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Optimizing Productivity in the Animal Feed Industry: A Lean Approach for Enhanced Efficiency and Quality Assurance

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Abstract

Improving productivity in the animal feed industry is crucial to ensure proper nutrition for animals and the quality of meat products, making it a vital sector for food security and the economy. The issue identified in the research relates to productivity and efficiency limitations in animal feed plants, caused by inefficient processes, waste, and extended changeover times, which affect the profitability and competitiveness of companies in the sector. The proposed solution included the implementation of Lean tools such as 5S, Heijunka, and SMED to optimize production processes, reduce changeover times, eliminate waste, and enhance operational efficiency in animal feed plants. The results of this research showed significant improvements in the productivity of the plant studied, with a 35% increase, a 73% reduction in changeover times, a 47% decrease in the production cycle time, and a 98% increase in production schedule compliance. These indicators reflect the positive impact of implementing Lean tools in the animal feed industry.

Keywords
Lean Manufacturing, productivity, Heijunka, 5S, SMED, food industry, animal feed.

1. Introduction

The implementation of lean manufacturing tools in the food industry has proven to be an effective strategy for enhancing productivity and operational efficiency. Particularly in plants manufacturing animal feed, the application of Lean Manufacturing methodologies has garnered interest in the pursuit of process optimization. These tools, focusing on waste elimination, organizational improvement, and reduction of setup times, have the potential to significantly transform operations in such plants.

Management literature has emphasized the importance of considering contextual factors when implementing changes within organizations, as these factors can influence the effectiveness of initiatives (Shah & Ward, 2002). Additionally, the application of tools such as value stream mapping has shown effectiveness in reducing losses and waste in food supply chains (Steur et al., 2016). Previous studies have underscored the relevance of lean practices implementation in the food industry, particularly in small and medium-sized enterprises (Dora et al., 2013).

Digitalization has also emerged as an enabler for implementing lean practices in manufacturing companies, offering new opportunities for continuous improvement (Queiroz et al., 2022). Furthermore, simulation through virtual reality has been identified as a promising tool for optimizing production lines in lean environments (Abidi et al., 2016). These technological advancements complement the array of tools available to drive efficiency in the manufacturing of animal feed.

In this context, the present article will focus on a case study analyzing the implementation of lean tools such as 5S, Heijunka, and SMED in a plant producing feed for pigs, guinea pigs, and poultry. The impacts of these methodologies on productivity will be explored, and best practices for their effective application in such facilities will be identified. Through a rigorous methodological approach, the aim is to contribute to the existing body of knowledge on process optimization in the food industry through lean manufacturing tools.

2. Literature Review

2.1. Lean Manufacturing in the food industry

The implementation of Lean Manufacturing in the food industry has garnered significant attention in academic literature. The importance of critical success factors for Lean implementation in small and medium-sized enterprises (SMEs) has been emphasized (Achanga et al., 2006). Furthermore, the lack of specific research on the application of Lean Manufacturing in food SMEs has been noted (Dora et al., 2013), underscoring the need for studies in this particular field.

Adapting Lean techniques from the manufacturing industry to the food industry may pose unique challenges that must be addressed to achieve successful and effective implementation. Existing literature highlights the importance and potential of Lean Manufacturing application in the food industry, emphasizing the need to understand critical success factors, address research gaps, and tailor Lean techniques to the specific characteristics of this sector.

Moreover, it has been observed that Lean Manufacturing implementation in companies across various sectors, including the food industry, can yield significant benefits such as improvements in productivity, profitability, and productivity competencies (Benítez & Silva, 2022). This suggests that adopting Lean Manufacturing can be an effective strategy for driving industrial development in diverse contexts.

In summary, the reviewed literature underscores the importance of Lean Manufacturing implementation in the food industry, emphasizing the need for specific research, consideration of critical success factors, and adaptation of Lean practices to the unique characteristics of this sector.

2.2. 5S applications in food processing industry processes

The application of the 5S methodology in the food industry has been a subject of interest in various studies. Randhawa & Ahuja (2017) conducted a comprehensive review of literature to understand the significance and implementation of 5S in organizations. They highlighted the importance of 5S as a quality improvement tool for sustainable performance. Furthermore, Dora et al. (2013) addressed the gap in the literature regarding the application of lean manufacturing in the food sector. This study sheds light on the relevance of lean practices, which can include methodologies like 5S, in enhancing productivity and economics in small and medium-sized food enterprises.

Moreover, Lamprea et al. (2015) conducted a case study in Colombia to evaluate the impact of the 5S methodology on quality, productivity, industrial safety, and organizational climate in manufacturing SMEs. Their findings suggest that implementing 5S can be an effective tool to improve various aspects of manufacturing companies, supporting the notion that 5S can positively influence different facets of operations within the food industry.

In conclusion, the literature supports the idea that the 5S methodology, when applied in the food industry, can lead to improvements in productivity, quality, safety, and organizational climate. By addressing the gaps in existing practices and emphasizing the significance of lean methodologies like 5S, organizations in the food sector can enhance their overall performance and competitiveness.

2.3. Heijunka applications in the food industry or similar scenarios

The Heijunka tool, utilized within the food industry and related sectors, played a pivotal role in enhancing production planning. Heijunka, translating to "workload leveling," has been demonstrated to enhance coordination throughout the value chain, reduce changeover times, and lead to smaller batches and increased performance (Grimaud et al., 2014). By implementing Heijunka, a more evenly distributed production over time is achieved, aiding in averting peaks and troughs in demand, thereby enabling more efficient production and better resource utilization (Poksińska et al., 2010).

Furthermore, the application of Heijunka in production systems has shown to improve both performance and the amount of work in progress (Rewers & Diakun, 2021). Proper workload leveling through Heijunka has yielded positive outcomes in reducing delivery time and optimizing production processes ("HVLV Manufacturing System Controlled with Heijunka-Kanban: A Simulation Study of Dead Time and Delay Constraints," 2022). This tool integrates with other lean practices, such as Kanban, to achieve more effective planning and agile responses to market demands (Kovács, 2018).

In summary, the implementation of Heijunka in the food industry and similar sectors not only enhances operational efficiency but also contributes to better demand management, reduced changeover times, and increased production flexibility, resulting in more effective planning and enhanced competitiveness in the market.

2.4. SMED applications in the food industry or similar scenarios

The SMED (Single Minute Exchange of Die) methodology has proven to be an effective tool in reducing machine setup time across various industrial sectors, including the food industry. Research studies, such as those conducted by Gomez et al. (2021), have successfully applied the SMED methodology in companies within the metalworking sector, resulting in significant improvements in tool change processes. Developed by Shigeo Shingo, this methodology focuses on reducing both internal and external operations to optimize changeover times, thereby translating into increased efficiency and productivity.

Furthermore, investigations conducted by Agreda and Castrillón (2017) have demonstrated that the implementation of the SMED technique in specific processes, such as ink changeovers in the packaging industry, has led to a 20% reduction in setup times, consequently generating a 10% increase in productivity. These enhancements in setup times directly yield operational and economic benefits for companies within the sector (Agreda & Castrillón, 2017).

Moreover, the effectiveness of the SMED methodology in the food industry lies in its ability to identify and eliminate non-value-added activities during machine changeovers. By minimizing these activities, optimization of setup times is achieved, resulting in greater flexibility and responsiveness to market demands within this highly dynamic and competitive sector.

In summary, the application of the SMED methodology in the food industry has proven to be an effective strategy for reducing machine setup time, enhancing operational efficiency, and increasing productivity in this key sector of the economy.

3. Contribution

3.1. Fundamental Contributions

The suggested production plan is easy to execute and does not necessitate a significant expense. The goal is to attain favorable results in productivity and competitiveness. The methodology incorporates different tools including the Value Stream Map (VSM) for process identification and the 5S for systematic organization of the work area and tools. The strategy is based on the problem tree resulting from the diagnosis carried out in the company, using the Systematic Interrogation Technique (SIT) diagram and the Ishikawa diagram to pinpoint main and contributing factors.

Two tools were identified in the analysis and were used in creating the suggested model. Heijunka is crucial because of the lack of sufficient production planning in the food production plant, causing uncertainties about the time needed to finish each manufacturing order. The 5S tool offers specific and detailed instructions for addressing excessive waste or the spread of defective products in the work area and plant warehouses. The VSM and AVA matrices were used to visualize the cycle times of each work activity and the total process execution time. The absence of a standard for configuring production machines when changing products requires using the Single-Minute Exchange of Die (SMED) tool to standardize and improve setup time. This will enhance plant capacity and decrease production lead time. **Figure 1** depicts the proposed model. The approach is applied in a context with scarce literature, particularly in the Peruvian industry of tiny enterprises that produce balanced animal feed, lacking understanding of procedures or tools for continuous improvement.

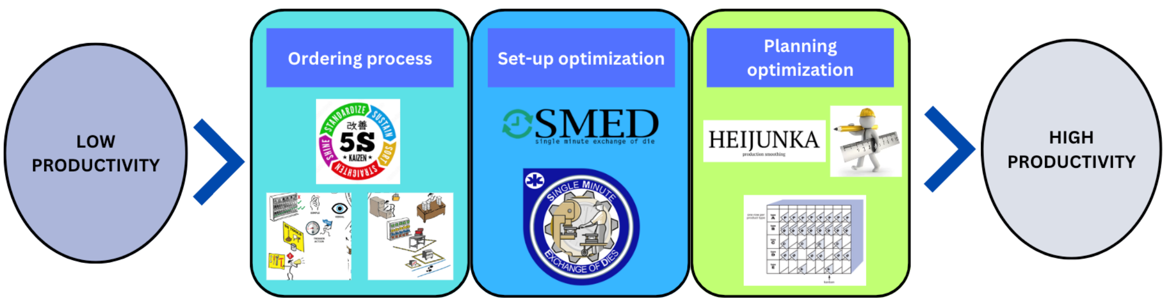

Figure 1. Proposed Model

3.2. Proposed Model

The model consists of three components that coordinate their actions following the continuous improvement approach. The initial component is on arranging and optimizing plant operations and storage facilities by designating precise locations for all goods and tools that are currently without assigned spaces. To tackle this problem efficiently, the 5S tool was used, which has five phases: The process involves sorting, setting in order, shining, standardizing, and sustaining.

The second component is to decrease production time by implementing standardized work and 5S tools simultaneously to standardize, organize, and clean work environments. Furthermore, it focuses on improving the configuration of plant machinery for the production of various products. The SMED tool was used to standardize setup operations, resulting in a decrease in machine setup time.

The third component's implementation entails optimizing production planning. The Heijunka tool is used to optimize workload on the production line, which in turn optimizes production time and boosts productivity.

The main goal of the model is to enhance the efficiency of the animal feed manufacturing process. It aims to create a favorable work environment by ensuring adequate organization and order in the workspaces, leading to enhanced productivity in the production zone. Consult **Figure 2** for an in-depth explanation of the methodology's development.

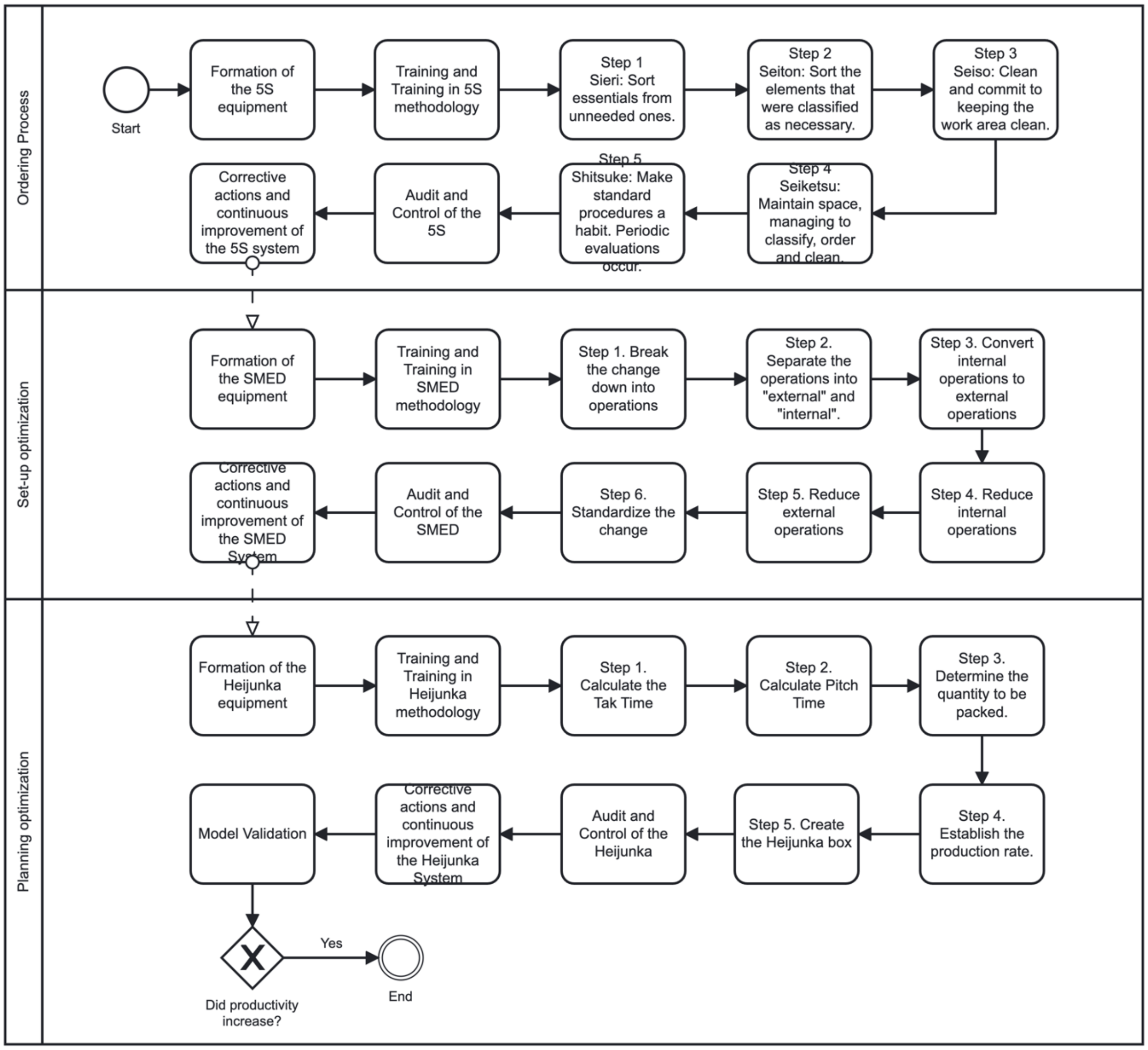

Figure 2. Method of implementation of the proposed Model

3.3. Model Indicators

The subsequent metrics will evaluate the efficacy of the suggested model. Selected specific partial productivity indicators, as outlined in equations (1), (2), (3), (4), and (5), were used to assess productivity in the workshop. The indicators were selected for their flexibility to meet project needs and because their variables are not influenced by seasonal considerations, such as sales.

$$Productivity = \frac{products\ produced}{recurces\ used} \times 100 \quad (1)$$

$$\text{Line preparation time} = \sum (Plant\ preparation\ activities) \quad (2)$$

(3)

$$Cycle\ time = \sum (\text{Production process activities})$$

$$5S\ Audit\ compliance\ rate = \frac{Qualification\ obtained}{Required\ qualification} \times 100 \qquad (4)$$

$$Production\ program\ compliance\ rate = \frac{Production\ made}{Planned\ production} \times 100 \qquad (5)$$

4. Validation

4.1. Initial Diagnosis

The case study focused on a small and medium-sized enterprise dedicated to the production of balanced animal feed, located in southern Peru. This entity faced the need to improve its low productivity, which was primarily attributed to the operational inefficiency of its plant. This inefficiency accounted for 87.44% of the identified problems. Among the deeply analyzed causes, it was found that low adherence to the production plan constituted 36% of the productivity shortfall. This issue was caused by an excessively long current processing cycle time, as well as by an inefficient method of scheduling production. Furthermore, it was identified that the high waiting times in the production process represented 74% of the problem under study, caused by extended setup times and by disorganization and disorder in the warehouses and plant. **Figure 3** of the case study illustrates a problem tree that summarizes the key points of the diagnosis, providing an integrated view of the critical areas that needed to be addressed for the operational improvement of the company.

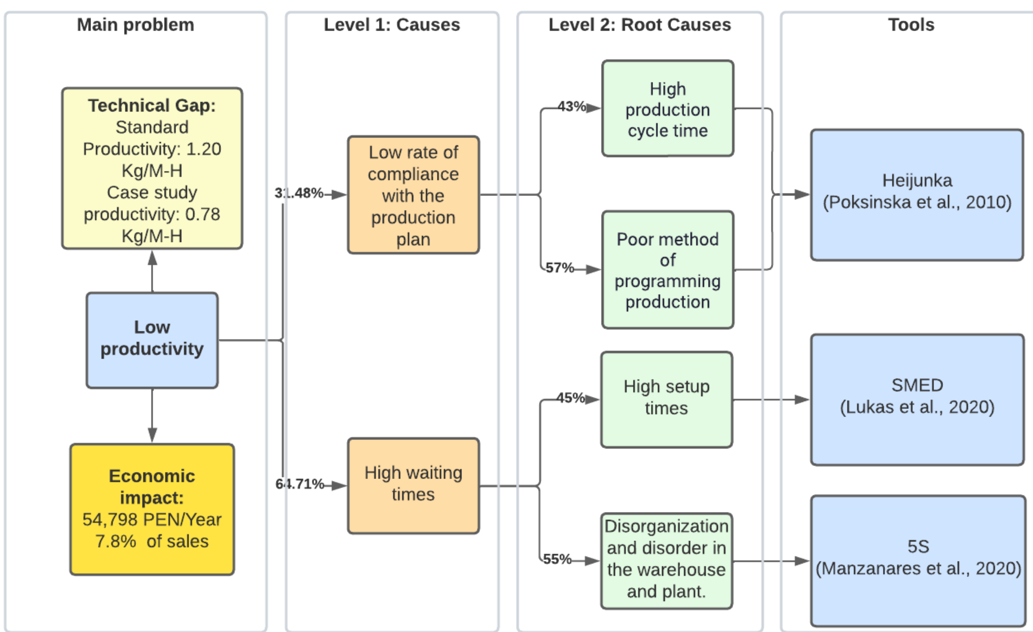

Figure 3. Problem Tree

4.2. Implementation of the 5S pilot scheme

The implementation of Seiri-Seiton resulted in the identification and elimination of non-essential elements, leading to an efficient organization of the storage system for inputs. The average time required to complete tasks significantly decreased. This implementation highlighted the benefits of increased productivity and efficiency. Additionally, an increase in employee satisfaction and a stronger identification with the organization's objectives were reported. The application of Seiso facilitated the creation of dedicated teams and programs for specific area cleaning, while the maintenance record card system ensured regular maintenance activities. Seiketsu introduced a dress code, thereby creating a more presentable work environment. A daily cleaning control sheet was also implemented to maintain the standards set by the first three 'S'. On the other hand, Shitsuke emphasized compliance through the establishment of a defined maintenance system, periodic review of procedures, and the promotion of a discipline and culture of operational excellence. **Figure 4** illustrates the before-and-after images of the 5S pilot program implementation.

Before	**After**	**Before**	**After**
			
			

Figure 4. Image before and after the implementation of 5S

Figure 5 shows the results of the audits of compliance with the 5S methodology before and after the implementation of this tool.

Figure 5. 5S Compliance Audit Before vs After

4.3. Implementation of Heijunka

Furthermore, following the implementation of the Heijunka tool, the current production cycle time was reduced to 40.56 minutes per kilogram. On the other hand, the adoption of this tool, which contributed an optimal method for scheduling production, allowed for an increase in the fulfillment rate of the production plan to 90.56%, thereby facilitating an increase in efficiency, reduction in costs, and enhancement of the process's productivity. This enabled the fulfillment of the sales plan budgeted by the commercial department of the company under study. **Figure 6** displays the current production schedule in kilograms per day, which did not allow for meeting the sales plan.

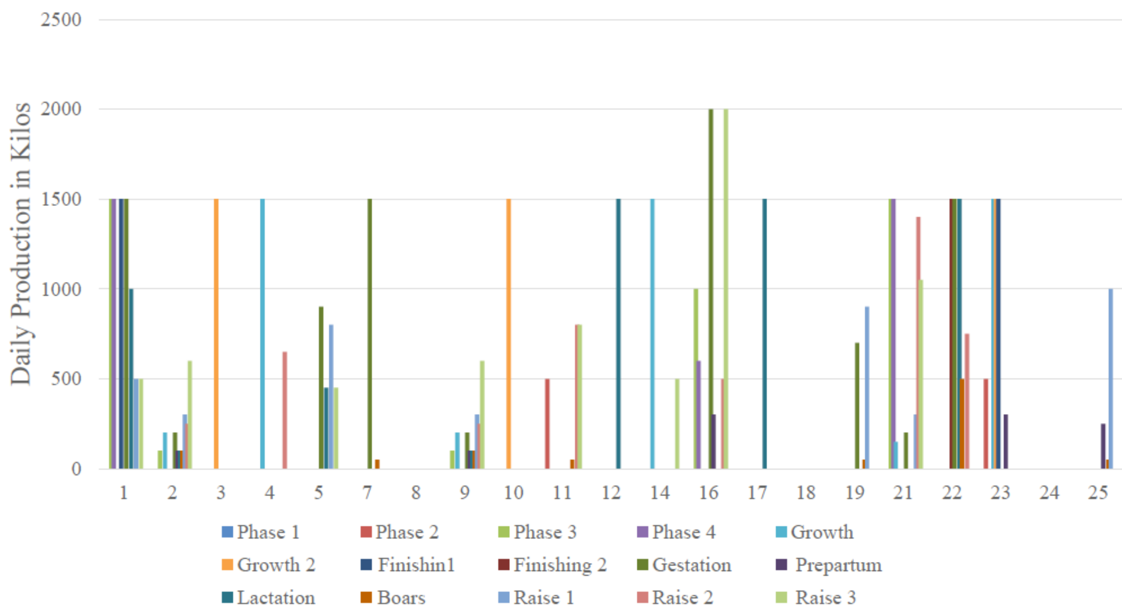

Figure 6. Current Production Schedule in Kilos/Day

After six months of implementing the Heijunka tool, a reduction in the production cycle time and an increase in the compliance rate of the production program were achieved. This allowed for the fulfillment of the sales plan and an increase in the plant's productivity. **Figure 7** shows the production plan after the implementation of the Heijunka tool, highlighting the improvements made.

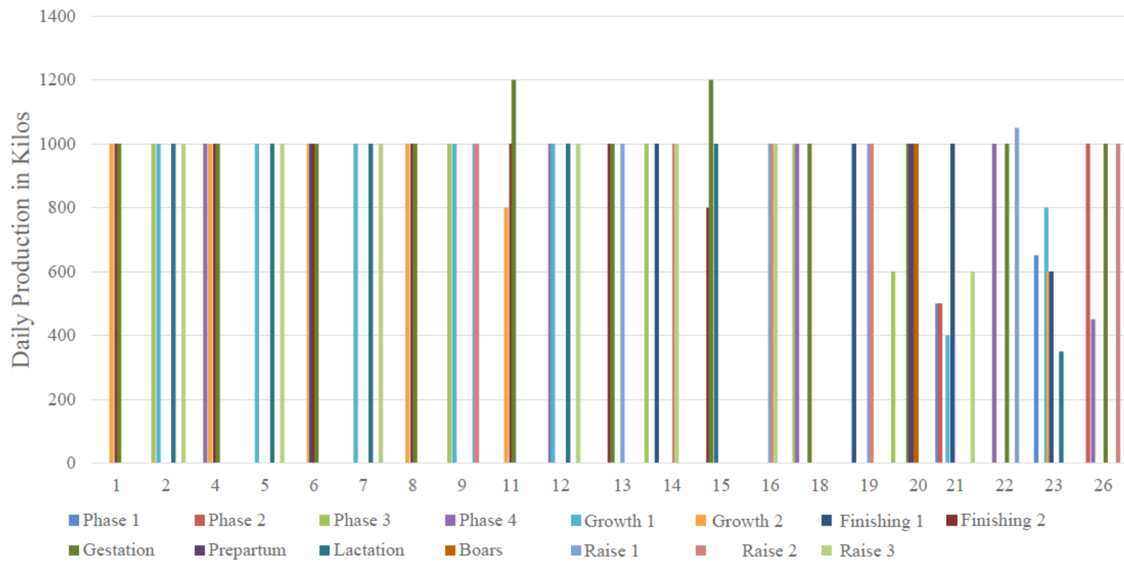

Figure 7. Lean Manufacturing Level Production in Kilos/Day - Heijunka

4.4. Implementation of SMED

This method was applied with the idea that it is always feasible to minimize series changeover times, potentially to the extent of eliminating them completely. Line changeover time was recognized to encompass both technical and organizational processes. Steps were outlined to minimize idle times and waiting periods during line changes. **Figure 8** depicted all the activities necessary in the existing procedure for line switching.

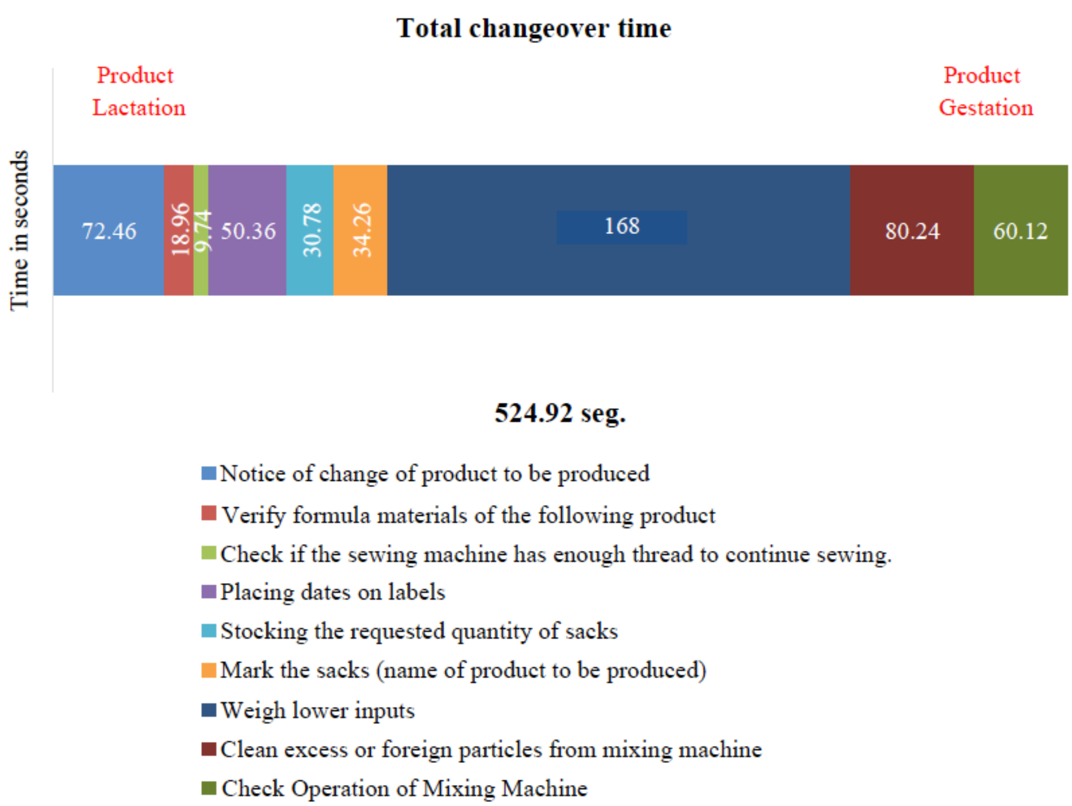

Figure 8. Total changeover time

Once the existing method for line change was understood, the implementation of the SMED tool was carried out, executing the six steps required by the methodology to achieve a reduction in setup time and the subsequent standardization of the new line change method. **Figure 9** illustrates the new line change method with optimized times, achieving a 73% reduction in time compared to the previous method, thanks to the application of the SMED tool.

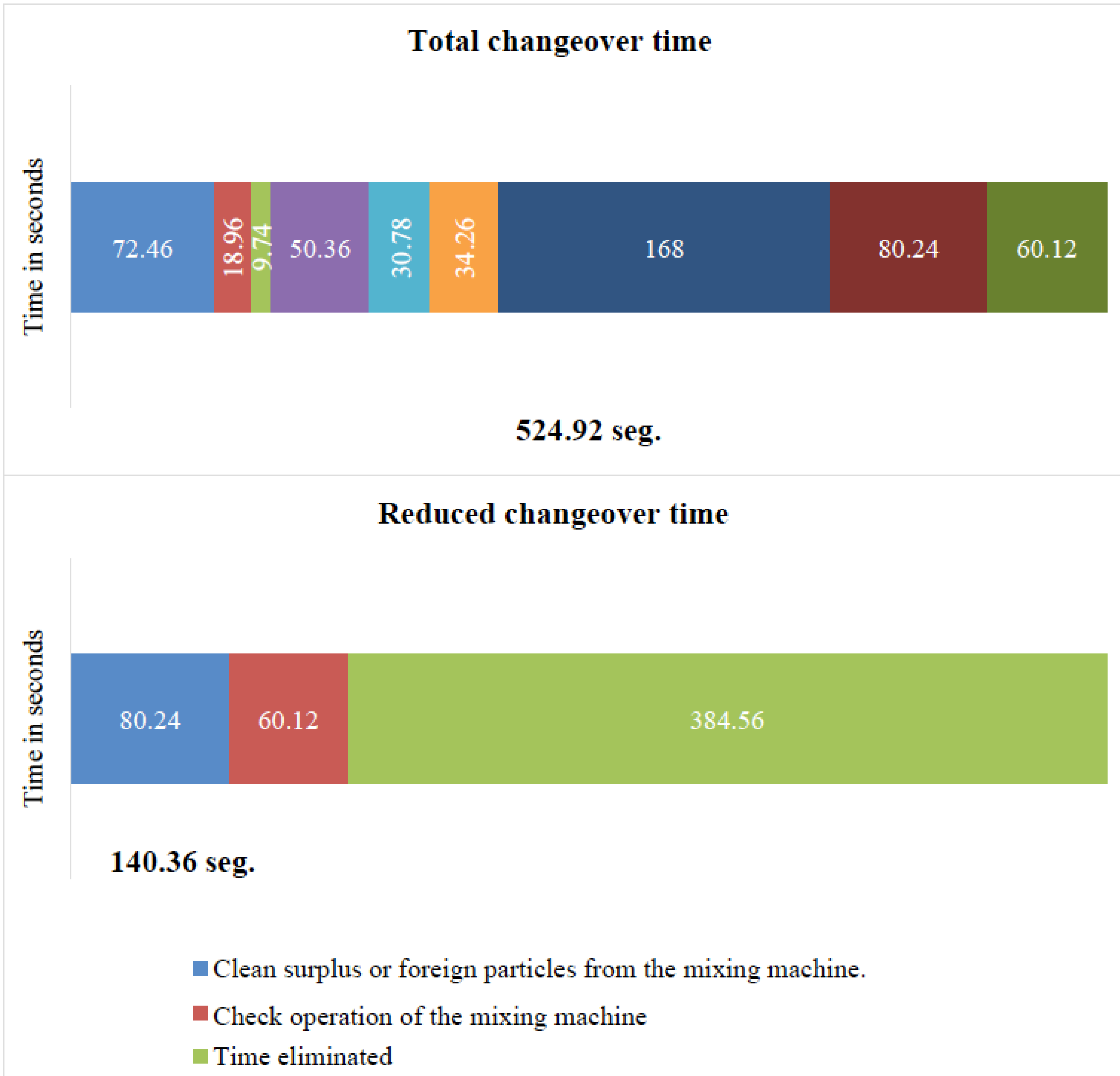

Figure 9. Total change time before and after SMED implementation

5. Results and Discussion

The implementation of each tool demonstrated significant improvements in productivity and process efficiency following the proposed standardized work improvement. A substantial increase in productivity was observed, amounting to 35%, with an average production of 1.05 kg of animal feed per man-hour, compared to 0.78 kg per man-hour before the improvement was made. Additionally, cycle time was reduced by 47%, from 76.45 minutes per kilo to 40.56 minutes per kilo. The implementation of the proposed model also led to a 73% decrease in preparation time for line changeovers, significantly contributing to a more organized and efficient work environment. These findings underscore the effectiveness of Lean methodologies and standardized work in optimizing manufacturing processes and improving overall efficiency in the animal feed industry.

Furthermore, the adoption of Lean methodology and its tools, specifically in terms of 5S and Heijunka, allowed for a demonstration of reduced resource consumption. This is attributed to the methodology's focus on reducing or optimizing resources. This efficiency was evidenced by the increase in production program compliance to 98%, thereby facilitating an increase in sales plan compliance and optimizing plant capacity, thus reducing operational costs.

Table 1 presents the results of the main indicators from the improvement project, showing that all indicators experienced an improvement, reflecting an increase in the productivity of the plant under study.

Table 1. shows the comparative results of the current situation, objective and the result obtained in the pilots .

Indicator	Methodology/Tools	As Is	To Be	Results	Variation (%)
Productivity (Kg/Man-Hour)	**Production Model**	0.78	1.2	1.05	**35%**
Line preparation time (seconds)	**SMED**	524.92	140	140.36	**-73%**
5S audit compliance rate	**5S**	2.35	5	3.5	**49%**
Cycle time (minutes/Kg)	**Heijunka**	76.45	38.78	40.56	**-47%**
Production program compliance rate (%)	**Heijunka**	45.64%	95%	90.56%	**98%**

The successful implementation of the 5S methodology has demonstrated significant improvements in quality and productivity across various companies. For instance, in a study conducted by Rahman (2010), it was found that the implementation of 5S practices in manufacturing companies in Hong Kong led to a successful enhancement in product quality and work life. Likewise, Ahuja & Randhawa (2017) reported that the implementation of the 5S at Arcelor Mittal, the largest steel company in Poland, as the foundation of the TPM initiative, resulted in a labor efficiency increase of up to 150% and a production cost reduction of 30%. On the other hand, the application of the SMED methodology has shown significant reductions in setup times for production lines. For example, Sahin & Koloğlu (2022) successfully applied the SMED methodology to a group of cold profile machines in a metallurgical industry company in Portugal, achieving reductions in setup times. Regarding productivity improvement through 5S, Ruiz et al. (2019) mention that the implementation of the 5S in a textile company allowed for a reduction in cycle time in the sewing process and an increase in value-adding activities by 7%. These studies highlight the effectiveness of the 5S and SMED methodologies in optimizing processes and enhancing productivity in various industrial sectors.

6. Conclusions

Productivity improvements in the animal feed industry through Lean tools are significant. The effectiveness of implementing Lean methodologies such as 5S, Heijunka, and SMED in optimizing production processes and reducing changeover times in the studied plants stands out. These tools proved to be key in eliminating waste, enhancing operational efficiency, and boosting productivity in the animal feed sector. Furthermore, it was demonstrated that adapting Lean tools to the specific needs of the food industry resulted in tangible improvements in efficiency and competitiveness for the businesses. The reduction of operational costs, resource optimization, and improvements in the quality of the final products were notable aspects of applying Lean in this particular context. Additionally, the importance of considering contextual factors and adapting Lean methodologies to the unique characteristics of the animal feed industry to achieve optimal results is highlighted. The combination of Lean approaches with emerging digital technologies offers new opportunities for continuous improvement and process optimization in this key sector for food security and the economy. Finally, the positive impact of implementing Lean tools in the animal feed industry is underscored, highlighting their capacity to drive operational efficiency, reduce costs, improve quality, and strengthen the competitiveness of businesses in a highly demanding and competitive environment.

References

Abidi, M., Lyonnet, B., Chevaillier, P., & Toscano, R., Contribution of virtual reality for lines production's simulation in a lean manufacturing environment. International Journal of Computer Theory and Engineering, 8(3), 182-189. 2016. https://doi.org/10.7763/ijcte.2016.v8.1041

Dora, M., Goubergen, D., Kumar, M., Molnár, A., & Gellynck, X., Application of lean practices in small and medium-sized food enterprises. British Food Journal, 116(1), 125-141. 2013. https://doi.org/10.1108/bfj-05-2012-0107

Queiroz, G., Junior, P., & Melo, I., Digitalization as an enabler to smes implementing lean-green? a systematic review through the topic modelling approach. Sustainability, 14(21), 14089. 2022. https://doi.org/10.3390/su142114089

Shah, R. and Ward, P., Lean manufacturing: context, practice bundles, and performance. Journal of Operations Management, 21(2), 129-149. 2000. https://doi.org/10.1016/s0272-6963(02)00108-0

Steur, H., Wesana, J., Dora, M., Pearce, D., & Gellynck, X., Applying value stream mapping to reduce food losses and wastes in supply chains: a systematic review. Waste Management, 58, 359-368. 2016. https://doi.org/10.1016/j.wasman.2016.08.025

Flores Benítez, F. R., & Núñez Silva, G. B., Aplicación del Lean Manufacturing a una pequeña empresa de fundición metálica. Revista E-IDEA 4.0 Revista Multidisciplinar, 4(11), 18-30. 2022. https://doi.org/10.53734/mj.vol4.id216

Achanga, P., Shehab, E., Roy, R., & Nelder, G., Critical success factors for lean implementation within smes. Journal of Manufacturing Technology Management, 17(4), 460-471. 2006https://doi.org/10.1108/17410380610662889

BENÍTEZ, F. and SILVA, G., Aplicación del lean manufacturing a una pequeña empresa de fundición metálica. E-Idea 4 0 Revista Multidisciplinar, 4(11), 18-30. 2022. https://doi.org/10.53734/mj.vol4.id216

Dora, M., Goubergen, D., Kumar, M., Molnár, A., & Gellynck, X. , Application of lean practices in small and medium-sized food enterprises. British Food Journal, 116(1), 125-141. 2013. https://doi.org/10.1108/bfj-05-2012-0107

Dora, M., Goubergen, D., Kumar, M., Molnár, A., & Gellynck, X., Application of lean practices in small and medium-sized food enterprises. British Food Journal, 116(1), 125-141. 2013. https://doi.org/10.1108/bfj-05-2012-0107

Lamprea, E., Carreño, Z., & Sánchez, P., Impact of 5s on productivity, quality, organizational climate and industrial safety in caucho metal ltda. Ingeniare Revista Chilena De Ingeniería, 23(1), 107-117. 2015. https://doi.org/10.4067/s0718-33052015000100013

Randhawa, J. and Ahuja, I., 5s – a quality improvement tool for sustainable performance: literature review and directions. International Journal of Quality & Reliability Management, 34(3), 334-361. 2017. https://doi.org/10.1108/ijqrm-03-2015-0045

Grimaud, F., Dolgui, A., & Korytkowski, P, Exponential smoothing for multi-product lot-sizing with heijunka and varying demand. Management and Production Engineering Review, 5(2), 20-26, 2014. https://doi.org/10.2478/mper-2014-0013

Kovács, G., Methods for efficiency improvement of production and logistic processes. Research Papers Faculty of Materials Science and Technology Slovak University of Technology, 26(42), 55-61. 2018. https://doi.org/10.2478/rput-2018-0006

Poksińska, B., Pettersen, J., Elg, M., Eklund, J., & Witell, L., Quality improvement activities in swedish industry: drivers, approaches, and outcomes. International Journal of Quality and Service Sciences, 2(2), 206-216. 2010. https://doi.org/10.1108/17566691011057366

Rewers, P. and Diakun, J., A heijunka study for the production of standard parts included in a customized finished product. Plos One, 16(12), e0260515. 2021. https://doi.org/10.1371/journal.pone.0260515

Agreda, F. and Castrillón, J., Aplicación de la técnica smed en el procedimiento de cambio de tintas de la referencia bolsa kraff colanta entera 3c a bolsa kraff amtex tannus 2c. Publicaciones E Investigación, 11(1), 113-124. 2017. https://doi.org/10.22490/25394088.2256

Gómez, L., Lopez, D., Castiblanco, A., & Mateus, T., Análisis de la metodología smed (single minute exchange of die) en una empresa del sector metalmecánico de la ciudad de manizales.. 2021. https://doi.org/10.26507/ponencia.1897

Ahuja, I. and Randhawa, J., 5s implementation methodologies: literature review and directions. International Journal of Productivity and Quality Management, 20(1), 48. 2017. https://doi.org/10.1504/ijpqm.2017.10000689

Belhadi, A., Touriki, F., & Elfezazi, S., A framework for effective implementation of lean production in small and medium-sized enterprises. Journal of Industrial Engineering and Management, 9(3), 786, 2016. https://doi.org/10.3926/jiem.1907

Darestani, S. and Zeinalpour, S., A roadmap for lean production tools implementation. International Journal of Business Excellence, 1(1), 1. 2021. https://doi.org/10.1504/ijbex.2021.10040214

Dora, M., Goubergen, D., Kumar, M., Molnár, A., & Gellynck, X., Application of lean practices in small and medium-sized food enterprises. British Food Journal, 116(1), 125-141. 2013. https://doi.org/10.1108/bfj-05-2012-0107
Mia, M., Nur-E-Alam, M., & Uddin, M., Court shoe production line: improvement of process cycle efficiency by using lean tools. Leather and Footwear Journal, 17(3), 135-146. 2017. https://doi.org/10.24264/lfj.17.3.3
Rahman, M., Implementation of 5s practices in the manufacturing companies: a case study. American Journal of Applied Sciences, 7(8), 1182-1189. 2010. https://doi.org/10.3844/ajassp.2010.1182.1189

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