Improved Production Efficiency through Lean Manufacturing Tool with the use of Value Stream Mapping (VSM)

Engr. Antonino D. Carpena

Flocerfida L. Amaya

University of Perpetual Help System Laguna

Abstract

Improving areas of business especially production takes a lot of efficiency output through the removal of waste and implementing a flow that are thoroughly done through various techniques such as the lean manufacturing strategy. Furtherance of this helped the researchers or even the people concerned to understand the importance and the actual way to do the lean manufacturing strategy focused on the value stream mapping. Utilization of the descriptive method of research with the preliminary observation targeted the manufacturing process of Carrageenan powder in the production area of Mioka Biosystems Corporation. The prominence was on the elimination of non-value-added activities and reduction of costs. Moreover, motion and transportation wastes were the most existed wastes present caused by poor execution of method design, poor equipments and tools, and others that must be made excellent and improved perhaps by the production company through strategies like training and improvement of the facilities.

INTRODUCTION

Background of the Study

In the relentless pursuit of competitiveness and profitability, higher numbers of companies were turning to lean manufacturing to reduce or totally eliminate wastes, as much as possible, in their production processes. Competition was the rivalry among sellers trying to achieve such goals as increasing profits, market share, and sales volume by varying the elements of the marketing mix: price, product, distribution, and promotion.

Value stream mapping provided an optimum value to the customer through a complete value creation process with minimum waste in design (concept to customer), build (order to delivery) and sustain (in-use through life cycle to service). This study helped the researchers understand the importance of lean manufacturing focusing on the value stream mapping in improving business performance in producing Carrageenan. Lean structured methods for conducting value stream mapping including the Current and Future State mapping in order to practice skills in the application of this method in Mioka Biosystems Corporation.

The study of Value Stream Mapping is a guide to meet perfection and reduce impurities within the production. It enhances the researchers' knowledge and decision making skills as well. This is a small contribution with the Mioka Biosystems Corporation but a handful improvement

has been settled within its production. The study's goal is to redesign the current production area of the plant.

Researchers applied Value Stream Mapping to formulate the Future State Map that will enhance the efficiency of production flow of the plant. Value Stream Mapping aimed to regulate and systematized the current and existing map of the production. By this, researchers verified and identified the bottlenecks and the wastes inside the production which didn't add value to meet and satisfy the consumers' demand.

The researchers considered production process development. The proposed methodology was restricted to the mapping and improvement of a single yet definable production process development and it was applicable for a particular product that the researchers had been observed.

The study focused on redesigning the process layout on the production area of Mioka Biosystems Corporation that produces Carrageenan powder. The Value Stream Mapping tool was used to analyze both the flow of information and the flow of materials.

Mioka Biosystems Corporation also known as Marcel Trading Corporation started business in 1969, exporting various sea products. In 1971, Mioka added dried seaweeds to its range of exports. Due to its policy of strict quality control and good value, the company quickly established strong supply relationships with many Carrageenan processors worldwide. Now, Mioka owns and operates two Carrageenan production plants and one blending facility, all located in the Philippines.

After conducting the preliminary observation in Mioka Biosystems Corporation, the researchers found certain problems that require improvement. The presence of unnecessary transportation and motion during a certain process caused by unorganized flow of materials, excessive inventory, and the process flow itself convinced the researchers to use Value Stream

Mapping as a lean manufacturing tool. VSM will help the researchers in formulating the future state value stream map that will improve the production processes and helps to increase the productivity as well as the efficiency of the workers.

The main purpose of this study is to increase the production efficiency through Lean Manufacturing tool with the use of Value Stream Mapping (VSM).

1. Identify the two (2) most existing lean manufacturing wastes in the production area.
2. Identify the causes and effects of the two (2) most existing lean manufacturing wastes in the production area.
3. Draw an effective Future State Map that will increase the company's productivity.

The main problem of this study is the inefficiency of the production area of the manufacturing of Carrageenan powder in Mioka Biosystems Corporation.

More specifically, it will sought answers to the following sub-problems:

1. What are the two (2) most existing lean manufacturing wastes currently present in the production area?
2. What are the causes and effects of the two (2) existing lean manufacturing wastes in the production area of Carrageenan powder?
3. What Future State Map will be more effective in increasing the company's productivity?

Literature Review

As the international competition and customers' demands are changing from time to time, manufacturer has to change their business strategy and factory management in order for them to adapt and accommodate to these kinds of rapid changes. Not only that, it is also crucial for the manufacturer to remain competitive in the industry, however this is not easy to achieve for most of the manufacturer as there are many internal and external factors that will downgrade the productivity and affect the competitiveness of the firm, thereafter deliver poor quality of products and delay the work processes in the factory.

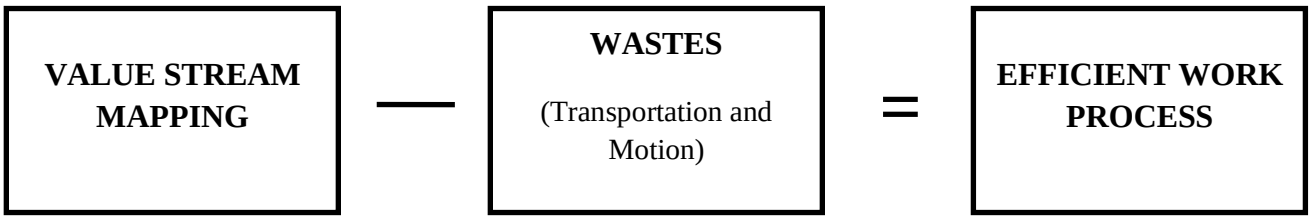


Figure 1.2 is the paradigm of the conceptual framework used in the study.

Therefore, it is important for the manufacturer to have an effective strategy that will guarantee, or at least help to reduce or minimize the operation cost by identify and eradicate wastes in the firm, hence to improve the quality in every area of the value streams, this shall inclusive of firm management. Furthermore, it also describes the effectiveness of the Value Stream Mapping (VSM) in moderating the impacts of the waste towards the process productivity. (KwaiFui Tay,2010)

Value Stream Mapping complicates the identification of waste, lead to misinterpretations and assessment mistakes, and undermine the implementation of future improvements. They have run such investigations to the main difficulties and limitations encountered during the construction of current state maps, analysis of the associated causes, and pointing out of guidelines to facilitate the use of VSM to map processes (Forno, 2014).

Lean manufacturing is the process of designing manufacturing systems to reduce costs by eliminating product and process waste. The emphasis is on eliminating non-value-added activities such as producing defective product, excess inventory charges due to work-in-process and finished goods inventory, excess internal and external transportation of product, excessive inspection, and idle time of equipment or workers due to poor balance of work steps in a sequential process.

The value stream consists of all activities required to bring a product from conception to commercialization. It includes detailed design, order taking, scheduling, production, and delivery. Understanding the value stream allows to see value-added steps, non-value-added but needed steps, and non-value-added steps. Value-added activities transform or shape material or information to meet customer requirements. Non-value-added activities take time or resources, but do not add value to the customer's requirement (but may meet company requirements).

The value stream improvement journey typically starts with training the team on key concepts in Lean, mapping the current state using value stream maps which document materials and information flow as well as any pertinent information on the process (such as wait times, processing times, and inventory levels). Improvements are identified. The desired future state is then documented as a future state value stream map, and the improvements are implemented to drive toward the future state goal (Juran, 2012).

Value stream mapping will allow everyone to see the wastes and plan to eliminate those. VSM can strengthen the gains by providing vision and plans that will eventually connect all improvement activities in the organization. As we continue our journey for operational excellence, VSM will make any organization globally competitive by shifting from a corrective to a preventive culture.

Value stream mapping is a lean management method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer. At Toyota, it is known as "material and information flow mapping". It can be applied to nearly any value chain.

Under this method the initial step should be planning and preparation. Identify the target product family or service. Create a charter, define the problem, set the goals and objectives, and select the mapping team. Then, socialize the charter with the leadership team.

Draw while on the shop floor a current state value stream map, which shows the current steps, delays, and information flows required to deliver the target product or service. This may be a production flow (raw materials to consumer) or a design flow (concept to launch). There are 'standard ‘symbols for representing supply chain entities. Next is to assess the current state value stream map in terms of creating flow by eliminating waste. After interpretation and evaluation process, draw a future state value stream map. Finally, work towards the future state condition (Rother and Graban, 2011)002E

Current state map of a value stream is a snapshot of how the material and information flows in that value stream. It tells where you are, shows where you want to go and gives you a plan on how to get there. On the other hand, the future state map of a value stream helps with the larger process of developing your Lean Manufacturing Strategy. It requires significant knowledge of

Core Disciplines and other specific topics. Designing a Future State requires more art, engineering and strategy than Present State mapping (Krueger, 2011).

As industries perfected their manufacturing processes, competition among manufacturers increased. Manufacturers had to find other ways of reducing the cost of production. Frederick Taylor and Frank Gilbreth further scrutinized manufacturing activities such as waste, effectiveness and efficiency. In the 1990s the Toyota Motor Company built on these efforts and came up with the concept of lean manufacturing (Ndahi, 2009). It also takes into consideration the workplace organization and management, quick changeover, and quality products (Chaneski, 2005). The goal was to create a manufacturing environment that is driven by demand and that holds only a small amount of inventory and products at any given time (Bacheldor, 2004). Proponents of lean manufacturing believed that the system eliminates waste, reduces inventory, and increases value throughout the supply chain (Kumar & Yin, 2004).

The visual technique of mapping is divided into two sections, flow of information and flow of material and it describes how a business currently operates and could operate. This vision provides the ability to eliminate the process that add no value, eliminate redundant and unnecessary information flows and combine or streamline those that do. Value stream mapping provides both a picture of the current state of affairs as well as a vision of how we would like to see things work. Identifying the differences in the current and future state yields a roadmap for continuous improvement activities. (Angeles, 2011)

Based from the articles gathered, constructing the current state map may encounter such difficulties and limitations throughout the study. Current state map will give the researchers insights on how all materials and information flow in the value stream. The journey in value stream mapping starts with the training the teams for better implementation of the future state map. The

researchers should also consider the management, workplace organization and the quality of the product. Lean manufacturing includes studies on the non-value added activities that can consider as waste. The researchers must identify all the information present in the value stream. With that, they will be able to determine the unnecessary information and the processes that do not add value in order to draw an effective future state map. This includes the improvement with regards to processes/methods and company's productivity in able for the firm to perform profitably.

Indian cottonseed oil industry was addressed using VSM and individually attacked all wastes to reduce or eliminate them from the system. In small manufacturing firm they have been claimed that 33.18% reduction in cycle time, 81.5% reduction in changeover time, 81.4% reduction in lead time and 1.41% reduction in value-added time during the working hours. (Singh, 2010)

Cookson 2011 found out that, developing the VSM was not difficult, but did require us to step back from the clinical situation and make notes about what we saw. The high level of staff acceptance of our presence and involvement in helping us develop the map was not only pleasing, but was also felt to be crucial to our success in identifying so much process waste.

The production process on the future-state map exhibits significant overall improvements. Total construction duration of the value stream decreases from 65.5 workdays to 38.5 workdays, amounting to a reduction of 27 workdays or over 5 weeks. The percentage of waiting time drops from 76 to 65% and the value added ratio increases from 17 to 26%. However, achieving the material flow envisioned in the future-state map requires that the amount of inventory on FIFO lanes should ideally be stabilized around six. Based on the statistical analysis, PSS needs to be improved from current 45–77% to upward of 90% and with standard deviation of cycle time for each task reduced to 1 workday, so that the probability that the cycle times of any two homes in a

series of six are longer than the average cycle time by more than 1 workday is below 10%. Although the actual probability of a shortage of jobs in the FIFO lane to fill the Kanban slots might be much lower due to possible completion of previous delayed jobs, focused attention on improving the reliability of the operation of sub trades will be required, (Yu, 2009).

To solve the production waste vis-a-vis the problem of decreasing raw fish supply and increasing tin can prices, a lean thinking approach was also conducted where overproduction, high inventories waiting and transport times are the non-value adding tasks shown in the current value stream map. To solve the production waste, inventory and demand level management, cellular manufacturing layout, work standardization, load-levelling, and 5s process were the lean tools and methodologies conformed to meet the proposed future state map of value stream mapping about the comprehensive set of cleaner production in Philippine fish canning industry, gathered from related literature and focus group discussions, were proposed to eliminate the waste streams on receiving, at its source. ("Cleaner production with lean thinking: an application to the fish canning industry of the Philippines" by Brillante, Cabahug, and Flores, 2009)

The existing lean manufacturing wastes are transportation, inventory, and motion. Upon observation that inventory waste is present because of the lack of information flow within the production line. It is observed that workers do not have standard machine designation where to deliver the processed aluminum sheets. Elimination of transportation, inspection, storage, and delay processes will increase lean rate of the entire production line. Lean rate will relatively increase if the value-added time is increased and the dock-to-dock time is decrease.
(Garcia, 2011)

Inventory waste most likely occurred as observed by the researchers are because of the lack of balance between workstations, unable to implement FIFO principle and workers not adhering

to proper procedures when working. The researchers also conducted that the lean manufacturing waste present in motion. Poorly designed ergonomic tools and equipment also contributed to the existence of such waste. Lastly, the researchers concluded that the transportation waste is present in the production line. It is present because of the large distances between workstation, absence of linear transportation of processed materials and its immediate transportation.

To put it in a nut shell, value stream mapping is the visual representation of the material flow and information flow in the production line. It starts from the raw materials up to the final consumers. It helps in formulating the future state value stream map of the production line.

According to Angeles 2011, Value Stream Mapping provides both a picture of the current state of affairs as well as a vision of how we would like to see things work. Identifying the differences in the current and future state yields a roadmap for continuous improvement activities.

Rother and Graban 2011 also stated that, Value Stream Mapping will allow everyone to see the wastes and plan to eliminate those. VSM can strengthen the gains by providing vision and plans that will eventually connect all improvement activities in the organization.

In the study of Garcia 2011, they have been identified existing lean manufacturing wastes such as transportation, inventory, and motion. Upon their observation, inventory waste is present because of lack of information flow within its production line. The study of Garcia also observes that a worker doesn't have designated location where to deliver the processed aluminum sheets. Garcia have been prove that with the use of Value Stream Mapping they've been identify existing wastes and identify the comparison between the current and future state that leads them to continuously improve their production line.

METHODOLOGY

2.1 Sample, Sampling Technique, Determination of Sample Size, and Study Size

The main subject of this study was the manufacturing process of Carrageenan powder in the production area of Mioka Biosystems Corporation.

Such study was to identify the considerations for adapting Value Stream Mapping in a product development environment and provide a “best practice” approach for VSM through the removal of waste and implementing a flow that will be effective to decrease costs and increase profit on long term. This was not a stand-alone or singular process rather a philosophy that applied techniques to improve areas of business. The approach to lean manufacturing was the reduction of waste based on human errors.

This included the components of the research design, the significant features of: (1) the method of research utilized in the study and the corresponding procedures and (2) the instruments prepared for generating data.

2.2 Instrumentation

The procedures for this study had been chosen to meet each of the project’s objectives. To have first-hand knowledge of the production flow and to be familiar with the activities being performed in the production area of manufacturing of Carrageenan powder in Mioka Biosystems Corporation, the researchers went through the area and identified each process involved from raw materials storage to the end-result.

2.3 Data Collection Procedure

The researchers utilized the descriptive method of research with the preliminary observation as the main source of data. The descriptive method was feasible for the study since the purpose of the study was to generate existing conditions prevalent in the setting of the study.

2.4 Data Treatment and Analysis

The following were the tools and procedures used in gathering data in the study:

- **PROCESS ACTIVITY MAPPING –** a Value Stream Mapping tool used to determine the physical process in the production area. It includes the sequential list of activities from the raw materials storage to the dispatch of Carrageenan powder.

#	STEP	TIME (min)	O	T	I	S	D
1							
2							
3							
4							
TOTAL							
OPERATIONS							
% OPERATIONS							

Where:

O - Operation. Activity where the materials are physically transformed and represent the activity for which the customer is willing to pay (value added activity).

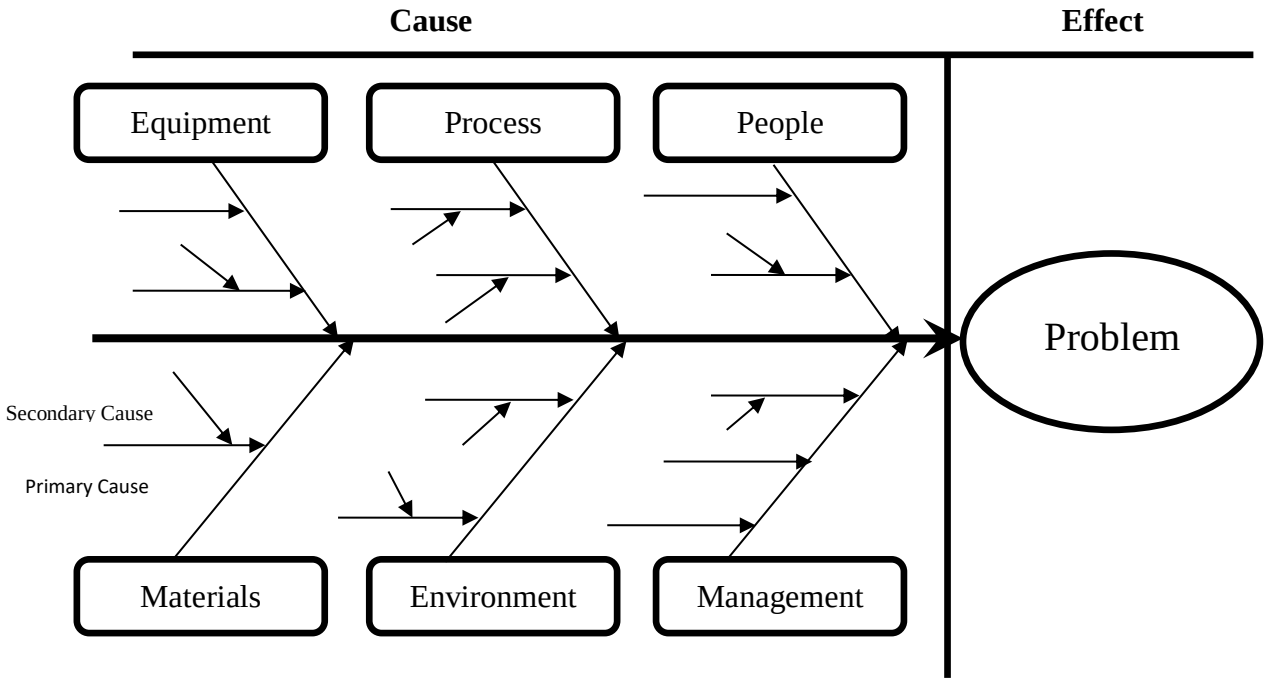
T – Transportation. Activity which involves the movement or transfer of materials within the facility.

I – Inspection. Activity that requires some tests and specifications.

S – Store. Activity that records where the materials are placed in a particular location.

D – Delay. Activity that needs to be improved through process of eliminating wastes within the production.

- **Ishikawa Diagram –** used to determine and establish the flow of factors between causes, main problem and the effects of the study. The researchers will use this to determine the Fish Bone Diagram (Cause and Effect Diagram) in order to track the existing manufacturing wastes present in making the product.



This method consists of defining an occurrence of a typically undesirable event or problem, that is, the effect which serves as the fish head and identifying the contributing factors, that is, the cause which serves as the fish bones attached to the backbone and the fish head. A good diagram will have several levels of bones and will provide a very good overview of a problem and its contributing factors.

The researchers found out that there are two most existing lean manufacturing waste that are present in the production area of MiokaBiosystems Corporation such as transportation and motion.

- **Line Balancing –** used to match the production rate after all wastes have been removed to the cycle time in each process of the value stream. This value stream tool will guide the researchers in making improvements in the process.

Process	**Time (min)**	**Manpower**	**Time (min)**	**Working hours**

2.5 Ethical Consideration

Studies involving interaction with a human sample usually had some ethical implications. It was important to establish trust with the research participants, and this was achieved by

ensuring anonymity and confidentiality to all respondents; carefully explaining the research process and how the data were presented; providing as much information on the project and its aims and objectives without influencing responses. People must be respected and not seen as passive sources of data but as people whose rights and welfare must be protected. Physical risk and psychological harm must be minimized. Risks and benefits from studies should be distributed fairly and evenly in populations. In some cases, an extra degree of sensitivity was required when conducting focus group observations or individual suspections.

RESULTS

This discussed the findings of data gathered from the observations and time study conducted by the researchers in accordance with the specific problems identified in the Introduction.

The major purpose of the study was to determine the two most existing lean manufacturing waste present in the company and give solutions to it. Such adequacy of knowledge were discussed and interpreted.

The researchers observed and measured various processes that may contain non-value adding activities that were present in the production area and its contributing factors to the existing lean manufacturing waste.

The researchers observed that the most visible lean manufacturing wastes that were present in the production area were transportation and motion. The researchers stated the following results.

SOLUTION FOR PROBLEM NO. 1: What are the two (2) most existing Lean manufacturing wastes currently present in the production area?

MOTION

The researchers conducted a time and motion study to determine the elements in processing materials in each machine and the time it takes to complete each (see Appendix B). The proponents were able to determine the operation, transportation, inspection, storage and delay that are present in the producing Carrageenan powder.

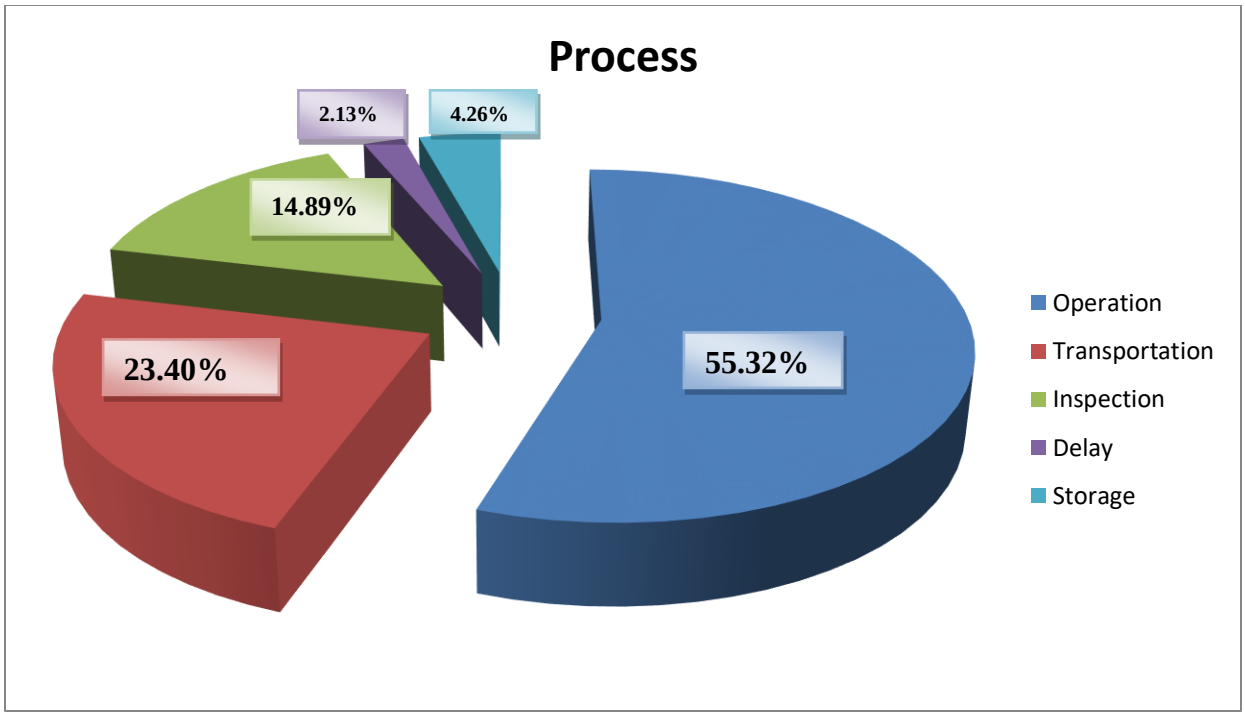


Figure 4.1 illustrates the Frequency and Percentage Distribution of Process in the production line.

As illustrated in Figure 4.1, majority of the process in the production line was Operation numbering 26 out of 47 composing 55.32% of the total process. 11 out of 47 processes were transportation and are composed of 23.40% of the entire process. 14.89% was composed by inspection in the process, 4.26% came from delay and whereas 2.13% came from the storage process.

TRANSPORTATION

For seaweed profiling, after the seaweed had been loaded to tote bins it will be transferred to seaweed shaker for removal of impurities. The location is quite convenient for the transportation since the seaweed shaker is also located at the warehouse where the raw material (seaweed) stored. After inspection from that process, it will be transferred to weighing machine located on the other building but the transportation is easy by means of conveyor. After getting the right weight, it will

be transferred to seaweed treatment area through rail. Pre-washing treatment is the first process, after that, it will go now to the cooking tank. Next will be on the bleaching area and after an hour seaweed will be transferred to washing area for the final wash. From the treatment area, seaweed bin is being transferred to the drying area. The location is quite near. After several hours on drying process, bin will now go to the milling area with the use of hammer mill. If the seaweeds have been already milled, it will go to the grinding area. From grinding machine, it will be transferred to the blending area which is the last process and also where specific mixtures of chemicals are being blended with the seaweed powder. Distances from each machine also vary. After the final process, Carrageenan powder will be transferred to the staging area for storage.

Figure 4.2 shows the Spaghetti Diagram of the Current Production Layout of the Company.

Figure 4.2 shows the time and motion study conducted by the researchers in determining the cycle time needed to finish the product.

Total time is computed based on Appendix B. Operations were computed by adding Element 1 of seaweed profiling, Element 3 and the rest of the operation activities in all processes. Transportation, Inspection, Storage and Delay were computed in the same way.

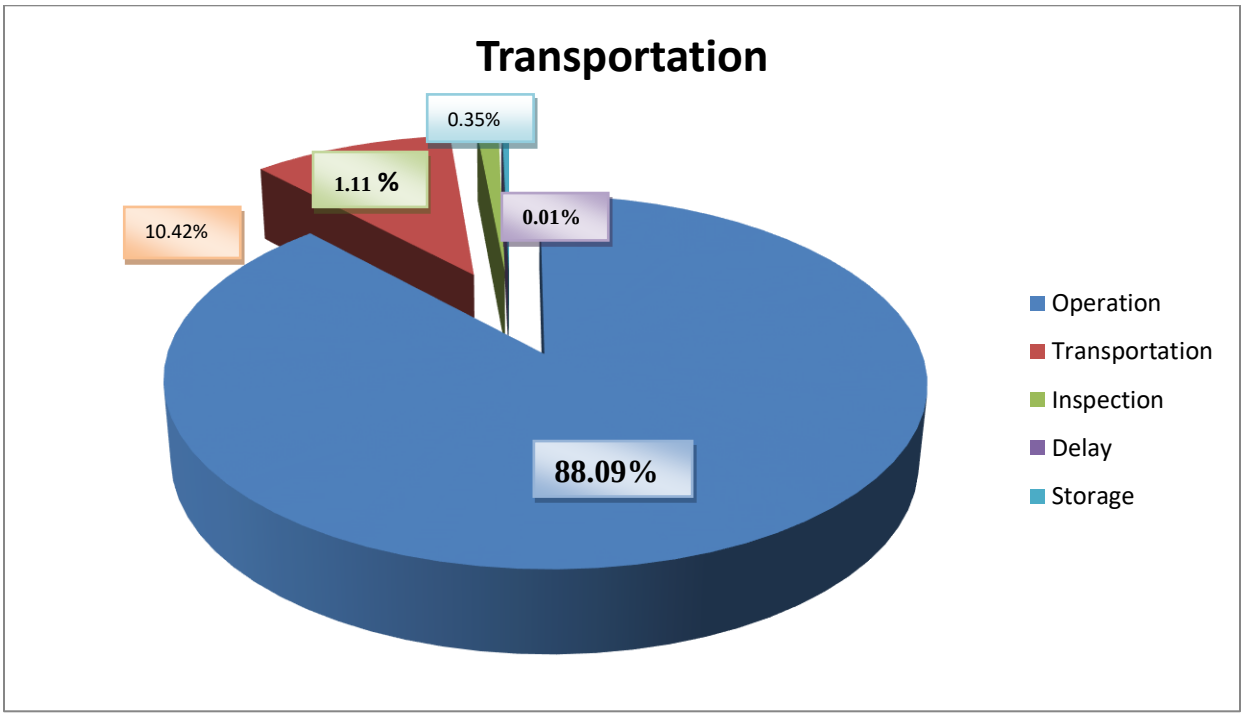


Figure 4.3 illustrates the Time and Motion Study of the Current Process.

As illustrated in Figure 4.3, majority of time is consumed by operation which is 88.09% of the total time. Next to this is the transportation numbering 66.34 minutes out of 636.42 minutes composing 10.42% of the total time. The data gathered serves as the basis by the researchers in getting transportation as the second leanest manufacturing wastes currently present in the production area. 7.08 minutes out of 636.42 of the total time were inspection and composed of

1.11% in the entire processes. Consequently, 0.35% came from delay and 0.01% of the total time came from storage.

SOLUTION FOR PROBLEM NO. 2: What are the causes and effects of the two (2) most Lean manufacturing wastes in the production area of Carrageenan powder?

TRANSPORTATION

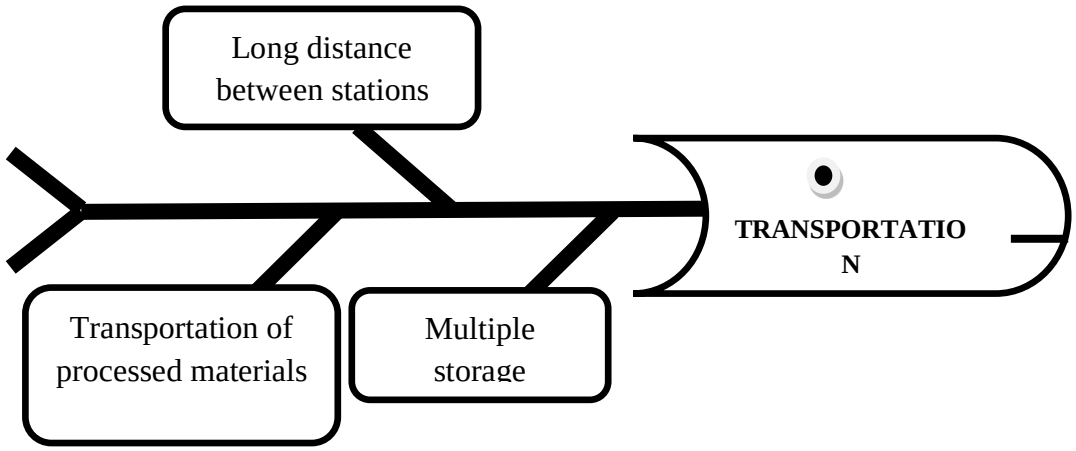


Figure 4.4shows the Transportation Ishikawa Diagram.

As observed by the researchers, there was a long distance between operations that affected time and activity where non-value was visible. The researchers also observed that there was no linear arrangement of the process that causes no linear transportation of the processed materials with multiple series of steps. Having multiple-storage in the production area led backtracking of materials needed for every process in the production that also grounds for motion waste that added no value.

MOTION

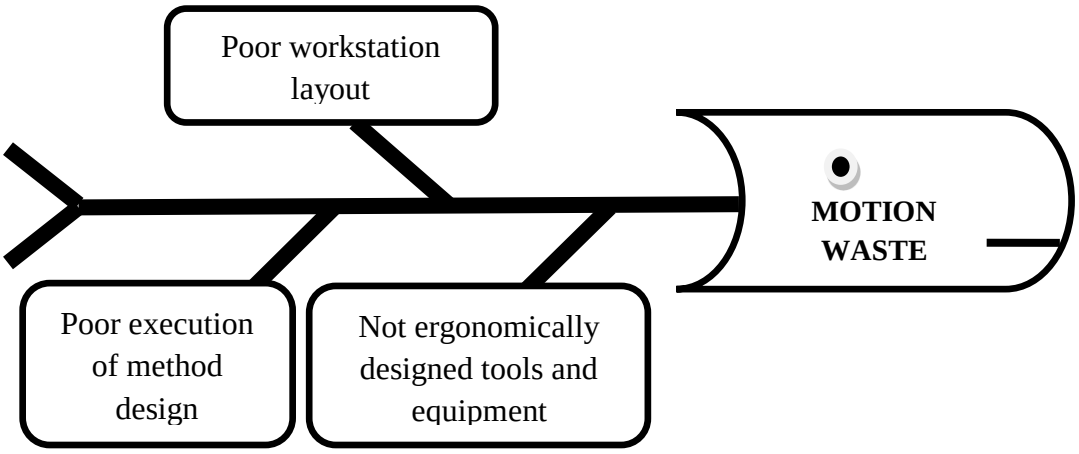


Figure 4.5shows the Motion Ishikawa Diagram.

As observed by the researchers, having a poor execution of method design caused a poor workstation layout that added in the existence of motion waste resulting into an excessive walking as well as not encompassing ergonomically designed tools and equipment that led to manual handling of materials. Excessive motion was one of the lean manufacturing wastes that do not contribute to the value of the product. This should be reduced if not eliminated.

SOLUTION FOR PROBLEM NO. 3: What Future State Map will be more effective in increasing the company's productivity?

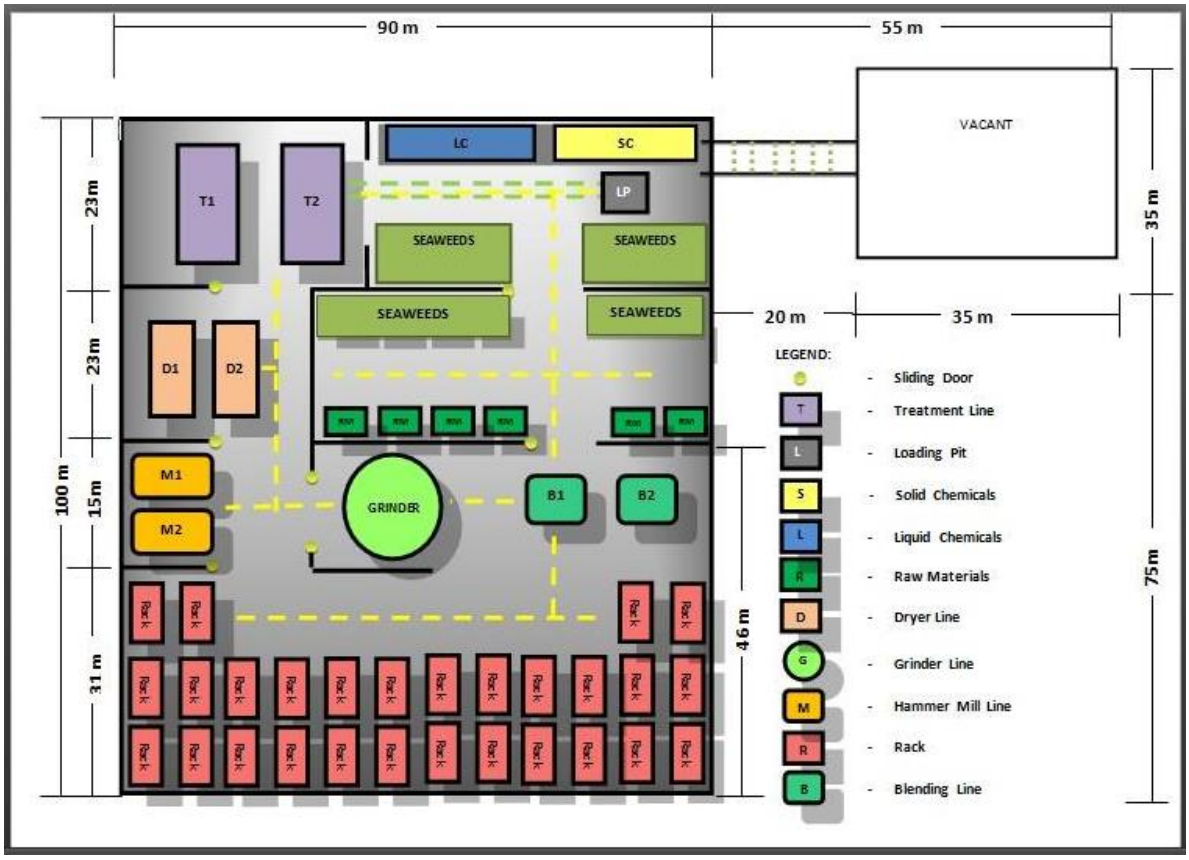


Figure 4.6 shows the Proposed Production Layout of the Company.

DISCUSSION

Nowadays, manufacturing companies prefer to adopt the methods of lean manufacturing to design manufacturing systems to reduce costs by eliminating the product and process waste. The emphasis is on eliminating non-value-added activities such as excess internal and external transportation of product, excessive inspection, and idle time of equipment or workers due to poor balance of work steps in a sequential process.

Understanding the value stream allows seeing value-added steps, non-value-added but needed steps, and non-value-added steps. Value-added activities transform or shape material or information to meet customer requirements. Non-value-added activities take time or resources, but do not add value to the customer's requirement (but may meet company requirements).

The value stream improvement journey typically starts with training the team on key concepts in Lean, mapping the current state using value stream maps which document materials and information flow as well as any pertinent information on the process (such as waiting timesand processing times). Improvements are identified. Then, the desired future state is documented as a future state of value stream map, and the improvements are implemented to drive toward the future state goal (Juran, 2012).

This study aimed to increase the production efficiency through lean manufacturing tool with the use of Value Stream Mapping (VSM).

Specifically, the researchers sought to answer the following questions:

1. What are the two (2) most existing lean manufacturing waste currently present in the production area?

2. What are the causes and effect of the two (2) existing lean manufacturing waste in the production area of Carrageenan powder?
3. What Future State Map will be more effective in increasing the company's productivity?

This study is about to increase the production efficiency through lean manufacturing tool with the use of Value Stream Mapping (VSM) aims to benefit the following:

1. The Company;
2. The Researchers;
3. The Future Researchers;
4. The Institution.

The researchers utilized the descriptive method of research with time and motion study and process activity map as sources of data. The descriptive method together with sources of data, are possible for the study since the purpose of the study is to increase the production efficiency and to draw an effective Future State Map that will suit the setting of the study, more particularly the redesign of production line of Mioka Biosystems Corporation through Value Stream Mapping.

4.1 Conclusion

1. Based from problem no. 1, the researchers concluded that there were 2 most existing lean manufacturing wastes present in the production area of Mioka Biosystems Corporation. These are the **motion** and **transportation wastes**.
2. Based from problem no. 2, the researchers identified and concluded the things that cause the 2 most existing lean manufacturing wastes in the production area of Mioka Biosystems Corporation. The following causes were:

- **Motion Waste**

The factors that contribute in motion waste were the poor workstation, poor execution of method design and not ergonomically designed tools and equipment.

Upon redesigning the production layout, transportation waste will be the first to accomplish, then, the result in distance will subsequently change the processes that can therefore reduce, if not eliminate, the causes of motion waste.

- **Transportation Waste**

The factors that contribute to transportation waste were the long distance between stations, transportation of processed materials, and multiple location of storage within the facility.

Due to the redesign of production layout, therefore, the process flow becomes smoother and more organize which lessen the distance between stations, it already had a linear arrangement of process for the transportation of processed materials, and totally eliminates the backtracking of materials between stations that also grounds for motion waste.

3. Based from problem no. 3, the researchers drew a future state map that can possibly help to reduce or even eliminate all the causes that occurs in transportation and motion waste.

As shown in Figure 4.6, the researchers proposed that the existing seaweed warehouse should removed and placed inside the production area since there is still enough space available for seaweed storage. The researchers also made a designated storage area for solid and liquid chemicals to avoid incidents that may harm the workers, and the racks for finished goods are now placed on one side of the production area to eradicate multiple storage location that causes frequent backtracking of materials.

4.2 Direction for Future Use

After a thorough study of Value Stream Mapping in Mioka Biosystems Corporation in relation with the productivity improvement of its workers, the researchers recommend the further study of the following for the enhancement of the research.

1. Use other data gathering tools in identifying waste like Total Productive Maintenance (TPM) which is a holistic approach to equipment maintenance that strives to achieve perfect production.

   This consists of eight pillars such as:

   - Autonomous Maintenance;
   - Planned Maintenance;
   - Quality Maintenance;
   - Focused Improvement;
   - Early Equipment Management;
   - Training and Education;
   - Safety, Health and Environment and
   - TPM in Administration.

It also introduces Overall Equipment Effectiveness (OEE) and Six Big Losses such as breakdowns, set-up and adjustments, small stops, slow running, start-up defects and production defects.

2. Excellent execution of Lean manufacturing principles in the production area of Carrageenan powder to attain the productivity and efficiency of the company. As well as the safety measures and procedures of the entire production area of Mioka Biosystems Corporation.
3. Implementation of the proposed process activity made by the researchers and costs benefit effect to the company after the implementation. The proposal of the researchers would reduce the total transportation time within the production area of the company by 82.18 meters. Reduction in distance could result in reduction of cycle time. It would also be an advantage to the part of workers because it could reduce stress and fatigue due to shorter distance per station.

REFERENCE

Angeles, K.A.A., Dicayanan, M.M., Garcia, D.R., Javana, G.G., Pamatiga, M.J.G. (2011). *Redesign of Production Line in Santa Rose Aluminum Products through Value Stream Mapping: A Lean Manufacturing Tool*. Philippines.

Brillante, Cabahug, & Flores. (2009). *"Cleaner Production with Lean Thinking: An Applicatio to the Fish Canning Industry of the Philippines"*. Philippines.

Forno, Ana. (2014). *Value Stream Mapping : A Study about the Problems and Challenges found in the Literature*. Philippines.

Hines, Rich. (1997). *Value Stream Mapping*. Retrieved from www.wikipedia.org/wiki/Value_stream_mapping

IFS. (2010). *Lean Manufacturing*.

Juran. (2012). *Lean Tool: Value stream Mapping*.

Krueger, K. (2011). *Introduction to Lean Production by Colby Hall*.

Mobley, R. (2013). *Best Practices for Using VSM as a Continuous Improvement Tool*.

Motavallian, Chalmers. (2013). "Application of Value Stream Mapping in Product Development".

Ndahi, et al. (2009). *Creative Thinking to Cleaner Production*.

Nemat, M. (2013). *The Importance of Lean Manufacturing Strategy*.

PharmOut. (2013). *Lean Manufacturing – reduction of duplication*. Retrieved from http://www.pharmout.net/downloads/white_paper_lean_pharma_manufacturing.pdf

Rother, M. & Graban, J. (2011). *Value Stream Mapping to Create Value and Eliminate Muda*.

Singh, B., Garg S. & Sharma S. (2010). *"Value stream mapping: literature review and implications for Indian industry"*.

Tay, Kwai Fui. (2010). *New Lean Tool*.

Tay, Kwai Fui. (2010). *Waste Elimination to improve productivity by using VSM in the factory*. Retrieved from http://eprints.ums.edu.my/3609/

Yu. (2009). *"Development of Lean Model for House Construction UsingValue Stream Mapping"*.