CHAPTER 3
SOLUTION ALTERNATIVES

3.1. Solution Alternatives

According to the research problem of the low production capacity and the stakeholders' concerns, there are three possible solution alternatives to resolve the issue. The solution alternatives are installing additional machines for production, adding more work shifts, and implementing lean manufacturing principle by waste identification and elimination. Table 3.1. shows the solution alternatives along with the analysis of each solution's practicability.

Table 3.1. Solution Alternatives

Solution Alternatives	Possibility by Theory	Case Appropriateness	Research Limitation	Conclusion
Installing additional machines	New machines will increase the output and it is a long-term investment.	The plant still has enough space for new machines.	Installing new machines will charge the company more costs.	Rejected, because it does not fulfill the research limitation.
Adding more work shifts	More production hours mean more products can be processed and produced.	Additional shifts may be applied since the current system has only one shift.	Additional shifts require more costs for employees and other operating costs, such as electricity.	Rejected, because it does not fulfill the research limitation.
Waste identification and elimination	Waste elimination will reduce the production time, so more products can be produced within the same working hours.	Some wastes are identified on early observations and can be eliminated.	Eliminating the waste will increase production capacity by utilizing the current resources.	Chosen, because it fulfills all aspects of considerations.

From Table 3.1., the analysis of every solution's feasibility considers three aspects: the possibility by theory, the case appropriateness, and the fulfilment of the research limitations. These factors will determine the most suitable solution for the research problem.

The first solution, the installation of new additional machines, is possible in this case because the factory plant still has enough space for new machines on the production floor. Moreover, the solution will become a long-term investment for the company, and it will increase the production capacity. Higher production quantity allows more sales to happen and lower operating costs. However, the company does not wish to be charged extra costs by the solution proposed. Therefore, the solution of installing new machines is not feasible in this research.

Then, the second solution will be adding more work shifts. Additional shifts are still available at CV X because they currently work only for one shift. Longer production hours will result in higher production quantity. Although this solution is possible in theory and will fulfill the research objective, more costs will apply to the company. Adding more shifts requires more employees to be hired and other costs, such as the electricity cost, will also become higher due to longer working hours. Due to the research limitations, implementing additional work shifts is not practicable.

The last alternative is waste identification and elimination on the production floor. By eliminating waste, the production time required will be decreased. Thus, within the same amount of time, more production quantity will be produced. Besides, some wastes on the production floor are identified during the observation at the company. Furthermore, this third alternative will not charge the company more costs since it can utilize the current available resources. Therefore, compared to the other alternative solutions, waste identification and elimination is the most suitable solution to be implemented for this research. After confirming with the owner of CV X, this solution is accepted and can be implemented on the company's shop floor.

3.2. Waste Identification Method Alternatives

Based on the Literature Review, there are two commonly used waste identification methods. They are Value Stream Mapping (VSM) and Waste Assessment Model (WAM). Previous studies have been done using the two methods and some of them are shown in Table 3.2.

Table 3.2. Previous Studies for Waste Identification

No.	Author	Year	Title	Objective	Method	Result
1	Alfiansyah & Kurniati	2018	*Identifikasi Waste dengan Metode Waste Assessment Model dalam Penerapan Lean Manufacturing untuk Perbaikan Proses Produksi (Studi Kasus pada Proses Produksi Sarung Tangan)*	Eliminating the waste in the gloves production at PT X.	Value Stream Mapping, Waste Assessment Model	Waste elimination is done by reducing defect process, maintenance system improvement, and management system development.
2	Sudjianto, et al.	2013	*Value Stream Mapping sebagai Upaya Pengurangan Waste di Departemen S PT A*	Reducing waste in S department	Value Stream Mapping	Incoming material scheduling, enhanced supervising and work ethics, material management development, upgrading material handling equipment, and changing the material intake flow decrease the lead time by 5.82%.
3	Maulana	2019	Identifikasi Waste dengan Menggunakan Metode Value Stream Mapping pada Industri Perumahan	Increasing productivity by reducing the waste	Value Stream Mapping	Improved communication system, standardized work method, and transportation system improvement reduce the lead time and increase productivity.
4	Tambunan, et al.	2018	*Penerapan Lean Manufacturing menggunakan Value Stream Mapping (VSM) untuk Identifikasi Waste & Performance Improvement Pada UKM "Shoes and Care"*	Identify the waste of the "fast clean" service and propose improvements	Value Stream Mapping	Working method and working tools improvement can reduce the cycle time from 2,275 seconds to 1,175 seconds.

Table 3.2. Continuation

No.	Author	Year	Title	Objective	Method	Result
5	Jufrijal & Fitriadi	2022	*Identifikasi Waste Crude Palm Oil dengan Menggunakan Waste Assessment Model*	Identify the waste on the production process	Waste Assessment Model	Overproduction, defects, and waiting become the critical wastes in the crude palm oil production process.
6	Putri, et al.	2017	*Identifikasi Waste Menggunakan Waste Assessment Model (WAM) Pada Lini Produksi PT. KHI Pipe Industries*	Identify the waste at PT KHI Pipe Industries and propose improvements	Waste Assessment Model	The defects waste reaches 27%, so machine maintenance, better raw material selection, and on-the-job training are proposed.
7	Hatpito, et al.	2019	Identifikasi Waste Proyek Konstruksi Jalan dengan Menggunakan Metode Lean Project Management	Identify the waste using lean project management approach to prevent delay, attain cost efficiency, and pass the quality standard	Waste Assessment Model	Better material storage, administration system improvement, regular tools maintenance, and human resources development program are proposed to reach the objective.

From Table 3.2., it can be concluded that both VSM and WAM can be implemented in various industries and projects. Therefore, animal feed industry such as CV X is no exception. Following this discovery, the best method to identify the waste in this research must be determined.

First, the Value Stream Mapping method is done by analyzing the stream of processes and operations in the company. Then, based on the VSM, a Process Activity Mapping is created to determine the value-added and non-value-added activities. Based on the Process Activity Mapping, the waste of the production process at the company can be identified. Next, the critical waste can be concluded from the total time of non-value-added activities in a particular process. By using VSM, the identification of waste will be comprehensive because the analysis is based on the whole operations in the company. Moreover, the VSM method considers the value-added activities, so the research may find the comparison between the total time of value-added activities and non-value-added activities. However, the VSM method cannot show the relationship among the wastes, such as how influential a waste is towards another waste, existing at the company.

Meanwhile, the Waste Assessment Model method is done by using the Waste Assessment Questionnaire. The questionnaire is filled in by someone who is considered eligible to assess the relationship between the wastes, such as the production manager. From the answer of the questionnaire, the total score of each waste can be found. Based on the total score, the weight for every waste will be symbolized in the Waste Relationship Matrix. Finally, by converting the weight from the Waste Relationship Matrix to a score, the values for the waste are found. The advantage of using the WAM method is the research can find the relationship between the waste in the company. Nevertheless, the WAM method is prone to subjectivity and human error because the respondent must be the employee of the company. Moreover, the WAM method assumes that all seven wastes exist in the plant, but additional investigation is required to determine in which stage the waste occurs in the process.

Considering the advantages and disadvantages of each method, the VSM method has more advantages offered to attain the objective of this research. The VSM method has better objectivity because the analysis is based on data and done by the researcher, not by an employee from the company. Furthermore, the VSM method can directly identify where the waste occurs in the system. Therefore,

improvement can be focused on the specific characteristics. Also, a comprehensive analysis of the VSM method becomes another advantage that this method offers compared to the WAM method. Thus, this research will use the Value Stream Mapping method to identify the waste at CV X. Later, improvements will be implemented based on the founding from the waste identified.

3.3. Research Uniqueness

The uniqueness of this research is the company's vision to sell exclusive and high-quality products. Thus, it has a specific market and market expansion is not as simple as other companies. Moreover, it requires many considerations to produce lower product quality with cheaper prices, since it will affect the company's reputation in the market. Besides, some workers, like the workers in the grinding department, do more than one job. Other than grinding the materials, they need to transport the material to the other department with a considerable amount of time and work addition. Furthermore, using the VSM on the animals feed production company is still rare to be found, proved by the results that show up from the search engine.