

Applying 5S and Standardized Work to Improve Productivity in a Food Production SME in Peru

Mario Rodríguez Vásquez de Velasco and Paulo Koochoy Delgado

Faculty of Engineering

University of Lima

Santiago de Surco, Lima, Peru

20201828@aloe.ulima.edu.pe, 20191052@aloe.ulima.edu.pe

Richard Nicholas Meza Ortiz

Professor, Faculty of Engineering

University of Lima

Santiago de Surco, Lima, Peru

rnmeza@ulima.edu.pe

Abstract

The food manufacturing sector in Peru faces persistent challenges related to low productivity, operational variability, and resource waste, which restrict the competitiveness of SMEs. The sector represented 13.2% of national GDP in 2025 (Ministerio de la Producción, 2025), but despite its importance, many food-sector SMEs show limited adoption of Lean Manufacturing tools, relying on informal practices and lacking standardized processes. This study evaluates the implementation of 5S and standardized work in a food manufacturing SME producing snack-type products. The improvement effort focused on the main production line, which includes four products and four stages: mixing, kneading, cutting, and baking. The diagnostic phase identified workplace disorder and nonstandardized tasks as key drivers of rework, idle time, and productivity variability. Using Deming's continuous improvement cycle (Plan-Do-Check-Act), productivity increased from 57.75 kg/USD to 69.53 kg/USD, waste decreased from 3% to 2.5%, and adherence to 5S improved from 30% to 78.22%. These results demonstrate the effectiveness of Lean tools in enhancing operational performance and highlight their potential to strengthen the competitiveness and sustainability of food-sector SMEs in Peru.

Keywords

Lean Manufacturing, productivity, 5s, standardized work, food industry

1. Introduction

Lean Manufacturing is a management approach that seeks to systematically eliminate waste in order to maximize the value delivered to the customer, using fewer resources compared to traditional methods (Womack & Jones, 2003). Among the most recognized Lean tools are the 5S, a methodology that establishes five fundamental principles: Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardize), and Shitsuke (sustain), whose objective is to improve organization, efficiency, and safety in the workplace (Imai, 2012). On the other hand, work standardization is a technique that defines optimal and repeatable procedures to ensure the consistency and quality of production processes, reducing errors and waste, and promoting greater productivity (Liker, 2004). These tools have proven to be essential for optimizing operational management in industrial environments and improving the overall performance of organizations. The implementation of Lean Manufacturing tools has shown significant improvements in various productivity indicators in the food industry. For example, Farissi et al. (2021) reported a 15% increase in operational efficiency and a 20% reduction in waste following the adoption of Lean practices in food companies in Morocco. In

a similar case, Castro and Posada (2019) documented a 25% increase in productivity and a 10% decrease in processing times in bakeries in Medellín, Colombia. Similarly, Marques et al. (2022) found that the implementation of Lean tools in a fresh food market in Portugal reduced product losses by 30% and improved operational sustainability by 18%. In Peru, Huarcaya-Melendez and Platero-Mamani (2023) achieved a 54.17% decrease in the percentage of shrinkage, reaching a final value of 0.66%, and an increase in compliance with the 5S methodology from an initial 30% to 82%. These quantitative results underscore the effectiveness of Lean Manufacturing in process optimization, positioning it as a viable solution for increasing the productivity and competitiveness of companies such as this company.

1.1. Objectives

The main objective of the project is to increase the productivity of the company by improving production processes through the implementation of Lean Manufacturing tools such as 5S and standardization. The specific objectives are:

- Identify the most relevant causes of the problem.
- Identify the appropriate Lean tools to address the causes of the problem.
- Design a solution model.
- Validate the solution model and assess its economic, social, and environmental viability.

2. Literature Review

2.1. PRISMA methodology

Across the literature, Lean Manufacturing emerges as a proven framework for improving operational performance in food-processing environments. Tools such as 5S and standardized work have demonstrated strong results in workplace organization, waste reduction, and process stability with multiple studies reporting significant productivity gains in food-industry contexts. This literature review on Lean Manufacturing tools and productivity in the food industry uses the PRISMA methodology developed by Denyer and Tranfield (2009) and updated by Page et al. (2021).

To ensure that this systematic review is consistent, the topic, research questions, search strategy, and criteria for including or excluding studies must be planned (Moher & Shamseer, 2015). The following research questions are then posed:

- How are Lean Manufacturing tools evolving in the food industry?
- What benefits does the implementation of Lean Manufacturing tools generate in the food industry?
- What motivates companies in the food industry to implement Lean Manufacturing tools?
- What are the most widely used Lean Manufacturing tools in the food sector?

The initial search yielded 378 documents in the SCOPUS database, which were progressively filtered by year, document type, relevance, and full-text review until 36 articles were selected, complemented by four additional references identified through citation tracking.

The review highlights the importance of the food manufacturing sector within the Peruvian economy, contributing by PEN 144,567.93 million to the country's total GDP in 2024 of PEN 1,095,204 million, with an annual growth rate of 3.3% (INEI, 2025). Despite this economic significance, Peruvian food-sector SMEs continue to face persistent challenges such as low productivity, high process variability, and limited adoption of structured improvement methodologies

2.2. Deming Cycle

The Deming Cycle (PDCA) has been widely applied as a structured methodology for continuous improvement in industrial and service processes. Montesinos González et al. (2020) applied the PDCA cycle to analyze operational inefficiencies by defining improvement plans based on root cause analysis and monitoring performance indicators to validate process improvements. Similarly, Alanis et al. (2022) used the PDCA approach to implement corrective actions in production systems, emphasizing the planning and checking stages to reduce process variability and operational waste. In a manufacturing context, Aliaga-Parcco et al. (2023) employed PDCA to test improvement actions through pilot implementations, allowing adjustments before standardization. Additionally, Antunes Júnior and Broday (2019) highlighted the use of PDCA as a managerial framework to institutionalize continuous improvement, where successful actions are standardized and integrated into daily operations to sustain long-term performance gains.

2.3. 5S tool

Recent empirical studies confirm that the implementation of the 5S methodology produces measurable improvements in productivity, efficiency, and operational performance in the food and beverage industry. Benites et al. (2024) reported that applying 5S within an integrated Lean and IoT model reduced travel time from 14.8 to 11 minutes and decreased disorder-related incidents from 47% to 22%, contributing to an overall 8% increase in production line performance. Similarly, De la Torre et al. (2024) indicated that the use of 5S in a Peruvian pizza SME is expected to increase efficiency from 80% to 85% and availability from 86.7% to 92.8%, with projected productivity gains from 74% to 81%. In a food processing case study, Huarcaya-Meléndez and Platero-Mamani (2023) found that 5S reduced standard cleaning and packaging times by 7.48 min/kg (a 3.19% decrease), supporting an overall 40.58% increase in labor productivity. At a sectoral level, Falconí et al. (2025) documented waste reductions of up to 52.2% and productivity increases of 20% following 5S implementation, reinforcing its effectiveness as a foundational Lean tool for operational improvement.

2.4. Standard Work tool

Recent empirical studies demonstrate that the implementation of Standard Work plays a critical role in reducing process variability, cycle time, and operational waste while improving productivity and service performance in food-related SMEs. Pérez-Canchanya et al. (2023) showed that integrating Standard Work with SMED and Kanban increased the order fulfillment rate from 82.4% to 95.6%, while reducing pack assembly cycle time by 19% and lowering penalty rates from 17.6% to 3.15%, evidencing improved process stability. Similarly, Flores-Pérez et al. (2023) reported that the standardization of value-adding activities reduced total cycle time from 20.3 to 17.51 hours, contributing to a reduction in waste from 3.5% to 1.76% and an overall 6.7% increase in productivity. In an agricultural SME, Saldaña-Romero et al. (2024) found that applying Standard Work within an integrated Lean and Circular Economy model increased productivity from 0.77 to 0.85, representing a 12.24% improvement, with significant economic benefits exceeding USD 1.6 million annually. Additionally, Bobadilla-Calderón et al. (2022) demonstrated that combining Standard Work with autonomous maintenance increased productivity by 17.01%, enabled the production of 2,000 additional kilograms of green coffee, and reduced outsourced processing by 80%, highlighting the effectiveness of Standard Work in stabilizing operations, minimizing losses, and supporting sustainable productivity improvements.

3. Methods

3.1. Macro design of the proposed solution

To address the problem, the project adopts Deming's continuous improvement cycle (PDCA) as the overarching framework to guide the diagnosis and implementation of improvements. In the Plan phase, tools such as the problem tree, objective tree, Pareto diagram, Ishikawa diagram, and literature review were used to define the main problem, identify its root causes, and select the improvement methods. In the Do phase, the chosen solutions were: 5S to organize the working environment and Standardized Work to reduce variability and operational errors, are implemented as a pilot test. The Check phase consists of evaluating the results by measuring indicators and comparing them with initial expectations to determine the effectiveness of the actions. Finally, in the Act phase, successful improvements are standardized and integrated into regular operations, while corrective adjustments are made when necessary to ensure sustained productivity gains.

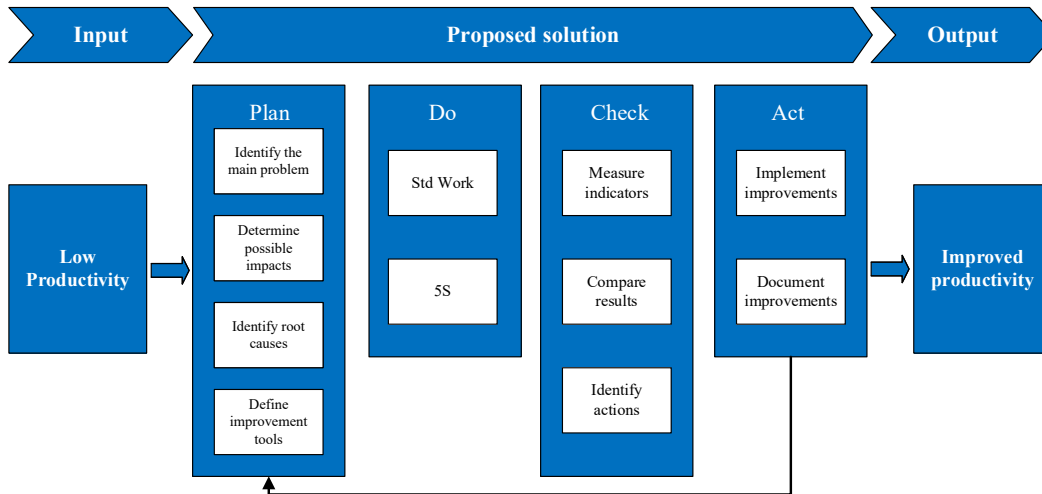


Figure 1. Model proposal – Deming cycle

Since long preparation times account for 70% of the overall impact on the company’s low productivity, this motive becomes the primary focus of intervention within the problem tree. The analysis identified three main root causes: errors in the work method (35%), resulting from inconsistencies in task execution and the absence of a defined sequence; reprocessing (20%), produced by incorrect dosing or handling that requires tasks to be redone; and unnecessary movements (45%), associated with workplace disorder, inefficient tool placement, and excessive operator displacement. Additional secondary causes such as unmaintained machinery and the resolution of unexpected issues contribute to minor inefficiencies and brief interruptions. Together, these factors explain the predominance of long preparation times as the key driver of productivity loss.

To address the identified root causes, the improvement proposal incorporates two complementary Lean tools: Standardized Work and 5S. Standardized Work aims to reduce variability and minimize operational errors by establishing a clear, consistent and repeatable method for performing tasks, ensuring more stable and predictable cycle times. On the other hand, the 5S methodology focuses on organizing and optimizing the workspace through sorting, ordering, cleaning, standardizing and sustaining discipline, which helps eliminate unnecessary movements, reduce search times and promote smoother operational flow. By targeting both process variability and workplace organization, these tools directly address the main sources of non-productive time and are expected to significantly improve the company’s operational performance.

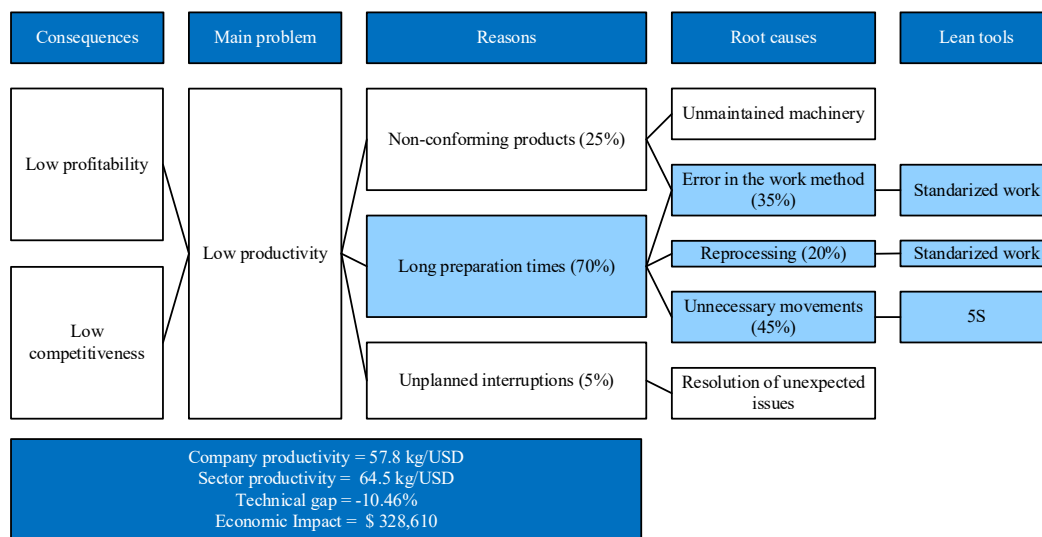


Figure 2. Problem analysis tree

4. Data Collection

One indicator for measuring the efficiency of a production plant is productivity. In this case, data from January to April 2024 was used. During the planning phase, it was identified that the company's main problem is low productivity, with a value of 57.75 kg/USD, which is lower than that of the sector of 64.49 kg/USD. It's important to note that a foreign exchange rate USD:PEN of 3.36 as of Jan 2025 was used to calculate certain results (Table 1).

$$\text{Productivity Level} = \frac{\text{Total production (kg)}}{\text{Labour consumption (USD)} + \text{Raw material consumption (USD)}}$$

Table 1. Productivity level analysis

Month	Production	Labour Consumption	Raw Material Consumption	Productivity Level (kg/USD)
January	2,832,605	29,159	19,719	57.95
February	2,811,100	25,897	23,731	56.64
March	3,260,527	27,935	27,562	58.75
April	2,810,525	29,159	19,719	57.50
Average	2,928,689	28,036	22,681	57.75

Another production indicator used in this analysis is the service level. This indicator allows us to evaluate what percentage of the units requested were delivered on time and in good condition (Table 2).

Table 2. Service level analysis

Month	Units produced	Units requested	Service level
January	273,068	297,784	91.70%
February	261,316	278,589	93.80%
March	299,352	317,784	94.20%
April	270,939	299,712	90.40%
Average	276,169	298,467	92.53%

Based on conversations with plant managers with extensive experience in the food industry, it was determined that factories in this sector handle 95% of their total orders, which is higher than the company's rate, representing a variation of -2.60% compared to the company's rate (Table 3).

Table 3. Industry gap analysis

KPI	Company	Standard	Variation %
Productivity Level (kg/USD)	57.75	64.49	-10.46%
Service Level	92.53%	95.00%	-2.60%
Installed Capacity Use	84.90%	75.00%	13.20%

Finally, according to the National Society of Industries (2021), it is mentioned that this sector operates at an average of 75% of its maximum installed capacity. In this case, the company is above the standard, which means that it does not generate any negative economic impact on the company.

4.1. Master Plan Development

For the implementation of the 5S and standardization tools, a pilot test will be used as the primary technique. This consists of applying the tools on a small scale in selected areas of the plant and monitoring the key indicators analyzed in this study. In the case of 5S, the pilot includes placing visual signs, delimiting work areas, and classifying and organizing tools according to their frequency of use.

For standardized work, the pilot involves developing standardization manuals for the production processes that exhibited the highest variability in standard times. Additionally, training sessions will be provided for the operators involved in these processes to ensure proper application of the standards and to allow the measurement of results during the pilot test. To calculate the sample size for both tools, the following formula was used:

$$n = \frac{N * Z^2 * p * q}{d^2 * (N - 1) + Z^2 * p * q}$$

To determine the sample sizes required for the pilot tests, the finite population formula was applied using the same parameters for all cases: a confidence level of $Z = 1.96$, an expected proportion of $p = 0.05$ ($q = 0.95$), and a precision of $d = 0.05$. These values were kept constant to ensure methodological consistency across the different indicators evaluated.

- For the 5S audits, the population was defined as the monthly number of production shifts ($N = 24$). The calculation resulted in a sample of 16 shifts, which were selected according to the company's operational availability.
- For the tool search-time indicator, the population corresponded to the total monthly working hours ($N = 192$). The resulting sample size was 53.14 hours, which were scheduled and monitored during the pilot implementation.
- Finally, for standardized work, the population was defined as the average monthly production volume ($N = 276,169$ units). The formula yielded a sample of 72,971 units (26% of the total). Due to operational constraints, convenience sampling was used, selecting the first units produced until the required sample size was reached.

5. Results and Discussion

5.1. Numerical Results

Table 4 summarizes the main quantitative results obtained after the implementation of the 5S methodology and Standardized Work. Productivity increased from 57.75 kg/USD to 69.53 kg/USD, resulting in an overall improvement of 20.40%, which reflects a more efficient use of labor and time during the preparation process. The scrap percentage decreased significantly from 3% to 0.50%, showing a reduction of 2.5 percentage points, which confirms that the interventions helped minimize quality defects and reprocessing activities.

Regarding operational efficiency, the time spent searching for tools decreased from 68.26 minutes/day to 50 minutes/day, representing a reduction of 30.58 minutes. This improvement is consistent with the expected outcomes of implementing workplace organization practices. Additionally, 5S plan compliance increased from 30% to 95%, with a final observed value of 78.22% during the evaluation period, indicating high adherence to the new organizational standards.

Table 4. Goals vs Results

Indicator	Units	As-is	To-be	Results
Productivity	kg/USD	57.75	64.49	69.53
Scrap Percentage	%	3%	0.50%	2.5%
Tool Search Time	Minutes/day	68.26	50	30.58
5S Plan Compliance	Points	30%	95%	78.22%

From an economic perspective, the project demonstrates feasibility and financial benefit in Table 5. The Economic Net Present Value (NPV) reached \$ 383,666.09, while the Economic Internal Rate of Return (IRR) was 29%, both indicating that the proposed improvements generated a positive economic return for the company.

Table 5. Economic Evaluation Indicators

Indicator	Value
NPV	\$ 383,666.09
IRR	29%

5.2. Graphical Results

Figure 1 presents the evolution of the 5S score across 20 work shifts following the implementation of the methodology. The results show a clear upward trend during the initial stages, with scores increasing from 68 to values above 85, demonstrating rapid adoption and improved workplace organization. Although minor fluctuations appear in later shifts, the overall trend stabilizes at levels significantly higher than the initial baseline, confirming sustained adherence to the 5S criteria.

The post-implementation results indicate a notable reduction in the median cycle time, decreasing from approximately 32.26 minutes to 30.31 minutes, and a clear reduction in variability. The interquartile range becomes narrower after implementation, and extreme values are reduced, suggesting greater process stability and consistency. These findings validate the contribution of Standardized Work and 5S to minimizing unnecessary movements, reducing execution errors, and achieving more predictable preparation times (Figure 4).

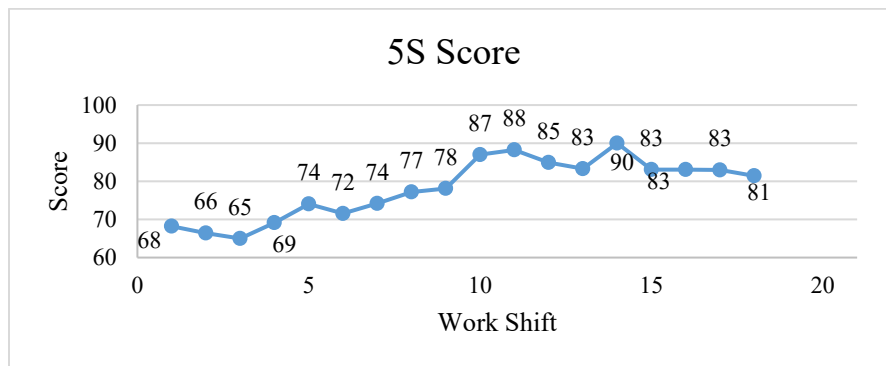


Figure 3. 5S Score post-implementation

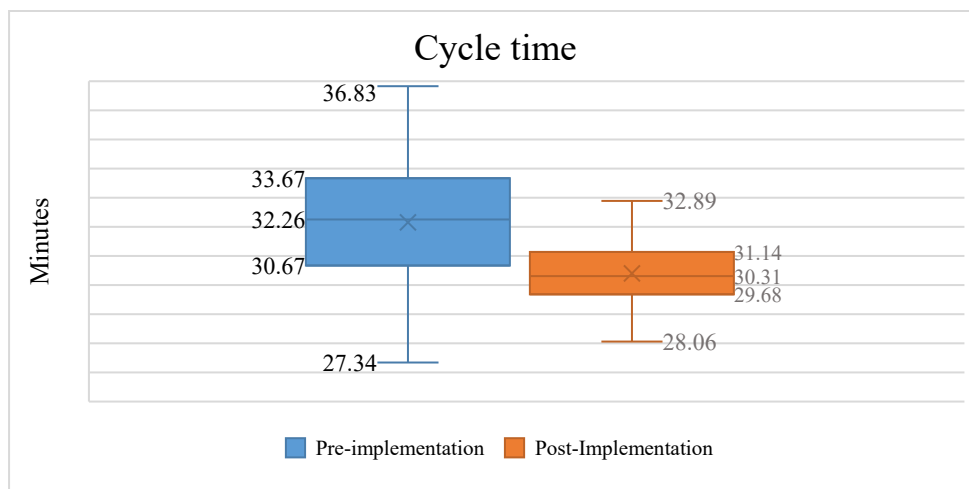


Figure 4. Cycle time post-implementation

5.3. Validation

To statistically validate the impact of the improvement actions on preparation cycle time, both a paired t-test and an F-test for variances were conducted. The paired t-test showed a significant reduction in mean cycle time, decreasing from 32.15 minutes before implementation to 30.40 minutes after, with a t-statistic of 25.28 and a two-tailed p-value of 6.74×10^{-112} , confirming that the decrease in average time is highly significant. Additionally, the F-test revealed that process variability was also significantly reduced, as the variance dropped from 4.20 to 1.09. The computed F-value of 3.85 exceeded the critical value of 1.10, and the p-value of 2.60×10^{-105} confirmed a statistically significant difference in variances. Together, these tests demonstrate that the implementation of 5S and standardized work not only shortened preparation times but also made the process more stable and consistent, reinforcing the effectiveness of the proposed improvements (Table 6).

Table 6. Paired t-test and f-test

Statistic	Pre-implementation	Post-implementation
Mean	32.1528	30.4018
Variance	4.1957	1.0901
Observations	1120	1120
Pearson correlation	-0.0207	–
Hypothesized mean difference	0	–
Degrees of freedom (df)	1,119	–
t Statistic	25.2784	–
P-value (two-tail)	6.7461×10^{-112}	–
t Critical (two-tail)	1.9621	–
F	3.849021405	–
P(F<=f) one-tail	2.60×10^{-105}	–
F Critical one-tail	1.103386974	–

6. Conclusion

The analysis of the company's initial operating conditions revealed performance levels below those of the Peruvian food industry. Productivity reached 57.75 kg/USD, 10.46% lower than the market benchmark of 64.49 kg/USD. Waste levels in the selected production line were 3%, exceeding the industry reference value of 0.66%, while tool search time averaged 68.26 minutes per work shift, 21.68% higher than the sector standard. These results confirmed the presence of operational inefficiencies affecting productivity and economic performance.

Root cause analysis identified errors in work methods as the main contributor to low productivity (35% of economic impact), followed by reprocessing activities (23%) and unnecessary movements at workstations (42%). These issues were mainly related to the lack of standardized procedures, workplace disorder, and interruptions in operator flow during preparation and handling activities.

To address these causes, a solution model based on 5S and Standardized Work, implemented through the PDCA cycle, was validated through pilot tests. Post-implementation results showed a 20.40% increase in productivity, rising from 57.75 to 69.53 kg/USD, exceeding the target value. Waste was reduced from 3% to 2.5%, and tool search time decreased by 56.05%, while compliance with the 5S plan improved from 30% to 78%, reflecting enhanced operational discipline and workplace organization.

From an economic perspective, feasibility and sensitivity analyses showed that 90% of the evaluated scenarios yielded a positive NPV, with an IRR above the cost of capital, confirming the financial viability of the model. The use of Lean tools such as 5S and Standardized Work proved appropriate due to their low implementation cost and minimal infrastructure requirements, making them suitable for food-sector SMEs with financial constraints. While advanced alternatives such as digital twins or AI-based tools may offer additional optimization potential, their application often requires higher digital maturity and investment. Therefore, this study demonstrates that low-cost Lean methodologies can deliver significant operational and economic benefits, while future research may explore the gradual integration of digital and analytical tools as SMEs develop their technological capabilities.

References

- Alanis, A., Zamalloa-Menacho, R., Manani-Rojas, A. E., Flores-Pérez, M. F. and Collao-Díaz, C., Proposal of production model based on lean and continuous improvement to improve productivity in baking SMEs: An empirical investigation in Peru, *Proceedings of the IEIM 2022 Conference*, Association for Computing Machinery, 2022.
- Aliaga-Parcco, J., Maldonado-Paricahua, C., Torres-Sifuentes, C. and Cespedes, C., Implementation of the 5S methodology and its impact on productivity in bread production following the PDCA cycle, *Proceedings of the LEIRD 2023 Conference*, 2023.
- Antunes Júnior, A. and Broday, E. E., Adopting PDCA to loss reduction: A case study in a food industry in southern Brazil, *International Journal for Quality Research*, vol. 13, no. 2, pp. 335–348, 2019.
- Benites, S. G., Eustaquio, L. T. and Núñez, V., Performance improvement model integrating lean and Internet of Things: A food production case, *Proceedings of the ICIBE 2024 Conference*, Association for Computing Machinery, 2024.
- Bobadilla-Calderón, J., Martínez-Flores, C. and León-Chavarri, C., Implementation of integrated autonomous maintenance and standard work to improve productivity in post-harvest production: A case study of a Peruvian coffee farm, *Proceedings of the 20th LACCEI International Multi-Conference for Engineering, Education, and Technology*, 2022.
- Castro, M. R. Q. and Posada, L. G. A., Implementation of lean manufacturing techniques in the bakery industry in Medellín, *Gestão & Produção*, vol. 26, no. 2, pp. e2505, 2019.
- De la Torre, K. M., Vilela, C. G. and Velasquez, J. A., Proposal to increase efficiency in the pizza production line in a Peruvian MYPE using lean manufacturing tools and IoT, *Proceedings of the International Conference on Industrial and Business Engineering (ICIBE 2024)*, Association for Computing Machinery, 2024.
- Denyer, D. and Tranfield, D., Producing a systematic review, In D. A. Buchanan and A. Bryman (Eds.), *The SAGE Handbook of Organizational Research Methods*, pp. 671–689, Sage Publications Ltd., 2009.
- Falconí, R., Núñez, L. and Jiménez, E., Optimizing efficiency in the Peruvian food sector: The impact of lean manufacturing methodologies, *Proceedings of the LACCEI 2025 Conference*, 2025.
- Farissi, A., Oumami, M. E. and Beidouri, Z., Assessing lean adoption in food companies: The case of Morocco, *International Journal of Technology*, vol. 12, no. 1, pp. 5–14, 2021.
- Flores-Pérez, A. E., Poma-Cornejo, V. and Vargas-Balbín, S., Reduction of excess waste through lean manufacturing and SLP tools in a Peruvian balanced food SME, *Proceedings of the 10th International Conference on Industrial Engineering and Applications (ICIEA 2023)*, 2023.
- Huarcaya Melendez, V. and Platero Mamani, A. C., Production model based on lean tools and SLP to increase production efficiency in a textile company, *Proceedings of the 3rd LACCEI International Multiconference on Entrepreneurship, Innovation and Regional Development*, Lima, Peru, 2023.
- Huarcaya-Meléndez, V. and Platero-Mamani, A., Production model based on lean tools and SLP to increase labor productivity in food industry companies, *Advances in Transdisciplinary Engineering*, vol. 20, pp. 92–101, 2023.
- Imai, M., *Gemba kaizen: A commonsense approach to a continuous improvement strategy*, 2nd ed., McGraw-Hill, 2012.
- Instituto Nacional de Estadística e Informática, Producto Bruto Interno Total y por Habitante 1994–2024 (Valores a precios corrientes), Available: <https://www.inei.gob.pe>, 2025.
- Liker, J. K., *The Toyota Way: 14 management principles from the world's greatest manufacturer*, McGraw-Hill, 2004.
- Loyola-Ferrer, G., Veldi-Díaz, W. F. and Quiroz-Flores, J. C., Enhancing service levels in a Peruvian beverage SME: An innovative model integrating machine learning and the 5S methodology, *International Journal of Engineering Trends and Technology*, vol. 73, no. 3, pp. 561–580, 2025.
- Marques, P. A., Carvalho, A. M. and Santos, J. O., Improving operational and sustainability performance in a retail fresh food market using lean: A Portuguese case study, *Sustainability*, vol. 14, no. 12, pp. 7262, 2022.
- Ministerio de la Producción, Reporte coyuntural: Industria manufacturera. Resultados del Indicador de Producción Industrial, Available: <https://www.gob.pe/produce>, May 2025.
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P. and Stewart, L. A., Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement, *Systematic Reviews*, vol. 4, no. 1, pp. 1, 2015.
- Montesinos González, S., Vázquez Cid de León, C., Maya Espinoza, I. and Gracida Gracida, E. B., Mejora continua en una empresa en México: Estudio desde el ciclo Deming, *Revista Venezolana de Gerencia*, vol. 25, no. 92, pp. 1863–1883, 2020.

- National Society of Industries, Memoria anual 2021–2022, Available: <https://sni.org.pe/wp-content/uploads/2023/05/Memoria-Anual-SNI-2021-2022.pdf>, 2021.
- Page, M. J. et al., The PRISMA 2020 statement: An updated guideline for reporting systematic reviews, *Revista Española de Cardiología*, vol. 74, no. 9, pp. 790–799, 2021.
- Pérez-Canchanya, C., Urbina-Suárez, M. and Flores-Pérez, A., Improvement model to increase the order fulfillment rate in a Peruvian SME food company using SMED, Kanban and standard work, *Advances in Transdisciplinary Engineering*, vol. 19, pp. 36–45, 2023.
- Raroeng, S. C., Kosasih, W., Daywin, F. J., Gozali, L., Salomon, L. L. and Santoso, C., Quality assurance in the production process of dried smoking fish using the Deming cycle approach, *Proceedings of the Tarumanagara International Conference on the Applications of Technology and Engineering (TICATE)*, 2023.
- Saldaña-Romero, L., Mansilla-Blanco, J. and Chavez-Ugaz, R., Operational model to improve productivity by applying lean manufacturing and circular economy in an agricultural SME, *Proceedings of the LEIRD 2024 Conference*, 2024.
- Womack, J. P. and Jones, D. T., *Lean thinking: Banish waste and create wealth in your corporation*, 2nd ed., Simon & Schuster, 2003.

Biographies

Mario Rodriguez is a bachelor's in Industrial Engineering from the University of Lima, where he graduated in the upper academic tier. He has over three years of professional experience in process optimization and performance measurement in real business environments. He works at EFIC Partners, an investment banking firm, where he supports M&A transactions through financial modeling, valuation, and operational analysis. Previously, he worked at Colca Capital, a private equity firm, contributing to due diligence processes and value creation initiatives across Latin America. His professional experience includes engineering-based process improvement methodologies and their evaluation to support investment decisions.

Paulo Koochoy is an Industrial Engineering graduate from the University of Lima, specialized in Business Intelligence, with strong academic performance. He has experience in operations improvement, financial analysis, and data-driven decision-making, with a focus on Lean Manufacturing, process optimization, and performance measurement. He has worked at Credicorp Capital and Dim Sum Express, contributing to technology-driven projects, process automation, investment analysis, sales forecasting, and budget control. In parallel, he has developed entrepreneurial initiatives in digital platforms and manufacturing, applying analytical and continuous improvement tools to enhance operational efficiency.

Richard Meza is the Demand, Distribution, and New Business Planning Lead at Ajeper and a Professor at the University of Lima. He holds a degree in Industrial Engineering from the University of Lima and a master's in Strategic Business Administration from PUCP. He has led multiple supply chain networks in multiple locations, both domestically and internationally for large bulk consumers, retailers, automotive industries and agricultural clients. He has been responsible for managing processes covering S&Op, Operations, Planning, Warehousing, Distribution planning, Procurement, Comex, Digital transformation and Reverse logistics.