

# Application Method of Value Stream Mapping to Increase Competitiveness in a Textile and Apparel Company

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## ABSTRACT

The textile and apparel sector is one of the most relevant and representative in Peru, due to its tradition and its contribution to the national economy. In recent years, however, it has had to become more competitive, largely due to the entry of international textile product suppliers into the local market. Therefore, companies that comprise this sector must adopt tools that will allow them to increase their productivity. In view of this situation, this research aimed to develop and implement an application model using Value Stream Mapping (VSM) in a textile and apparel company that manufactures garments for export, demonstrating at the same time that VSM is the best tool to visualize the entire supply chain in a single document. It also makes it possible to identify areas of opportunity, perceive the contribution of direct value to the products, distinguish forms of waste, and identify bottlenecks. The methodology adopted for the research is a case study, due to the use of various sources of information, including personal and documentary sources, and the conditions for its development. The results show the determination of the optimal takt time (1060.08 s), and the reduction in the lead time from 20.87 days in the current state map to 16.7 days in the future state map, thus contributing to the improvement of the company's competitiveness.

**Keywords:** VSM; continuous improvement; competitiveness; textile production; value flow.

## INTRODUCTION

Value Stream Mapping (VSM) is a visual tool of Lean Manufacturing (Paredes, 2017) that shows the flow of materials and information from the supplier to the buyer. When first used for the description of the process under study, it is handwritten, which is a distinctive feature in the development of the fieldwork (Marudhamuthu et al., 2011; Xia & Sun, 2013). It makes it possible to recognize tasks that do not provide "added value" so that they can be eliminated (Rajadell & Sánchez, 2011; Xia & Sun, 2013). Moreover, it is also a tool that improves competitiveness, as by analyzing the present situation through the current state map and the desired future state map, it is possible to identify and eliminate waste, which leads to the streamlining of key processes, reduction of costs and delivery times as well as increases in quality (Jeong & Yoon, 2016). A VSM analysis starts by plotting the current state map, which it converts into a baseline representation of an organization's operations. (Lucherini & Rapaccini, 2017).

Xia and Sun (2013) believe that the design of the future state map design should be based on questions that corresponds to three VSM levels. At level 1 (basic), the following questions are asked: What is the company's production timeline? Will finished products be directed to intermediaries or to end consumers? In which procedures of the value chain can continuous flow processing be included? Where will the company be able to use pull

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systems? At level 2 (heijunka), also known as production leveling, the following questions are asked: What single point in the production line will be considered as a pacemaker process for operational scheduling? How will the production be leveled at the pacemaker process? What regular labor increment will be used for production and withdrawal at the pacemaker process? Finally, at level 3 (Kaizen or improvement) the question what continuous improvement process will be needed? is asked.

Peruvian textile and apparel companies experience management problems at an organizational and quality level; likewise, the idle capacity of these companies is over 60%, due in large part due to an absence of workload because most do not meet quality requirements demanded by the global market (Arroyo, as cited in Tinoco et al., 2016, p. 2). In turn, Becerra and Carbajal (2019) state that small or medium-sized textile companies exporting cotton knitted garments currently experience the following drawbacks: increase in process costs (15%) caused by the number of defects in their cutting process; exceeding the standard lead time for the manufacture of a sample by 9 days; a high lead time of 23 days compared to the 15 days provided by competitors in other countries; a lead time of 17 days in the purchasing process, being 7 days more than the market standard; and at the national level, a 67% standard efficiency of product development, which is a problem as it is below the established ideal of 80.44%.

Research has been conducted that demonstrates the usefulness of VSM on textile and apparel companies in order to increase their competitiveness. Internationally, Loos et al. (2016) demonstrated its applicability in the textile sample development process and found that people working in these environments do not always discover opportunities for operational improvement. However, using VSM, it was possible to design their workflows and understand which activities did or did not add value, ultimately leading to the development of exclusive samples for customers and to an increase in the company's sales volume.

At a national level, Lucioni (2018) thanks to VSM, identified overproduction, defective products, inventory accumulation, high waiting time, unnecessary transportation, and defects as types of waste in an export garment manufacturing company. Similarly, Lecaros (2018), using the current VSM, identified overproduction, inventories, transportation, unnecessary movements, waiting times, unnecessary processes, defects, and misused human resources as *mudas*. As a result, he compared the

identified metrics with optimal ones according to the Lean methodology, i.e., the minimum percentage accepted by the industry to be considered a competitive company. In his research, Lecaros (2018) determined an overall equipment efficiency (OEE) of 69.30%, which served as a baseline, and set a target of 75.00%; he calculated the mean time between failures (MTBF) at 109.20 hours, which served as a baseline, and set a target of 163.80 hours. For mean time to repair (MTTR), the baseline was 84.50 minutes, and a target was set at 59.11 minutes.

Similarly, VSM allowed Ruíz (2016) to map the current state of the company's operations and identify the pace of customer demand by implementing takt time. Results showed an increase of 24.14 % and a reduction of 26.87 days in non-value-added time due to the implementation of value activities related to the delivery percentage indicator. The use of VSM has benefited the cotton garment industry as well as the alpaca fiber-based export garment industry. Moore and Norabuena (2019) applied VSM to analyze the current supply chain, specifically the production process of garments made using weaving sticks in high Andean communities. It revealed deficiencies regarding the timely delivery of orders, poor information flow, and the absence of quality parameters for the raw material required.

It is necessary to indicate what result is needed and it is important to demonstrate the application of VSM to obtain the future map in a textile and garment export company, given that they cater to international markets that increasingly require certified, competitively priced quality products as well as the speedy delivery of orders, which is the basis for this study (Bardales, 2018).

The company under study is located in the department of Lima, Peru. Its main economic activity is the production and manufacture of cotton t-shirts and printed dresses for men and women of all ages. Due to the increase in input costs and the progressive decrease in production resulting from poor management, the company found it necessary to use continuous improvement tools to detect problems in the production flow and identify opportunities for improvement in order to increase its competitiveness. Therefore, this study aims to develop and implement a method for applying the VSM tool to increase the competitiveness of the company. The hypothesis to be tested is that there is a significant difference in the company's competitiveness before and after implementing the VSM tool application method in the textile and apparel company.

This paper is intended to be relevant and useful for the scientific community and, therefore, presents the development of a VSM application method as an innovative factor that will serve as a guide to implement this renowned tool in the textile industry and improve the competitiveness of Peruvian companies. Based on the results and the hypothesis testing, the practical validity of the method will be demonstrated, opening the door to future research in order to apply it in similar contexts.

**Lean Manufacturing**

Lean Manufacturing is an organizational and supply chain management paradigm that involves people, materials, machines, and methods. Its main functions are to improve quality and efficiency by continuously eliminating waste and increasing customer satisfaction (Socconini, 2019). The Lean Manufacturing methodology is ideal for contexts where product manufacturing is performed by discrete and repetitive processes, either for small, medium, or large volumes (Soler, 2015). Certain factors must be considered for its correct application, such as having a well-adapted team and a knowledge of information gathering and analysis (Kafuku, 2019).

**Supply Chain**

A supply chain is defined as an information system that involves people, labor, and goods, and whose interaction enables a product to move from the producer to the consumer. It also encompasses the relationship between the management of suppliers, the purchase of raw materials, and the manufacture

and distribution of the final product. However, supply chain should not be limited to the links it comprises, but rather should be characterized by its core operating attributes (Santander et al., 2014).

**Value Stream Mapping (VSM)**

Value stream mapping (VSM) is a conceptual tool that maps the value chain, emphasizing material and information flow, starting from the supplier and continuing to the customer (Jimmerson, 2017). It is designed to depict the productive activities to identify the value chain, detect where tasks do not add value to the company, and identify the processes with significant waste (Rohac & Januska, 2015).

**Application Method of VMS in the Textile Industry**

The method presented in this research is based on the application of the VSM tool to improve the competitiveness of a textile and apparel company. Figure 1 illustrates the proposed method.

**METHODOLOGY**

Our research follows a case study approach. Yin, McCutcheon, and Meredith, cited by Jeong and Yoon (2016), consider this methodology appropriate under three conditions. First, if related to the analysis of a particular situation within its original or natural context; second, if related to the limited or zero ability of the researcher to manipulate the event; and third, if associated with the question “how”. The question in our study was how is VSM applied in order to obtain the future map of the organization under study?

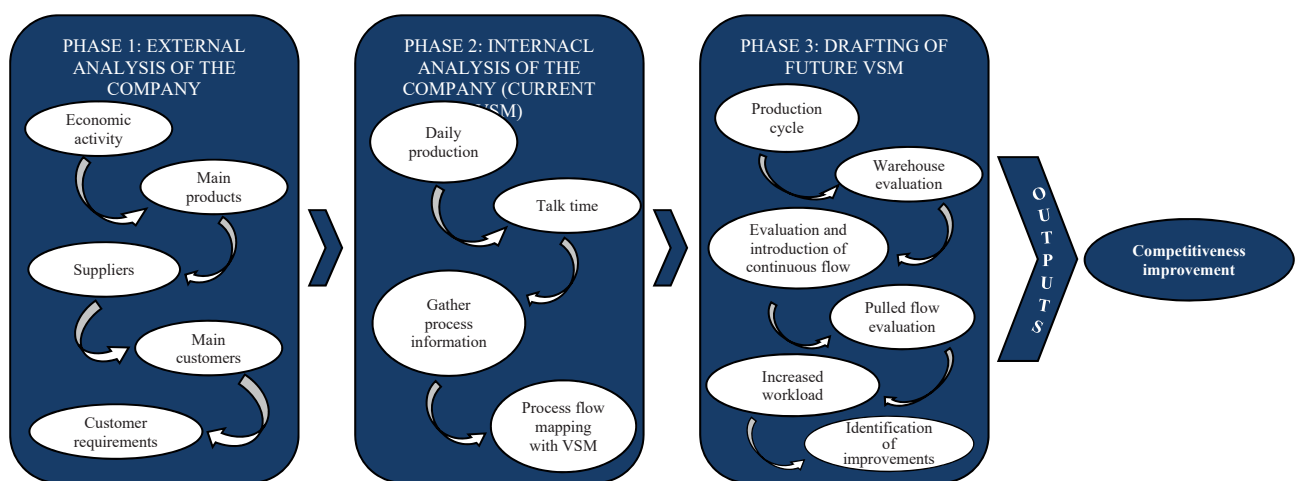


Figure 1. VSM Application Method in the Textile Industry.

Source: Prepared by the authors.

According to Amador and García (2019), VSM is a methodology for the application of value chain mapping, involving the following steps:

Step 1: Select a critical productive area

Step 2: Draft the current state map

- 2.1. Review existing documentation
- 2.2. Identify main processes
- 2.3. Determine non-existing data to be collected
- 2.4. Gather information

Step 3: Analyze the current state map

Step 4: Future state map

- 4.1. Calculate takt time
- 4.2. Determine the desired time
- 4.3. Execute improvement tools

Data was collected firstly through personal interviews with a total of 16 managers from areas of Spreading, Cutting, Sewing, Embroidery, Stamping, Finishing, and Metal Detection. The current state map was drafted by hand so as not to interfere with the development of the company's operational activities. It is customary in this type of case study to resort to the method of triangulation of subjects (Díaz et al., 2011) to ensure the quality of the data and results obtained; therefore, the results obtained from the personal interviews conducted with the personnel in charge of each of the areas were contrasted.

## RESULTS

### Phase 1: External Analysis of the company

#### 1. Economic activity

The company under study specializes in the manufacture of knitwear; it also has two specialized knitting and dyeing plants located in Peru, which manufacture and export their products to markets such as the United States and Brazil.

#### 2. Main products

- Smart casual cotton polo shirts for men and women
- Printed dresses for women and other products for children

#### 3. Select suppliers

##### • Trimmings supplier

The request is made by e-mail. On average, 6 decorative buttons are needed per garment, with a shrinkage of 2%. Delivery every 2 weeks.

**Trimmings consumption - buttons** = no.garments \* no.buttons \* 1/(1-shrinkage %)

$$= 10000 * 6 * \left(\frac{1}{1 - 2\%}\right) = 61224.49 * \frac{1 \text{ gross}}{144 \text{ buttons}} = 425$$

##### • Printed fabric supplier

The request is made by e-mail. Consumption by size XS/1 S/2 M/3 L/1. Delivery every 3 days.

**Consumption per garment**=(usable width\*usable length\*density)/(no.units\*1000)

$$= \frac{1.83 * 7.89 * 220 \text{ g/m}^2}{7 * 1000} - \frac{0.45378 \text{ kg}}{\text{garment}} * 2000 = 907.56 \frac{\text{kg}}{\text{wk}}$$

##### • Knitwear supplier of textile and apparel company plant 1 Los Olivos

The request is made by e-mail. Consumption by size S/3 M/2 L/2 XL/2. Delivery every 2 days.

**Consumption per garment**=(usable width\*usable length\*density)/(no.units\*1000)

$$= \frac{1.79 * 8 * 220 \text{ g/m}^2}{8 * 1000} = \frac{0.3938 \text{ kg}}{\text{unit}} * 10000 = 3938.12 \frac{\text{kg}}{\text{wk}}$$

#### 4. Main customers

The company's direct customers are well-known department stores such as Black Denim, Lilly Pulitzer, Infinity, Polo Ralph Lauren, and Tommy Bahama. Repeat customers tend to place orders on a weekly basis and deliveries are made every 3 weeks per shipment.

#### 5. Identify customer requirements

- The customer of polo shirts of a certain brand requires that their garments carry a metal detection sticker indicating that their garments are of high quality and do not contain any harmful metals.
- Confecciones Perú requires customers to place orders 6 weeks in advance.
- On average, a total of 12 000 units are produced per month for each block: 4000



fashion garments/month, 6000 basic t-shirts/month and 2000 printed fabric garments/month.

**Phase 2: Internal Analysis of the company**

*1. Calculate the daily production*

- Number of units that the company can produce during a working day

$$\text{Daily production} = \frac{12\,000 \text{ units/month}}{25 \text{ days/month}} = 480 \text{ units/day}$$

A graphic representation of the information flow is shown in Figure 2, consisting of customers, the company's Production Control Area, and suppliers.

*2. Calculate available time and takt time*

The company works 25 days a month, two shifts in all areas, each work shift is 8.5 hours plus overtime if necessary, two 10-minute breaks per shift, and the lunch hour is unpaid.

$$\text{Available time per shift} = (8.5 \text{ h} * 60 \text{ min} - 2 * 20 \text{ min}) * 60 \text{ s} = 28\,200 \text{ s}$$

$$\text{Takt time} = \frac{(8.5 \text{ h} * 60 \text{ min} - 2 * 20 \text{ min}) * 60 \text{ s}}{\frac{12\,000 \text{ units}}{\text{month}} / (\frac{25 \text{ days}}{\text{month}} * \frac{2 \text{ shifts}}{\text{days}})} = \frac{28\,200 \text{ s}}{240} = 117.5 \text{ s/unit}$$

*3. Gather information and map process flow with VSM*

**Spreading Area**

Manual equipment, 2 operators per spreading table (4 tables), cycle time equal to 59.46 s, changeover time between sizes equal to 2 min, and reliability of 80%. Inventory before the start of the process:

3 days (supplier's delay), 1 day of fabric rest, and inventory after process: 0.5 days.

**Cutting Area**

Manual equipment, 1 operator per machine, 3 working modules, cycle time equal to 49.20 s, changeover time between sizes equal to 5 min, and reliability of 100%. Inventory after process: 1 day.

The graphical representation of the Spreading and Cutting areas with their respective inventories in the process is shown in Figure 3.

**Sewing Area**

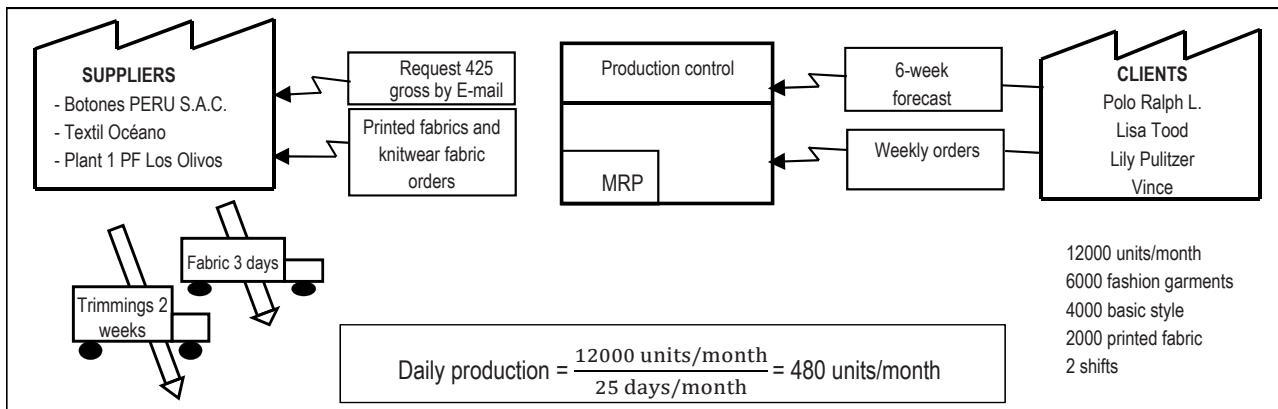
Manual equipment, 1 operator per operation (average = 16), cycle time equal to 616.86 s/garment, changeover time between sizes equal to 1 min, and reliability of 80%. Inventory after process: 1 week.

**Embroidery Area**

Manual equipment, 1 operator, cycle time equal to 73.08 s/garment, changeover time between sizes equal to 60 s, and reliability of 100%. Inventory after process: 3500 basic garments and 500 fashion garments.

**Stamping Area**

Manual equipment, 3 operators per machine (2 machines), cycle time equal to 64.68 s/garment, changeover time between sizes equal to 60 s, and 100% reliability. Inventory after process: 4500 basic garments and 500 fashion garments.



**Figure 2.** Graphical Representation of Information Flow.

Source: Prepared by the authors.

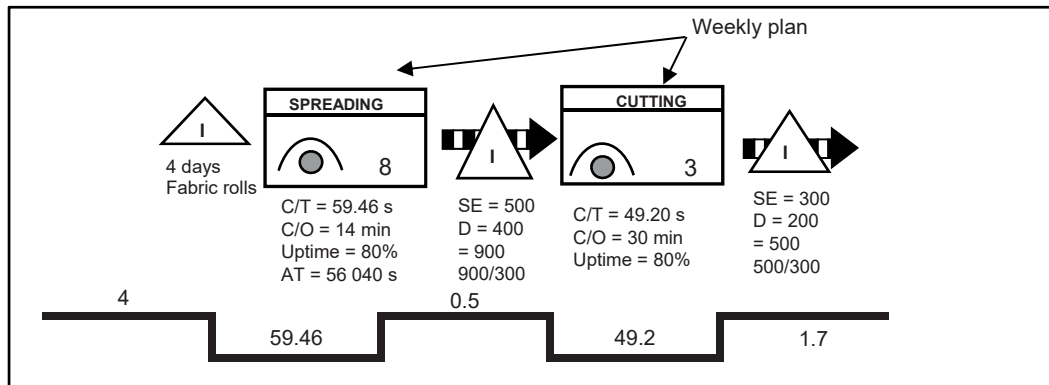


Figure 3. Graphical Representation of the Spreading and Cutting Areas.

Source: Prepared by the authors.

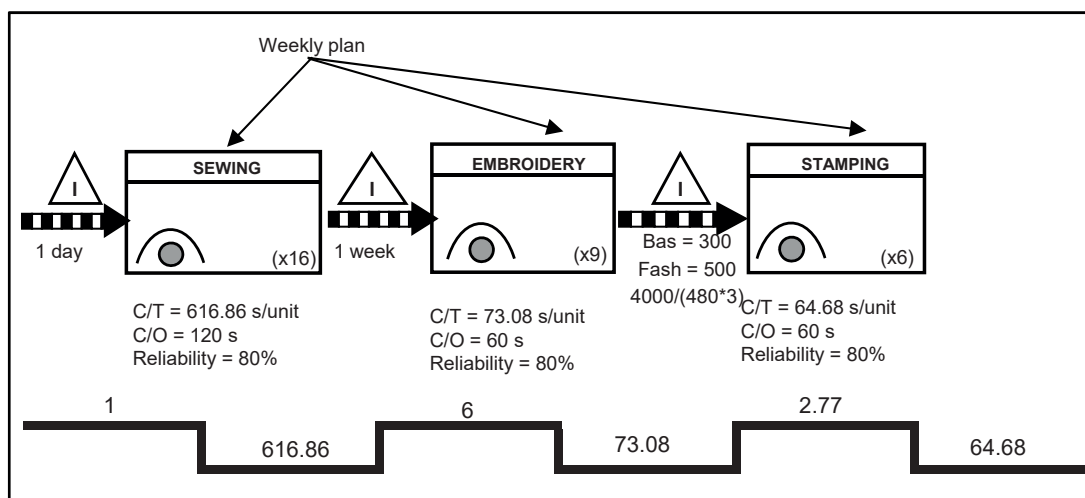


Figure 4. Graphical Representation of the Sewing, Embroidery, and Stamping Areas.

Source: Prepared by the authors.

The graphical representation of the Sewing, Embroidery, and Printing areas with their respective in-process inventories is shown in Figure 4.

### Finishing Area

Manual equipment, 9 operators (3 production lines), cycle time equal to 616.86 s/garment, changeover between sizes equal to 60 s, 100% reliability. Inventory after process: 3500 basic (metal detection area) and 2000 fashion (shipping area).

### Metal Detection Area

One operator is needed, cycle time equal to 2.76 s/garment, changeover time between sizes: none, and 100% reliability. Once in the Metal Detection Area, trucks go every 3 weeks to the shipping port.

### Shipping

Three operators are required, cycle time equal to 30 s/garment, and, once in dispatch, trucks go every 3 weeks to the port for shipment.

The graphical representation of the Finishing and Shipping areas with their respective in-process inventories is shown in Figure 5.

The previous graphical representations (Figures 2, 3, 4 and 5) allow the development of the current VSM of the textile and apparel company under study (Figure 6).

### Phase 3: Drafting of future VSM

Question 1: *What is the production cycle of the textile and apparel company?*

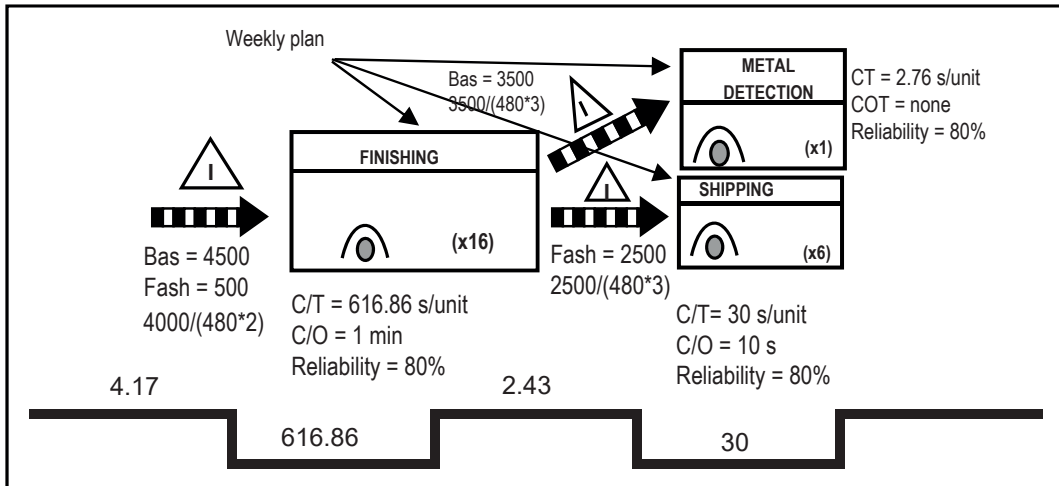


Figure 5. Graphical Representation of the Finishing and Shipping Areas (final process).

Source: Prepared by the authors.

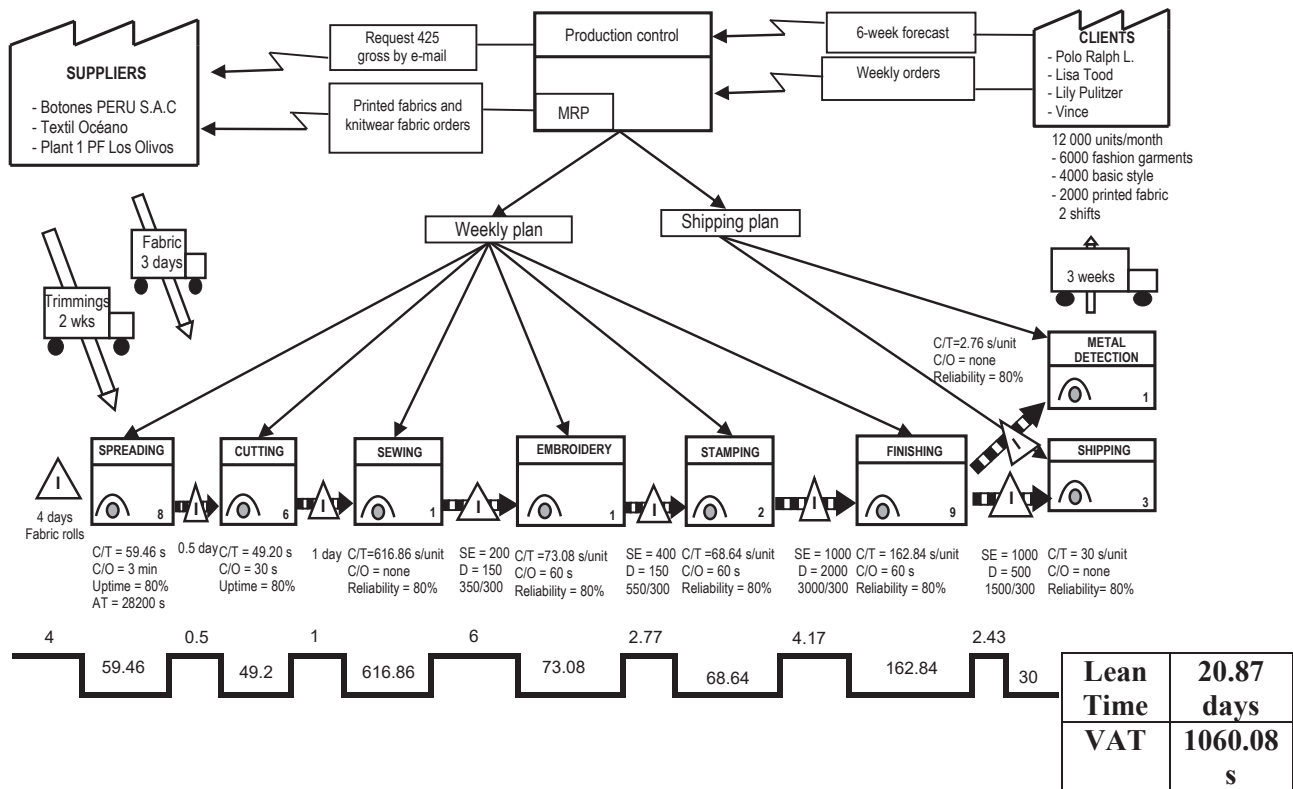


Figure 6. Current VSM.

Source: Prepared by the authors.

- Available time per shift = (8.5 h \* 60 min \* 60 s) = 30 600 s
- Time not spent working = (20 min/shift \* 60 s) \* 2 shifts = 2400 s
- Available time = 30 6000 s – 2400 s = 28 200 s
- Customer demand per shift = (12 000/month ÷ 25 days) / 2 shifts = 240 units/shift
- **Production cycle** = 28 200 s ÷ 240 units = **117.5 s/unit**

Question 2: *Should the textile and apparel company use its finished goods to restock supermarkets or produce them for direct shipment?*

The textile and apparel company has a reliability of 80%, so an inventory of finished goods is unnecessary. If there is a supermarket, it should pass from Sewing to Finishing, inspection should be eliminated and a quality control evaluation should be performed.

The transport time and number of garments between the finishing and dispatching processes, as well as steaming and quality control, are graphically represented in Figure 7.

Question 3: *In which processes of the value chain can the textile and apparel company under study introduce continuous flow?*

$$\begin{aligned} \text{Operator balance} &= \frac{59.46 + 49.20 + 616.86 + 73.08 + 68.64 + 162.84 + 30}{117.5} \\ &= \frac{1060.08}{117.5} = 9.02 \end{aligned}$$

The maximum number of operators in the production cycle should be 9, yet such is not the case. Merging compatible operations and then converting them into cells is an option to improve their cycle

time. Figure 8 shows the histogram of the cycle times of each process and its comparison with the takt time. In addition, processes with similar cycle times, such as “spreading” and “cutting”, “embroidery” and “stamping” are shown in Table 1.

Table 1. *Time per Machine.*

Item	Machine	Time
1	Spreading	59.46 s
2	Cutting	49.2 s
3	Sewing	616.86 s
4	Embroidery	73.08 s
5	Stamping	68.64 s
6	Finishing	162.84 s
7	Shipping	30 s
8	Takt time	117.5 s

Source: Prepared by the authors.

Upon noticing that the cycle times of “spreading” and “cutting”, and “embroidery” and “stamping” are similar, U-shaped and L-shaped cells will be implemented respectively to merge the processes in a continuous flow, thus eliminating in-process inventories and reducing the number of operators (Figure 9).

Following the training of personnel in the Shipping Area, only one person was left in charge of this area, and the other one was transferred to the Finishing Area, where more assistance is required in folding the garments (Figure 10).

Question 4: *Where will the textile and apparel company under study have to use a supermarket pull system?*

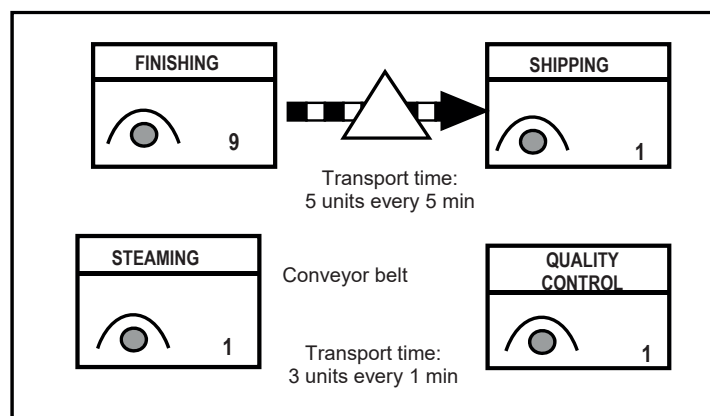
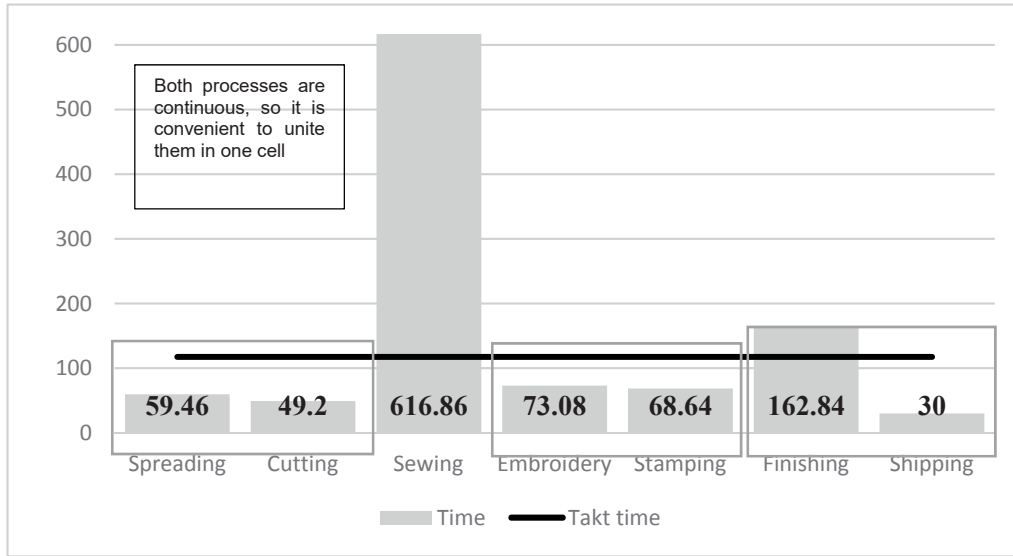


Figure 7. Graphical Representation of Garment Transport Time.

Source: Prepared by the authors.





The processes are merged to balance the number of operators since some of them have idle time.

Figure 8. Histogram of the Cycle Times of Each Process and Its Comparison with the Takt Time.

Source: Prepared by the authors.

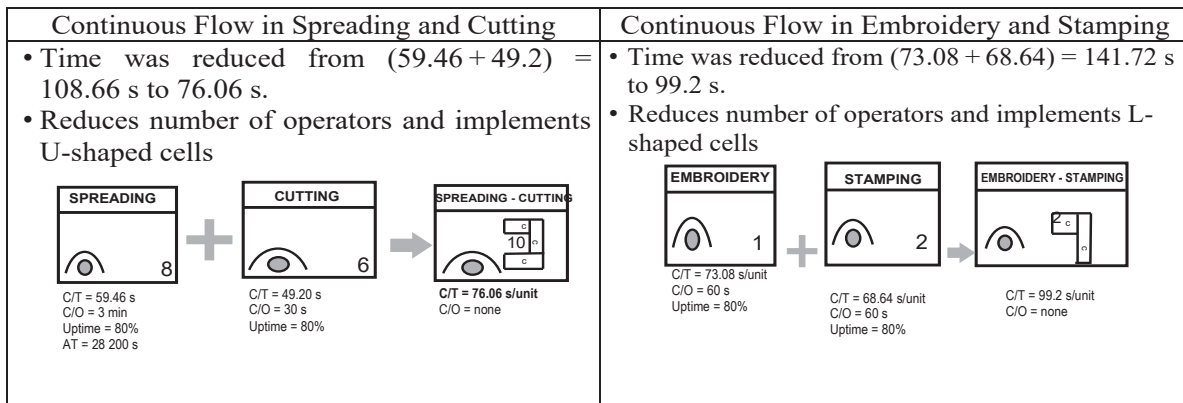


Figure 9. Improvements in the Continuous Flow in the Spreading and Cutting, Embroidery and Stamping Areas.

Source: Prepared by the author.

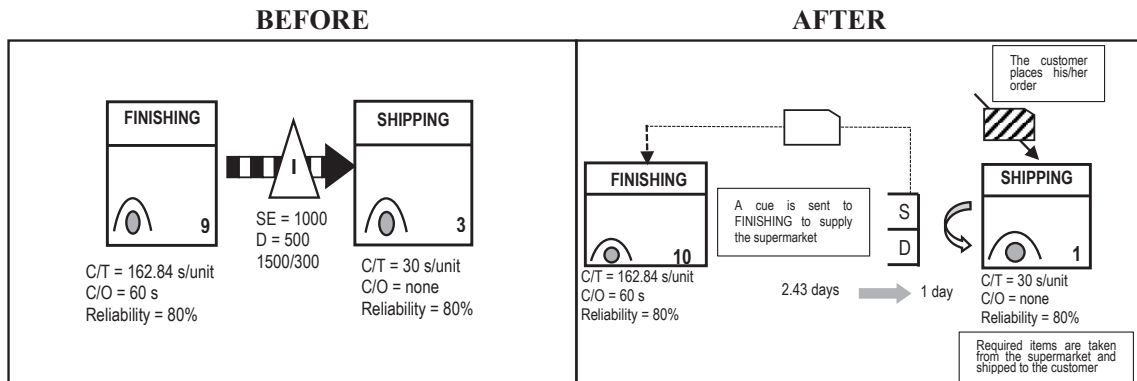


Figure 10. Improvements in the Continuous Flow of Inventory in the Finishing and Shipping Areas.

Source: Prepared by the authors.

A supermarket will be needed for fashion, basic, and printed t-shirts since their sales fluctuate greatly during the year; it is also necessary to control the production of fashion, basic, and printed t-shirts for men and women by extracting them from the supermarket (pull flow).

**Suggestions**

- Suitable shelves with sufficient capacity and distributed according to model, size, and color
- Increase the frequency of model and size changes (lean manufacturing)

Fashion garments=6000/25= 240 units/day

Basic style garments=4000/25=160 units/day

Printed fabric garments=2000/25=80 units/day

$$480 \frac{\text{units}}{\text{days}} * \frac{1 \text{ day}}{16 \text{ hours} - \frac{4 \text{ shifts} * 20 \text{ minutes} * 1 \text{ hour}}{60 \text{ minutes}}} = 33 \text{ units/hour}$$

**Shelf Spacing**

- Each shelf space shall have the capacity to store one working hour or 33 garments. Each will have a Kanban card.
- The operator transporting the 33 garments/hour from the Cutting to the Sewing cell will leave the Kanban card. The cutting area operator will receive the card and know that he has to produce another batch of 33 garments (Figure 11).

Question 5: *What specific point in the production chain will the textile and apparel company choose (as a pacemaker process) to schedule production?*

The processes prior to the pacemaker process must be in a continuous flow. The scheduling point for the textile and apparel company is the Embroidery-Stamping cell. Earlier scheduling is impossible since the cycle times of the cutting and sewing are differ considerably.

Question 6: *How could the textile and apparel company level the product mix in the pacemaker process?*

In the Embroidery-Stamping cell, the garment mix produced in a shift is leveled through the pull-flow of the picked garments instead of maintaining so much inventory in the Dyeing-Cutting garment supermarket (Figure 12).

Pitch = takt time × number per package (1 package = 10 garments).

$$\text{Pitch} = 117.5 \times 10 = 1175 \text{ s} = 19 \text{ min } 35 \text{ s}$$

Question 7: *What regular increment of work will the textile and apparel company use for production and pick-up in the pacemaker process?*

There is an increase in work in the embroidery-printing module at the textile and apparel company: 117.5 seconds of production cycle × 33 units = 64.63 minutes. This garment production step corresponds to one card for every 33 garments. Table 2, called the leveling box, shows the scheduling of the production shifts.

Question 8: *What process improvements will be needed to achieve the textile and apparel company's value chain flow as described in the future state map?*

The following are the improvements needed:

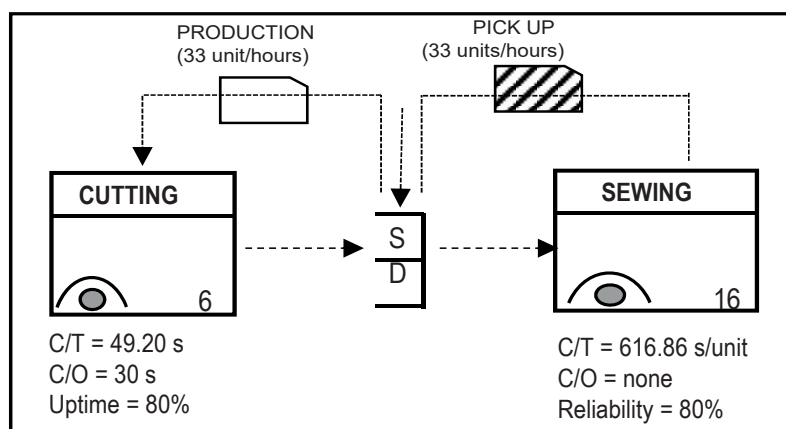


Figure 11. Graphical Representation of Supermarket Implementation.

Source: Prepared by the authors.

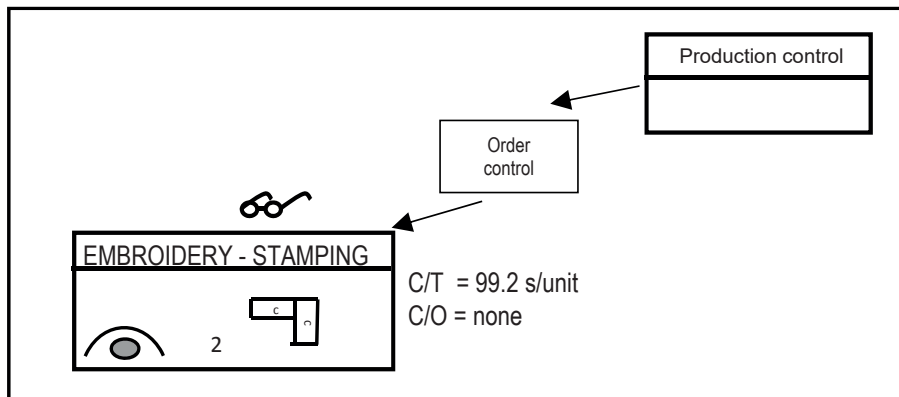


Figure 12. Production Leveling.

Source: Prepared by the authors.

Table 2. Production Shift Leveling Box.

<b>Shift 1</b>	08:00	09:00	10:00	11:00	12:00	01:00
<b>Shift 2</b>	03:00	04:00	05:00	06:00	07:00	08:00
<b>Fashion garments</b>	M			M		
<b>Basic style garments</b>		B			B	
<b>Printed fabric garments</b>			E			E

Source: Prepared by the authors.

- Reduce product changeover time in the Cutting Area to zero and lower the lot size to zero to reach the goal of “every piece, every shift”.
- Eliminate the time (10 min) needed for changeover between garment types (basic, fashion, and printed) to achieve a continuous flow.
- Improve production time in the sewing process by implementing 5’S.

These elements can be found in the future state map marked with the Kaizen icon in Figure 13.

Results of the comparison between the current state and the future are positive owing to the leveling of production in the Spreading-Cutting, Embroidery-Stamping, and Finishing-Shipping cells. The company can further reduce the amount of in-process and finished garments stored in supermarkets. Their conditions evidence the importance of equipment reliability and the ability to forecast production as a function of the cycle. Table 3 shows the before, with level-flow production, and with production with total inventory turnover leveling. A reduction in lead times and an increase in total inventory turnover are observed.

**Total Inventory turnover = Total days per year / Production lead time**

Total days per year: 25 days × 12 = 300

Before: 300/20.87 = 14.37 <> 14

Production with continuous flow: 300/14.9 = 20.13 <> 20

Production with leveled flow: 300/9 = 33.33 <> 33

**HYPOTHESIS TESTING**

The research question posed in this study was the following: Is the VSM application method capable of increasing competitiveness in a textile and apparel company? Based on this question, a general hypothesis was formulated, as shown below:

H<sub>0</sub> = There is no significant difference in competitiveness before and after the implementation of the VSM application method.

H<sub>a</sub> = There is a significant difference in competitiveness before and after the implementation of the VSM application method.

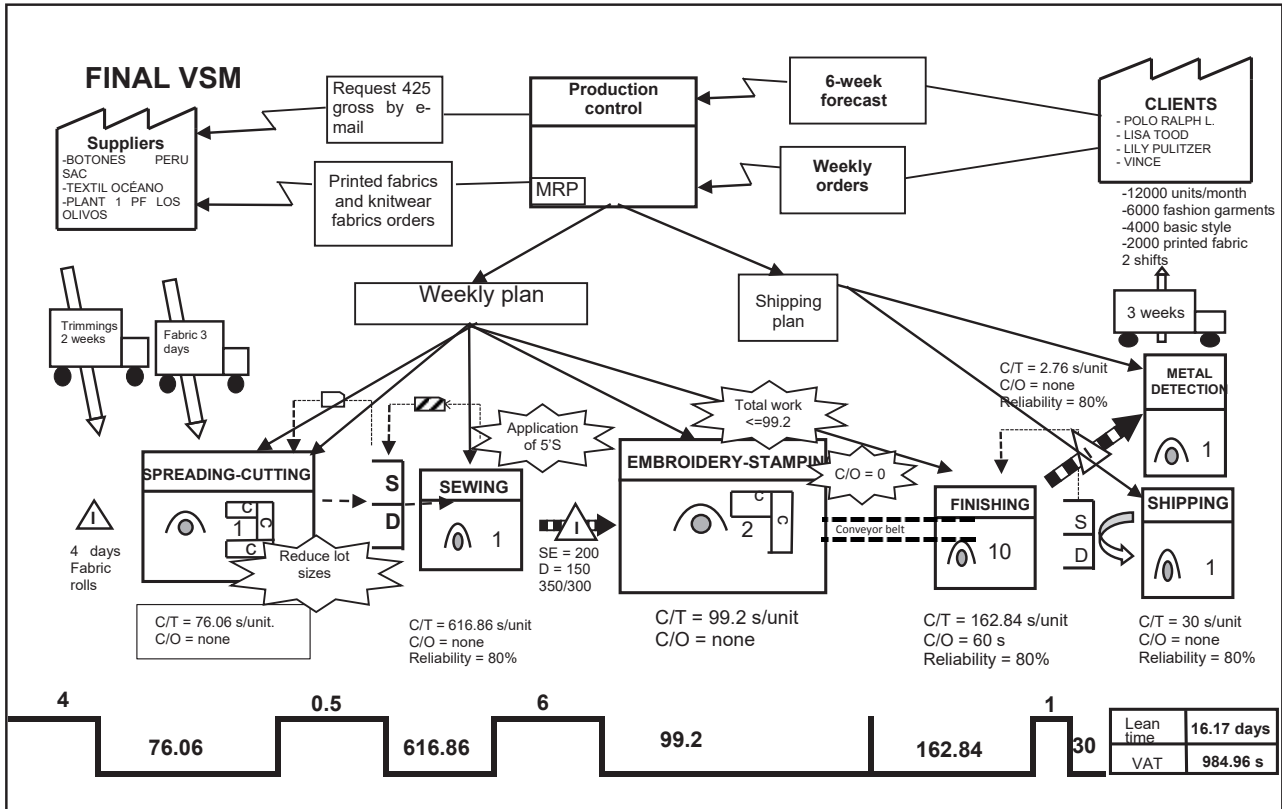


Figure 13. Future VSM.

Source: Prepared by the authors.

Table 3. Reduced Lead Times and Increased Total Annual Inventory Turnover.

	Rolls	Spreading and Cutting	Sewing	Embroidery and Stamping	Metal Detection	Production with Leveling	Total Inventory Turnover
<b>Before</b>	4 days	1.5 days	6 days	6.94 days	4.1 days	2.76 days	14 days
<b>Continuous Flow Production</b>	3 days	1 days	4 days	3 days	2 days	1.9 days	20 days
<b>Production with Leveling</b>	2 days	0.5 days	2.5 days	1.5 days	1 days	1.5 days	33 days

Source: Prepared by the author.

First, Anderson-Darling normality test was conducted using MINITAB 2018 software to verify the distribution of the data, which yielded a  $p$ -value of 0.161. As the significance coefficient was 0.05, it was concluded that the data followed a normal distribution.

Subsequently, a Student's  $t$ -test was performed to test the hypothesis, which yielded a  $t$ -value of 8.31 and a  $p$ -value of 0.0000. Since the  $t$ -value is significantly higher than the  $p$ -value, the  $H_0$  is rejected, and the  $H_a$  is accepted. Therefore, it can be asserted that

there is a significant difference in competitiveness before and after the implementation of the VSM application method.

**DISCUSSION**

A takt time of 117.5 s/unit was obtained through the application of the VSM, that is, the time that the company should take to manufacture the product and satisfy the customer. As for the time elapsed from the start of a production process until it is

completed (lead time), the current state map shows a result of 20.87 days, while in the future state map, this was reduced to 16.7 days. In other words, this is the time it will take for the product to be delivered to the customer. Likewise, the current state map shows a value-added time (VAT) of 1060.08 seconds, understood as the time it takes for the product to be manufactured or transformed until the final result is obtained. These results are consistent with those obtained by Lucioni (2018), Lecaros (2018), and Ruiz (2016) on the usefulness of VSM as a tool for diagnosis that, by identifying waste in the operational processes of textile and apparel companies, together with other practices of the Lean methodology, allows them to increase their productivity. It also ratifies Rajadell and Sánchez (2011) and Xia and Sun (2013), who argue that it identifies non-value-added activities since it is a visual tool.

## CONCLUSIONS

This study provides a method for the practical application of Value Stream Mapping as a tool for competitiveness in a textile and apparel company that manufactures garments for export, using the single-case methodology to obtain a detailed analysis of the subject under study. The collection of data and information about the company to develop the value stream map made it possible to detect the opportunities for improvement in a company like this one. Using daily operational management, problems were identified via comparative dashboards between standard and actual procedures. Production flow benefited considerably from this measure, as it allowed reducing waste and establishing a continuous product flow. The mentioned factors resulted in a significant reduction of time and waste, which in turn led to a reduction in costs and an increase in productivity and competitiveness in the organization's processes.

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