IMPROVING MATURITY TOWARDS GREEN MANUFACTURING
(CASE STUDY: FERTILIZER COMPANY - ADIBIO10)

THESIS

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By

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2021

AUTHENTICITY STATEMENT

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I hereby certify that this work represents solely my own work, that no one has written it for me, that I have not copied another individual's work, and that all sources that I have used have been properly cited and clearly documented. I understand that any investigation of misconduct concerning any aspect of my work may lead to my disqualification as as undergraduate candidate in Universitas Islam Indonesia.

Yogyakarta, September 2021

Muhammad Hafidz Brilian

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DEDICATION PAGE

This research is wholeheartedly dedicated to my beloved parents who have been my source of inspiration and gave me strength when i thought of giving up, who continually provide moral, spiritual, emotional, and financial support.

To Adisty who always cheer me up, and always reminding me that this thesis must be finished soon, as well as helping in finding a way out.

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Yogyakarta, September 2021

Muhammad Hafidz
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MOTTO

"For indeed, with hardship [will be] ease." "Indeed, with hardship [will be] ease."

- Q.S. Al-Insyirah [94]: 5-6

"So, which of the favors of your Lord would you deny?"

- Q.S. Ar-Rahman [55]: 61

"Sesungguhnya mereka yang membencimu, Cuma tak mampu mengalahkan akhlak dan kebaikanmu, jadi tak perlu marah apalagi membalas"

- Syaikh Ali Saleh Mohammed Ali Jaber

ABSTRACT

Adibio10 is a company engaged in the supply and manufacture of fertilizers. The complex supply chain activities of adibio 10 still have various impacts on the environment. These impacts can occur due to problems in the procurement of raw materials and processing of liquid waste. Therefore, there is a need for environmentally friendly supply chain management. This study aims to determine the value of performance, recommendations to improve performance, and what are the obstacles to implementing a green industry at Adibio10. This research was conducted at the Adibio10 Fertilizer Company located in Ringin Pitu Village RT.04/RW0.4 Ketitang, Kalioso, Boyolali. Data were collected by means of observation, documentation, interviews, questionnaires, and literature studies. The data was processed using the Lean Manufacturing and 5S Kaizen. The results showed that in Adibio10 companies, Value Added was 65.441%, non-Value Added was 2.941%, and Necessary but non-Value Added was 31.618%. Maturity level of lean and green maturity levels is 2.14, it is at STABILIZATION level.
Keyword: Green Company, Adibio10, Manufacturing

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CHAPTER 1
INTRODUCTION

1.1 Study Background

Pollution is one of the major problems facing developing countries. These include air, water and soil pollution. The causes are various, ranging from industrial waste, household waste, agriculture (Cahya, 2019). To improve the standard of living of the Indonesian people, rapid economic growth is needed by promoting development. One of the important elements in this development is development in the industrial sector. However, industrial activities will be followed by the negative impact of industrial waste on the human environment. Toxic industrial waste will worsen environmental conditions and will increase disease in humans and damage to other environmental components (Supraptini, 2002).

With the existence of industry in Indonesia, many people will be helped, but on the other hand, with the existence of factories, there must be waste that is released. Few factories are not able to treat their waste properly. Sometimes some factories just throw it away without treating the waste they produce it has a bad impact on the environment and the community itself.

The green manufacturing concept is a system of manufacturing that environmentally friendly. Green manufacturing involves transforming industrial operations in three ways, namely using green or environmentally friendly energy, developing and selling green or environmentally friendly products, and using green or environmentally friendly processes in its business operations (Green Manufacturing, 2011). The green manufacturing concept became very popular after being discussed in study conducted by the OECD (The Organization for Economic Co-operation and Development).

A company cannot abandon the existence of the environment in surroundings. Therefore, there is a need for a system that can regulate sustainability company efficiently, but still pay attention to environmental aspects. That matter can be done by implementing a Green Management System. Green Management A system is a set of standard processes and practices that can help companies to improve sustainability by planning, conducting, evaluating and set environmental policies (liao, 2017).

A good company deserves to implement Green Manufacturing concept in running its business. Green Concept Manufacturing itself has previously been discussed by Mark Atlas and Richard Florida in 1998 (Florida 2000).Increasing awareness of the importance of Green Manufacturing in a company making more and more research related to this study such as research carried out by the OECD (The Organization for Economic Co- operation and Development) (2011), and Deif (2011). Green Manufacturing can be applied to all processes that exist in a manufacturing start from processing the process raw materials, production processes, waste treatment processes. The essence of the Green concept Manufacturing itself is creating a manufacturing system that green or what we often call environmentally friendly. This concept can One way to do this is by limiting the use of existing energy and using time-saving technology. By applying this concept, a company will increase effectiveness and efficiency in a company manufacturing system.

Maturity levels are commonly used as an instrument to conceptualize and measure maturity of an organization or a process regarding some specific target state. Labelled synonymously are readiness models with the goal to capture the starting-point and allow for initializing the development process. Maturity levels has 5 stages, starting with Ad-hoe, Defined, linked, integrated, then end up with Extended (Schumacher, A., Erol, S., & Sihn, W., 2016).

Indonesia is an agricultural country where most of the population are farmers, so the agricultural sector has a very important role in Indonesia. Therefore, fertilizers are needed in Indonesia. The need for both organic and inorganic fertilizers in Indonesia continues to increase, along with increasing demand from the plantation sector, especially oil palm plantations, rubber, cocoa, coffee, sugar cane, cotton, tobacco, corn, rice and many others. According to a survey conducted by CDMI, in 2011 the need for organic fertilizers reached 12.3 million tons, in 2012 it increased to 12.6 million tons and in 2013 it was predicted to reach 12.9 million tons, the same thing also happened with the need for inorganic fertilizers, The largest is urea fertilizer with an average consumption level of above 70%, so that urea fertilizer is very sensitive to price and often suffers from scarcity.

Generally, there are 2 types of fertilizers used in Indonesia, namely chemical fertilizers and organic fertilizers, but in Indonesia, farmers rely on chemical fertilizers as their main fertilizer, even though chemical fertilizers have many negative impacts, such as making the soil hard and damaging the nutrient content of the soil that is contaminated. important for plants. In contrast to organic fertilizers that are rich in benefits such as those produced by the company Adibio10.

Adibio10 as a company who engage in the provision and manufacturing of organic fertilizer, even Adibio10 produces organic fertilizer just like other fertilizer company, Adibio activities also have impact to people and environment around Adibio10 itself. In this research writer want to examine how adibio10 use maturity level and green manufacturing with lean manufacturing and 5S Kaizen methods to manage and avoid impact damage to the people and environment around Adibio10 because of adibio10 activity itself.

Previously company never do any measurement. The 5S Kaizen method itself has 3 main bases of Kaizen in improvement with a common sense, low-cost approach, namely standardization, 5S and elimination of waste. The 5S Kaizen program was first developed and implemented in Japan as a movement in sorting (seiri), structuring (seiton), cleaning (seiso), maintaining steady conditions (seiketsu), and self-awareness of the habits needed to carry out work efficiently. good (shitsuke). In Indonesia 5S is known as 5R (Concise, Neat, Clean, Treat, Diligent), or 5K (Order, Neatness, Cleanliness, Sustainability, Discipline).

In the manufacturing industry where a company that implements 5S Kaizen properly will look neat and clean. Workers are encouraged to perform simple factory cleaning activities using the 5S Kaizen concept. (HOSHIN KANRI Strategy: Four Management Strategies DAVID HUTCHINS 2008) Not only that, the benefits of 5S Kaizen in a company are the ease of getting the goods needed, mental and moral improvement employees, employee productivity increases, waste is easily recognized and reduced, systems and standard operating/work procedures are easy to understand and clearly visible, efficiency occurs which ultimately improves company performance and image and good place maintenance reflects good employee morale and strong personal discipline (Inspirational Transformation by Benny DS & Gustav, 2017).

1.2 Problem Formulation

Based on the background of the problem, the formulation of the problem that will be discussed in this study is:

1. How is value added, non-value added, necessary but non value added and maturity level on Adibio10?
2. How to minimize waste in the adibio10 fertilizer production process by applying Lean Manufacturing and 5S Kaizen?
3. How is the application of green manufacturing in Adibio10?

1.3 Problem Limitation

Limitation of the problem is necessary so as not to arise bias at the time of discussion and analysis to be conducted. This study limits the issues that will be discussed only on:

1. Research data based on Adibio10 Company.
2. The method used is Lean Manufacturing and 5S Kaizen.
3. Data used only from May 2021 to June 2021.

1.4 Objective

The Objectives of the research are:

1. Finding the maturity level and value added of the Adibio10 company.
2. Improving Maturity Level Towards Green Manufacturing and minimize waste using Lean Manufacturing and 5S Kaizen at Adibio10.
3. Giving suggestion to the company to reach green manufacturing standard.

1.5 Benefit of Research

This research will provide benefits for students and companies, including:

1. For Student

a. Students are able to implement the knowledge and skill of industrial engineering in realistically.
b. Students are able to gain a clear understanding of the company production process as a whole.
c. Students are able to gain experience in working in a company, making it easier for them to practice their skills in decision making and judgment.
d. Build the character of professionalism, critical thinking, and responsibilities in the work-life.
e. Measure the abilities and skills possessed.
f. As a comparison between theory in lectures and practice in real situations

2. For the Company

a. Improving Maturity Towards Green Manufacturing at Adibio10, so that the company can produce environmentally friendly products ranging from the procurement of raw materials, waste treatment and distribution of products to consumers
b. Students could give a different perspective of problems that occurred in the company.
c. The company could apply the suggestions from student for better company management.

1.6 Systematics Writing

The Undergraduate Thesis report is compiled systematically in the form of chapters consisting of.

Chapter 1 Introduction

This chapter contains the study background, problem formulation, problem limitation, research objectives, research benefits and systematic writing of the Undergraduate Thesis report.

Chapter 2 Literature Review

This chapter contains a study of deductive and inductive literature as a support for research.

Chapter 3 Methodology

This chapter explains how this research will be carried out, the data that will be used in the study, the research variables and the research flowchart to be carried out.

Chapter 4 Data Collecting

CHAPTER 2
LITERATUR REVIEW

2.1 Inductive Study

An inductive study is a study that discusses previous research to help determining the direction of research. Below is a table of previous studies regarding to performance measurement in production process. Based on the table below, it will be identified the difference between previous research and the current research that will be conducted. Table 2.1 below is the previous research data.

Table 2. 1 Inductive Study

Nr	Title	Author (Year)	Method	Result
1	A maintenance Maturity assessment method for the manufacturing industry	Marco Macchi and Luca Fumagalli (2013)	The method assumes that a maintenance department is evaluated in terms of its managerial, organizational and technological capabilities. By its adoption it is possible to analyse the maturity level reached by a company, in order to classify the criticalities	Findings – The paper presents the method as a support to identify the levers to improve the maintenance management system. The method is demonstrated on a company whose maturity is assessed before making a benchmark against a sample of other manufacturing

			in its maintenance processes; a company can also make a benchmark with the best companies of a reference sample.	companies located in the Northern Italy.
2	A Maturity Level-Based Assessment Tool to Enhance the Implementation of Industry 4.0 in Small and Medium-Sized Enterprises	Erwin Rauch, Manuel Woschank, Marco Unterhofer, Rafael A. Rojas, Luca Gualtieri and Dominik T. Matt (2020)	The aim of this research was to develop an assessment model for SMEs that is easy to apply, provides a clear overview of existing Industry 4.0 concepts, and supports SMEs in defining their individual strategy to introduce Industry 4.0 in their firm.	The maturity level-based assessment tool presented in this work includes a catalog of 42 Industry 4.0 concepts and a norm strategy based on the results of the assessment to support SMEs in introducing the most promising concepts. For testing and validation purposes, the assessment model has been

				applied in a field study with 17 industrial companies.
3.	Maturity Levels For Logistics 4.0 based on nrw's Industry 4.0 maturity model	Marjan Sternad, Tone Lerher, Brigita Gajšek (2018)	The theoretical background on Industry 4.0 Maturity models was compiled from scientific literature review. Scientific papers were found in Google Scholars, Web of Science and Elsevier. Practical examples of Industry 4.0 Maturity models are mostly published by consulting organizations to attract new customers. Only minority	Although a number of maturity models for industry 4.0 have been developed, maturity models for Logistics 4.0, as an emerging phenomenon, are still in their infancy. Because no dominant design for Logistics 4.0 company is find already, NRW's Industry 4.0 maturity model is studied with purpose to deduce a rough outlines of Logistics 4.0 maturity model.

			of practical examples were found in scientific papers.	
4.	A system model for green manufacturing	Ahmed M. Deif (2011)	-	Manufacturing systems evolution is afunction in multiple external and internal factors. With today's global awareness of environmental risks as well as the pressing needs to compete through efficiency, manufacturing systems are evolving into a new paradigm. This paper presents a system model for the new green manufacturing paradigm. The model captures

various planning activities to migrate from a less green into a greener and more eco-efficient manufacturing. The various planning stages are accompanied by the required control metrics as well as various green tools in an open mixed architecture. The system model is demonstrated by an industrial case study. The proposed model is a comprehensive qualitative answer to the question of how to design and/or improve green manufacturing systems as well as

				a roadmap for future quantitative research to better evaluate this new paradigm.
5.	Research on green manufacturing technology	Guomin Lin, Botao Hao (2020)	-	The current situation, the contents and the features of green manufacturing technologies are introduced. The related technologies and the key technologies of green manufacturing technologies are analyzed. The contents, the targets and the carry out ways of green manufacturing technologies are researched. The development tendency and the application vistas

				of green manufacturing technologies are prospected.
6.	Implementation of Lean And Green Manufacturing to Increase Sustainability at PT. Sekar Lima Primary	Rony Prabowo, Ahmad Puji Suryanto	Lean Manufacturing	The result of this study identification with the lean manufacturing concept that is carried out, it can concluded that the waste that occurs in the cotton fabric finishing process includes waste delays (waiting time), process, and defects. Waste is obtained through analysis of the VALSAT table which produce mapping tools with the highest ranking, namely process activity mapping with bob 47,625, quality filter

				mapping with a weight of 33.00, and supply chain response matrix with a weight of 23.00.
7.	Application of Lean Manufacturing in ITC Production CV .MANSGROUP Using Value Stream Mapping and 5S Kaizen	Karina Arbelina, Rani Rumita	Value Stream Mapping, Metode 5S Kaizen	The result of this study Lean manufacturing on ITC production with value stream mapping approach, process activity mapping and 5S Kaizen improvement is necessary applied because it can bring benefits finance for the company. This is due to production capability has increased as much as 16.12%.

2.2 Deductive Study

2.2.1 Green Manufacturing

Manufacturing is one of the important elements of sustainable development because it produces the goods necessary to meet the needs of society. Manufacturing is an inputoutput system, in which resources are inputs and transformed through the manufacturing process into semi-finished products or products (Sangwan and Mittal, 2015).

Green manufacturing is closely related to sustainable manufacturing (SM). Sustainability can be obtained by doing the green concept (Dornfeld, 2014; Tseng, et al., 2013). Sustainable manufacturing is defined as "the creation of products of economic value through processes that minimize negative impacts on the environment, conserve energy and natural resources, and conserve natural resources and energy to ensure their future availability.

The process must also be safe for employees, the public, and consumers." Sustainable manufacturing is an evolution from the traditional manufacturing system, then lean manufacturing that focuses on reducing waste reduction, green manufacturing with 3R, to finally the concept of sustainable manufacturing with a 6R approach to the product life cycle (Figure 2.1). The implementation of Sustainable Manufacturing leads to the achievement of sustainable development as stated by the World Commission on Environment and Development (David A. Dornfeld, 2013) is defined as "development that meets current needs without sacrificing the ability of future generations to meet their own needs."

Sustainability should be associated with a triple bottom line approach where environmental, economic, and social factors must be met. The three pillars (environmental, economic, and social) must be well-related and fulfilled so that a company can thrive and survive competition without adversely impacting the environment. Social pillars are also important for the success of manufacturing companies although it is difficult to define in real terms on business or manufacturing practices. Measures of social impact can include worker training levels, pay levels, employee retention, work-related accidents or injuries, and so on. The concept of how manufacturing relates to the three pillars of sustainability is described in Figure 2.1

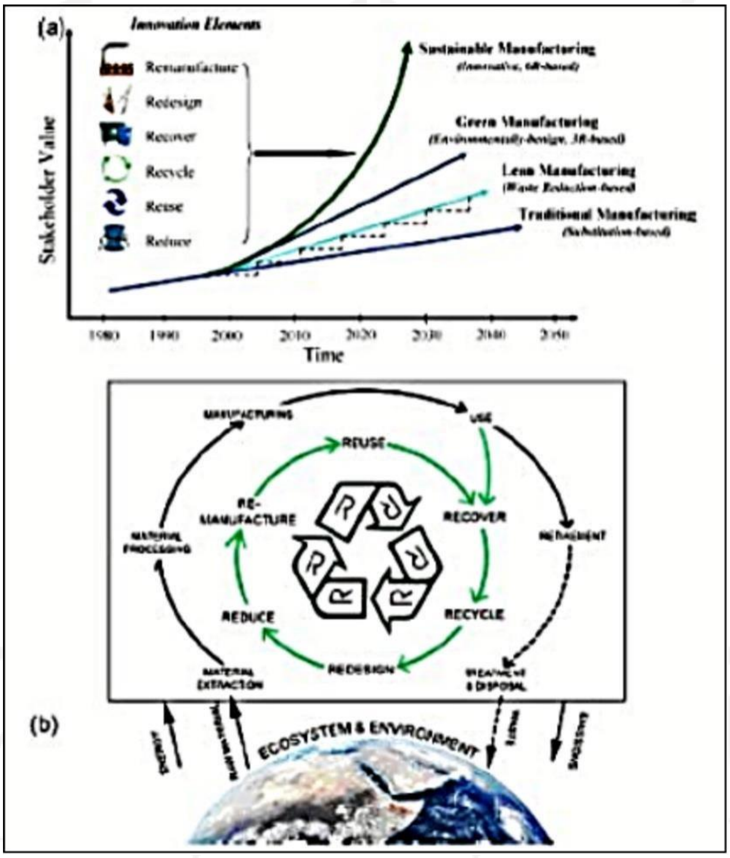


Figure 2. 1 (a) Evolution of Sustainable Manufacturing (b) Product life cycle with 6R approach

(Jaafar et al. 2007 at Jayal et al., 2010)

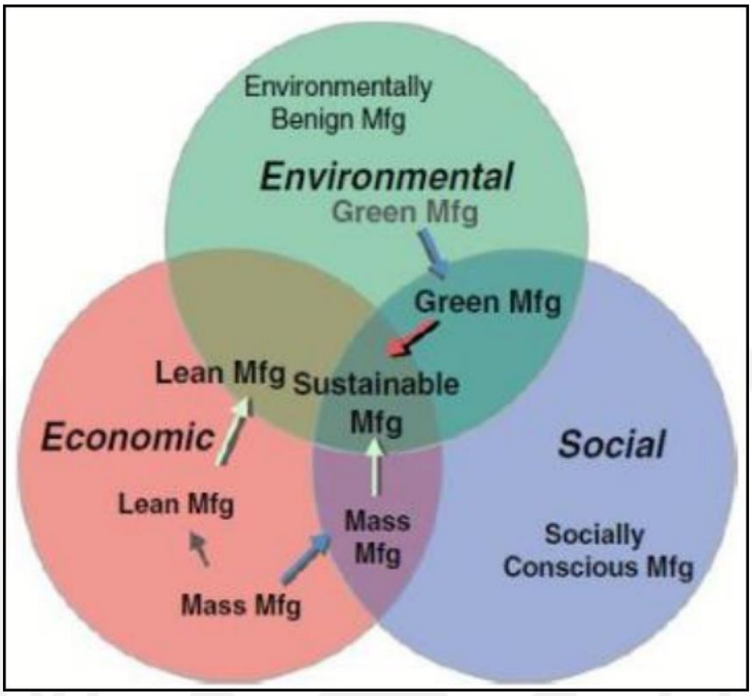


Figure 2. 2 The three pillars of sustainable
(David A. Dornfeld, 2013)

The concept of green includes the process of making products with minimal material use and processes that minimize negative impacts on the environment, save energy and natural resources, safe for employees, communities, and consumers, while remaining economically valuable (Dornfeld, 2013; Rehman et al., 2013). The term green can also be used to denote or refer to a series of activities to reduce the impact of a manufacturing process or system on the environment when compared to initial conditions, such as reducing hazardous waste generated, reducing the use of coolant in machining processes, or changing the energy mixture used so as to allow for the use of renewable energy sources (Dornfeld, 2013). Green Manufacturing (GM) is also known by a number of different names or the terms clean manufacturing, environmentally conscious manufacturing, environmentally benign manufacturing, environmentally responsible manufacturing, sustainable manufacturing), or sustainable production (Sangwan and Mittal, 2015). GM is a manufacturing method that minimizes waste and pollution through product design and processes.

Green manufacturing is more likely to be a philosophy than a standard or process (Maruthi and Rashmi R, 2015). The main goal of GM is sustainability so that every manufacturing sector must pay attention to how the natural resources used today are conserved in order to ensure their availability for future generations. In this case, GM involves investing more in improving the production process than discussing technology.

1. Driving Factors and Inhibition of Green Manufacturing Implementation

Research on driving factors and inhibitors in GM implementation is largely conducted with case studies and surveys. Dornfeld (2013) argues that the motivations that encourage companies to implement GM include pressure from the government (regulations, penalties, and taxes), a desire to make efficiencies, scarcity of resources, continuous improvement, community / consumer / competitor pressure, and the desire to maintain market leadership. Factors inhibiting gm implementation according to Dornfeld (2013) are divided into 3, namely economic, technological, and managerial. Another study conducted by Mittal & Sangwan (2014c, 2014d), outlined gm driving factors and inhibitions in companies from an environmental, social, and economic perspective then sorted those factors according to their level of importance. Driving factors including future legislation, public pressure, pressure from partners, and top management commitments are the most important factors from an environmental perspective; public pressure and top management commitment are the most important factors from a social perspective; and from an economic perspective there are incentive factors, cost savings, competitiveness, customer demand, technology, and organizational resources. Gm inhibiting factors include lack of awareness (limited awareness of 'green' trends, limited access to literature on GM; scarcity of adequate information); technological risks (threats to implement new technologies/ complextechnologies; fear of problems from the technology used; compatibility problems with existing systems); weak legislation (absence of complete environmental laws and ineffective laws); low law enforcement; and 'trade off'.

Mittal & Sangwan (2014a, 2014b) in another article also discusses the driving factors and obstacles of environmentally conscious manufacturing that some consider to be another term of Green Manufacturing. The dominant driving factors include consumer demand, pressure from the community, pressure from partners, community image, regulations or legislation and pressure from the supply chain. While the inhibiting factors are divided into three parts, namely from policy (weak law and regulation enforcement, uncertainty of future rules, and lack of pressure from society), internal (low management commitment, lack of resources and information, and technological risks), and economy (high short-term costs, low consumer demand, uncertainty of benefits to be obtained and trade off). The results showed that internal inhibitory factors affect the inhibition of policy and the economy. Ghazilla et al. (2015) discussed the driving factors and inhibitions of GM implementation in small and medium-sized companies (IKM case study in Malaysia). The biggest driving factors for GM implementation are the desire to build the company's image, improve competitiveness, improve the quality of the products produced, and to gain recognition from the wider community. Factors that are inhibiting include the company's weak organizational structure in support of GM implementation and lacking structured environmental management. In addition, the company owner's knowledge of GM practices was not realized into GM practice due to the assumption that GM practices would only cost a significant amount of money without providing significant benefits to the company.

Other studies on gm driving factors and inhibitors are research from the point of view of energy savings and emissions reduction (Reddy, 2013; Zhu and Geng, 2013; Cagno et al, 2015), implementation of environmental strategies at manufacturing companies (Bey, Hauschild, and Mcaloone, 2013), from a supply chain point of view (Diabat and Govindan, 2011; Drohomeretski, Costa, and Lima, 2014), as well as from the point of view of the use of environmentally friendly technology (Luken and Van Rompaey, 2008). In addition to articles that discuss the driving factors and obstacles to GM implementation, there are several articles that discuss the Critical Success Factor (CSF) of GM implementation including Chuang and Yang (2014), Achanga et al. (2006) and Ghazilla et al. (2015).

2. Implementation of Green Manufacturing

The goal of Green Manufacturing (GM) is the continuous integration of environmental improvements of industrial processes and products to reduce or prevent air, water, and soil pollution, reduce waste at their source, and to minimize risks to humans and other species (Van Berkel et al., 1997). Challenges related to GM implementation are how to meet consumer/customer demand for environmentally friendly products, develop recycling schemes, minimize the use of raw materials, and choose raw materials with minimal environmental impact. With regard to the process, GM aims to conserve raw materials and energy, eliminate the use of toxic substances, and reduce the waste produced. With regards to products, GM tries to minimize environmental impact throughout the product lifecycle.

On a process and product perspective, there is overlap as it adopts the product life cycle which means that the environmental impact of the manufacturing process must also be considered. Green manufacturing includes a number of activities, namely pollution prevention, reduction of toxic substance use (Bergendahl et al., 2005), and design for the environment (Johansen et al, 2007). Pollution prevention focuses on how to avoid and minimize waste through reducing waste sources or recycling on-site. Reducing waste sources can be achieved in different ways both related to the process and with the product (Van Berkel et al., 1997), including product modification by changing the shape and composition of the raw materials of the product; inputsubstitution so that the use of raw materials and additives that cause pollution and the use of process aids (e.g. lubricants and coolers) are less; technology modification involves improvement of automation processes, process optimization, equipment redesign and process substitution; as well as changes in operational and management procedures to reduce or eliminate waste and emissions.

Several articles describe gm implementation by reducing, reusing and recycling different types of industries, such as in the manufacturing industry in general (Bey, Hauschild, and Mcaloone, 2013; Luken and Van Rompaey, 2008; Masoumik, Abdulrashid, and Olugu, 2015); ceramic flooring/tile industry by making changes to the use of raw materials, energy and water consumption efficiency (Gabaldón-estevan, Criado, and Monfort, 2014); rubber industry (Marimin et al., 2014); automotive industry by implementing water treatment used in production, and the use of more environmentally friendly materials (Drohomeretski et al., 2014); reducing food waste in food producing companies is done by remanufacture, repackaging, sales at a discount, donations to social institutions, doing waste management (Garrone et al., 2016); and metal casting industry (Arulrajah et al., 2017). Other examples of GM implementations are recycling used pad-batch washing water in the textile industry by oxidation process (Tezcanl, Nadeem, and Dizge, 2016), reuse of biological sludge in the paper and cardboard industry (Huber et al., 2014), and wastewater reuse in the electronics industry (Eksangsri and Jaiwang, 2014).

2.2.2 Maturity Level

Capability Maturity Model abbreviated as CMM is a model of capability maturity (capability) process that can help the definition and understanding of the processes of an organization. Development of this model was started in 1986 by the SEI (Software Engineering Institute) of the United States Department of Defense at Carnegie Mellon University in Pittsburgh, UNITED STATES. CMM was originally intended as a tool to objectively assess the ability of government contractors to handle a given software project. Although derived from the field of software development, this model can also be applied as a general model that helps understand the maturity of organizational process capabilities in various fields. For examples software engineering, systems engineering, project management, risk management, information technology, as well as human resource management.

In general, maturity models usually have the following characteristics:

1. The development process of an organization is simplified and described in the form of a certain amount of maturity (usually four to six levels)
2. The level of maturity is characterized by certain requirements that must be achieved.
3. The existing levels are arranged sequentially, ranging from the initials level to the suffr ending level (the last level is the level of perfection)
4. During development, the entity moves forward from one level to the next without being able to pass through one of them, but gradually sequentially.

In 2000 CMM was merged into CMMI (Capability Maturity Model Integration). This smelting is due to criticism that the application of CMM in software development in particular can cause problems due to CMM models that have not been integrated in and throughout the organization. This then brings up cost burdens in terms of training, performance assessment, and repair activities. But CMM is still used as a theoretical reference model in the public domain for different contexts. CMM itself has been renamed SE-CMM (Software Engineering CMM).

The digital maturity model we are using is taking in consideration a number of existing digital maturity models, ACATECH maturity model firstly (Schuh et al., 2017). In order to use a more familiar terminology and fitting scale for the Danish companies that are currently addressing – or starting to address - the digital transformation, a “zero digitalization” level has been introduced and the two “basic digitalization” levels presented by

ACATECH have been unified. As an outcome, the maturity model used to assess the digitalization level of an organization is composed by six sequential digital maturity stages:

1. None: no digital awareness, idea or plan nor presence of digital data within the organization (e.g. everything is registered on paper or not registered)
2. Basic: digital processes are in place and operative as they generate digital data (e.g. machines on the production floor generate digital data related to their process) and there is a willingness towards the digital transformation from the management side
3. Transparent: data is collected and shared according to value streams needs (e.g. alert data from the equipment are collected and transmitted to the service department) and there is a digitalization plan from the management side in terms of development direction
4. Aware: data is analysed to capture valuable information in order to understand the business insights (e.g. proactive activities identification by crossing error data, product number, machine downtime, etc.) and there is a clear digitalization agenda (e.g. resources and activities are defined) shared at all hierarchical levels
5. Autonomous: decision making is performed autonomously based on automatically synchronized data from the organization and its direct customers and suppliers (e.g. logistics scheduling is automatically performed based on production state, customer orders and location, traffic condition etc.) and digital development is a wellestablished company practice at all hierarchical levels
6. Integrated: decision making is performed autonomously based on automatically synchronized data from the whole

organization's network (e.g. suppliers' suppliers and customers' customers) and digital development is a well-established practice at all hierarchical levels within the whole organization's network Each digital stage is considered to be the necessary enabler of the following, as its features need to be in place in order to pursue the digital transformation on a further level, e.g. to perform data analytics – aware stage - it is necessary to have data available – transparent stage - in the first place.

In order to map the digital capabilities of the organization, they are grouped into five areas, called digital dimensions. These have been obtained by clustering dimensions from

the existing digital maturity models that have been analysed. They consist of:

1. Governance: indication of the current state of the company at an organizational level (e.g. strategy and plan, resource allocation, digital awareness, engagement on different hierarchical levels).
2. Technology: presence of the elements that make possible to generate and process digital data (e.g. business intelligence tool, cloud computing platform, MES, ERP, augmented and virtual reality tools)
3. Connectivity: availability of the infrastructural elements needed for data transmission inside and outside the organization (e.g. data sharing capabilities, IT security, standard data structuring or data transmission architectures)
4. Value creation: ability to capture value from available data (e.g. pay-per-use or payper-save business model, take-back program, data usage for orders forecasting or product usage monitoring to enable predictive maintenance or guide the product design)

5. Competence: presence of the mind-set and of the skills (internally or based on external partnerships) needed for performing the digital transformation and operat

Figure 2. 3 RM Maturity Curve

2.2.3 Lean Manufacturing

The popular definition of Lean Manufacturing and the Toyota Production System usually consists of the following: (Lonnie Wilson. 2009, How to implement Lean Manufacturing, Mc Graw Hill, 9-10)

- ➢ It is a comprehensive set of techniques that, when combined and matured, will allow you to reduce and then eliminate the seven wastes. This system not only will make company Leaner, but subsequently more flexible and more responsive by reducing waste.
- ➢ Wikipedia says "Lean is the set of 'tools' that assist in the identification and steady elimination of waste (muda), the improvement of quality, and production time and cost reduction. The Japanese terms from Toyota are quite strongly

represented in 'Lean.' To solve the problem of waste, Lean Manufacturing has several 'tools' at its disposal. These include continuous process improvement (kaizen), the '5 Whys' and mistake-proofing (poka-yoke). According to Gaspersz and Fontana (2011), explain the 7 types of waste, namely:

- Overproduction: producing more than internal and external customer requirements or produce faster than the time needed customer.
- Delays (waiting time): time delays waiting for machines, equipment, raw materials, suppliers, machine maintenance and so on.
- Transportation: moving materials by great distance from process to process the following can result in time increased material handling.
- Processes: additional processes or work activities unnecessary or inefficient.
- Inventories: hide problems and give rise to additional handling activities which shouldn't be needed.
- Motions: a movement of people or machine which does not add value to the goods and services to be provided to customers, but only adds to the cost and time.
- Defect products: rework of product or if the product is defective then it must be destroyed.

2.2.4 Concept 5S Kaizen

5S Kaizen (seiri, seiton, seiso, seiketsu, shitsuke) is a five-step arrangement of and workplace maintenance developed through intensive efforts in the field of manufacture. When translated into Indonesian, the five steps of maintenance. This workplace is referred to as the 5R (Concise, Neat, Clean, Treat, and Diligent) with understanding as follows (Imai, 1986):

1. Seiri, distinguishing between what is needed and not needed in the work area and get rid of the unnecessary. Create a compact workplace, which only accommodate only what is needed.
2. Seiton, everything has to be put in the right position so that it is ready used when needed.
3. Seiso, maintain the condition of the machine that is ready to use and in a clean state. Create clean workplace and work environment. Cleaning is not just cleaning but must be viewed as a form of inspection. Cleaning is a process that considers every machine or tool important because it has own demands and abilities and strives to take good care of them.
4. Seiketsu, expands the concept of personal hygiene and continuously practice the previous three steps. Always try to maintain the current situation well through the standard. Seiketsu is intended so that each individual can continuously apply the previous three principles. Implementation of this seiketsu phase will make the environment is always maintained continuously.
5. Shitsuke, build personal self-discipline and get used to applying 5S Kaizen through work norms and standardization. The emphasis is on creating a place work with good habits and behavior. Teach everyone what must be done and instruct everyone to do it, then Bad habits will be discarded and good habits will be formed.

CHAPTER 3
RESEARCH METHOD

3.1 Research Object

This research has conducted at Adibio10 Fertilizer Company, that located in The Ringin Pitu Village RT.04/RW0.4 Ketitang, Kalioso, Boyolali. Adibio10 runs the production under CV. GALIH JATI. CV. GALIH JATI is a company that was founded in 2006, this company only focused on wood business, but since 2009 they has susbsidiary company named Adibio10, Adibio10 engaged in agriculture that produces organic products that are rich in plus and minus micro-organisms that can be put together so that they can help the decomposition process in the soil. Contains macro and micro nutrients, especially phosphorus which is almost all soluble in water, neutral, not hygroscopic, easy to mix with urea, Za and other fertilizers.

Adibio's Product is an organic fertilizer for various types of Rice, Palawija, Vegetables, annual plants that are environmentally friendly. To provide input to industry in general, especially in the fertilizer industry at Adibio10, how implementation, constraints and evaluations that must be done in order to improve maturity supply chain towards green manufacturing.

3.2 Data Collection Technique

Data collection techniques used in this study in the form of:

1. Observation: Observations are made to see the problems that exist in the company and the extent of the handling that has been done by the company. Result: Cycle time, Finish Product and Current State Map.
2. Documentation: Research collects data derived from journals, tabulates questionnaire data and also records theories related to the research being conducted. Result: Deductive Study.
3. Interview: Method of data collection by asking directly to the authorized management to provide related data in this study.

Interviews are not mandatory, as they are only additional data that have not been listed in the questionnaire. Result: Production Process, Production Schedule and List of Inventory.

4. Questionnaire: Data collection method conducted by sharing a list of questions that are closed to respondents so that respondents only choose the answers provided. Result: Maturity Level.
5. Literature Study: The method of collecting data by this method is a researcher trying to find references derived from literature, journals, published scientific works and or expert opinions related to the theories to be used in the research being conducted. Result: Literature Study.

3.3 Data Processing

In this study, the goal to be achieved is the achievement of Green Manufacturing standards using the concept of level on Maturity from the results of analysis and calculations of lean manufacturing and 5S Kaizen so that it can bring up suggestions for improvement for companies to increase company standards to reach the point of Green manufacturing. Some of the measurement stages that must be carried out in this study are as follows.

1.3.1 Lean Manufacturing

To reach the point of green manufacturing, it is necessary to carry out Lean Manufacturing Implementation which is carried out continuously to create improvements to processes and innovations in the company, so that the company carries out what is called continuous improvement to achieve operational excellence and customer intimacy by suppressing the 7 wastes below. this:

1. Waste of Overproduction

Waste or waste that occurs due to excess production in the form of Finished Goods and Semi-Finished Goods but there is no order from the Customer.

2. Waste of Inventory

   Waste or waste that occurs because inventory is one result of waste overproduction, waste of inventory can be an indication of overproduction, as well as declining company sales.

3. Waste of Defects

   Waste or wastage that occurs due to poor quality or damage (defect) so that repairs are needed.

4. Waste of Transportation

   Waste or wastage that occurs due to poor production layout, poor workplace organization that requires moving goods from one place to another.

5. Waste of Motion

   Waste or wastage that occurs due to unnecessary movements of workers and machines and does not provide added value to the product.

6. Waste of Waiting

   When a Person or Machine is not performing work, the state is called waiting. Waiting can be due to an unbalanced process or material that is not ready so that there are workers and machines who have to wait to do their work.

7. Waste of Overprocessing

   Not every process can provide added value to the products produced and the customer. This process that does not provide added value is a waste or redundant process.

In order to suppress the 7 wastes above, the researcher applies the value stream mapping method to facilitate the improvement process at the Adibio10 company.

1.3.2 Value Stream Mapping

Value Stream Mapping The application of value stream mapping is very important in this research. The initial mapping is the establishment of a current state value stream mapping to make the flow of materials and information transparent in the Adibio10 production process. The Current State Map will make it easier for everyone involved in VSM to understand the condition of the process from start to finish, making it easier to find out whether the current work process is optimal, and where the waste or waste occurs. The Current State Map shows 3 interrelated flows, namely: process flow, material flow, and information flow. From here, it will be easy for us to identify where the waste is located. After that, we can only create a Future State Map which can be used as a basis for improvement to be applied in real work areas. This map was made by considering the findings obtained when mapping the Current State Map. The mapping process will indirectly bring us closer to the KAIZEN theory, namely continuous improvement.

1.3.3 5S KAIZEN

Through the application of the 5S Kaizen concept, it provides many benefits for companies to build a strong foundation in creating a productive, efficient, high work ethic and discipline culture so that they can reach the point of Green manufacturing. The 5S Kaizen program also provides the basis for changing attitudes, behavior or mindset of management and workers towards increasing productivity with the principle of "KAIZEN" which is gradual but continuous improvement. 5S Kaizen is an abbreviation of Seiri, Seiton, Seiso, Seiketsu and Shitsuke It is a sequence and technique of structuring the workplace and work environment 5S Kaizen can be interpreted as Sorting, Systematic, Shining, Standardizing, and Sustaining which means by fixing the points above the company can be able to rise and achieve its goal of getting to the point of Green manufacturing.

3.4 Research Flowchart

An overview of the research will be easier if it is displayed in the form of a flowchart. The research starts from preliminary study, identification of problems, determination of research objectives, problem boundaries, literature study, data collection, data calculation, results and discussion, consultation and recommendations. The stages of this research are illustrated in Figure 3.1.

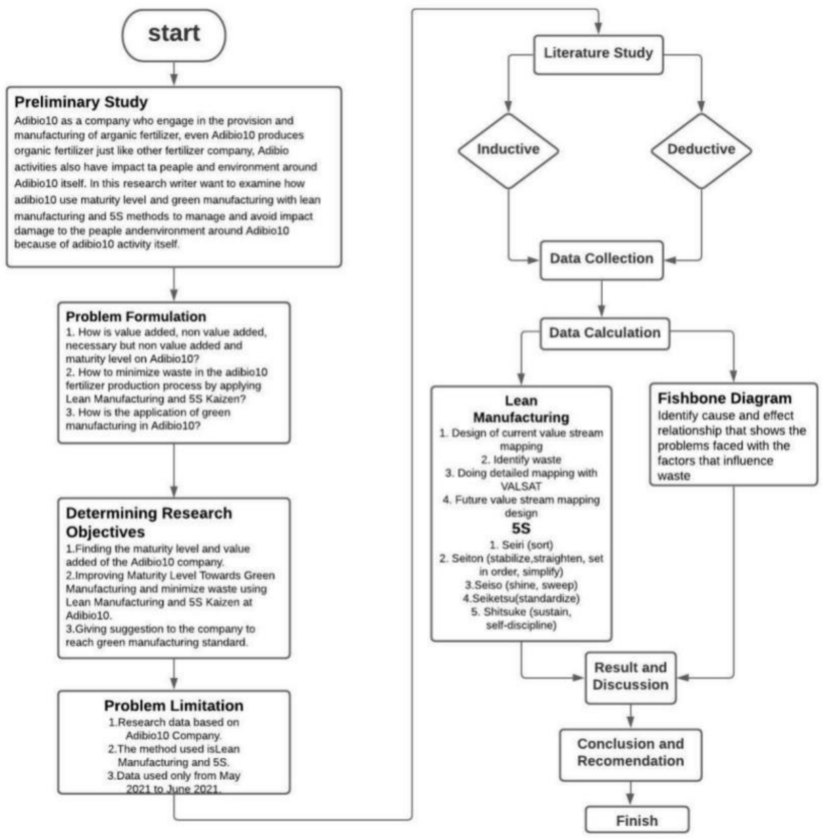


Figure 3. 1 Research Flowchart

Explanation of the flowchart stage above are:

1. Preliminary Studies

Researchers conduct learning about the material and concepts needed to support knowledge through learning theoretical theories and previous research.

2. Problem Identification

   At this stage, direct observation will be carried out to identify problems or obstacles that arise in the company's supply chain management system.

3. Determining Research Objectives

   The determination of the research objectives is done by direct observation and interviews with the company.

4. Problem Limitation

   It provides limits on research so that research remains focused on the objectives that have been formed.

5. Literature Study

   Literature study is conducted through inductive and deductive study to review previous research and theories needed in order to support the process of research.

6. Data Collection

   The data collection process is carried out by direct observations, interviews and designing questionnaires to obtain primary data.

7. Data Processing

   Data processing is done by identifying the production process using the methods in Lean Manufacturing and 5S Kaizen.

8. Analysis and Discussion

   After the results of performance measurements are obtained, an analysis and discussion are carried out to provide recommendations for improvement and decision making based on the results of data processing that has been carried out on the company's production process.

9. Conclusion and Recommendation

Finishing Stage. The conclusion will be drawn from the current research conducted in the form of recommendations for improvement and decision making. Brainstorming will be carried out to consider all recommended actions. After that, suggestions will be given for further research to support the creation of better research.

CHAPTER IV
DATA COLLECTING AND PROCESSING

4.1 Research Result

Data collection and processing is carried out according to a lean manufacturing approach. At this stage, the data needed is the company's real-time condition, namely a description of the company's state that is used to identify waste that occurs to design production process improvements.

4.1.1 Data Collecting

4.1.1.1 Company Profile

CV. GALIH JATI is a company that was founded in 2006 and has subsidiary company named Adibio10. Adibio10 engaged in agriculture that produces organic products that are rich in plus and minus micro-organisms that can be put together so that they can help the decomposition process in the soil. Contains macro and micro nutrients, especially phosphorus which is almost all soluble in water, neutral, not hygroscopic, easy to mix with urea, Za and other fertilizers. Adibio10's Product is an organic fertilizer for various types of Rice, Palawija, Vegetables, annual plants that are environmentally friendly.

VISI

- To advance and develop as a company that produces better organic fertilizers, is environmentally friendly and provides the best satisfaction value for customers and partners through quality services and products.

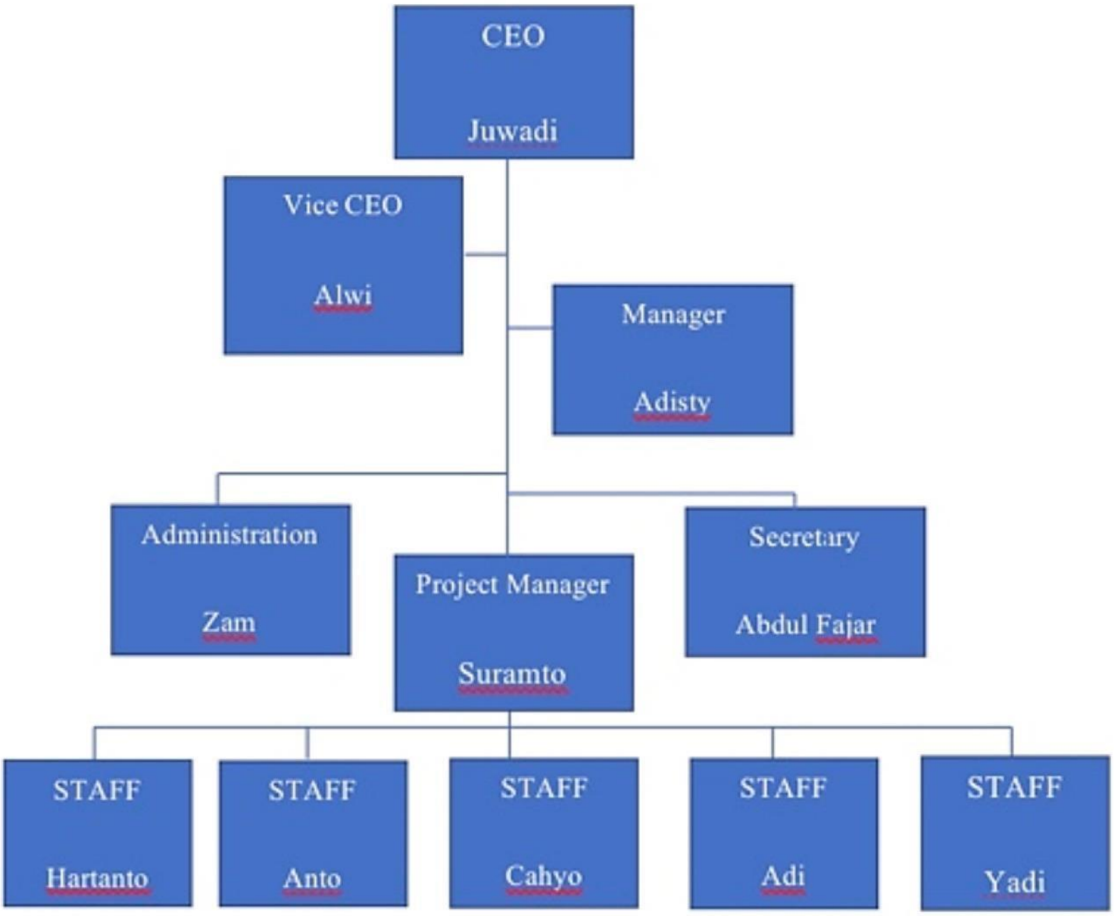
MISI

- Opening opportunities and productive businesses in helping the Indonesian economy.
- Improving optimal results, maintaining customer trust and satisfying customers in terms of services, quality and quantity of goods needed.

BUSINESS ENTITY LEGALITY

- Surat Izin Usaha Industri (SIUI) Nomor : 202002-2809-1508-6682-997
- Nomor Induk Berusaha (NIB) :0220004202885
- Nomor Pokok Wajib Pajak (NPWP): 02.765.513.3-527.000

4.1.1.2 Company Organization Structure



4.1.1.3 Production Process

Production process held in 4 steps, starts with Granulation, Drying, Filtering and finish with Packaging. The process explanation shows as below:

1) Granulation Process

The process of granulating or making organic fertilizer into granules is the core of the POG (Pupuk Organik Granul) manufacturing process by entering dolomite powder, phosphate and manure that has been measured into the granulator machine (mixing process), then sprayed with bioto to form granules with an average diameter of 3mm and the level of wetness. factory standard.

2) Drying

The drying process is carried out by drying in the sun for 3 hours / until it dries.

3) Filtering

The filtering process is carried out by inserting it into a filter machine in order to get the size according to the factory standard, granules that are too large will be crushed back into powder and then mixed into granules that are too small so that they can be repeated in the mixing process and no raw material is wasted.

4) Packaging

This process is carried out using sacks that have been determined and is a common process, packaging is carried out into 50kg sacks and is ready to be marketed.

Work maps are a good tool as a bridge to reach the best state. The information needed to analyze the components of the formation of a complete product can be obtained through a processing flow diagram (Sutalaksana, I. Z., et al, 2006).

Based on the results of the identification process, there are 4 activities in the processing of organic fertilizers starting from preparing materials to storage. This activity uses materials such as manure, water, dolomite, phosphate, bio and packaging materials. Adibio10's water consumption for the April-June period can be seen in Table 4.1.

Table 4. 1 Calculation of Water Use

Periods	Water Used (Ltr)	Production (Kg)
April Week 3rd	2.197	10.985
April Week 4th	2.104,6	10.523
Mei Week 1st	2.197	10.985
Mei Week 2nd	2.005	10.025
Mei Week 3rd	2.170,4	10.852
Mei Week 4th	2.150	10.750
Juni Week 1st	2.077	10.385

Based on Table 4.2. Adibio10's total water consumption until June 2021 is 14,901 L. Adibio10 energy consumption data is shown in Table 4.2.

Periods	Used (Kwh)	Production (Kg)
April Week 3rd	104,17	10.985
April Week 4th	103,93	10.523
May Week 1st	104,19	10.985
May Week 2nd	103.76	10.025
May Week 3rd	104,13	10.852
May Week 4th	104,07	10.750
June Week 1st	103,84	10.385

Table 4. 2 Calculation of Electricity Usage

Based on Table 4.2. Adibio10's total energy consumption up to June 2021 is 728.09 kWh. The Water use and Electricity usage are shown as proof that was not categorized as waste, because the usage is too low.

4.1.1.4 Production Layout

The Adibio 10 Production Layout is located at Dk Ringin pitu Rt.004 Rw.004 Ketitang, Nogosari, Boyolali. Pictures of the production layout can be seen in Figure 4.1. below:

Figure 4. 1 Production Layout

4.1.2 Data Processing

Data processing in this study by paying attention to aspects of green manufacture and using lean manufacturing methods. Aspects of green manufacturing include:

1. Material and energy input specs.
   a. Water input comes from bore wells.
   b. Energy input comes from PLN and generators.
2. Product aspect. The green product indicator is that the product is made from non-toxic materials that have an impact on soil, water and is always oriented towards the environment. Adibio10 products are derived from materials that are harmless to soil, water and the environment.

3. Aspects of occupational safety and health Adibio10 has a mission so that the company's activities do not cause environmental damage and achieve "Zero Work Accidents" and do not cause social problems. Based on visual observations, Adibio10 has not made evacuation routes and gathering points for worker safety in the event of a force major/emergency event, and has not provided APAR, completed personal protective equipment for workers, and made rules and regulations related to occupational health and safety.

The steps taken to get to green manufacturing are:

1. Preparation phase.
   a. Mapping of manufacturing activities.
      The map of manufacturing activities.
   b. Selection of indicators for continuous improvement of manufacturing and environmental quality. The indicators selected are: Intensity or amount of water use and Intensity or amount of energy use.
2. Measurement Stage.
   a. Measurement of production process inputs can be seen in Figure 4.2 Energy input data uses company data search results.
   b. Assessment of the efficiency of utilization of manufacturing operational facilities and utilities.
   c. Evaluation of the resulting product.

Product processing can be seen in Figure 4.2.

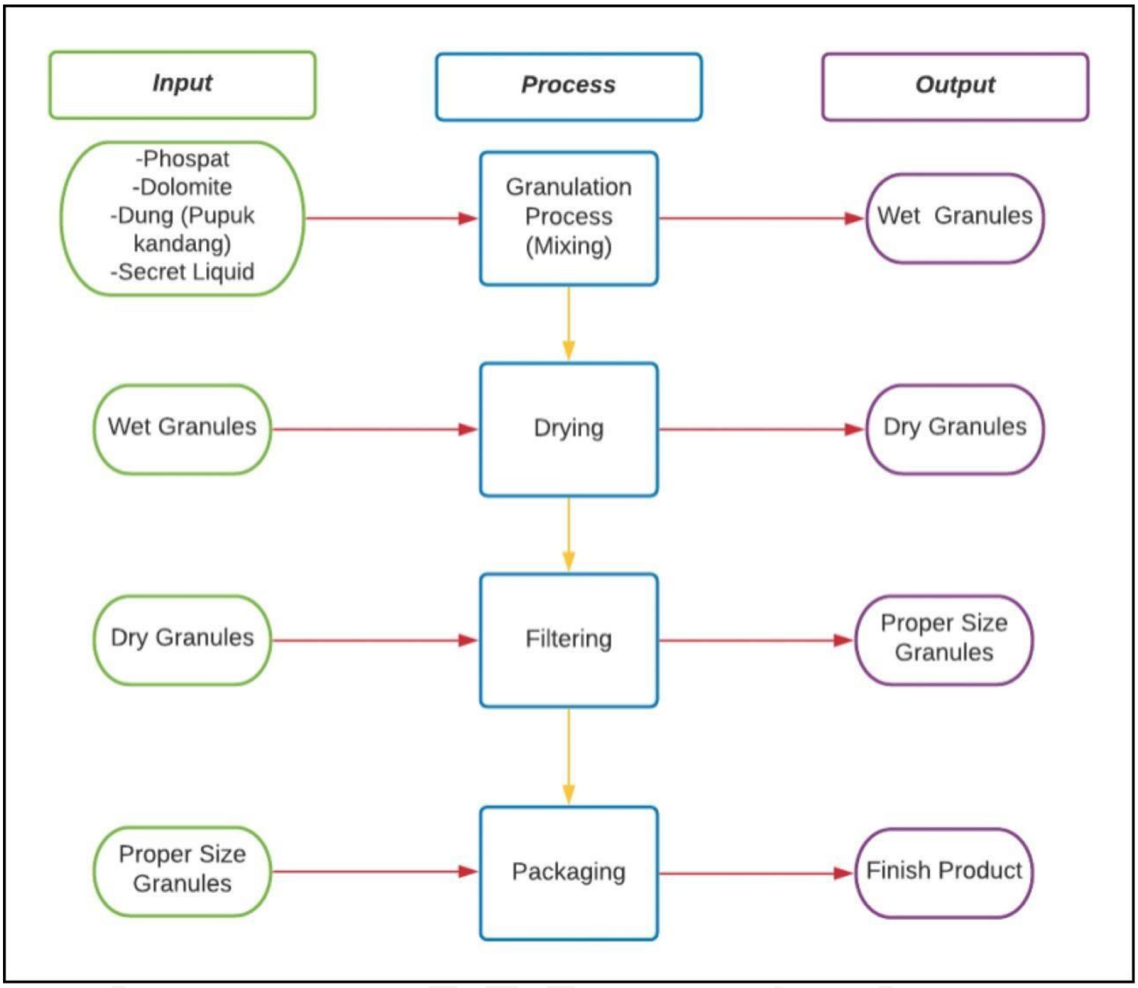


Figure 4. 2 Product Processing

3. Repair Stage.

   a. Meet the trend of workers and manufacturing.
   b. Make a plan of action/action. The action/action plan is carried out using the lean manufacturing method.

4.1.2.1 Waste Reduction

This stage consists of 2 activities, namely process identification, mapping flow diagrams, VSM, fishbone diagram, green industry criteria.

4.1.2.1.1 Process Identification

The stages of the production process flow are divided into 4 processes, namely:

1. Granulation Process

The process of granulating or making organic fertilizer into granules is the core of the POG (Pupuk Organik Granul) manufacturing process by entering dolomite powder, phosphate and manure that has been measured into the granulator machine (mixing process), then sprayed with bioto to form granules with an average diameter of 3mm and the level of wetness. factory standard.

2. Drying

The drying process is carried out by drying under the sun for 3 hours / until it dries.

3. Filtering

The filtering process is carried out by inserting it into a filter machine in order to get the size according to the factory standard, granules that are too large will be crushed back into powder and then mixed into granules that are too small so that they can be repeated in the mixing process and no raw material is wasted.

4. Packaging

This process is carried out using sacks that have been determined and is a common process, packaging is carried out into 50kg sacks and is ready to be marketed.

4.1.2.1.2Mapping Flow Diagram

The process flow map is a map that contains relatively complete information regarding the process in a factory, but the map does not show a picture of the direction of flow during work. Flow diagram is a picture according to the scale of activity, which means the movement of a material or person from one place to the next, represented by lines in the diagram. The flow diagram serves to complete the process flow map. (Sutalaksana, I. Z., et al, 2006). The activities depicted on the flow diagram correspond to the activities that occur in the process flow map. Process activities and material use can be seen in Figure 4.3.

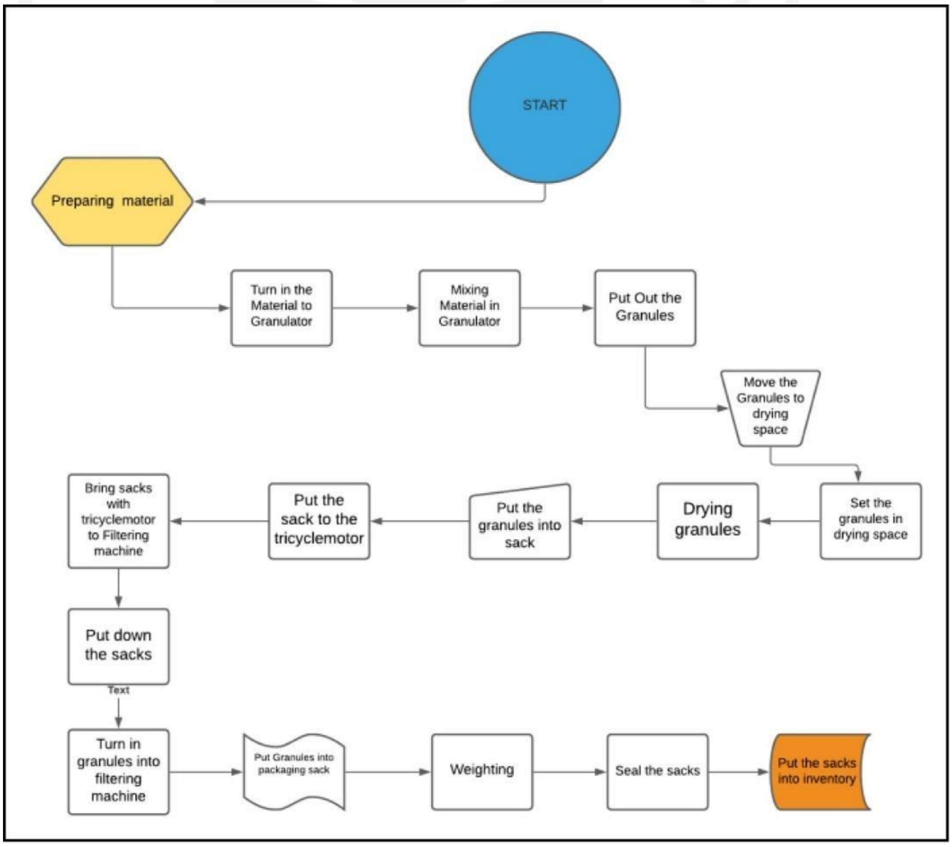


Figure 4. 3 Process Activities and Material Use

4.1.2.1.3 Value Stream Mapping

Adibio10's production flow on the production floor can be described by value stream mapping in Figure 4.7. From the value stream mapping image below, it can be identified that there is waste caused by transportation and movement to and from the process occurs because operators often move repeatedly to pick up the necessary tools. in different places even outside the production floor, movements caused by operator movements or activities that do not need to be carried out during operation. Waste is also caused by waiting because the drying process naturally uses sunlight. The wastage of waste should not occur if the company wants an efficient production process. To clarify the waste that occurs in each activity, process activity mapping (PAM) is used Table 4.3.

Table 4. 3 Process Activity Mapping

Process	Activity	Tools	Distance (meter)	Time (minutes)	Category Activity	Value Category
	Preparing Material	Manual	0	13	D	VA
	Turn in the Material to Granulator	Small Scoop	0	17	O	VA
Mixing Procces	Mixing Material in Granulator	Granulator Machine	0	55	O	VA
	Put Out the Granules	Small Scoop	0	19	D	NNVA
Drying Process	Move the Granules to	Trolley	4	12	T	NNVA

	drying space					
	Set the granules in drying space	Stick	0	23	O	NNVA
	Drying granules	The sun	0	148	O	VA
	Put the granules into sack	Small Scoop	0	13	S	VA
	Put the sack to the tricyclemotor	Manual	3	12	T	NVA
Filtering Process	Bring sacks with tricyclemotor to Filtering machine	Tricyclemotor	150	4	T	NNVA
	Put down the sacks	Manual	0	9	D	NNVA
	Turn in granules into filtering machine	Filtering Machine	0	36	O	NNVA
	Put Granules into	Bucket	0	15	S	NNVA

Packaging	packaging sack					
Process	Weighting	Scales	0	7	I	VA
	Seal the sacks	Portable sewing tool	0	14	O	VA
	Put the sacks into inventory	Manual	10	11	S	NNVA

Description:

O = Operation, T = Transportation, I = Inspection, S = Storage, D = Delay

VA = Value Added

NNVA = Necessary but Non-Value Added

NVA = Non-Value Added

Based on Process Activity Mapping, the results of the calculation of time and percentage of each activity are described in the Table 4.4.

Activity	Amount	Total Time (minutes)	Percentages (%)
Operation (O)	6	293	71,814
Transportation (T)	3	28	6,863
Inspection (I)	1	7	1,716
Storage (S)	3	39	9,558
Delay (D)	3	41	10,049
VA	7	267	65,441
NVA	1	12	2,941

NNVA	8	129	31,618

Cycle Time 408

Table 4. 4 Calculation of Time and Percentage of Each Activity

$$\textit{Value added ratio} = \frac{\text{value added time (process time)}}{\textit{total process cycle time}} \times 100\%$$

$$= \frac{267}{408} \times 100\% = 65{,}441\%$$

To show the current production flow a Current State Map is created, which used to identify waste that occurs and make improvement and improvement of the company. The current production flow can be seen in Figure 4.4.

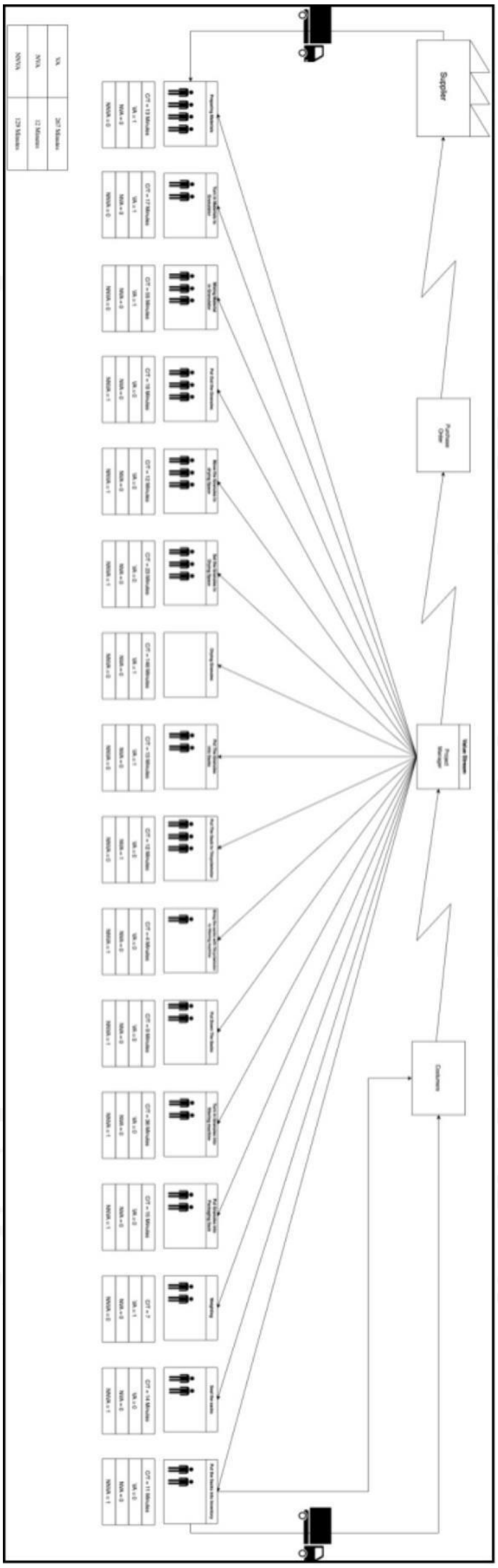


Figure 4. 4 Current State Map

From the current state map image above, it can be seen that the total time value added in the production process is 267 minutes, the total time for non-value added is 12 minutes and the total time for non-value added is 129 minutes. In the production process, operating activities reached 293 minutes with a percentage of 71,814 percent. total transport time is 28 minutes with a percentage of 6.863%, total time storage is 39 minutes with a percentage of 9.558% and a total time delay of 41 minutes with a percentage of 10.049%, so efforts are needed to minimize waste to increase productivity.

4.1.2.1.4Fishbone Diagram

Cause and Effect Diagram (Diagram Cause and Effect) is called a fishbone diagram because of its shape that resembles a fishbone. In the Fishbone Diagram there is a cause-and-effect relationship that shows the problems faced with the factors that influence them. Fishbone diagram can be seen in Figure 4.5.

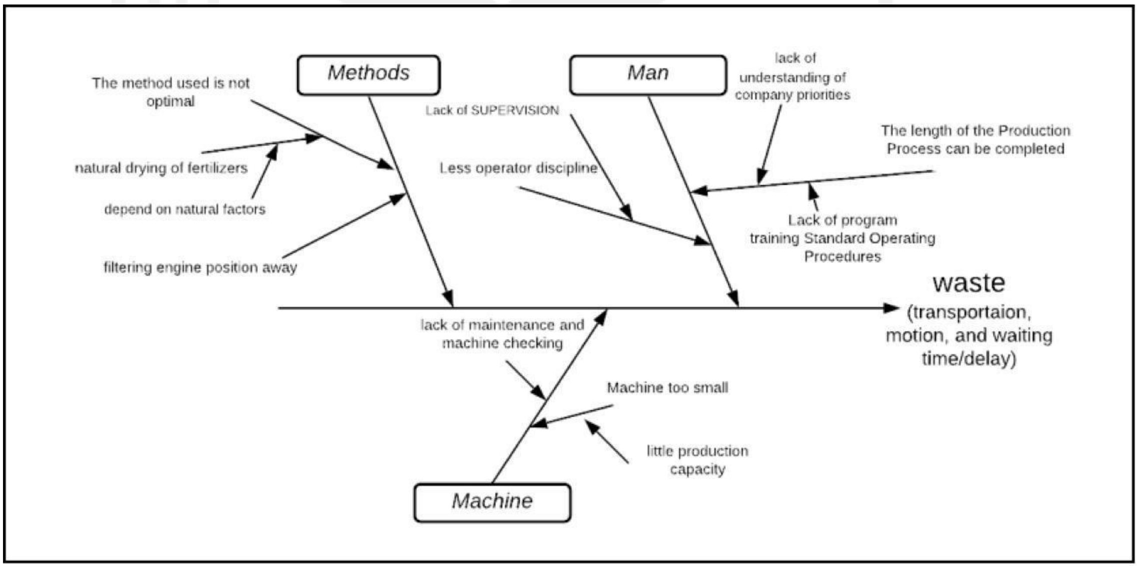


Figure 4. 5 Fishbone Diagram

Human Factor

a. Lack of Supervision so that it becomes less operator discipline

b. Lack of understanding of company priorities and lack of program training Standard Operating Procedures so that it becomes the length of the Production Process can be completed

Methods Factor

a. Natural drying of fertilizers so that it becomes depend on natural factors and the method used is not optimal
b. Filtering engine position away

Machine Factor

a. Machine too small so that it becomes little production capacity
b. Lack of maintenance and machine checking

	energy	water	material	garbage	Transportation	Emissions	Biodiversity
Preparing Material							
Turn in the Material to Granulator							
Mixing Material in Granulator	X	X					
Put Out the Granules							
Move the Granules to drying space					X		
Set the granules in drying space							
Drying granules						X	
Put the granules into sack							

Put the sack to the tricyclemotor					
Bring sacks with tricyclemotor to Filtering machine				X	X
Put down the sacks					
Turn in granules into filtering machine	X				X
Put Granules into packaging sack					
Weighting					
Seal the sacks					
Put the sacks into					

inventor

y

Table 4. 5 Waste List on Activity

4.1.2.1.5 Environmental Value Stream Mapping

The Environmental Value Stream Mapping method is carried out to evaluate the environmental aspects of a company using several parameters, namely Energy, Water, Materials, Garbage, Transportation, Emissions, Biodiversity. The table below shows the identification of waste at each stage of activity.

The expected target for reducing environmental waste in Adibio10 is air pollution that disturbs the surrounding environment. Air pollution caused by the natural drying process of fertilizer in the open yard and the filtering process.

4.1.2.2 Lean and Green Maturity Levels

In the maturity level questionnaire, accompanied by interviews with the management, an assessment of the maturity level of lean and green manufacturing in Adibio10 was carried out. In the questionnaire, there were 16 questions that were asked to 4 respondents. From these questions, the average is taken to determine the maturity level of activities related to waste and green manufacturing in the Adibio10 organic fertilizer production process.

For the answer, a choice is provided:

1. CHAOTIC: The organization is not aware of its waste and has no ability to keep the Lean and Green systems in place.
2. STABILIZATION: Isolated practices of Lean and Green are being applied. There is awareness of waste and basic indicators are used.
3. STANDARDIZATION: The Lean and Green systems can coexist even though they.

4. are not integrated, there are unquantified goals and specific indicators are applied.
5. OPTIMIZATION: Statistical level. There is Lean and Green integration with quantified improvement goals that are aligned with business objectives.
6. INNOVATION: Lean and Green synergy is achieved with all quantified objectives. Actions can be anticipated to promote improvements.

Overall, here are the results of the recapitulation of the questionnaire:

Table 4. 6 Recapitulation of Maturity Level questionnaire results

	Maturity Level							Maturity Level
Activity	**0**	**1**	**2**	**3**	**4**	**5**	**Total**	
1		1	1	1	1		10	2.5
2		1	2	1			8	2
3			2	2			10	2.5
4		2	1	1			7	1.75
5		1	1	2			9	2.25
6		4					4	1
7			2	2			11	2.5
8	1		3				3	0.75
9		2	1	1			7	1.75
10		2		2			8	2
11		2	1	1			7	1.75
12			2	2			10	2.5
13		3	1				5	1.25
14		1	1	2			9	2.25
15				2	1	1	15	3.75
16				1	2	1	16	4
Average								**2.14**

CHAPTER V

RESULT AND DISCUSSION

This chapter will discuss the results of data processing from Chapter IV and also an analysis of the results that have been obtained.

5.1 Analysis Current State Environmental Value Stream Mapping

Current State Environmental Value Steam Mapping provides an overview regarding the processing time of each activity through Value Steam Mapping. In the Manufacturing Industry, there are three activities carried out namely value added (VA), necessary but non value added (NNVA), and non- value added (NVA). Non value added (NVA) is an activity that does not add value to the product, is a waste of activity and needs to be eliminated. Necessary but non-value added is an activity that needs to be done but the possibility of a waste and does not add value.

According to the VSM method of physical flow and information flow that has been made, it is possible to identify problems that occur in the Adibio10 organic fertilizer production process. These problems include:

1. Starting from the mixing process, which still uses a small scope to turn in the material to the granulator and the granulator machine used has a small capacity so that the production process can only be done on a small scale.
2. After that, there is a process that has no value and must be followed, namely the drying process. In the drying process, set the granules in drying space still using the manual method, namely arranging with a stick on the ruler. While the process of drying granules is still natural by using sunlight so it still depends on the weather if it rains the production will not be able to run. Drying granules takes a long time, namely 148 minutes. After the fertilizer is dry, put the granules in the ruler into the sack using a small scoop, so it takes a long time, resulting in waiting waste.
3. After that, in the filtering process, there is a waste of energy and energy because the location of the filtering machine is 150m from the drying space, so you have to use a tricycle motor to transport it. From the mix the granules process to the filtering process, the process is done manually and

there is no crane line connecting each process, resulting in wastage in terms of movement.

4. The final step is the Packaging Process put granules into packaging sacks using a bucket so that it is less efficient, and the tools to seal the sacks are too old, so there is a potential for failure to sew the sacks.

5.2 Analysis of the Causes of Waste with Fishbone Diagram

As illustrated in Figure 4.5, there are 3 effects of waste, namely human, methods, and machine. On the human Factor where Lack of Supervision so that it becomes less operator discipline and lack of understanding of company priorities and lack of training program Standard Operating Procedures so that it becomes the length of the Production Process can be completed. The waste that is influenced by the Methods Factor is Natural drying of fertilizers so that it becomes dependent on natural factors and the method used is not optimal. filtering engine position away. And on the Machine Factor where Machine is too small so that it becomes little production capacity and lack of maintenance and machine checking. Waste that appears is transportation, motion, and waiting time/delay.

The following are recommendations for improvement as a solution to minimize waste, namely the future state mapping which can be seen in Figure 5.1.

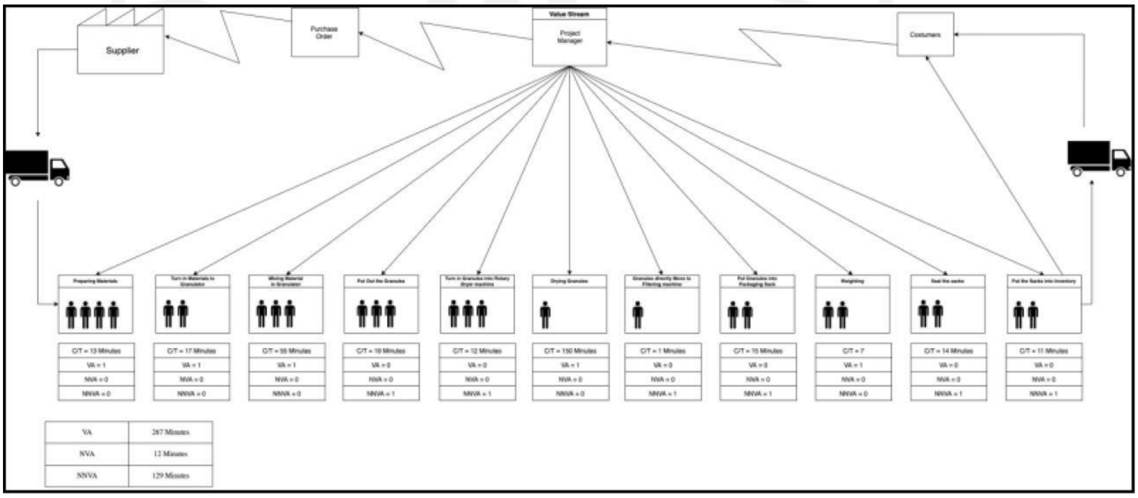


Figure 5. 1 Future State Mapping

The different that makes future state mapping better than current state mapping are listed below:

-Remove "Move the garules into drying space", "Set the granules in drying space", "Put the granules into the sack", "Put the sack to tricyclemotor", "Bring the sack to filtering machine", "Put down the sack", "Turn in granule into filtering machine".

-Add "Turn in granules into rotary dryer machine", "Granules directly move to filtering machine".

-Increase Value added from 65,441% to 81,529%.

-Reduce Non-Value added from 2,941% to 0%.

-Reduce Necessary Non-Value added from 31,618% to 18,471%.

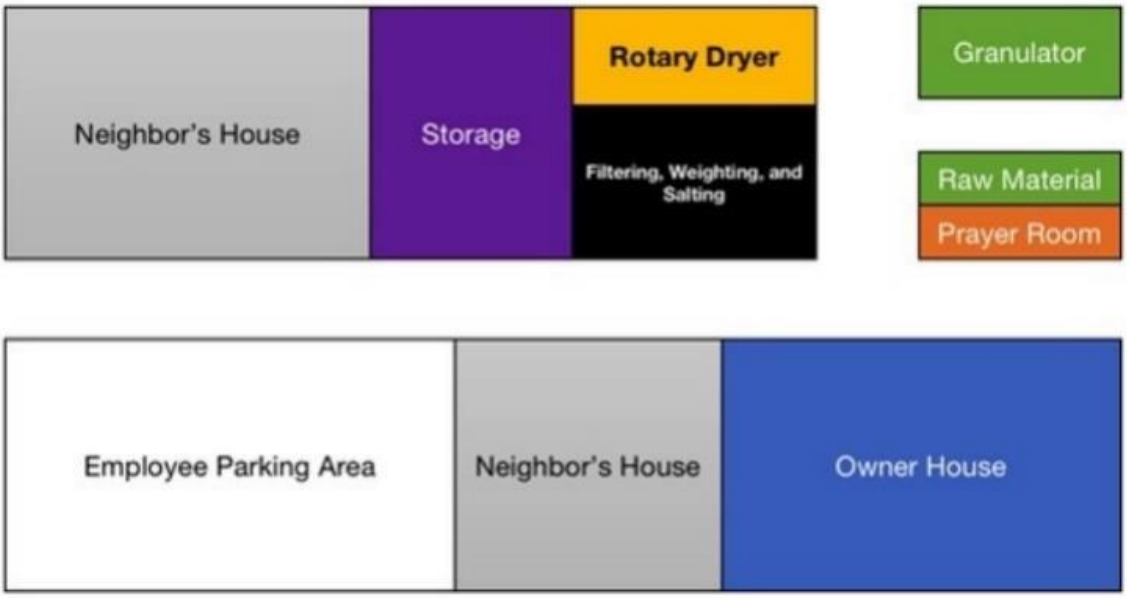


Figure 5. 2 Future Production Layout

5.3 Process Activity Mapping (Future State)

In its use, this tool is often used by several industrial engineering experts to map all activities in detail to eliminate waste, inconsistency, and irrationality in the work area so as to increase performance efficiency through improving quality, speeding up processes and reducing costs.

Process Activity Mapping provides a description of the physical and information flow, the time required for each activity, the distance traveled and the measurement of inventory in each stage of production. The ease of identifying an activity is divided into five groups, namely operation, transportation, inventory, inspection and delay. Operations and inspections are value added (VA) activities. Meanwhile, transportation and storage are important but not value added (NNVA). Then delay is a non-value add activity (NVA) that should be avoided to increase efficiency.

The following are the results of the repair process in Table 5.1 describing the activity mapping process (future state) after the repair.

Table 5. 1 Activity Mapping Process (Future State) After the Repair

Process	Activity	Tools	Distance (meter)	Time (minutes)	Category Activity	Value Category
Mixing Process	Preparing Material	Manual	0	13	D	VA
	Turn in the Material to Granulator	Big Scoop	0	17	O	VA
	Mixing Material in Granulator	Bigger Granulator Machine	0	55	O	VA
	Put Out the Granules	Big Scoop	0	19	D	NNVA
Drying Process	Turn in Granules into Rotary	Big Scoop	0	12	O	NNVA

	Dryer Machine					
	Drying granules	Rotary Dryer	0	150	O	VA
Filtering Process	Granules Directly Move to Filtering machine	Automatically		1	D	NNVA
	Put Granules into packaging sack	manual	0	15	S	NNVA
Packaging Process	Weighting	Scales	0	7	I	VA
	Seal the sacks	Portable sewing tool	0	14	O	VA
	Put the sacks into inventory	Manual	0	11	S	NNVA

Table 5. 2 Amount And Proportion Of Time For Each Activity After Repair

Activity	Amount	Total Time (minutes)	Percentages (%)
Operation (O)	5	248	78,981
Transportation (T)	0	0	0
Inspection (I)	1	7	2,230
Storage (S)	2	26	8,280
Delay (D)	3	33	10,509

VA	6	256	81,529
NVA	0	0	0
NNVA	5	58	18,471
Cycle Time 314			

Value added ratio =

$$\frac{\text{value added time (process time)}}{\textit{total process cycle time}} \times 100\%$$

$$= \frac{256}{314} \times 100\%$$

= 81,529%

5.4 Environmental Value Stream Mapping

Environmental waste analysis in the Adibio10 Fertilizer production process is:

1. Water Use.

   The use of water in Adibio10 fertilizer is minimal because it is only needed in the Mixing Material in Granulator process. From April to June 2021, the use of water used was 14,901 L.

2. Waste.

   In the production process, waste is found in the Drying granules process, bring sacks with tricycle motor to Filtering machine and Turn in granules into filtering machine. Where the waste generated is air pollution that can pollute the air around the production.

3. Energy Consumption

   Energy consumption is related to non-renewable natural resources and is directly related to environmental sustainability. This is to assess the energy consumption in each process. Energy use in Adibio10 fertilizer from April to June is 728.09 kWh.

4. Material

   The material used to make Adibio10 fertilizer uses natural ingredients such as cow dung or manure and does not contain harmful ingredients. The amount of material used is already environmentally friendly.

5.5 Lean and Green Maturity Levels

From the results of the questionnaire and the author's analysis of the lean and green maturity levels based on field surveys and the results of data processing such as vsm and fishbone, the overall maturity level of lean and green maturity levels is 2.14.

Maturity Level assessment criteria shown below.

Chaotic: Level 1,0 - 1,99

Stabilization: Level 2,0 - 2,99

Standardization: Level 3,0 - 3,99

Optimization: Level 4,0 - 4,99

Innovation: Level 5,0

The following is an explanation of each question of the maturity level questionnaire:

1. What do you think is the level of effectiveness and efficiency in the process of preparing Material activities at the Adibio10 Company?

   In this process the maturity level is at 2.5. This is because the process of preparing materials has not yet been labeled based on the type of material, which causes workers to experience a few problems but can still be solved.

2. What do you think is the level of effectiveness and eff iciency in the Turn in the Material to Granulator activity process at the Adibio10 Company?

   In this process the maturity level is at number 2. This is because the Turn in the Material to Granulator process still uses a small scoop and workers require more energy and time.

3. What do you think about the effective and efficient level of the Mixing Material in Granulator activity process at the Adibio10 Company?

   In this process the maturity level is at 2.5. This is because the Mixing Material in Granulator process still uses a machine with a small capacity so that the results are still small.

4. What do you think about the effectiveness and efficiency of the Put Out the Granules activity process in the Adibio10 Company?

   In this process the maturity level is at 1.75. This is because the Put Out the Granules process is still manual and uses a small scoop so it requires more power.

5. What do you think is the effective and efficient level of the Move the Granules to drying space activity at the Adibio10 Company?

   In this process the maturity level is at 2.25. This is because the process of Move the Granules to drying space still needs to spread the granules which requires energy and takes time.

6. What do you think about the effective and efficient level of the Set the granules in drying space activity at the Adibio10 Company?

   In this process the maturity level is at number 1. This is because the Set the granules in drying space process, workers must ensure that the granules are evenly distributed so that they dry completely.

7. What do you think is the effective and efficient level of the Drying granules activity in the Adibio10 Company?

   In this process the maturity level is at 2.5 this is because the Drying granules process uses solar energy so it still depends on weather conditions.

8. What do you think is the level of effectiveness and efficiency in the Put the granules into sack activity process at the Adibio10 Company?

   In this process the maturity level is at 0.75. This is because the process of Put the granules into sack activity is still manual and uses a small scoop which requires extra time and energy.

9. What do you think is the level of effectiveness and efficiency in the Put the sack to the tricyclemotor activity process at the Adibio10 Company?

   In this process the maturity level is at 1.75. This is because the process of Put the sack to the tricycle motor workers feel this activity is a waste of time and energy.

10. What do you think is the effective and efficient level of the Bring sacks with tricycle motor to Filtering machine activity process at the Adibio10 Company?

    In this process the maturity level is at number 2. This is because the Bring sacks with tricycle motor worker feels that the distance between the Drying Space and the Filtering Machine is very far, so this activity is considered a waste of time and energy.

11. What do you think is the level of effectiveness and efficiency in the Put down the sack activity at the Adibio10 Company?

    In this process the maturity level is at 1.75. This is because the process of putting down the sacks of workers feels that this activity is a waste of time and energy.

12. What do you think is the level of effectiveness and efficiency in the Turn in granules into filtering machine activity process at the Adibio10 Company?

    In this process the maturity level is at 2.5. This is because step Turn in granules into filtering machine process to lift the sack containing granules into the filtering machine requires extra power.

13. What do you think is the effective and efficient level of the Put Granules into packaging sack activity process at the Adibio10 Company?

    In this process the maturity level is at 1.25. This is because the Put Granules into packaging sack process makes workers feel that the activity of inserting and removing granules into the sack is an activity that wastes energy.

14. What do you think is the level of effectiveness and efficiency in the process of Weighting activities at the Adibio10 Company?

In this process the maturity level is at 2.25. This is because the process of weighting workers still needed to lift the sack on the scales.

15. What do you think is the level of effectiveness and efficiency in the process of Seal the sacks activities in Adibio10 Company?

In this process the maturity level is at 3.75. This is because the Seal the sacks process is quite good.

16. What do you think about the effectiveness and efficiency of the Put the sacks into inventory process at the Adibio10 Company?

In this process the maturity level is at number 4. This is because the process of Put the sacks into inventory is an activity that really needs to be done in production activities.

5.6 Design Suggestion

One of the improvement efforts made is by applying tools in the lean manufacturing method, namely applying the 5S Kaizen. The proposed improvement design to minimize waste is to apply seiri, seiton, seiso, seiketsu, and shitsuke in almost all workstations.

Table 5. 3 Design Suggestion

Problem	Reason	Suggestion
In the Mixing Process the production can only produce fertilizer on a small scale and turn in the material to granulator and put out the granules is less efficient	Small mixing machines and tools used to put material into the granulator and remove it still use a small scoop	Replacing the mixing machine with a larger diameter and replacing the small scoop with a more precise scoop.
The Drying process takes a long time and depends on nature	Still using natural methods, namely sunlight	Using the dryer

In the filtering process there is a waste of motion	The location of the filtering machine is 150 m from the fertilizer drying area and must use the tricyclemotor	Moving filtering machine
Packaging Process put granules into packaging sack is less efficient	using bucket	Direct from filtering machine
There is a potential for failure to sew the sack	Sewing machine is old	Replace it with a new one

5.6.1 Design Seiri

Seiri's design is sorting out items that are still needed and what is not needed. It is intended that in the work area there are only items that are really needed by the operator in the production process.

Table 5. 4 Analysis of Strengths and Weaknesses

Suggestion	Strength	Weakness
Red Tag	Giving red tags helps operators to identify items/equipment that are often used in the work area and helps how to store each item/equipment.	Operator trouble in deciding goods/equipment still required and who does not required and area needed specifically for keep goods/equipment who does not needed.
Changing small buckets and scoops to larger and more proper sizes	More efficient	Requires extra fee

5.6.2 Design Seiton

Seiton's design is to determine the proper layout of goods and equipment in the production area to make it easier for operators to find the goods and equipment needed. The design of seiton is expected to reduce processing time which does not have added value due to the activity of looking for goods. To reduce the processing time of activities that do not have added value, several tools are made in the sewing and cutting work area. In making the design of tools in the work area using body dimensions in determining the dimensions of the tools.

Table 5. 5 Analysis of Seiton's Strengths and Weaknesses

Suggestion	**Strength**	**Weakness**
Moving the filtering machine near the milling machine	Reducing motion and transportation waste	It costs money
Changing the method of drying granules that still uses sunlight to a drying machine	Reduce waste waiting/delay, because production will not be affected by nature and also faster	It costs extra to buy a dryer and requires more energy in the production process
The design from the mix the granules process to the filtering process is done by creating a connecting path between each process	Reducing motion and transportation waste	Needed cost addition

5.6.3 Design Seiso

Seiso design is an effort to make the work area cleaner and neater so as to create a healthy and comfortable work area and motivate workers to do their work.

Table 5. 6 Analysis of Seiso's Strength and Weakness

Sugesstion	**Strength**	**Weakness**
Addition rubbish bin	make it easy operator in throw away rubbish	Needed cost addition for provide the place trash on every area work
Add cleaning tools	Operators are easy to find cleaning tools	Need cost addition for provision equipment cleanliness
Checklist Sheet Seiso	Provide information to operators regarding what activities must be carried out in an effort to maintain the cleanliness	Requires self-initiative to maintain cleanliness in the workplace.

and tidiness of the work area		

5.6.4 Design Seiketsu

Seiketsu design is the stage of maintaining the continuity of 3S (seiri, seiton, seiso) in the work environment by standardizing so that the previous 3S stages can run consistently. The design of seiketsu in the production area is carried out using work rules and visual management.

Table 5. 7 Analysis of Seiketsu's Weaknesses and Strengths

Suggestion	**Strength**	**Weakness**
Make work rules	The operator will take care of the running 3S	It takes time for employees to adapt
Sticking posters 5S Kaizen	Operator will always remember and always apply 5S Kaizen	-
Make an evaluation every week	Evaluation can maintain and discipline the application of 5S Kaizen	Operators have to adapt

5.6.5 Design Shitsuke

Shitsuke design is a step to ensure that all entities in the work environment always follow the implementation of the 5S Kaizen program. In this case, it can be done using the design of the 5S Kaizen audit sheet form.

Table 5. 8 Analysis of Shitsuke's Weaknesses and Strengths

Suggestion	**Strength**	**Weakness**

Form 5S Kaizen Evaluation	More disciplined operators are maintained	Operators have to adapt to the new work environment

CHAPTER VI
CONCLUSIONS AND SUGGESTIONS

After conducting the analysis and discussion, in this chapter conclusions will be drawn to answer the research objectives. In addition, it also contains research suggestions so that it is expected to be useful, constructive and useful research in the future.

6.1 Conclusions

Based on data processing and analysis in this study, the conclusions obtained are:

1. Based on the results of the research, it was found that the most common types of waste are Operation (72%), Transportation (7%), Delay (10%), and Storage (10%). In Adibio10 companies, Value Added was 65.441%, Non-Value Added was 2.941%, and Necessary but Non-Value Added was 31.618%. Maturity level of lean and green maturity levels is 2.14, it is at STABILIZATION level. (Isolated practices of Lean and Green are being applied. There is awareness of waste and basic indicators are used).
2. From the use of mapping tools, process activity mapping can be seen that the percentage of transportation activities (7%) has the third largest proportion of time, where this activity is included in necessary but non-value add activities. After repairing transportation activities, the result of the percentage value is (0%), with the value-added Ratio (VAR) before the repair has a percentage value of 65%, while after the implementation of the improvement the VAR value becomes 81,529%.

Efforts made by researchers to minimize motion waste is to implement the 5S Kaizen program (Seiri, Seiton, Seiso, Seiketsu, Shitsuke). From the implementation of the 5S Kaizen program, several suggestions for improvements were made to minimize motion waste, including:

a. Sticking Red Tags.
b. Changing small buckets and scoops to larger and more proper sizes.
c. Remove the stick to arrange in the drying process.
d. Moving the filtering machine near the milling machine.

e. Changing the method of drying granules that still uses sunlight to a drying machine.
f. The design from the mix the granules process to the filtering process is done by creating a crane line that connects each process.
g. Adding a trash can.
h. Adding cleaning tools.
i. Seiso Checklist Sheet.
j. Create work rules.
k. Sticking posters 5S Kaizen.
l. Make an evaluation every week.
m. 5S Kaizen Evaluation Form.

3. Green manufacturing in Adibio10 is quite good, judging from the Environmental Waste Analysis in the Adibio10 Fertilizer production process, starting from Water Consumption where the use of water in Adibio10 fertilizer is very minimal because it is only needed in the Mixing Material in Granulator process, and from the aspect of Adibio fertilizer waste emit air pollution which according to the author is still within reasonable limits and does not disturb the surrounding community, aspects of energy consumption also do not require large amounts of energy, and aspects of the materials used are safe and do not contain chemicals.

6.2 Suggestions

After going through the results of the analysis and communicating with the production department, there are some suggestions for Adibio10 about how to reduce waste, process efficiency and improve quality as follows:

It is hoped that there will be further research on the implementation of sustainable lean manufacturing with productivity within the company, thus creating a dynamic policy in terms of future company development.

Applying the value streaming mapping method to the company's entire supply chain.

Because it can be seen from this research, there are several problems that need to be evaluated. For this reason, the relevant divisions may have to focus on evaluating related problems as described above.

It is necessary to do further research on other aspects of green manufacturing in addition to the aspects that have been discussed in this study.

Conduct a broader and general waste analysis including supplier performance and then distribution until the goods reach the consumers.

Further research is needed on the results of the analysis of the implementation of the existing improvement strategies so that better improvement scenarios can be found and simulated in a better, systematic and sustainable manner.

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