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Improvement Of Work Activities To Reduce Antaside Production Process Time Using Lean Manufacturing Principles As An Effort During The Covid-19 Pandemic

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Abstract. *During the current Covid-19 pandemic, a faster supply process is needed, especially such as medicines that are needed and urgently needed. Antacids as Stomach Acid Drugs are one example, because Chronic Stomach Acid Disease can worsen the condition of Covid-19 patients. PT. Lucas Djaja is a manufacturing industry company in the current production conditions, there are indications of waste that causes the production process to be less efficient. The purpose of this study is to identify waste that occurs in the production line. The method used to map the activity process in order to identify the occurrence of waste is to use Value Stream Mapping, which in this mapping is divided into two, namely Current Stream Mapping and Future Stream Mapping. In the Current Stream Mapping is made to describe the current flow of material, then Value Stream Analysis is carried out by weighting activities that are not value added. It was found that there were four activities including waste, namely waiting for the Work in Process to cool down, waiting for the Coding Etiquette and Carbox process, waiting for work order documents and rework on bottle caps. After this, improvements are made with Root Cause Analysis to identify the root cause of the waste. Then use 5w + 1h to get the proposed improvement. After the proposed improvement is obtained, then a mapping is carried out with Future Stream Mapping to provide an idea if the waste can be eliminated. So that the Antacid production process time can run according to the expected processing time and become more efficient than before. The production process time that has been saved is 48 minutes 14 seconds.*

Keywords: *Process Mapping, Waste, Lean, Value.*

1. INTRODUCTION

PT. Lucas Djaja, located in Bandung City, West Java, is a manufacturing company engaged in the pharmaceutical sector that processes drugs such as antacids, analgesics, antibiotics, antiepileptic, antifungal etc. However, the focus of this research is antacids. Antacids are drugs to relieve symptoms of heartburn or acid reflux disease. So far, comorbid diseases that are often touted as "killers" for COVID-19 patients are heart disease, hypertension, and chronic kidney disease. But, did you know that people with GERD also have the same level of danger? Patients who experience GERD when exposed to COVID-19 even have a high risk of death. Antacids are national essential drugs based on Decree of the Minister of Health of the Republic of Indonesia HK.01.08/MENKES/688/2019.

In the antacid production process there are four activities, namely transportation, operation, inspection and waiting (waiting time), and as we all know that waiting time is a waste. The first waiting activity is waiting for the mixing results to cool down, the second waiting activity is waiting for the etiquette coding process and carbox coding. Then the third is waiting for a letter or work order document, this usually happens in the process before labeling starts because before starting labeling there must be a work order first, otherwise the workers will not carry out any activities. This is due to adjusting to which product will be processed first according to customer demand or in accordance with company policy.

By identifying the waiting time, it will result in an increase in cycle time and have an impact on the production process time which is getting longer so that the target is not achieved as planned. The production process time is on target, especially if it can be shorter, it will help the availability of antacids, especially during the current Covid-19 pandemic. The purpose of this study was how to design improvements to reduce the time of the antacid manufacturing process and how long the process of making antacids resulted from the improvement.

Disasters and pandemics such as Covid-19 pose unique challenges to health care delivery, thereby opening up space for research, including :

1. This paper explains that health care resources continue to grow due to the increasing burden of the coronavirus disease (COVID-19) pandemic, telemedicine, including tele-education, can be an effective way to rationally allocate medical resources. During the COVID-19 pandemic, a multimodal telemedicine network in West China's Sichuan Province was activated immediately after the first outbreak in January 2020. The network synergizes newly established 5G services, smartphone applications, and existing telemedicine systems. Hong Z, Li N, Li D, Li J, Li B, Xiong W, Lu L, Li W, Zhou D. (2020);

2. This article provides practical guidance on how to use telemedicine and virtual care during COVID-19 pandemic. This study has implications for the potential consolidation of virtual care solutions in the near future towards contribute to integrating digital technology into healthcare. Anthony, Bokolo. (2020);

3. This paper studies medical 4.0 exclusively and also in the context of COVID-19. This paper describes the significant medical revolution that has been carried out so far and identified significant enabling technologies of Medical 4.0. The main discussion is medical capability 4.0 for health care during the COVID-19 pandemic crisis. Role of Medical 4.0 in healthcare during the COVID-19 pandemic is studied, and finally, this paper identified ten significant applications of Medical 4.0 in healthcare during the COVID-19 strain pandemic. We observe that the contemporary phase of mass-level development & production of Smart medical devices don't happen in the same way that smart devices do electronic devices and application devices. Engineers will have an important role in taking health challenges that can reach ordinary people. Haleem, A, & Javaid, M. (2020);

4. COVID 19 (Coronavirus) pandemic has created surge demand for essential healthcare equipment, medicines along with the requirement for advance information technologies applications. Industry 4.0 is known as the fourth industrial revolution, which has the potential to fulfil customised requirement during COVID-19 crisis. This revolution has started with the applications of advance manufacturing and digital information technologies. Javaid, M., Haleem, A., Vaishya, R., Bahl, S., Suman, R., & Vaish, A. (2020);

5 This paper describes how pharmacists from high- and low-middle-income countries contribute to essential patient care and community well-being during the COVID-19 pandemic. While the news media, the public, and politicians often overlook pharmacists as important frontline healthcare providers, we hope that the list of contributions of pharmacists from nine countries in this article can help change this perspective. Goff, D A., Ashiru-Oredope, D., Cairns, B A., Eljaaly, K., Gauthier, T P.,

Langford, B J., Mahmoud, S F., Messina, A P., Michael, U C., Saad, T., & Schellack, N. (2020).

So from the studies mentioned above, which were specifically investigated during the COVID-19 pandemic, no one has researched how to provide the medicines needed, let alone thinking about efforts to accelerate the supply of these medicines because it is urgent.

2. LITERATURE REVIEW

2.1 Value Stream Mapping

According to Hines, Peter, & Rich, Nick. (1997), Value stream mapping is a collection of all activities in which there are activities that provide added value as well as those that do not provide added value needed to bring a product or a group of products from the same source to through the main streams, from raw materials to the hands of consumers.

According to Rother, M, and Shook, J. (2003). These activities are part of the overall supply chain process that includes information flow and operations flow, as the core of any successful lean process. Value stream mapping is an ideal tool as an initial step to carry out process improvement within a company that is used to visualize the entire production process, which represents both material flow and information flow to obtain lean manufacturing conditions.

Value stream mapping can be divided into two types, namely:

a. Current stream mapping

Current stream mapping is the starting point for us to see the current process flow before making improvements.

b. Future stream mapping

Future stream mapping is a description of the process and information after improvements have been made.

The instructions for making current stream mapping are as follows :

Determination of the product family that will be used as the Model Line.

1) This stage is the initial stage in drawing current stream mapping. After knowing the correct concept of lean, at this stage it is necessary to determine the product that will be used as a model line as a target for improvement. The purpose of selecting the line model is so that the description of the system focuses on only one product which can be considered as a reference and representation of the existing production system. Identifying a product family can be done using both product and process matrices to classify the same process steps for different products. To determine which product family to map depends on the company's decision which can be determined from a business perspective such as sales levels, or according to the company's focus.

2) Determining the value stream manager to see the value stream of a product as a whole, of course, the company needs to be seen as a unified whole, so that organizational boundaries within the company need to be broken. Because basically companies tend to be organized for each department (process) and not based on averages because it is important to use actual pictures rather than historical averages provided by the company.

For the manufacture of each data box, the required sizes include :

- Cycle Time (C/T)

Cycle Time (C/T) is one of the important measures needed in lean activities in addition to value-creating time (VCT) and lead time (L/T). Cycle time states all elements or work activities in making a part before repeating activities to make the next part. Value-creating time (VCT) represents all the elements of work that normally transform a product in a way that consumers are willing to pay for. Lead time (L/T) Stating the time required for the entire process or in a value stream, from the beginning to the end of the process. Usually: VCT < C/T < L/T.

- Change over time (C/O)

Stating the time required to change the position (switch) from producing one type of product to another. In this case, the changeover time usually represents the time to move from the left position to the right position in the manufacture of a symmetrical product.

- Uptime

Stating the capacity of the machine used in working on a process. Machine capacity is on-demand machine uptime. This means that this machine information is fixed.

- Number of operators

Indicates the number of people required for the process.

- Working Time

The working time required for each shift in a process after deducting the time for rest (break), meeting time (meeting), and time to clean the work area (cleanup times).

The last step is to create a future stream mapping. The purpose of value stream mapping is to clearly identify the sources of waste and help create target areas for real process improvement. Future stream mapping is nothing more than implementing a plan that describes the tools needed in a lean process to eliminate waste and where (in what process) these tools are needed in the value stream of a product.

The instructions for making a future state map are as follows :

1. Develop continuous flow where possible. Continuous flow shows the process of producing a product at one time, where each item immediately passes from one process to the next without any stagnation (also there is no waste) between the processes.

2. Using supermarkets to control production when continuous flow does not reach the upstream stage. There are sometimes areas in the value stream where continuous flow is not possible while clustering is necessary. There are several reasons that could cause this, including:

a. Some processes are designed to operate in very fast or even very slow cycle times and require changeovers to serve multiple product families at once.

b. Some of the processes at the supplier are located far away so that the delivery of one product at a time becomes unrealistic.

c. Some processes have too many lead times or it makes no sense to directly combine one process with another in a continuous flow.

According to Grewal, Chandandeep. (2008), Value Stream Mapping (VSM) has emerged as preferred way to support and implement a lean approach. VSM is very helpful a tool to identify areas of wastage and improvement. VSM allows companies to see the whole process in both the current state and the desired future. VSM is a visual illustration of the whole value flow (from customer order entry through purchasing, manufacturing) and delivery of finished products at the facility). This paper describes about implementation of VSM in small manufacturing companies as lean manufacturing improvement initiatives. It involves mapping the company's activities, identify opportunities for improvement and then commit to the company a repair program. A map of the current state was prepared to illustrate existing positions and various problem areas. TAKT time calculation is done to regulate the production rate. Future country map prepared to display proposed corrective action plan. Value stream achievement implementation is the reduction of lead time, cycle time and inventory levels.

2.2 Lean Manufacture

According to Chen a, Joseph C, Li b, Ye & Shady, Brett D. (2008), Although lean manufacturing has been widely recognized for its effectiveness in continuously improve productivity, product quality, and on-time delivery to customer. This paper presents a case study of lean implementation in a small factory in United States of America. Starting with gathering process information, flow a value stream map is created that reflects the current state of the operation. A future value stream map is then proposed as a guide for future lean activities. Next, the obstacles that prevent companies from

moving towards the future of the country are identified. The '5 why' method is used to uncover the root cause for each hurdle, followed by a kaizen event proposed as a solution. In this case study, two kaizen events are proposed. For the first kaizen event, the Taguchi experimental design was used to find the optimal machining parameters that reduce variation in the plasma cutting process. As a result it eliminates rework time and increases productivity. In the second kaizen event, the implementation of rabbit chase increased the flexibility of the system and consequently reduced inventory levels between workstations..

3. RESEARCH METHODS/METHODOLOGY

Explain why it is carried out in a certain time period. Describe the respondent involved in the research or the materials used in the study. Write down the criteria of the respondent or materials.

The paper Hines, Peter, & Rich, Nick. (1997), is the basis for enrichment in understanding value stream mapping as a method that will be used to map from upstream to downstream the problems in this research.

The book Rother, M, and Shook, J. (2003) is the main reference for the method used, namely value stream mapping. This book clearly describes the stages and sequences in mapping using value stream mapping. Including the usability and results that can be achieved from the use of value stream mapping. So it can be clearly decided that value stream mapping is the method that best suits the objectives that are expected to be achieved by the results of this study.

The similarity with this Grewal, Chandandeep. (2008), paper is that both improvements are time-oriented, although this paper is multi-purpose by adding the aim of reducing lead time and reducing inventory levels.

This Chen a, Joseph C, Li b, Ye & Shady, Brett D. (2008) research is one of the inspirations in solving efficiency problems on the production floor in lean manufacturing principles. The difference with this research is that the improvement approach uses the Kaizen principle, and to find the problem the first time using the Taguchi experimental design.

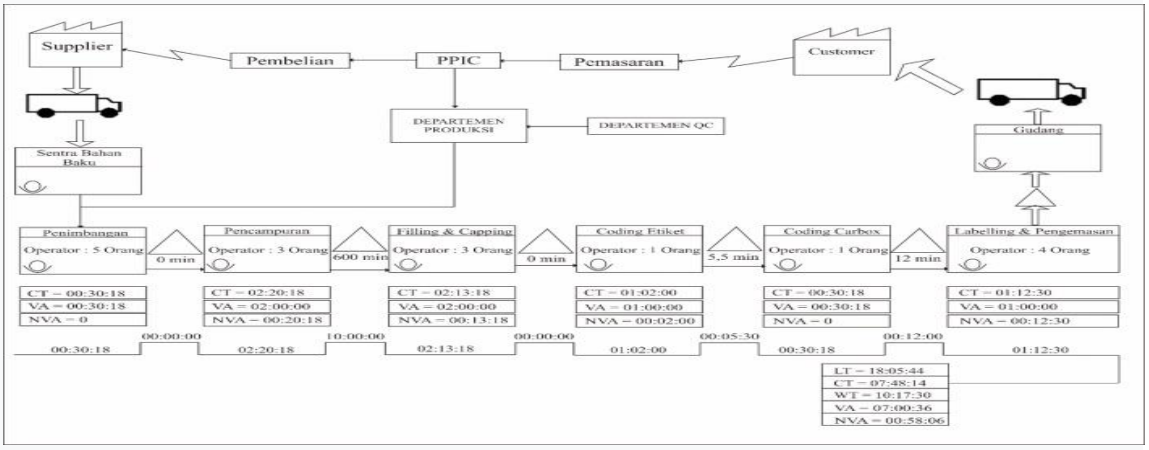
Actually, in industrial engineering, there are known overall work maps that can describe work activities from upstream to downstream, which contain information regarding operations, inspections, delays, transportation, and storage. And all these activities are equipped with processing times for each operation, worker activities, activities that are subject to material, use of tools and machines, material transfer and worker movement, but are very technical and difficult to understand by lay people, because they are usually used to analyze and make improvement plans. work system. So it's better to use flow diagrams as a basis for developing a more familiar value stream mapping.

At the research stage, the data collection process was carried out by direct observation in the field, namely at PT. Lucas Djaja, which is located in Bandung City, West Java, is a manufacturing company engaged in the pharmaceutical sector that processes drugs such as antacids, analgesics, antibiotics, antiepileptic, antifungal agents. Observations to obtain data flow diagrams, number of operators, cycle time, change overtime and production activities. For the data processing stage, the first step is to make a current stream mapping, to describe the current flow of material. Then identify the existing waste with value stream analysis tools. The next stage is to find out the root cause of the waste with root cause analysis to find the root cause of this problem using 5w1h. The next stage is to propose a better future stream mapping, this future stream mapping is made after identifying and improving the material flow.

4. RESULTS AND DISCUSSION

This section is the most important in a study because it illustrates how to do research, how to test hypotheses, or explain the relevance of theory to the research problems. Therefore, this section is the most dominant part or the longer page. It is recommended that the sections of this chapter are separated into several sub-chapters, each of which has different problems. The main goal is that readers easily understand it. Likewise, the explanation of each material or object is done using paragraphs. In addition, if necessary, images, schemes or matrices may be included as supporting research explanations.

Data collection is carried out to seek clear information regarding existing activities, regarding processing time at each work station, and the number of workers, value added activities and non-value added activities. The basis of mapping with current stream mapping comes from flow diagrams. Using current stream mapping, identifies activities in the antacid production process from beginning to end so that processes that are not added value are found and are considered as waste. In this mapping, identification of each activity is also carried out to determine the right improvement proposal by eliminating activities that are not added value and become a waste. So to find out whether there are seven types of waste, a search is carried out, so that from the seven types of waste, we get what activities can be improved by eliminating the activities that are not added value.



Picture 1. Current Stream Mapping Antacide Production Process

This current stream mapping describes the flow of the current production process, in which there are still non-value-added activities. This non-value added activity occurs because the process carried out has a cycle time that exceeds the standard time that has been set. Therefore, identification and improvement are needed to eliminate activities that become waste.

Table 1. Process Time at Workstations

Workstation	*Cycle Time*	*Value Added*	Waktu Standar	*Nonvalue Added*
Penimbangan	00:30:18	00:30:18	00:30:18	00:00:00
Pencampuran	02:20:18	02:00:00	02:00:00	00:20:18
Filling and capping	02:13:18	02:00:00	02:00:00	00:13:18
Coding Etiket	01:02:00	01:00:00	01:00:00	00:02:00
Coding Carbox	00:30:18	00:30:18	00:30:18	00:00:00
Labelling dan Pengemasan	01:12:30	01:00:00	01:00:00	00:12:30

From the mapping, it can be seen that the value added and non-value added activities are visible. Value added activity is a predetermined production process time, while non-value added activity is a time that exceeds a predetermined time or standard time, this is because there are still activities that contain sources of waste, which are carried out by workers so that the production cycle time is less efficient. . As a result, there are several periods that are not achieved according to the planned target, therefore it is

necessary to identify the seven types of waste to eliminate these non-value added activities.

The next stage is to identify waste using value stream process mapping to find out activities that are value added, not value added but needed in processes and activities that are not value added. The following is the concept of value stream analysis tools (VALSAT), namely by weighting. In the table of antacid production process activities that can be categorized into value added, necessary but non value added and non value added based on the current stream mapping that has been made. For value-added activities, a total of seven activities are obtained, for activities that are necessary but not value-added a total of 16 activities are obtained and non-value-added activities are obtained a total of three activities. The following is a table of antacid production process activities that have been weighted with value stream analysis tools (VALSAT).

Table 2. Antacide Production Process Activity Category

No	Aktivitas Produksi Antasida	Ketegori		
		VA	NNVA	NVA
1	Serah terima bahan baku ke ruang sentra bahan baku		√	
2	Proses uji bahan baku oleh QC		√	
3	Proses penimbangan bahan baku	√		
4	Mengangkut bahan baku ke ruang stagging bahan baku		√	
5	Mengangkut bahan baku ke dari ruang stagging ke ruang mixing, filling and capping		√	
6	Proses mixing	√		
7	Proses pengujian sampling mixing oleh QC		√	
8	Mengangkut WIP *mixing* untuk disimpan sementara		√	
9	Menunggu WIP *mixing* sampai dingin			√
10	Mengangkut WIP *mixing* ke mesin filling and capping		√	
11	Mengangkut bahan kemas primer (botol) ke mesin *filling and capping*		√	
12	Proses *filling and capping*	√		
13	Pengujian sampling QC		√	
14	Mengangkut WIP ke ruang Antara		√	
15	Mengangkut WIP dari ruang antara ke ruang stagging ruahan sirup		√	
16	Proses *coding etiket*	√		
17	Proses *coding carbox*	√		
18	Menunggu proses *coding etiket* dan *carbox*			√
19	Mengangkut *etiket* dan *carbox* ke ruang *lebelling* botol		√	
20	Menunggu dokumen perintah kerja			√
21	Proses *labelling*		√	
22	Proses pengemasan	√		
23	Proses penimbangan produk yang telah dikemas	√		
24	Mengangkut produk jadi ke pallet		√	
25	Mengangkut pallet ke gudang sementara		√	
26	Mengangkut produk jadi ke bagian gudang		√	
	Jumlah	7	16	3

Description :
VA = *Value Added*
NNVA = *Necessary but Non Value Added*
NVA = *Non Value Added*

Then the identification of the seven types of waste that occurred and obtained wastage on bottle cap rework. So that we get four activities that are categorized as not adding value, namely reworking the bottle cap, waiting for the WIP mixing to cool, waiting for the etiquette and carbox coding process and waiting for work order documents

The next step is to eliminate non-value added waste from all activities along the value stream. Root cause analysis is a tool that can be used to identify the root cause of the problem. Based on the identification of the waste that occurs in the antacid production process, the waste that occurs can be seen in the following table.

Table 3. Waste Type

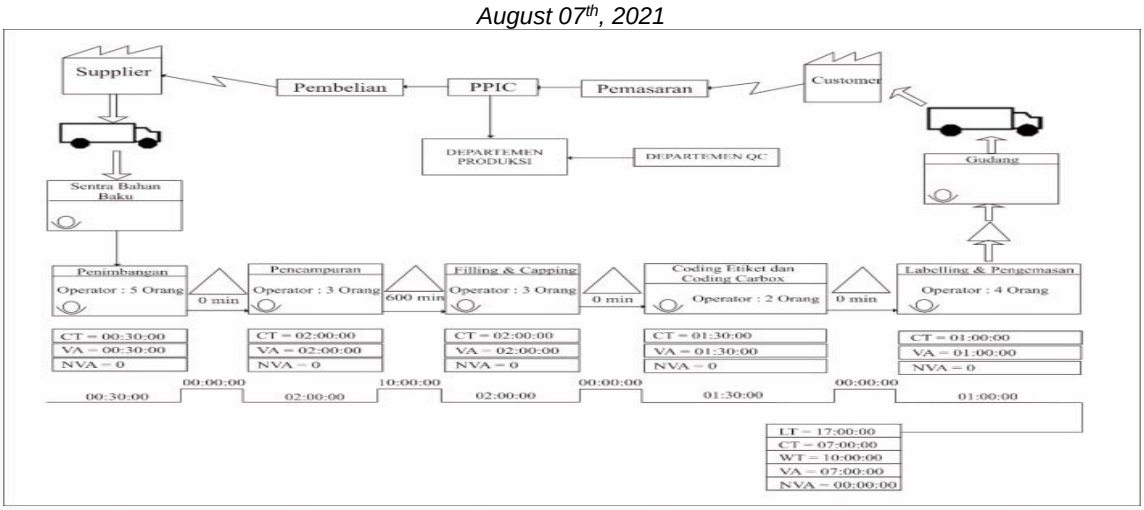
Jenis Pemborosan	Aktivitas	Stasiun Kerja
Sisa bahan dan pengerjaan ulang	Pengerjaan ulang pada tutup botol	*Filling and capping*
Waktu Tunggu	Menunggu *WIP mixing* sampai dingin	*Mixing*
	Menunggu proses *coding etiket* dan *carbox*	*Labelling* dan engemasan
	Menunggu dikumen perintah kerja	*Labelling* dan engemasan

The first wastage that occurred in the rework of bottle caps. Therefore, prevention can be done beforehand by way of filling and capping bottle caps that are not in accordance with the standard, can be separated or sorted so that rework does not occur when the bottle will be packaged. For the second waste that occurs during waiting time, first waiting for work in mixing process, second waiting for etiquette and carbox coding process, third waiting for work order documents. With this waiting activity, it will certainly result in the production process time in the mixing process and in the labeling and packaging process will exceed the standard time that has been previously set. To design improvements in overcoming waste, 5w1h is used, in order to systematically identify the causes of problems and find ways to overcome them in depth. The results of the discussion to overcome the waste of waiting time with 5w1h in the following table.

Table 4. Waste Activity Improvement Proposed

Where	When	Who	How
Bottle Cap Rework	No sorting	Check before Labeling	To avoid rework
Waiting for work in process until it cools down	no temperature check and cooling time is not specified	procedure improvement by adding temperature checking activity to the mixing result	to find out the temperature has dropped
waiting for the etiquette and carbox coding process	lack of monitoring of the etiquette of the carbox that will be used	create a monitoring form for the label and carbox that will be used before	to ensure the etiquette and carbox to be used
waiting for work instruction document	lack of direction in making work instruction documents	reexamination of documents to be made for priority products	so that work instruction documents can be completed earlier
Filling and Capping Room	Before the process is done	Filling and Capping Operator	Checking the Capping Process
Work Instruction Sheet	After mixing process is finish	Mixing Operator	Modifying Work Instruction Sheet
Coding Etiket and Carbox Room	Before the Labelling Process and packaging is done	Coding Etiket and Carbox Operator	Making Etiket and Carbox Checksheet Monitoring
Labelling and Packaging Room	Before the Labelling Process and packaging is done	Head of Production	Redirecting Production Staff

Waste in rework can be done by checking when the capping process is carried out. To wait for the work in process mixing to cool can be done by modifying the work instruction sheet. To wait for the etiquette and carbox coding process by making a label and carbox monitoring check sheet. To wait for work instruction documents can be done by giving a re-direction to the production staff. Future stream mapping is a mapping of identification results based on current stream mapping of activities that become a waste and activities that do not add value. Then improvements are made to the activities that are not added value to be eliminated, so that the time of the antacid production process becomes more efficient. The following is a mapping with future stream mapping when the non-value added activities are eliminated.



Picture 3. Antacide Production Process Future Steam Mapping

It is known the cycle time of the results of improvements in the antacid production process, where the mapping with current stream mapping describes the current condition, before making suggestions for improvements to eliminate existing waste. The total cycle time is 7 hours 48 minutes 14 seconds, this cycle time is the amount of time from weighing, mixing, filling and capping, coding etiquette, coding carbox as well as labeling and packaging. Then after the proposed improvement is made by eliminating the waste that occurs, so that the processing time at each work station is in accordance with the standard time given. So a mapping with future stream mapping was made to describe the material flow and processing time after the proposed improvements were made. And after the proposed improvements are made so that the production process time is according to the given standard, the new total cycle time is 7 hours.

CONCLUSION

The conclusions that can be drawn from this research are as follows : Activities that are not added value that become a waste are rework and waiting time. Waste in rework can be done by checking when the capping process is carried out. To wait for the work in process mixing to cool can be done by modifying the work instruction sheet. To wait for the etiquette and carbox coding process by making a check sheet monitoring etiquette and carbox. To wait for the work instruction document, it can be done by re-directing the production staff. Then the waste activity is eliminated as a proposal for improvement, so that the cycle time of the antacid production process can run according to the standard time that has been previously set by the company. So that it can eliminate the process of making antacids of 48 minutes 14 seconds.

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