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# Lean Manufacturing Production Method using the Change Management Approach to Reduce Backorders at SMEs in the Footwear Industry in Peru

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**Abstract.** This article proposes a production method that aims to increase the manufacturing capacity of a footwear small- and medium-sized enterprise (SME) to reduce backorders. Therefore, an assessment is carried out and delays in production processes, excess product transport time, defective products, and inefficient work methods are identified. This article proposes designing a Lean manufacturing method using the change management approach, whose methodology is composed of six phases. In phase 0, change management is carried out; in phase 1, the company's current situation is reviewed using the Value Stream Mapping (VSM); in phase 2, the work area is reorganized (implementing SLP and 5S); in phase 3, production is balanced (implementing Line Balancing); in phase 4, continual improvement is established using the Kaizen tool; and finally, in phase 5, the results are evaluated. Through validation, it was possible to confirm that Lean manufacturing tools along with change management increased order deliveries by 82%.

## 1. Introduction

Worldwide, footwear production reached an estimated 45,000 million pairs in 2018, a 3% increase over the previous year. The majority of shoe manufacturing is carried out in Asia, where 86% of the world's shoes are produced. The top shoe production countries are in Asia, and include China, Vietnam, and Indonesia. In 2018, the footwear industry in Peru had an impact equivalent to 2.9% of the Gross Domestic Product (GDP) and represents 4.1% of all employment [1]. Today, there are several problems in the production of footwear small- and medium-sized enterprises (SMEs), such as lack of quality in their processes and products, low productivity, high rate of defective products, poorly trained personnel, and more. These problems have led to a high rate of backorders, which has consequently generated less economic income, high production costs, and dissatisfied customers.

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In January 2019, footwear manufacturing production had a percent variance of -29.33%. Companies that produce footwear are primarily micro enterprises with 96.7% of the market, while small enterprises account for 3.2%, and medium- and large-sized enterprises account for 0.1%. These data are calculated based on the Ministry of Production's 2018 Industrial Census [2].

Using these improvement tools is recommended for SMEs, as they have major problems such as a high percentage of backorders, low production capacity, a high percentage of defective products, and more, which jeopardizes their ability to stay in business. Currently, there is not much information about integrating Lean manufacturing and change management in small- and medium-sized enterprises. Therefore, the reason for writing this article is to provide a model design that implements Lean manufacturing focused on change management, considering success factors, to address the problems that SMEs in the footwear industry face [3] [4].

## 2. State of The Art

### 2.1. Lean Manufacturing

Authors Lande, Chauhan & Randhawa agree that Lean manufacturing is recommended for SMEs, as they have major problems such as a high percentage of backorders, low production capacity, and a high percentage of defective products. Therefore, Lean tools can increase a company's production capacity and improve its sustainability [5] [6] [7]. Lean Manufacturing tools include flexibility in managing an Indian company's resources, meaning workers and machinery [8]. In addition, lean manufacturing is used to eliminate waste in the cutting area of a small footwear company in Colombia. Using the "5 Whys," Value Stream Mapping (VSM) in a car parts manufacturing company in India identified root causes and implemented a future roadmap to improve productivity within the company [9].

### 2.2. Change Management

According to Budhiraja, there is a vast amount of literature on change management practices at large companies to process all the changes necessary for growth. However, within SMEs, it is necessary to develop an ecosystem to improve adaptability to changing circumstances, to increase their competitiveness [10][11]. According to the literature, in the change process, senior management is enthusiastic and willing to provide infrastructure. However, the process is limited by employee motivation levels, as there is a negative attitude toward accepting change [12][13]. Knol's research makes use of the elements inherent to organizational change to establish how organizations can address this phenomenon. Using conceptual reflections, developing and interpreting this concept is described over time. In addition, it shows that organizations understand that the only constant over time is change and that it has become a factor that can cause them to be unstable [14].

## 3. Input

### 3.1. Proposed Method

The method has the following five phases: change management, review of the current situation, reorganization of the work area, balancing production, and continual improvement. (See Figure 1). The purpose of the proposed method is to reduce backorders for footwear SMEs, thereby reducing cycle times in bottlenecks and therefore increasing production capacity. In comparison with other models, this includes an initial awareness using change management to avoid problems with implementing Lean tools.

*3.1.1. Phase 0: Change Management.* Change management is a structured orientation and aims to help management, employees, and sponsors accept change in their business environment.

3.1.2. Phase 1: Review of the Current Situation. In this phase, the processes are studied, times are recorded, and the plant’s capacity is determined. In addition, the production process’s waste or changes are found. Thus, using the VSM tool is proposed (Figure 2).

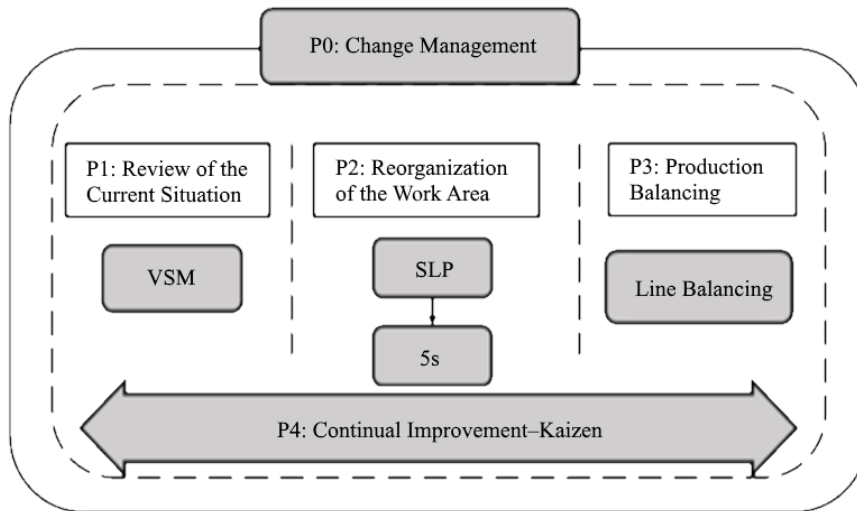


Figure 1. Proposed method

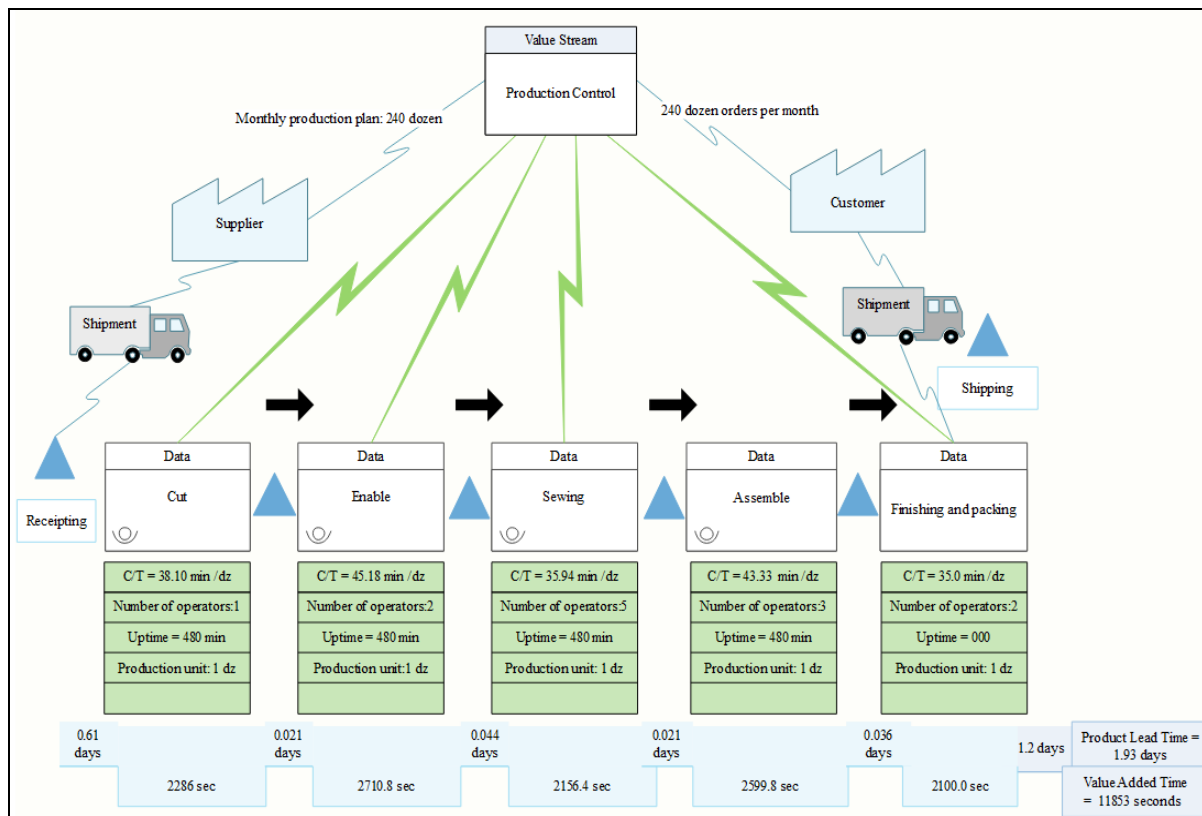


Figure 2. Value Stream Map

3.1.3. Phase 2: Reorganization of the Work Area. This phase aims to improve the work area to reduce unnecessary time searching for tools, unnecessary movements, and routes between areas. We propose two tools: SLP and 5S.

The objective of the Systematic Layout Planning (SLP) tool is to reduce the distance that materials travel, to logically structure processes and to make the plant’s distribution more flexible for future modifications. The objective of the 5S tool is to prevent the work environment from becoming disorganized, lack of instructions, unnecessary movements, and more.

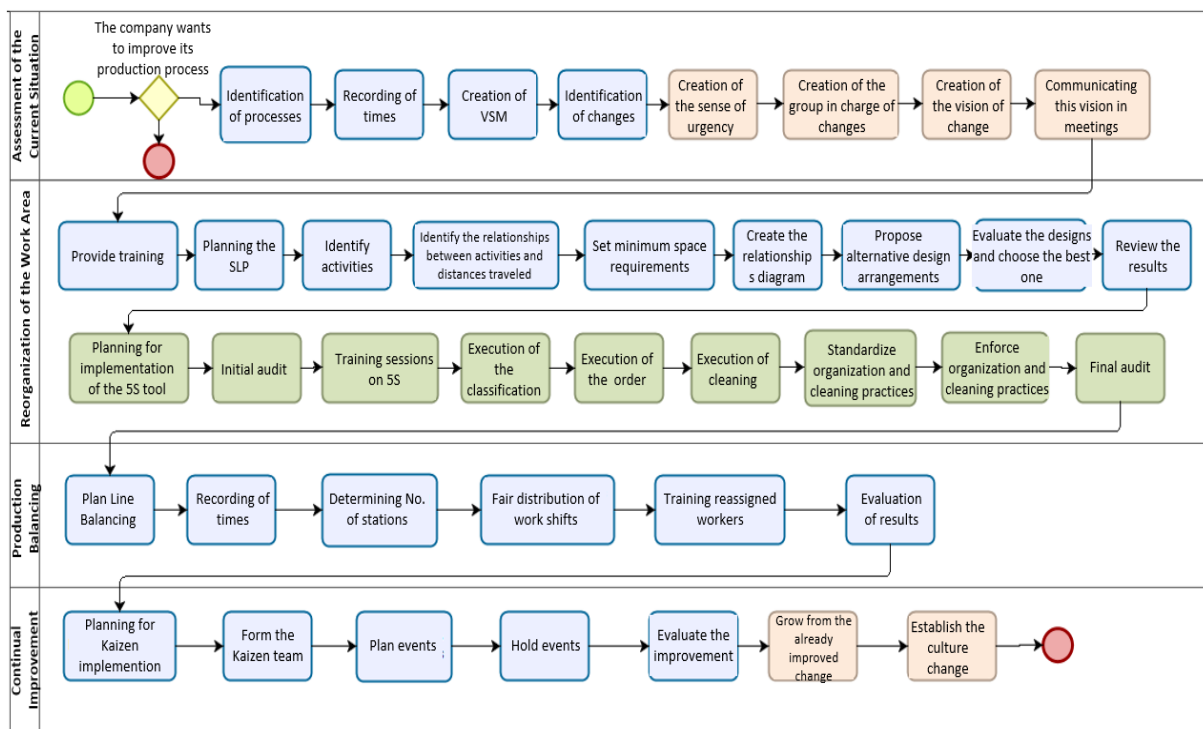
*3.1.4. Phase 3: Production Balancing.* This phase aims to balance the workload of each station, to minimize the times in the bottlenecks that exist in the production process of the shoes, since the idle times between processes lead to high production costs. The main objective of the Line Balancing tool corresponds to the equalization of working times at all stations in the process and the optimal distribution of workers.

*3.1.5. Phase 4: Continual Improvement.* This phase promotes the culture of continual improvement and constantly improving production processes. To do so, the Kaizen tool was proposed. The objective of implementing Kaizen is to eliminate exceptional changes identified using Kaizen events.

The Kaizen philosophy implemented consists in the incentive of teamwork through weekly meetings of all operators with the heads of each area of the SME. In these meetings, the operators give ideas to improve the processes and the changes to be made are decided. In addition, the weekly production objectives are established so that each operator strives to achieve its objective.

*3.2. Proposed Method (Flowchart)*

An implementation guide was described to optimally implement this method. The activities in pink are the change management steps and those in green are from 5S, the tools that comprise the basis for this study.



**Figure 3.** Proposed implementation model

### 3.3. Indicators

#### 3.3.1. Production capacity percentage

$$\% \text{ de PC} = \frac{PC \text{ Obtained} - \text{Initial PC}}{PC \text{ Obtained}} \quad (1)$$

#### 3.3.2. Excess product transport time (movement)

$$\text{Excess time} = \frac{\text{Initial Movement} - \text{Movement Obtained}}{\text{Initial Movement}} \quad (2)$$

#### 3.3.3. Percentage of defective products

$$\% \text{ of DP} = \frac{\text{Initial \% of DP} - \% \text{ of DP Obtained}}{\text{Initial \% of DP}} \quad (3)$$

#### 3.3.4. Wait time between processes

$$\text{Wait time between processes} = \frac{\text{Initial WT} - \text{Final WT}}{\text{Initial WT}} \quad (4)$$

#### 3.3.5. Percentage of on-time deliveries

$$\% \text{ of OTD} = \frac{\text{Final \% LD} - \text{Previous \% LD}}{\text{Current \% of DP}} \quad (5)$$

## 4. Validation

### 4.1. Case Study Description

To validate the previously described proposal, the method was implemented by studying M&F, a small shoe distribution company that has been manufacturing and marketing wholesale and retail footwear since 2006. It is known for its high quality and innovative products. The production line has equipment, machinery, and manual operations. The company is located at San Pablo Street N° 588, Belaunde, Comas. The shoe company only works with three lot sizes: 40 dozen, 60 dozen, and 80 dozen. The company only accepts these sizes because of its knowledge of purchases in these sizes.



**Figure 4.** M&F company

#### 4.2. Assessment

The company has a cycle time of 45.18 minutes per dozen and its sales revenue was 770,880 Peruvian Soles last year. The assessment was carried out in five phases.

**Table 1.** Initial result

Indicator	Initial result
% order delivery	50.88%
Production capacity	212 doz/month
Excess transport time	41.40 min/doz
% of defective products	10%
Wait time between processes	13.32 min/doz

#### 4.3. Applying the Method to the Case Study

**4.3.1. Phase 0: Change Management.** The first results when validating change management were presenting the economic benefits, instructing the work area to reduce the risk of accidents, reducing material transport time, and reducing cycle time. Finally, the team must be maintained so that they can continue to implement more changes.

**4.3.2. Phase 1: Review of the Company's Current Situation.** The company was asked for the 2018 information required to be able to complete the VSM, to observe the flow of information and materials from the production process, obtaining a cycle time of 45.18 minutes per dozen.

**4.3.3. Phase 2: Reorganization of the Work Area.** To validate this phase, two Lean tools were implemented: SLP and 5S. The first tool was able to reduce the product's total transport time by 70% and reduced the cycle time from 45.18 to 44.9 minutes per dozen. A final audit was carried out using the second tool and the score obtained was 107 out of 156 points, which represents a 38% improvement. This tool reduced cycle time from 44.9 to 44.56 minutes per dozen.

**4.3.4. Phase 3: Production Balancing.** The tasks that must be fulfilled to make the company's products and their sequential order were determined to create the station priority diagram. With the new stations, the production area's cycle time was reduced from 44.56 to 42.8 minutes per dozen. As a result, production capacity increased from 53 to 56 dozen per week.

**4.3.5. Phase 4: Continual Improvement.** When the improvements were implemented, teams were formed to promote the Kaizen philosophy among all workers. This tool reduced cycle time from 42.8 to 40.5 minutes per dozen, or a 5% reduction.



#### 4.4. Indicators

**Table 2.** Results Obtained

Indicators	Initial Results	Results Obtained	Expected Results
Percentage of deliveries	50.88%	82%	80%
Production capacity	212 doz/month	237 doz/month	230 doz/month
Excess product transport time	41.4 min/doz	12.42 min/doz	4.06 min/doz
% of defective products	10%	4%	3.5%
Wait time between processes	13.32 min/doz	4.06 min/doz	4.70 min/doz

Table 2 shows that, in most cases, the expected results were exceeded, with the exception of the “wait time between processes” indicator. Its expected result of 4.70 minutes per dozen was not reached, obtaining 4.06 min/doz.

#### 5. Conclusions

The general objective was achieved, as backorders were reduced, increasing order deliveries by 82%. In addition, within the specific objectives, production capacity increased from 213 to 237 dozen per month. This article’s contribution was to reduce wait time between processes from 13.32 minutes per dozen to 4.04 minutes per dozen. By applying SLP, a more organized and fluid work environment was obtained through personnel shifts. With the 5S tool, it was possible to improve organization and cleaning practices by 38%.

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