CHAPTER I
INTRODUCTION

This chapter presents the research background, problem formulation, research objectives, problem formulation, scopes of the problem, and outline of the Final Project.

1.1 Background

The rapid development of the industrial world has led the fierce competition among companies. Every company is competing not to lose in competition from its competitors. The effort that can be made by the company in order to not losing the competition is improve the company's performances continuously. These performances are seen from the dimensions of the company's goals which are customer satisfaction, return for stakeholders, the dignity of employees, and benefits to the environment. Customer satisfaction is an important component of a business strategy as well as customer retention and product repurchase. Customer satisfaction is influenced by specific product or service features and perceptions of quality (Khadka and Maharjan, 2017). The dignity of employees can be seen from the comfort of work, loyalty to the company, and do the job wholeheartedly because they feel participated in bringing the company to be better. Return the stakeholders can be seen from the good relationship between stakeholders and the profit earned from each stakeholder. Benefits to the environment can be seen from the waste produced by companies and benefits caused to the surrounding environment.

In order to achieve this target dimensions, each company attempts to run effectively and efficiently. Lean and Green Manufacturing are the approach to make the systems effectively and efficiently. Lean Manufacturing is a business model and a set of tactical methods that emphasize non-value-added activities

(waste) must be eliminated in order to produce quality products on time, minimize costs with greater efficiency (EPA, 2007). Green Manufacturing focuses on reducing environmental waste in providing products and services to consumers.

According to the US Environmental Protection Agency (2007), the environmental waste is the use of resources or unnecessary substances or excessive released into the air, water, or soil that could harm human health or the environment. Environmental waste can be generated by the company in the production process or serving customers, or when consumers use the product and dispose of the product. That included in the environmental footprint are energy, water, raw material, pollutants, wastes, and hazardous substances.

The environment becomes a global issue with the decreasing quality of the environment. The increasing concentration of CO2 in the atmosphere is blocking the release of heat from the Earth so that the temperature is likely to increase. According to Salim, as quoted Ervianto (2011), the concentration of CO2 in the air has increased after the industrial revolution. CO2 emissions produced to become a measuring tool to see the size of the effect of a process to the environment (Ervianto, 2011). The amount of cement produced is equivalent to the amount of CO_2 emissions produced (Kubba, 2010). Excavation of mining materials group C (which contains a lot of lime, silica, and clay) also has a lot of impact on the environment such as damage to infrastructure, drainage, and erosion of land (Azmi, 2016).

PT Igasar is one of the companies that use cement as the main raw material in the production process. PT Igasar is a subsidiary of PT Semen Padang, which was founded in 1971. Currently, PT Igasar engaged in several fields such as a distributor PT Semen Padang, transportation services, contractors, and production of building materials. The product that produced by PT Igasar are Block Concrete (Hollow Brick, Block Paving, Kanstein, and Concrete Panel), and Ready Mix Concrete (RMC).

Based on an interview with production staff, it is known only Hollow Brick Type C that is produced by make to stock system, while other products produced by make to order system. Make to stock system require special attention so that the production is able to meet consumer demand and there is no excessive production. Production and sales of Hollow Brick Type C in 2016-2018 show in **Figure 1.1**.

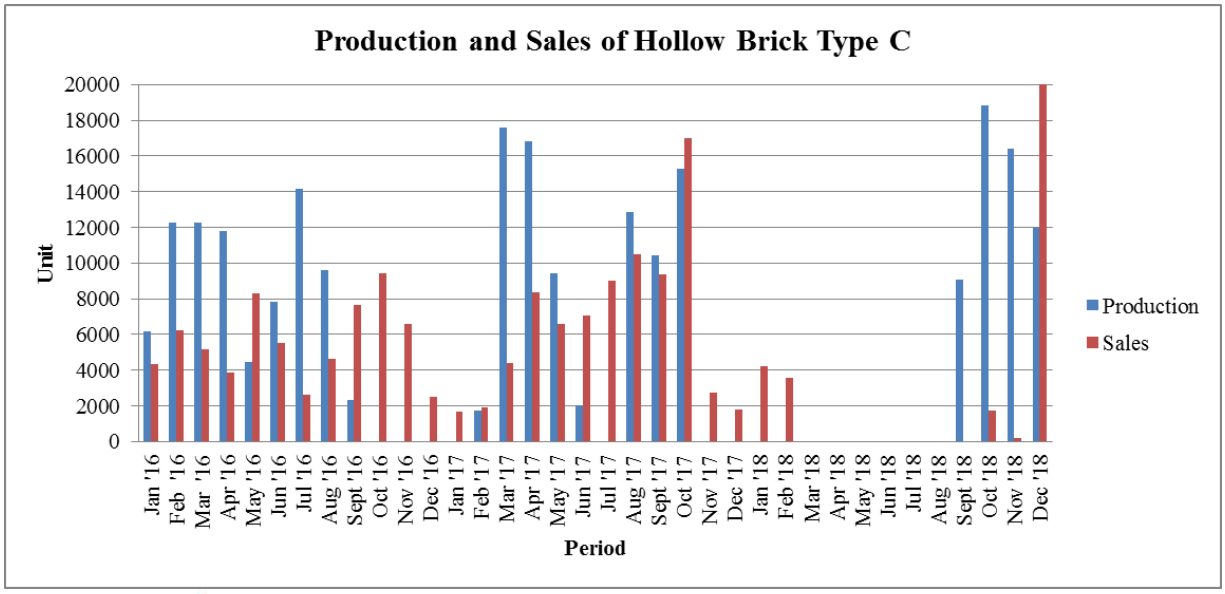

Figure 1.1 Production and Sales of Hollow Brick Product Type C 2016-2018 (Source: PT Igasar)

Raw materials of Hollow Brick Type C are cement, split, and water. The split is made from basalt stone that parsed. The composition of Hollow Brick Type C is shown in **Table 1.1.**

Table 1.1 The Composition of Hollow Brick Type C

Materials	Amount	Percentage
Cement	0.83 kg	4.72%
Split 0-10	16.22 kg	92.16%
Water	0.55 kg	3.13%

(Source: PT Igasar)

Figure 1.1 shows from October 2016 to January 2017 and January to August 2018 PT Igasar does not do production Hollow Brick Type for a long

time. These are due to the broken of Machine Block, the lengthy process of repair of the machine, and company decision. Production activities that stop become a problem because the resulting resources are not used properly. Although workers on the production line Hollow Brick Type C are labor, PT Igasar still assigns permanent workers tasked to supervise the production of Hollow Brick Type C.

Beside human resources, raw materials also idle as it waits for machine repairs. During storage, while waiting for the machine can be operated again, split in the form of granule has the potential swept away by the wind or rain. Cement materials are potentially hardened or agglomerate into big particles so it becomes cement lumps. So, cement lump had to be parsed again into small particles beforehand. Otherwise, it will affect the quality of products to be made. This process will increase the time of the production process. Basalt stone material that stored in an open area for a long time has the potential to be overgrown by moss.

Production activities that stop within a relatively long time resulted in the disruption of the production flow. This causes the available capacity not to be used optimally. PT Igasar only relies on the existing stock to cover the demand of consumers when it not produces. The absence of a request in March to September 2018 caused by the amount demand of customers cannot be covered with the remaining stock. This causes the company to lost sales. Resources and inventory which were waiting to use and lost sales as a result of broken machines cause waiting for the next activities that should be eliminated in the Lean Manufacturing concept.

Table 1.2 Stock Opname Results on Hollow Brick Type C Inventories in PT Igasar 2016-2018

	2016	**2017**	**2018**
Unit (a)	Unit	Unit	Unit
Initial Inventory (b)	186	4961	10345
Purchase (c)	80790	86180	56270
Use (d)	66735	80296	30030
End Inventory (d=a+b-c)	14241	10845	36585
Physical (e)	13976	8659	34062
Difference (f=e-d)	-265	-2186	-2523

Table 1.3 Stock Opname Results on Raw Material Inventories in PT Igasar 2016-2018

	2016			2017			2018		
	Basalt Stone	**Split 0-10**	**Cement**	**Basalt Stone**	**Split 0-10**	**Cement**	**Basalt Stone**	**Split 0-10**	**Cement**
Unit (a)	Ton	Kg	Sacks	Ton	Kg	Sacks	Ton	Kg	Sacks
Initial Inventory (b)	136.3	10080.23	17.5	12712.98	386.06	10	8590.33	0	0
Purchase (c)	39446.51	14095.84	190	0	1215.42	84.55	0	1797.19	1027
Use (d)	26678.59	15246.61	207.64	5158.17	1600.64	94.54	1653.74	900.02	1025.95
End Inventory (d=a+b-c)	12904.22	8929.46	-0.14	7554.81	0.84	0.01	6936.59	897.17	1.05
Physical (e)	12749.12	420.11	9	8590.33	0	2.05	6546.38	1065.1	0
Difference (f=e-d)	-155.1	-8509.35	9.14	1035.52	-0.84	2.04	-390.21	167.93	-1.05

Based on the stock opname in **Tabel 1.2,** there has been overproduction on Hollow Brick Type C product. PT Igasar didn't produce much but still said as overproduction because of the number of stock and the number of sold product is not established. Overproduction means using more raw materials and resources to produce Hollow Brick Type C. In other words, it would be a waste of raw materials and resources due to overproduction. During storage, Hollow Brick Type C also has the potential to be damaged or overgrown by moss. Therefore, overproduction belongs to the waste that should be eliminated in the Lean Manufacturing concept.

These materials and resources also have negative impacts on the environment such as producing CO2 emissions released into the atmosphere. CO2 are emitted by machine use and raw material such as cement. Total CO2 that emitted because of overproduction which derives from cement use is equivalent to cement usage of overproduction as shown in **Table 1**.4. Therefore, overproduction belongs to the waste that should be eliminated because it inhibits the application of Green Manufacturing. **Table 1.4** shows the equivalent raw materials used to produce the excess product of Hollows Brick Type C. Amount of overproduction is taken based on the number of remaining products at the end of 2016 until 2018.

Table 1.4 Equivalent Raw Materials of Overproduction

Material	**Requirement /unit**	**Overproduction in 2016 (14241**	**Overproduction in 2017 (10845)**	**Overproduction in 2018 (36585)**
Cement	0.83 kg	11820.03 kg	9001.35 kg	30365.55 kg
Split 0-10	16.22 kg	230989 kg	175905.9 kg	593408.7 kg
Water	0.55 kg	7832.55 kg	5964.75 kg	20121.75 kg

Hollow Bricks Type C are produced using Multi-block machine having the power of 12 kW. Total CO2 that emitted from the use of machines to produce the excess product from 2016 until 2018 amounted to 991.808 kgCO2, 694.080 kgCO2, and 2341.440 kgCO2.

Based on **Table 1.2**, there are differences between the recorded quantity in the book and the physical check of inventory. The differences recorded in the book indicate the loss of products or raw materials. So that it needs further investigation about the causes. The differences also indicate poor inventory control. The loss of raw materials and products means that they need to obtain the replacement that can generate environmental impacts. Therefore, loss of products or materials included in the inventory waste that must be eliminated in order to Lean and Green Manufacturing can be applied to PT Igasar.

The excess products of Hollow Bricks Type C are included in the inventory because the products are stored to await further treatment that is sold to consumers. Excess products are stored in an uncertain time when it will be sold. Because of that, there are capital costs that are kept in the stored products. Hollow Brick Type C that has been pressed had to be dried until product aged 15 days depending on the weather to get the desired level of hardness. Products that have achieved the desired level of hardness but are still placed in open areas directly exposed to sunlight and rain will pose a risk such as mossy or cracked products. Product storage location that is close to the area of material handling products poses a risk of broken. Therefore, the products pile up activity in areas that are not a special storage area will increase the chances of occurrence of defects in the products during storage.

Based on raw material data in **Table 1.3**, it can be said that the stored splits are overstock. Splits are stored around the stone crusher machine. Stone crusher machine is a machine for processing basalt stones into a split. Splits are stored in an open area so that directly exposes to wind and rain. Split is granules so that it is easily carried away by wind and rain. This will have a negative impact

on the environment, including the disruption of traffic lanes on the shop floor, wastes, and air pollution. Moreover, overstock is also found on basalt stones. These findings can be seen in **Figure 1.2** below.

Figure 1.2 Basalt Stone in The Field

Based on product inventory data in PT Igasar the end of 2018 in **Table 1.2** and **Table 1.3**, it is known that there has been overstock in Hollow Bricks Type C product and raw materials such as basalt and split. Overstock included in the waste of inventory that should be eliminated in the concept of Lean Manufacturing. That is because there are costs kept on the goods stored, overstock will take a lot of places, and the stocks are potentially lost or damaged if not handled properly.

Figure 1.3 Defective Hollow Bricks in The Field

Based on the preliminary survey that has been done, there are findings of defective Hollow Bricks Type C that are stored in the production area of PT Igasar. These findings can be seen in **Figure 1.3**. Defect included in the waste that should be eliminated in Lean Manufacturing concepts. Defective products are said to be waste because the raw materials, energy resources, human resources, time, and costs used to make the products become useless.

Based on Pratama (2018), in 50 units Hollow Brick Type C produced by PT Igasar, there are approximately 2% of defective products. Based on the amount of production in 2018, defects of Hollow Brick Type C are approximately 1258 units. The defective product cannot be sold so it will be a waste of the environment. In addition, the negative impacts on the environment caused during the retrieval of raw materials to manufacture products to be useless. This indicates that the defective Hollow Brick Type C not in accordance with the Green Manufacturing concept.

Based on the problems described above, PT Igasar requires further identification of wastes with the Lean and Green Manufacturing concepts in order to reach the company's goals. Lean Manufacturing concept is used to analyze the wastes in the manufacturing system. It will be associated with the environment so

Lean and Green Manufacturing concepts can be applied simultaneously. At the end of the study, recommendations will be given for improvements to minimize wastes. The integration of Lean and Green Manufacturing is expected can help the company improve the effectiveness and efficiency of the company.

1.2 Problem Statement

Based on the background above, the problem in this research is what are recommendations of improvements are given to minimize wastes in the manufacturing system at PT Igasar by applying Lean and Green Manufacturing concepts.

1.3 Objectives

This research conducted to reach the following objectives:

1. To identify wastes in the manufacturing system at PT Igasar and its causes.
2. To make recommendations for improvements to minimize wastes in the manufacturing system at PT Igasar by applying Lean and Green Manufacturing concepts.

1.4 Research Scope

The following are describes the scopes of this research:

1. This research is conducted within the scope of activity in the manufacturing system PT Igasar, especially only for Hollow Brick Type C.
2. The environmental impact discussed only relate to the wastes found in the manufacturing system in PT Igasar.
3. The problems that occur are indicated by data from the past three years (2016-2018) to see the significance of the problem. However, due to incomplete data from the company, there are some limited data when displayed.

1.5 Outline of The Final Project

Outline of the Final Project used in this research are:

CHAPTER I INTRODUCTION

This chapter describes the research background, problem statement, objectives, research scope, and outline of the Final Project.

CHAPTER II LITERATURE REVIEW

This chapter contains theories related to the research topic of the Final Project as the basis for completing the research undertaken. These theories are obtained from various sources such as books, journals, and the Internet.

CHAPTER III RESEARCH METHODOLOGY

This chapter describes the steps conducted in the research systematically and clearly so that research can run as objectives that will be achieved.

CHAPTER IV EVALUATION OF EXISTING MANUFACTURING SYSTEM

This chapter contains the evaluation of the scope of activity in the manufacturing system PT Igasar about the identification of wastes which causes Lean and Green Manufacturing has not been implemented properly and its causes and effects on the environment. The evaluation will be carried out through Define, Measure, and Analyze stages.

CHAPTER V RECOMMENDATION OF SYSTEM IMPROVEMENT

This chapter contains the recommendations of improvements through Improve and Control stages to minimize the wastes that occur in the scope of activity in the manufacturing system PT Igasar according to the Lean and Green Manufacturing concepts.

CHAPTER VI CONCLUSIONS

This chapter contains a summary of the research results and suggestions for future research.