	98.90%	88.32%	86.54%	111.72%	91.64%	89.21%	82.84%	84.59%	75.11%	70.95%	75.51%	69.06%	81.95%
5R2	76.80%	89.50%	86.78%	87.45%	90.06%	93.45%	100.60%	99.36%	90.94%	74.83%	67.70%	76.67%	77.90%	70.79%	66.93%	64.31%	73.14%
6R1	90.40%	93.79%	92.69%	89.89%	93.62%	85.47%	102.64%	84.07%	99.57%	91.79%	91.89%	92.04%	79.27%	74.63%	79.78%	64.95%	81.39%
2W1	5.85%	43.03%	40.27%	46.88%	55.26%	42.44%	45.31%	35.28%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	69.59%	80.62%	70.81%
3W2	78.81%	58.22%	0.00%	0.00%	0.00%	0.00%	0.00%	4.37%	63.28%	68.71%	57.27%	50.85%	90.71%	54.51%	84.33%	0.00%	0.00%
4W1	78.61%	71.83%	50.09%	65.29%	75.97%	56.18%	69.25%	71.37%	63.57%	65.17%	80.24%	56.46%	90.63%	10.63%	63.62%	79.38%	85.12%
5W1	75.28%	74.88%	63.50%	52.96%	29.20%	61.75%	68.41%	85.68%	52.10%	62.45%	60.65%	68.04%	72.88%	84.65%	81.23%	48.27%	5.61%
6W1	60.32%	58.08%	100.42%	97.81%	91.51%	96.18%	77.23%	97.06%	73.48%	97.53%	87.16%	82.08%	64.59%	91.68%	82.18%	65.93%	44.60%
2Z1	74.95%	68.27%	75.07%	82.32%	80.04%	27.60%	88.18%	76.09%	69.58%	68.21%	68.22%	74.83%	95.87%	99.85%	95.96%	96.32%	92.26%
3Z2	58.26%	60.10%	59.83%	0.00%	59.81%	55.57%	69.97%	61.99%	59.98%	56.97%	52.00%	53.72%	48.47%	101.26%	84.18%	91.73%	88.07%
4Z1	70.09%	61.66%	57.03%	65.35%	62.26%	49.08%	68.63%	69.96%	65.95%	67.59%	56.33%	60.34%	85.03%	40.44%	86.81%	81.86%	99.89%
4Z2	53.36%	63.19%	62.21%	69.75%	72.20%	76.97%	73.72%	70.58%	73.00%	75.27%	59.33%	60.25%	74.96%	76.56%	39.44%	60.00%	49.67%
5Z1	102.98%	99.76%	94.60%	95.51%	54.70%	100.68%	103.69%	99.81%	93.56%	92.98%	93.92%	93.69%	81.23%	88.64%	76.75%	91.83%	72.26%
5Z2	86.13%	95.56%	99.76%	101.75%	69.89%	101.25%	100.45%	86.84%	98.16%	99.99%	101.03%	91.23%	98.99%	88.44%	72.03%	58.70%	83.66%
6Z1	107.13%	65.68%	85.43%	89.15%	90.85%	87.71%	75.09%	99.79%	100.45%	106.69%	100.27%	105.14%	78.71%	102.96%	113.63%	111.19%	103.92%

The value of target OEE in PT Semen Padang is 75% (Maintenance Planning and Evaluation of PT Semen Padang, 2019). Based on **Table 1.1**, there

are several OEE values that do not reach the target. Thus, it can be concluded that TPM has not been implemented properly. Besides the OEE value, the other measures that can be used to evaluate TPM implementation on AM pillar are based on basic maintenance activities consist of cleaning, inspection, lubrication, and tightening. These activities have not been well implemented in PT Semen Padang. Therefore, an appropriate evaluation of the TPM implementation in PT Semen Padang is needed especially on AM pillar.

1.2 Problem Formulation

The problem formulation of this research are:

1. How to evaluate the implementation of Total Productive Maintenance in PT Semen Padang?
2. What are the proposed improvements needed for the implementation of Total Productive Maintenance in PT Semen Padang?

1.3 Research Objectives

The objectives of this research are to:

1. Evaluate the implementation of Total Productive Maintenance in PT Semen Padang.
2. Propose the improvements to the implementation of Total Productive Maintenance in PT Semen Padang

1.4 Research Scopes

The research scopes in this study are :

1. Evaluation of Total Productive Maintenance (TPM) implementation is conducted in Indarung IV plant of PT Semen Padang because the average of OEE value in Indarung IV plant is classified lower than the other plants.
2. Evaluation of Total Productive Maintenance implementation is only focused on Autonomous Maintenance (pillar 1) because AM pillar is the

key to TPM success (Min et al, 2011) and has the highest weight of all pillars in key performance index assessment of PT Semen Padang.

1.5 Outline of Report

The outline of this final project report are as follows:

CHAPTER I INTRODUCTION

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

CHAPTER II LITERATURE REVIEW

This chapter describes a review of the related literature of the research. The literature review consists of theories and tools to be used in problem solving, consisting of Maintenance, Concept of Total Productive Maintenance (TPM), Pillars of TPM, Analytic Hierarchy Process (AHP) Method, Objective Matrix (OMAX) Method and TPM in PT Semen Padang.

CHAPTER III RESEARCH METHODOLOGY

This chapter explains the methodology used in this research consist of preliminary study, literature study, problem formulation, research objective, method selection, data collection, data processing, results, discussions, conclusions, and suggestions for further research.

CHAPTER IV EVALUATION OF TOTAL PRODUCTIVE MAINTENANCE IMPLEMENTATION IN PT SEMEN PADANG

This chapter describes the results of the research based on data collection and data processing. It is consists of Identification of Indicators (KPIs), Validation of KPIs, Determining the Importance Weight of KPIs, Development of Evaluation Instrument of TPM Implementation on AM pillar, Validation of Evaluation Instrument of TPM Implementation on AM pillar, Assessing the TPM Implementation on AM pillar in Indarung IV plant of PT Semen Padang, Score

Calculation using OMAX Method, Evaluation of assessment data of TPM Implementation on AM pillar in Indarung IV plant of PT Semen Padang using OMAX Traffic Light System method, and Developing Improvement based on the evaluation results.

CHAPTER V DISCUSSIONS

This chapter explains the analysis based on the results obtained. It is consists of discussion on Importance Weight of Indicators and KPIs, discussion of Performance Scoring calculation using OMAX and discussion on Improvement suggestions based on the evaluation results.

CHAPTER VI CONCLUSIONS

This chapter describes the conclusions of the research conducted and suggestions for further research.