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# Lean production management model under the change management approach to reduce order fulfillment times for Peruvian textile SMEs

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**Abstract.** Currently, small- and medium-sized enterprises face order fulfillment issues, thus generating reduced service levels. In addition, these companies are usually not aware of the importance of continuous improvement tools or of training staff as a mitigation strategy for this situation. Within this framework, the authors performed a literature review to compile production models through which downtimes could be reduced. The production model designed therefrom comprises Lean Manufacturing and work study tools within a Change Management approach. This design focuses on model implementation by small companies without requiring large investment, cutting-edge technology, or qualified personnel. Finally, an application case study was conducted in a small textile manufacturing company located at the Gamarra Fashion Center in Lima, Peru. The results that were reported revealed that late order fulfillment instances reduced by up to 18%, which had an impact on downtimes, unnecessary movements, and in-process inventory levels, thus increasing productivity by 85%.

## 1. Introduction

In recent years, Asian companies have ventured into different international markets by offering lower prices than those offered by the existing suppliers in those geographies, thereby exerting a negative impact on the exports from different local markets, which, in turn, has left the sector in crisis [1]. Consequently, companies are seeking to improve their production processes and increase their service levels by identifying the different issues affecting their operating costs. Hence, to compete with the Chinese approach to sales, more value had to be added to the process in order for it to be passed on to customers [2]. In light of this, companies strived to remain competitive by implementing different techniques of manufacturing quality products, while delivering them within the deadlines set forth by customers. However, a survey conducted on companies operating within the sector revealed that three

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out of five companies were struggling to fulfill their orders in time [3]. This affected mostly small- and medium-sized companies, where the lack of production planning, training, and organizational culture compromised service levels. In addition, several studies note that this problem is mainly caused by downtimes and defects, with the latter usually causing serious production delays [4]. Further, other studies claim that these issues are rooted in delayed deliveries of raw materials on site, as well as frequent replacements of defective garments. Therefore, companies must focus on developing new operating procedures to improve product yield and quality through engineering techniques.

Therefore, this paper proposes a production model that is based on Lean Manufacturing and work study techniques focused on Change Management aimed at reducing late order fulfillment times at a textile company. This model seeks adaptability at all production levels within small companies because of their large numbers within the field.

## 2. State of The Art

Using this framework as a point of departure, a literature review compiled production models that could be applied to small companies attempting to reduce downtimes and improve quality to offset late order fulfillment times.

Small companies usually tend to carry out production activities empirically and in a disorderly manner. Therefore, different authors argue that the implementation of production models within a company is a critical effort in the mitigation of these issues. A study conducted in a textile manufacturing company noted that an eclectic production model was able to increase production capacities by up to 50% [5]. In addition, a 35% reduction in operating costs was reported after eliminating activities that did not add value to the process through production planning and control activities [6] [2]. Conversely, other authors propose that Lean Manufacturing-based production models be used to identify and eliminate waste [7]. A study conducted in a spinning company where Lean Manufacturing was implemented reported 20% reductions in operating costs and a 15% reduction in late order fulfillment [8].

However, some authors suggest that even better results are achieved by prioritizing the company's workforce first before making any changes to the production processes. For example, a study carried out in a textile manufacturing company reported that Change Management contributed toward reducing production times by 15% [9]. Finally, several European and Asian authors assert that using a proper combination of Lean Manufacturing and Change Management in production models would beget great benefits for companies wishing to significantly reduce production times. In light of this, a combination of these two methodologies in a small automotive company increased productivity by 34% while reducing downtimes by 20% [10]. An additional study conducted in another automotive company also proved that efficiencies improved from 40% to 65% when these two methodologies were combined [1].

## 3. Contribution

The proposed production model is based on Lean Manufacturing and work study tools. Likewise, a Change Management approach is proposed throughout the model to foster efficient adaptation of the new techniques by company employees. Through Change Management, the production model may guarantee adequate production cycle times, thus reducing late order fulfillment instances without compromising on quality and production costs.

Consequently, the model starts with preparation for change, where staff members are trained in adapting a continuous improvement initiative. Change is then nurtured throughout the company on the basis of the 5S philosophy with the clear purpose of reducing product defects by process standardization. (Fig. 1).

In addition, the Theory of Constraints, Line Balancing, and Method Time Measurement (MTM) are set forth as pillars of change, reducing production cycle time by identifying and balancing critical process tasks. Likewise, these pillars also reduce unnecessary movements and improve ergonomics of the staff members engaged.

Finally, the model is standardized by performing the last Change Management and 5S steps to commit staff members to the new production model.

Therefore, the proposed method consists of thirteen steps (Fig. 2).

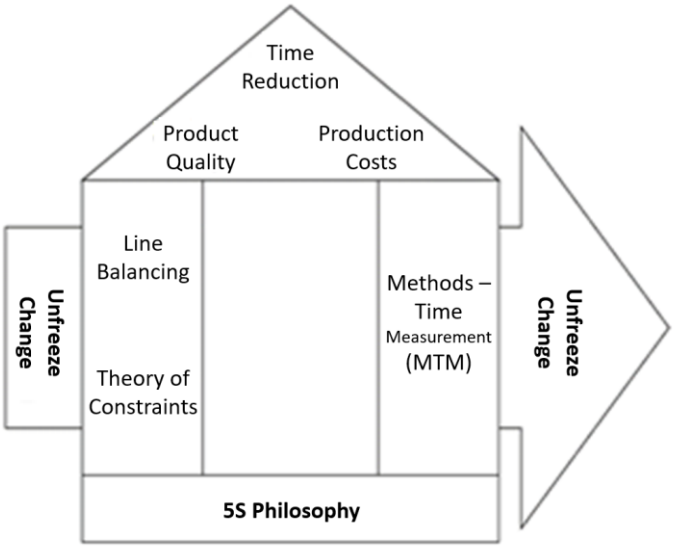


**Figure 1.** Proposed production model

*3.1. Indicators*

The proposed methodology dictates that the production process must be controlled. Therefore, the following indicators are defined:

*3.1.1. Late Order Fulfillment Instances.* Indicator that controls the number of times a product order is fulfilled after the established deadline.

$$IT = \frac{Number\ of\ Orders\ Fulfilled\ Late}{Number\ of\ Orders\ Fulfilled} x100\% \quad (1)$$

*3.1.2. Productivity.* Determines the number of products made on a daily basis.

$$PDT = \frac{Number\ of\ Garments}{Day} \quad (2)$$

*3.1.3. Cycle Time.* This indicator controls the number of garments made with each minute that passes.

$$TC = \frac{Number\ of\ Garments}{Minute} \quad (3)$$

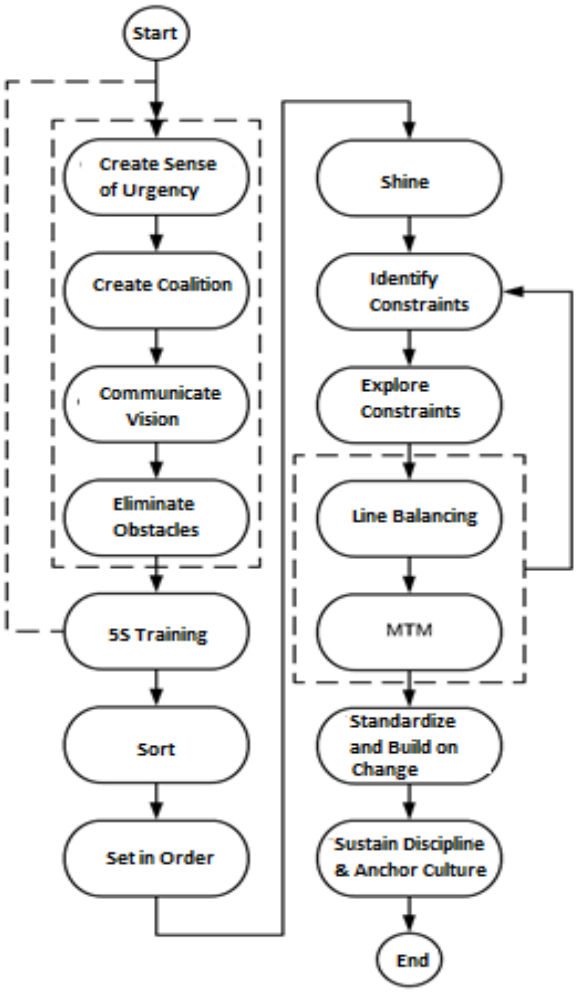


**Figure 2.** Proposed methodology

## 4. Validation

This section discusses the implementation of the production model in a textile manufacturing company located in the Gamarra Fashion Center, which manufactures sportswear, school uniforms, etc. This company reports order fulfillment delays of up to 5 days after the proposed deadline, as well as a 13% increase in operating costs. To validate the effectiveness of the production model, pre-implementation indicators will be compared against post-implementation indicators.


**Figure 3.** Textile manufacturing company

*4.1. Implementation of a Production Model*

*4.1.1. Change Management.* A production model strategy that is focused on engagement and collaboration by all company staff members, from the owner to the operators. Therefore, awareness training sessions were held to encourage staff members to own the problem and adopt a new production model. To this end, we relied on a team member who exerted influence on other staff members, thus fostering greater model adaptability. In addition, change adoption was monitored through surveys.

*4.1.2. 5S Audit.* Based on the level of awareness and commitment displayed by team members regarding the new production model, the initial 5S audit was performed to identify compliance with the pillars of this philosophy. The results were not favorable as at least 54% of the staff members neither acknowledged nor complied with the criteria assessed.

*4.1.3. Organization.* This first stage of the philosophy required participation by all team members to use red cards in order to eliminate agents, considered foreign to the production process.

*4.1.4. Order.* At this second stage, workplaces were defined by yellow lines to avoid cluttering in-process products within the area, thereby reducing unnecessary movements and accidents.

*4.1.5. Cleaning.* At this stage, all machinery, wiring, etc. were inspected. Similarly, cleaning standardization policies were established for the area.

*4.1.6. Execution of Theory of Constants.* Upon organizational culture standardization, bottlenecks were identified. With regard to this, closures and pockets were singled out as critical manufacturing activities. Therefore, all other activities were subordinated to these activities, scheduling operator lunch and break times so that the process never stops.

*4.1.7. Line Balancing.* To offset production cycle times in stations, two workstations that used the longest time or had the lengthiest candidate criteria were eliminated.

*4.1.8. MTM Application.* Having changed process flows, the model focused on operator motion to assess the time lost because of unnecessary motion from poor posture. The study determined that the tables were not adequate because they did not allow the operator's arms to rest at the proper height of 96 cm above the floor. Therefore, the worktables were replaced. In addition, the new tables requested had drawers (as requested) wherein work tools could be stored.

*4.1.9. Standardize and Build on Change.* At this stage, collaborators became more engaged in the face of the new production model; hence, the purpose here was to standardize activities though signposting and toolbox talks.

*4.1.10. Sustain Discipline and Anchor Culture.* This last stage monitored the current status of the production model, undertaking staff member surveys and audits to measure model compliance.

The post-production model implementation results obtained are as follows.

**Table 1.** Comparison of case study indicators

| Concept | Pre-Implementation | Post-Implementation | Variation |
|---|---|---|---|
| % Late Fulfillment | 39% | 18% | +19% |
| Productivity | 13 min / garment | 24 min / garment | +85% |
| Cycle Times | 26.8 min | 20.1 min | -33% |

As can be observed, after the new production model was implemented, a 19% reduction was explained by the main problem reported by the company. Similarly, productivity increased by 85% for the sweat suit process while cycle times decreased by 33%. On the other hand, operating costs decreased by 20% because of the reduction in overtime caused by unnecessary motion.

## 5. Conclusions

By implementing a production model based on Lean Manufacturing and work study tools with a Change Management approach, late order fulfillment incidences were reduced by 18% even as product quality improved.

The transversal Change Management approach deployed in this model was crucial for the implementation and adaptability of engineering techniques in a small company at the Gamarra Fashion Center. In addition, the staff members had always performed their jobs on the basis of customary practices instead of relying on technical preparation. Therefore, nurturing a new mindset was critical for fostering model adaptation.

In conclusion, the study proved that workers required continuous training in Lean Manufacturing. Likewise, tools must be continuously monitored to guarantee long-term implementation, which could allow new hires to easily adopt the production model.

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