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LEAN Production Management Model based on Organizational Culture to Improve Cutting Process Efficiency in a Textile and Clothing SME in Peru

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Abstract. In recent years, homegrown SMEs have had low production levels when compared with Chinese garment imports, losing their competitive advantage in the domestic market. SMEs represent 96% of garment companies in Peru and have a positive impact on the creation of jobs. The search for a technique to improve SME output was conducted in various studies; however, the efforts did not bear fruit over time. Thus, this article seeks to improve the low production efficiency in textile and clothing SMEs. Therefore, we proposed a model and validated it in the production area of a denim clothing manufacturing company in Peru. We conducted business diagnostics and found a production efficiency problem. Later, we adapted the Lean production management model to the prevailing organizational culture. The main result was that the company's production efficiency increased from 68% to 71%. Finally, employee commitment, along with the combination of the Lean model and organizational culture, allowed the improvements to stand the test of time after their implementation.

1. Introduction

In recent years, the main problems in the textile and clothing industry are the lack of productivity and competitiveness. We analyzed these problems to identify their causes, including high logistics costs, labor and tax cost overruns, low international prices, very low exchange rates, and the closure of markets because of the international recession [1]. This industry counts on a large number of micro and small enterprises, which represent 96% of the organizational structure of the clothing industry in Peru, which is the most important manufacturing activity [2]. According to the Global Competitiveness Report 2017–2018, which evaluates the factors that drive productivity and growth in 137 countries, Peru ranks 72nd with a GDP per capita of US\$6,198.6 and 2,496 hours worked per year, which depicts a setback of five positions when compared with the 2016–2017 Report [3]. Nowadays, low production efficiency harrows SMEs, with most of them pointing to the lack of

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qualified personnel as well as escalating costs as impediments to improving productivity. However, this is also a matter of entrepreneurial culture with respect to innovation [4].

It is necessary to study the low production efficiency in the textile and clothing industry because it accounts for 7.2% of manufacturing GDP, occupies an important place in nontraditional exports (11% of the total), and has a positive impact on Peru's economic performance because it creates both direct and indirect employment [5].

This research study is necessary because it seeks to integrate Lean tools with organizational culture in textile and clothing SMEs—something that previous studies have not attempted. The expected result is the improvement of production efficiency in textile SMEs through the alignment of organizational culture with Lean process improvement methodologies. Thus, we hope that the improvements implemented in most cases prevail over time with the appropriate personnel guidelines.

2. State of The Art

2.1. Production Management Models

SMEs deal with functional barriers, which consist of human resources, production, and financial issues that show that the difference between areas represents obstacles to SMEs that affect their exports [6]. This problem generated doubt with regard to determining the productive management model to implement in industrial SMEs. Therefore, the companies decided to follow a traditional management system based on mass production. They aim to achieve significant results in costs by operating in large, highly standardized batches and producing at maximum capacity [7].

2.2. Lean

The cases related to Lean tools aim at combining techniques to improve SME productivity by eliminating waste. The SMEs in question apply improvement programs to identify problems and propose solutions by verifying the manner in which their results affect their production process [8]. SMEs establish the best possible way for companies' improvement and profitability. Therefore, environment assessment is important for establishments in that it enables them to determine whether the tools have been adjusted with respect to their dimensions [9][10].

2.3. Organizational Culture

Organizational culture shows the importance of creating a commitment and involvement identity in a company, which refers to the improvement of organizational processes and performance [11]. With regard to this, family businesses are an impediment to organizational culture because their practices are transmitted through generations, growing with no option to improve. Therefore, a study evaluated both cases through the organizational culture assessment instrument (OCAI), which showed that there are no outstanding differences and explains how organizational culture, through various types of family businesses, contributes as a first step toward adopting cultural patterns based on the resources that are needed to compete [12].

3. Contribution

3.1. Proposed Model

The general model is based on the organizational mission with three Lean stages (5S methodology, Poka-yoke, and standardized work) and is complemented by organizational culture through its dimensions (adaptability, involvement, and standardized work). The model structure is presented below (Figure 1):

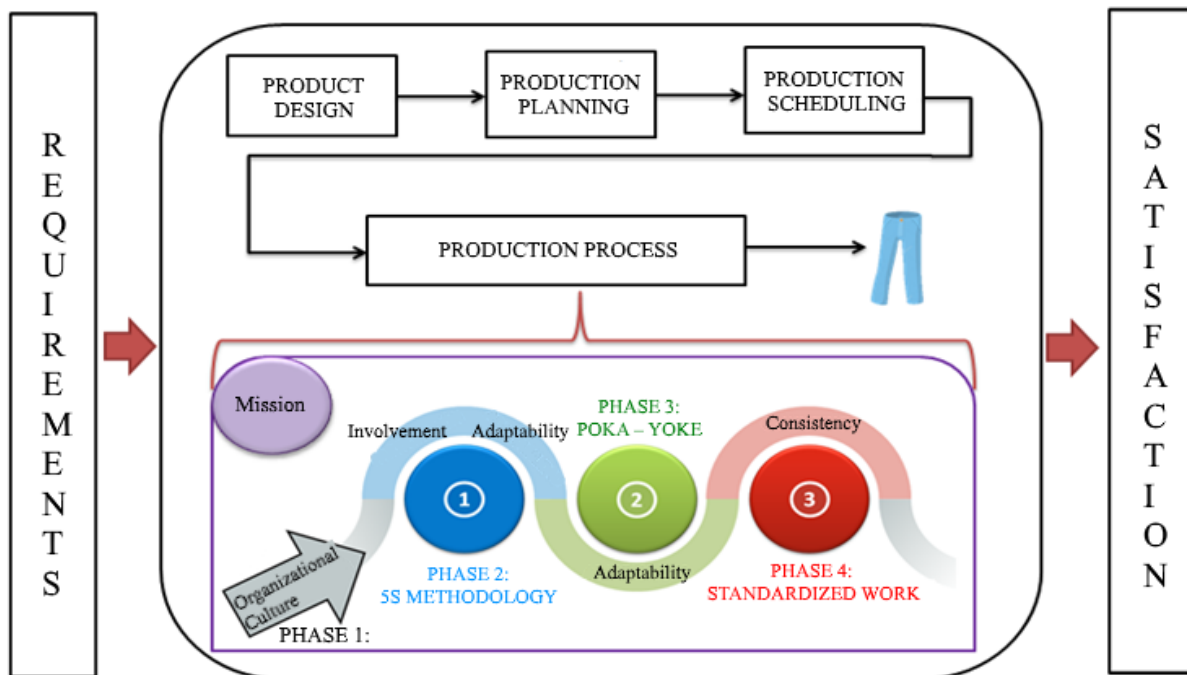


Figure 1. Lean production management model based on organizational culture

3.1.1. PHASE 1. Organizational mission and culture: To align the company's objectives with organizational culture dimensions to form the Denison Model audits.

3.1.2. PHASE 2. Stage 1 – 5s Methodology: Improve the company's working environment and product quality through five steps. Dimension 1: Adaptability and involvement: Involve the personnel in workshops to support the implementation of improvements such as work in the company.

3.1.3. PHASE 3. Stage 2 – Poka-Yoke – Mistake proofing: Prevent errors through a visual warning to a work method that requires it. Dimension 2: Involvement: Involve the employee in the implementation and the form of prevention applicable to their work.

3.1.4. PHASE 4. Stage 3 – Standardized work: Record the standard process in a flow that is within the reach of everyone. Dimension 3: Consistency: Maintain improvements with constant evaluations.

3.2. Proposed Method

The following depicts the entire sequence of activities involved in the working of the proposed model as a tool to improve production efficiency in a textile and clothing SME (Figure 2).

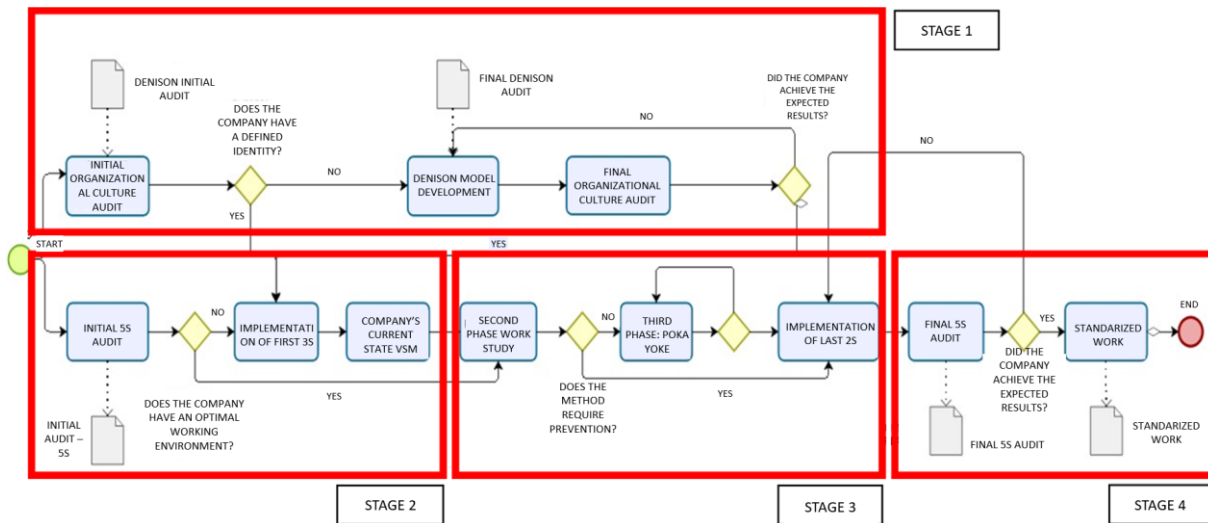


Figure 2. Process flowchart

3.3. Indicators

3.3.1. Inventory Shrinkage (IS) Ratio:

$$IS = \frac{Kg. of shrinkage}{Kg. of denim fabric} 100\% \quad (1)$$

3.3.2. Error Occurrence (EO) Ratio:

$$ER = \frac{No. of erros (jeans)}{No. of cutting operations per piece} 100\% \quad (2)$$

3.3.3. Production Efficiency (PE) Ratio:

$$PE = \frac{Actual output}{Effective capacity} 100\% \quad (3)$$

4. Validation

4.1. Case Study:

From the textile and clothing industry, we selected the company Bonice Jeans S.A.C. for this case study. This company is located in the Gamarra Commercial Center and is dedicated to the manufacture of denim clothing for women.

4.2. Business Diagnostics

We analyzed the supply chain and found the main problem to be the low cutting process efficiency. The initial diagnostic presented the following results: 17% shrinkage for each denim fabric roll; 15% errors in operations of each production batch; labor productivity of 7.9 and production process efficiency of 68%.

4.3. Application of The Model in The Case Study

4.3.1. First Phase – Denison Organizational Culture Model. We used the Denison Model, which consists of a questionnaire. The scoring is based on the following scale: (1) Strongly disagree; (2) Disagree; (3) Neutral; (4) Agree; and (5) Strongly agree. By applying the improvement, the results of

the study positioned the company within the normal degree with a score of 17.9, surpassing the initial 12.9.

Table 1. Denison final matrix

Levels/ Dimension types	Agree	Neutral	Disagree	Total	Degree of compliance with organizational culture
Strategic direction		3		3	Normal
Goals		3		3	Normal
Vision		3		3	Normal
Values		3		3	Normal
Agreement	4			4	Good
Integration		3		3	Normal
Teamwork			2	2	Poor
Capability development		3		3	Normal
Empowerment			2	2	Poor
Creating change		3		3	Normal
Customer focus		3		3	Normal
Learning	4			4	Good

4.3.2. Second Phase – Workplace Organization Using the Lean 5S Method. We carried out the initial audit, by means of which we assessed the current development of each of the denim clothing manufacturing process operations. To this end, we considered a rating scale of 0–50. Then, we created a matrix to evaluate each step of the method according to the objectives by considering the following score: (1) Strongly disagree; (2) Disagree; (3) Neutral; (4) Agree; and (5) Strongly agree. The final 5S matrix showed a result of 26.6, exceeding the score of 9.6 achieved in the initial audit, which indicates that the company is in a state that is considered to be normal.

Table 2. Final 5S matrix

Goals/ Steps	Optimal work environment	Ease of search	Pleasant workplace	Cultural awareness	Total
Set in order	3	2	2	4	11
Sort	2	2	4	5	13
Shine	3	3	2	3	11
Standardize	2	2	3	2	9
Sustain	3	2	2	5	12

4.3.3. Third Phase – Critical process control through the Poka – Yoke Lean tool. We created a matrix to evaluate the alternatives according to the criteria and selected a tape measure to attach it to the cutting machine as a reference to indicate the proper height at which to cut.

4.3.4. Fourth Phase – Production Process Consolidation by Means of a Standardized Work Lean Tool. The manufacturing time was reduced from 30.28 minutes to 28.31 minutes to manufacture a pair of jeans, which was recorded on a standardized worksheet.

Finally, we present the final metrics used to evaluate the results of each phase.

Table 3. Summary of ratios

Phases	Ratios	Previous	Current
Phase 1: Culture Management	Denison Audit	12.9	17.8
Phase 2: Workplace Organization	Production within the Normal Range (PNR)	16%	11%
Phase 3: Critical Process Analysis	Shrinkage Ratio (SR)	17%	12%
Phase 4: Production Process Control	Error Occurrence (ER) Ratio	15%	10%
Project: Production Efficiency Improvement	Production Efficiency (PE)	68%	71%

As shown above, in the first phase, the culture level increased by 5 units; moreover, the last three model phases achieved improvements with a reduction of 5% each, and the main production efficiency ratio increased by 3%.

5. Conclusions

The implementation of the proposal resulted in a 3% increase in production efficiency over the previous year (2018), reaching 71%, which led to the generation of an additional 30 trousers per month. The involvement of operators is essential in evaluation to ensure the continuity and efficiency of the proposed model. The model contributes to citizenship by shaping employee behavior for them to identify with the company's values and put them into practice in society.

6. References

- [1] Arrarte R, Bortesi L and Michue E 2018 Productivity and Competitiveness article in the Peruvian Textile and Clothing Industry 2015 - 2018 *Quipukamayoc* **25** 113-121
- [2] Klaus S, Xavier S I M, World Economic Forum 2017 Global Competitiveness Report 2017 -2018 (*World Economic Forum*)
- [3] ComexPerú *ComexPerú*. Retrieved from <https://www.comexperu.org.pe/articulo/el-repunte-de-las-exportaciones-textiles>.
- [4] PRODUCE 2015 Textile and Clothing Industry (*Lima*).
- [5] Loayza N 2016 Productivity as the key to growth and development in Peru and the world *J Econ Stud* **31** 9-28
- [6] G. Triveño 2015 About the textile sector.
- [7] IEES Sector Report 2018 Textile and clothing industry (*Lima*).
- [8] Andrade Y, Cardenas L, Viacava G, Raymundo C and Dominguez F 2019 Lean manufacturing model for the reduction of production times and reduction of the returns of defective items in textile industry *Adv. Int. Sys. Comp* **954** 387-398
- [9] Aurora I. and Cavazos J. L. M. 2017 Transfer of knowledge within the company: analysis of precursor variables in a Lean-Kaizen environment *Nova Scientia*
- [10] Kumar S, A. Dhingra, Singh B 2018 Process improvement through Lean-Kaizen using value stream map: a case study in India *Int. J. Adv. Manuf. Tech.* **96** 2687-2698
- [11] Ahmady G A, Aghdas N and Mehrpour M 2016 Effect of Organizational Culture on knowledge Management Based on Denison Model *Procedia Soc Behav Sci* **230** 387-395
- [12] Urban W 2015 The Lean Management Maturity Self-Assessment Tool Based on Organizational Culture Diagnosis *Procedia Soc Behav Sci* **213** 728-733