Universidad de Lima
Facultad de Ingeniería
Carrera de Ingeniería Industrial

SERVICE MANAGEMENT MODEL BASED ON LEAN SERVICE TOOLS TO INCREASE THE PRODUCTIVITY LEVEL OF OPERATIONS IN PERUVIAN SMEs IN THE SPORTS SECTOR

Tesis para optar el Título Profesional de Ingeniero Industrial

Santiago Andres Rivadeneyra

Código 20180089

Nicolas Andres Rodriguez Paredes

Código 20181653

Asesor

Alberto Enrique Flores Pérez

Lima – Perú

Julio de 2023

Service Management Model based on Lean Service Tools to Increase the Productivity Level of Operations in Peruvian SMEs in the Sports Sector

Santiago Andrés-Rivadeneyra*
Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú
20180089@aloe.ulima.edu.pe

Nicolás A. Rodríguez-Paredes
Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú
20181653@aloe.ulima.edu.pe

Alberto Flores-Perez
Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú
alflores@ulima.edu.pe

Bertha Díaz-Garay
Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú
bdiaz@ulima.edu.pe

ABSTRACT

The sports industry continues to show a drastic increase in its influence around the world. When mentioned, the first sector of the industry that comes to mind is the entertainment industry, with multiple million-dollar deals globally. However, the recreational sector is also growing at a significant rate, which means SMEs in this industry should try to follow this trend. This research focuses on the application of three tools that optimizes the circuit assembly time, increasing the productivity of a recreational center by allowing to expand the number of available shifts for the customers. The model presents the use of standard work as a measure to create patterns in the set-up process, 5s for the redistribution of the sporting materials, and systematic layout planning for the accommodation of the circuits and boxes. The validation method used was Arena Software and resulted in an increase of 10.82% of the productivity indicator, providing an effective service management model to be replicated in other companies. Furthermore, an economic and financial evaluation was carried through, as a validation method for the expansion of the number of available shifts, where the NPV for the proposed model resulted in USD 87,107, meanwhile the IRR achieved was 70%, and a cost-benefit indicator of 1.726.

CCS CONCEPTS

• Business Process Management; • Operations research; • Business Process Management Systems; • Process Management;

KEYWORDS

Standard Work, Systematic Layout Planning, 5s Methodology, Process Optimization, Sports Industry

*Corresponding Author.

ACM ISBN 978-1-4503-9852-7/23/01...$15.00
https://doi.org/10.1145/3587889.3587907

ACM Reference Format:
Santiago Andrés-Rivadeneyra, Nicolás A. Rodríguez-Paredes, Alberto FloresPerez, and Bertha Díaz-Garay. 2023. Service Management Model based on Lean Service Tools to Increase the Productivity Level of Operations in Peruvian SMEs in the Sports Sector. In *2023 The 10th International Conference on Industrial Engineering and Applications (ICIEA-EU 2023), January 09–11, 2023, Rome, Italy.* ACM, New York, NY, USA, 7 pages. https://doi.org/10. 1145/3587889.3587907

1 INTRODUCTION

The sports industry is currently dominating the world of entertainment, generating millions of jobs and income thanks to the factor of emotion and expectation within people. The economic impact of sport has generated increasing interest in the academic world [1]. The sports industry provides employment for more than 1.3 million people in Europe, and between 2015 and 2020, employment grew by 1.6% year on year [2]. However, the entertainment sector is not the only one within the sports industry, there is also the recreational sphere, and this is where gymnasiums, training fields, functional centers, among others come into play. Currently in Peru, there is no generalized development of the industry as can be seen in neighboring countries such as Argentina or Brazil, and this can be caused by diverse factors. One of them can be the authorities who show no interest in developing the industry, as demonstrated when "the former president of the Peruvian Football Federation was arrested by the police for his alleged links to a corruption network with high-ranking judges" [3]. In addition, we find that the pandemic left economic sequels in all sectors of the country, businesses belonging to the sports sector reduced their income by at least 50% [4]. Although this is an anomaly, it is considered important to take it into account when analyzing a SME in the sports sector.

The problem identified leads us to the case of study of a sports industry SME where the main problem is the low productivity, that can be caused by various factors, such as the lack of planning of the training circuits, the absence of standardized layouts, lack of standard times, among others. This causes service waste regarding the useful time of the hours rented. On the other hand, we find research where the abandonment rate of gyms is predicted, considering that between 30% and 60% of members continue with their gym membership after the first year [5]. The conclusion of this study shows that, in order to reduce this abandonment rate, the behavior of the customers must be analyzed, considering the study of strategies of loyalty and personalization of the service. These kinds of problems lead us to thinking that there are shared problems within the customers of the sports industry. Increasing the effectiveness of the processes, and reducing the service waste, can lead to greater customer satisfaction, and as a consequence increase the level of productivity of the company.

For this research, a case study was chosen based on a sports industry Peruvian SME, which reflects the problem of low productivity and high service waste, demonstrated in the percentage of productive time related to the rental of football fields. The largest waste identified is the circuit assembly time, which refers to the number of minutes it takes for the workers to set-up the circuits and leave the field ready for training to begin. This research will offer a service model, where the set-up times are arranged, and a standard layout is established, to reduce service waste, and as a consequence increase the number of shifts available per day from five to seven. Although there is research that relates Lean Service practices with companies belonging to the sports industry, it is considered pertinent to apply knowledge of set-up time and standard work to increase the productivity of a SME belonging to this sector.

Considering that there is no scientific literature in the Peruvian context regarding this economic sector, a need was identified to conduct research in this field of study. The scientific article will be divided in six parts: Introduction, State of the Art, Contribution, Validation, Discussion, and Bibliography.

2 STATE OF THE ART

2.1 Standard Work in Service Industry

Standard work seeks to identify appropriate ways of executing a job, that guarantees good results, and that generates satisfaction to the worker who performs this work [6]. The goal of standardization is to create best practices and get every team member to use the established best practices in the same way [7]. Moreover, according to Mogaramendi et al [8], if the implementation is executed correctly, the benefits are visible, and the creativity of workers can be increased. In addition, this tool gives the freedom to work teams to organize themselves and implement standardization as they see fit [9]. On the other hand, according to Ribeiro et al. [10], this tool generates stability and autonomy in workers. Furthermore, it is observed that non-standardized work increases processing time and process waste, as well as the proportion of defective products [11]. On the other hand, the case study of standardized work implementation by Aisyah et al. [12], obtained a time 2 seconds faster than the required takt time and thus was able to meet the customer's needs of 1200 pieces/day, evidencing the success of the tool. In addition, in a case of improvement by Canales-Jeri, et al. [13], a remarkable improvement can be evidenced regarding the out-of-time deliveries that represented 60% of the deliveries made and were reduced to 29.9%.

2.2 Systematic Layout Planning

The Systematic Layout Planning tool has been used to design the best layout alternative and minimize the material transfer time that occurs in a production plant [14]. Despite this, it is observed that in a service process, there are activities that do not add value, such as waiting time, over processing, unnecessary movements, and unnecessary transportation [15]. Not having a standard layout planned is identified as one of the main causes of the mentioned problem, considering that an effective layout can decrease operating costs by 10-30% [16]. To successfully achieve the application of this tool, the current layout must be evaluated, however, this is a challenging task considering subjective objectives of quantitative and qualitative nature [17]. Implementing standard layouts through this tool, will allow fast flow of materials with the least amount of handling [18]. However, it should be noted that this tool cannot be applied to all contexts in the same way, since each layout design has its own characteristics and limitations [19]. On the other hand, some success cases such as Ruiz et al. [20], mention that the use of this SLP tool reduced the cycle time from 33.64 minutes to 25.32 minutes. Furthermore, in a Peruvian footwear production company, the main problem was the delivery of orders and by implementing SLP it was fulfilled by 100%, in addition to increasing production capacity, reducing defective products by 3% and increasing productivity by 8% [21].

2.3 5S Methodology for Work Area Organization

The implementation of 5S brings the plant to an orderly, organized state and results in improved overall product productivity [7]. However, some companies find it difficult to assimilate the 5S principles and believe that it is only a cleaning process [22]. This methodology follows five essential steps: classify, sort, clean, standardize, and maintain [23]. For the first step, unnecessary items in the warehouse must be sorted and separated, second, the necessary materials are organized to be available quickly. The third step seeks to have a clean work area and the fourth step standardizes the previous three steps by repetition. Finally, the fifth step maintains what was established in the previous four steps [24]. Thus, in the case study conducted by Gupta & Jain [7], quite a few improvements were achieved. It was observed that workers used to spend on average 30 minutes a day looking for a tool, after applying the 5S, the average time was only five minutes a day, thus saving a significant amount of money. In addition, standard operating procedures (SOPs) were used to specify which materials and tools are needed to perform the job. With these, workers can monitor work efficiency and improve their performance. On the other hand, León-Enrique et al [24], the implementation of tools managed to increase productivity in the unloading and storage processes by 40%.

3 PROPOSED MODEL

For the model proposal, a literature review was carried through, and Table 1 below shows the authors who have contributed the most to identify the tools required for the model.

Figure 1 shows the proposal for the redesign of the assembly process for the circuits, focusing on a productivity improvement. The innovation of this model lies in the fact that the use of these tools to improve the productivity of a company belonging to the sports industry had not been found before. The model seeks to decrease the setup time from 30 to 10 minutes, in order to allow two new shifts to be added to the regular schedule. Standardized work will be used for the set-up times, while 5s will be applied for the redistribution of boxes and sport instruments in these. Systematic Layout Planning will redefine where the boxes will be placed for the circuit set-up process. The integration of these three tools should decrease the set-up time, allowing the case study company to add two shifts to the regular schedule, increasing the total capacity of the service provided.

3.1 Model Components

The model is divided into three components, which will be explained below.

Table 1: Comparative Matrix of the Proposal’s Components vs. State of the Art

Authors/ Causes	Decrease of set-up process time	Standard Layout	Work Area Organization
Supriyanto, H., & Saputra, Y. A. (2019).	Lean Service		
Alfiansyah, N. , Awibowo, S. , Saraswati T. 2020.	Time study	Systematic Layout Planning	DMAIC
Tarigan U., Ishak A., Hutauruk Y.O., Siregar K., Sari R.M. 2020.	Lean Service	Systematic Layout Planning	
Ruiz, S., Simón, A., Sotelo, F., & Raymundo, C. (2019).		Systematic Layout Planning	5S
Ke Yang. 2021.		Systematic Layout Planning	
Gupta, S., & Jain, S. K. (2015).			5S
Ishijima, H., Eliakimu, E., & Mshana, J. M. (2016).	Work Standardization		5S
Senthil Kumar, K. M., Akila, K., Arun, K. K., Prabhu, S., & Selvakumar, C. (2022).			5S
Shahriar, M. M., Parvez, M. S., Islam, M. A., & Talapatra, S. (2022).			5S
Robello R., Miller C. 2022.	Work Standardization		5S
Realyvásquez-Vargas, A., Flor-Moltalvo F.J, Blanco-Fernández J., Sandoval-Quintanilla J.D., Jiménez-Macías E., y García-Alcaraz J.L. 2019.	Work Standardization		Work Area Redesign
Nallusamy S, Saravanan V. 2016.	Work Standardization, Kanban		5S
Proposal	Work Standardization	SLP	5S

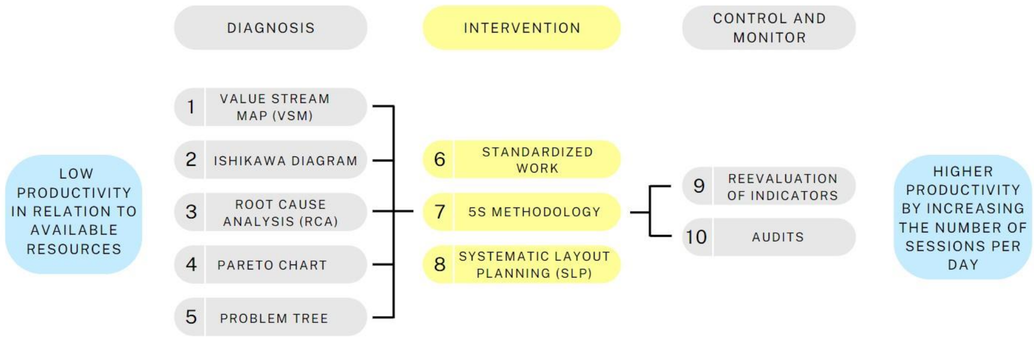

Figure 1: Proposed Improvement Model

3.1.1 Component 1: Problem Analysis. The first phase is composed of the diagnosis of the company. This allowed us to build a problem tree of the causes that may be generating the problem identified within the company, in this case, the low productivity with respect to the resources available. The main cause is related to the time invested in the assembly of the training circuits.

3.1.2 Component 2: Intervention. The second component is based on the implementation of the tools described in the model. The first tool implemented is standard work which aims to significantly reduce the times of assembling training circuits, through the assignment of tasks to each worker, and considering a standard time of set-up for each type of circuit. This was made by a redistribution of the implements in each of the plastic containers that must be conducted, followed by an analysis of the tasks to assemble the circuits in the most efficient way possible. Finally, a time study must be carried out to establish a standard time.

After the use of work standardization, 5s methodology will be implemented step by step. For the first step, the unnecessary elements within the warehouse must be classified and separated. Then the plastic containers will be labelled in relation to the circuit for which it is planned. For the third step, walls, floors and surfaces of boxes and storage areas will be cleaned. In addition, it is crucial to have cleaning protocols with the sports equipment that is used. For the fourth step, each of the workers will be taught the previous three steps several times so that habits are created in the work area. Finally, the fifth step seeks to maintain what has been established in the previous four steps, the compliance with these tools will be verified through visual control of the workstation.

Finally, the third tool used is Systematic Layout Planning (SLP). This tool will be used to plan a redistribution of the place where the plastic containers will be placed on the field to set-up each circuit. Currently, the plastic containers are on the left edge of the playing field, and from there the implements are mobilized for each type of circuit. This tool will have as its main objective to reduce the time of transport of implements to the circuits.

3.1.3 Component 3: Control and Monitoring. The last component consists of validating the improvement model by the review of KPI’s. To achieve this, the Arena Simulator software will be used, which will allow simulating the operation of the company with the application of the previously mentioned tools in the construction of the new model. This will allow measuring with significant indicators, which will be observed later, and demonstrate if it is really possible to achieve a substantial change in the productivity of “Pro Amateur Fútbol” company. The results are controlled by the table of indicators presented in Table 2.

Table 2: Comparison of Indicators

Indicator	Formula	Use
%Productivity	(Productive time/Total Time)	Total productive time represents the hours of training over the total time in a full working day.
Transfer time	(Transfer time/Total Time)	Total transfer time represents transfer time of plastic containers over the total time in a full working day.
Set-up time	(Set-up time/Total time)	Total Set-up time represents time of coordination, transfer of plastic containers, sports materials, and set-up of training circuits over the total time in a full working day.
%Income	(Real income /Actual revenue)	The factor compares the revenue obtained before and after the implementation of the proposed model.

4 VALIDATION

4.1 Initial Diagnosis

The set-up time for the circuits represents 40% of the total time reserved for the football courts. This is the main takeaway of the initial diagnosis made for the SME “Pro Amateur Futbol”. The main focus of this research is to drastically decrease this percentage, which shows low productivity regarding the number of training sessions per day. When studying set-up times for the circuits, on average, this process lasts for approximately 30 minutes, and the objective established is 10 minutes, meaning this indicator presents a 20-minute technical gap.

Three main causes were identified for the low productivity regarding the number of training shifts per day in the initial diagnosis phase: long circuit set-up time represented 30%, absence of classification and organization in the box warehouse 20% and lack of planning for court and boxes distribution 10%. The remaining 40% belongs to other causes. Figure 2 presents a problem tree that summarizes the diagnosis conducted in the case study.

4.2 Validation of the Improvement Proposal Compared to the Initial Diagnosis

The validation of the proposed model is composed of three phases, which were presented in chapter 3. In the first place, the diagnosis had the objective of identifying the root causes, which were found through tools such as Value Stream Mapping, Root Cause Analysis, among others. The three root causes found were long circuit set-up time, absence of classification and organization in the box warehouse and lack of planning for court and box distribution. The second phase is based in the implementation of three tools. Standard Work, where tasks and times were studied and registered, in order to create a standard pattern of work. Then, 5s methodology was used for the classification, distribution and labeling of boxes that contain sporting materials. Finally, Systematic Layout Planning was applied for the location of the boxes and the circuits. The third phase seeks to analyze the indicators with the objective of revisiting key performance indicators established before the implementation.

4.3 Improvement - Simulation Proposal

Prior to the simulation, field data was collected regarding set-up process time on multiple occasions. This data was used for the validation of two different simulations, in which we compared the results of the actual process used for the set-up of circuits, and another simulation for the proposed model, where non-value adding activities were eliminated, and transportation times were decreased caused by the application of the tools mentioned.

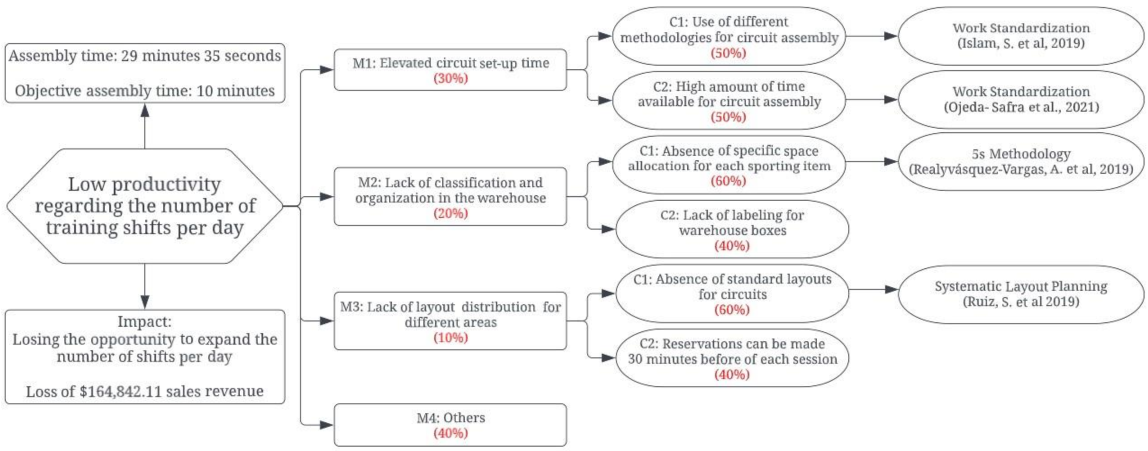

Figure 2: Problem Tree

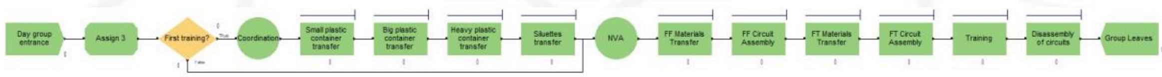

Figure 3: Simulation of the Current Situation for Circuit Set-Up

Arena software was used for the simulations previously mentioned, with the purpose of demonstrating the feasibility of the tools proposed in a service management model. This section will describe the simulation conditions, such as input variables, sample sizes, entities, restrictions, among others. The first scenario for the simulation is the current situation for the circuit set-up process. A simulation equivalent to a working day was performed. It begins with the arrival of a group of clients with a constant frequency of 1.5 hours between groups. Then, the process to set-up the training circuits begins, starting with a coordination meeting conformed by a normal distribution with a mean of 4 minutes. After defining in the coordination meeting the training circuit to be followed, the staff begins with the transfer of eight small plastic containers, six large plastic containers and two heavy plastic containers to their corresponding zones, this whole process takes approximately 13 minutes. Once in the zones, they proceed to move the necessary sports materials for each training circuit, afterwards they proceed to assemble each of the training circuits with the sports materials, this process takes approximately 11 minutes. After everything is organized and in place, the clients enter the football field, and the training begins for them to enjoy the service. Figure 3 shows the simulation of the circuit set-up process.

The second scenario simulates the proposed model, where the three tools are already applied. The simulation of the proposed model also represents a full working day. It begins with the arrival of a group of clients with a constant frequency of 1.5 hours between groups. During visits to the company, it was observed that the training sessions are not always full. Although the maximum capacity per training session is forty-eight clients, normally the number of clients per training session ranges from 25 to 36. Currently, they always take out all the plastic containers even if the number of materials is not used in their entirety. Therefore, this model proposes standard work to determine the number of containers needed according to the number of customers to attend. In this way, the number of plastic containers was standardized for each training so that for training type 1, a total of two plastic containers are taken out; training type 2, four containers; training type 3, six containers; and for training type 4, eight containers. For this situation, a discrete distribution was used for the training type, 1 in 15% of the cases, 2 in 35%, 3 in 35% and 4 in 15% of the cases. Then, the use of the 5s methodology helped to eliminate the transfer of the small containers, since it was considered that they were not necessary for the process and the material was redistributed to the large and heavy containers. Then, the SLP tool helped us to eliminate unnecessary material movements by redistributing some areas of the plant. Figure 4 shows the simulation of the proposed model for the circuit set-up process.

Figure 5 presents the indicator board of the proposed model and the results of both simulations, the current situation, and the proposed model.

5 DISCUSSION

The proposed model presents the main focus on increasing the productivity of a sports industry SME using tools such as Systematic Layout Planning, work standardization and 5s methodology, which could be applied to other companies in this economic sector, specifically in the recreational area. The results of the implementation of the model are shown in figure 5.

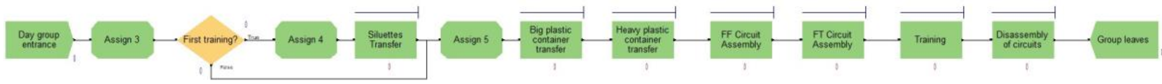

Figure 4: Simulation of the Proposed Model for Circuit Set-Up

Proposal Model Measurements								
Problem	**Actual**	**Objective**	**Results**	**Cause**	**Indicator**	**Actual**	**Objective**	**Results**
Low Productivity in relation to available resources	71.43%	> 80%	82.35%	Use of different methodologies for circuit assembly	Set-up time	27:03 min	< 10 min	12:33 min
				Elevated circuit set-up time				
				Lack of layout distribution for different areas	Transfer time	14:37 min	12 min	8:07 min
				Lack of classification and organization in the warehouse	Income	$ 412,105	$ 494,526	$ 576,947

Figure 5: Indicator Results

When reviewing the results obtained, the indicator that showed the most significant variation was the productivity with an improvement of 11%. One of the causes of this improvement is the reduction of set-up time from 27 minutes to 12 minutes with a reduction of 54% in time, achieving greater efficiency in the company's operations through the use of standard work and SLP and in this way eliminate activities that do not generate value [20], [25]. The transfer time of plastic containers was reduced from 14 to 8 minutes with an improvement of 44% thanks to the application of the 5s methodology, which reduced the number of plastic containers to be transferred [22]. Finally, there was a positive economic return on income, which increased by USD 164,842 representing a 17% improvement in the company's annual revenue [20].

Moreover, the economic and financial validation showed significant results regarding to the increasing of two shifts daily for the SME studied. The net present value (NPV) for the proposed model is USD 87,107, meanwhile the IRR was 70%, with a cost-benefit indicator of 1.726.

6 CONCLUSION

The implementation of the proposed model in the recreational sports industry, considering the utilization of the three tools, obtained the results within the expected range. The main indicator being the set-up process time showed a decrease to 12 minutes, allowing to add two shifts to the schedule, which means that eighty new customers daily could access the service. The economic impact of this addition of two shifts could mean an increase of approximately USD 164,842 in the gross annual revenue of the SME "Pro Amateur Futbol".

As for the other indicators, the reduction of transfer time reveals that there were unnecessary materials that increased the time of the activities; with the 5s methodology, these materials were eliminated and consequently there was a 44% improvement in the plastics containers transfer time. Also, reducing the assembly time was one of the main objectives, and it was achieved satisfactorily with the standard work and SLP tools. Although the 10-minute target was not reached, reducing it to 12 minutes was quite positive, since it made the process more efficient, and it was possible to add two extra training shifts.

REFERENCES

[1] V. Ratten and K. Babiak, "The role of social responsibility, philanthropy and entrepreneurship in the sport industry," Journal of Management and Organization, vol. 16, no. 4, pp. 482–487, 2010, doi: 10.1017/S1833367200001875.
[2] Eurostat, "Employment in sport in the EU," Nov. 27, 2021. Accessed: Nov. 18, 2022.
[Online]. Available: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20210927-1
[3] M. Aquino, "Presidente Federación Peruana de Fútbol, detenido por supuestos vínculos con red corrupción.," Lima, Dec. 06, 2018. Accessed: Jul. 18, 2022. [Online]. Available: https://www.reuters.com/article/peru-corrupcion-futbolidLTAKBN1O51MD
[4] C. Lengua, "Industria deportiva en Perú: ¿a cuánto asciende el daño generado por la pandemia? ," El Comercio, 2021. Accessed: Nov. 18, 2022. [Online]. Available: https://elcomercio.pe/economia/peru/industria-deportiva-en-peru-a-cuantoasciende-el-dano-generado-por-la-pandemia-coronavirus-peru-ncze-noticia/
[5] I. Clavel San Emeterio, J. García-Unanue, E. Iglesias-Soler, J. Luis Felipe, and L. Gallardo, "Prediction of abandonment in Spanish fitness centres," Eur J Sport Sci, vol. 19, no. 2, pp. 217–224, 2019, doi: 10.1080/17461391.2018.1510036.
[6] C. Miller Verano, R. Robello Ponce, A. Flores-Perez, J. Quiroz-Flores, and M. Collao-Diaz, "Increasing Sales in a Real Estate Company Using 5S and Standardization Work: A Case of Study," in Proceedings of the 7th North American International Conference on Industrial Engineering and Operations Management, 2022.
[7] S. Gupta and S. K. Jain, "An application of 5S concept to organize the workplace at a scientific instruments manufacturing company," International Journal of Lean Six Sigma, vol. 6, no. 1, pp. 73–88, 2015, doi: 10.1108/IJLSS-08-2013-0047.
[8] M. Mogaramedi, H. Nel, and A. Marnewick, "Impact of standard work for leaders on reducing unused employee creativity during lean implementation," South African Journal of Industrial Engineering, vol. 31, no. 2, pp. 1–10, 2020, doi: 10.7166/31-2-1842.
[9] W. Fazinga, F. Saffaro, E. Isatto, and E. Lantelme, "Implementation of standard work in the construction industry | Implementación del trabajo estandarizado en la industria de la construcción," Revista Ingenieria de Construccion, vol. 34, no. 3, pp. 288–298, 2019, doi: 10.4067/S0718-50732019000300288.
[10] P. Ribeiro, J. C. Sá, L. P. Ferreira, F. J. G. Silva, M. T. Pereira, and G. Santos, "The impact of the application of lean tools for improvement of process in a plastic company: A case study," in Procedia Manufacturing, 2019, vol. 38, pp. 765–775. doi: 10.1016/j.promfg.2020.01.104.
[11] A. Realyvásquez-Vargas, F. J. Flor-Moltalvo, J. Blanco-Fernández, J. D. SandovalQuintanilla, E. Jiménez-Macías, and J. L. García-Alcaraz, "Implementation of production process standardization-A case study of a

publishing company from the SMEs sector," Processes, vol. 7, no. 10, 2019, doi: 10.3390/pr7100646.

[12] S. Aisyah, H. H. Purba, and S. Dwi Setiaji, "Analysis Work Standardization Using the Standardized Work Combination Table on CNC of Mission Case Line Process at PT Astra Otoparts, Tbk-Nusametal Division," in IOP Conference Series: Materials Science and Engineering, 2020, vol. 1003, no. 1. doi: 10.1088/1757899X/1003/1/012044.

[13] L. Canales-Jeri, V. Rondinel-Oviedo, A. Flores-Perez, and M. Collao-Diaz, "Lean model applying JIT, Kanban, and Standardized work to increase the productivity and management in a textile SME.," in ACM International Conference Proceeding Series, Jan. 2022, pp. 79–84. doi: 10.1145/3524338.3524351.

[14] Sunardi, J. Ananda Esya, and B. Santoso, "Redesign of the Production Facility Layout by Using Systematic Layout Planning Method at Cahaya Bintang Mas Company Surabaya," in Journal of Physics: Conference Series, 2020, vol. 1569, no. 3. doi: 10.1088/1742-6596/1569/3/032007.

[15] U. Tarigan, A. Ishak, Y. O. Hutauruk, K. Siregar, R. M. Sari, and U. P. P. Tarigan, "Implementation of Lean Services and Facility Layout to Improve Health Clinical Service Processes," in IOP Conference Series: Materials Science and Engineering, 2020, vol. 1003, no. 1. doi: 10.1088/1757-899X/1003/1/012031.

[16] D. Suhardini, W. Septiani, and S. Fauziah, "Design and Simulation Plant Layout Using Systematic Layout Planning," in IOP Conference Series: Materials Science and Engineering, 2017, vol. 277, no. 1. doi: 10.1088/1757-899X/277/1/012051.

[17] E. C. Maina, P. N. Muchiri, and J. N. Keraita, "Improvement of Facility Layout Using Systematic Layout Planning," IOSR Journal of Engineering (IOSRJEN), vol. 8, no. 5, May 2018.

[18] A. Nagi and S. Altarazi, "Integration of value stream map and strategic layout planning into DMAIC approach to improve carpeting process," Journal of Industrial Engineering and Management, vol. 10, no. 1, pp. 74–97, 2017, doi: 10.3926/jiem.2040.

[19] A. P. Lista, G. L. Tortorella, M. Bouzona, S. Mostafad, and D. Romeroe, "Lean layout design: a case study applied to the textile industry," Production, vol. 31, 2021, doi: 10.1590/0103-6513.20210090.

[20] S. Ruiz, A. Simón, F. Sotelo, and C. Raymundo, "Optimized plant distribution and 5S model that allows SMEs to increase productivity in textiles," in Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology, 2019, vol. 2019-July. doi: 10.18687/LACCEI2019.1.1.59.

[21] S. E. M. Silvestre, V. D. P. Chaicha, J. C. A. Merino, and S. Nallusamy, "Implementation of a Lean Manufacturing and SLP-based system for a footwear company," Production, vol. 32, 2022, doi: 10.1590/0103-6513.20210072.

[22] J. S. Randhawa and I. S. Ahuja, "Evaluating impact of 5S implementation on business performance," International Journal of Productivity and Performance Management, vol. 66, no. 7, pp. 948–978, 2017, doi: 10.1108/IJPPM-08-2016-0154.

[23] V. Chero-Alvarado and A. Panchana, "Application of the 5S methodology in line number # 1 of classification and packaging of a shrimp packing company located in Duran," Journal of Asia Pacific Studies, vol. 5, no. 3, pp. 598–610, Jan. 2019.

[24] E. Leon-Enrique, V. Torres-Calvo, M. Collao-Diaz, and A. Flores-Perez, "Improvement model applying SLP and 5S to increase productivity of storaging process in a SME automotive sector in Peru.," in ACM International Conference Proceeding Series, 2022, pp. 219–225. doi: 10.1145/3524338.3524372.

[25] T. K. Kamma, N. V. S. Shankar, S. Jajimogala, S. Rama Krishna, and Shabana, "A case study of service firm to optimize the cycle time – advanced lean techniques to design plant layout," in Proceedings of the International Conference on Industrial Engineering and Operations Management, 2020, vol. 59, pp. 1609–1634.

ARTICULO ANDRES - RODRIGUEZ

INFORME DE ORIGINALIDAD

8%	6%	8%	2%
INDICE DE SIMILITUD	FUENTES DE INTERNET	PUBLICACIONES	TRABAJOS DEL ESTUDIANTE

ENCONTRAR COINCIDENCIAS CON TODAS LAS FUENTES (SOLO SE IMPRIMIRÁ LA FUENTE SELECCIONADA)

3%

★ Sayuri Kawakami-Arevalo, Martha Sofia Veliz-Torres, Juan Carlos Quiroz-Flores, Maria Teresa Noriega-Aranibar. "Increased Productivity through a Production Model Based on Lean Manufacturing and SLP Tools in Small Furniture Manufacturing Workshops", Proceedings of the 8th International Conference on Industrial and Business Engineering, 2022

Publicación