Universidad de Lima

Facultad de Ingeniería

Carrera de Ingeniería Industrial

SERVICE MODEL UNDER THE LEAN SERVICE AND MACHINE LEARNING APPROACH TO INCREASE EXTERNAL USER SATISFACTION: A CASE STUDY IN THE HEALTH SECTOR SMEs IN PERU

Tesis para optar el Título Profesional de Ingeniero Industrial

Andrea Ximena Valdivia Castro

Código 20171601

Joselyn Estefanny Villavicencio Condor

Código 20171709

Asesor

Martin Fidel Collao Diaz

Lima – Perú

Julio de 2023

Service Model under the lean service and machine learning approach to increase external user satisfaction: A case study in the health sector SMEs in Peru.

ANDREA, X, VALDIVIA-CASTRO

Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú, 20171601@aloe.ulima.edu.pe

JOSELYN, E, VILLAVICENCIO-CONDOR

Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú, 20171709@aloe.ulima.edu.pe

MARTIN, F, COLLAO- DIAZ

Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú, mcollao@ulima.edu.pe

RAFAEL, CHAVEZ-UGAZ

Facultad de Ingeniería y Arquitectura, Universidad de Lima, Perú, rchavezu@ulima.edu.pe

The problem identified in the health sector was the low level of external user satisfaction in medical health centres. Due to this, a model based on Lean methodology (TPM and work standardization) and machine learning were developed to improve external user satisfaction. Furthermore, a case study was carried out to validate the model in a company in Metropolitan Lima. Through the analysis of indicators, an increase in the level of patient satisfaction to 81.40% was shown, taking into account the percentage of cancelled appointments, availability of the CT scanner, downtime due to failure, and CT scanner handling time.

CCS CONCEPTS • General and reference~Cross-computing tools and techniques~Design

Additional Keywords and Phrases: Lean Service, Total Productive Maintenance, Standardization, Machine learning, Small and Medium Enterprises

ACM Reference Format:

Andrea, X., Valdivia-Castro, Joselyn, E., Villavicencio-Condor, Martin, F. Collao-Diaz and Rafael, Chavez-Ugaz, 2022. Service model under the lean service and machine learning approach to increase external user satisfaction: A case study in the health sector SMEs in Peru. In 2022. *The 4th International Conference on Industrial Engineering and Industrial Management* (Europe) (IEIM-2022-Europe). *January 9-11, 2022*. Roma, Italy. ACM, New York, NY, USA, 11 pages.

1 INTRODUCTION

In managing health services, one of the crucial factors is user satisfaction, from how the service is perceived and behaves to what is expected and what is obtained from the quality of care [1]. Furthermore, in good management, the processes that contribute more to care must be correctly established, knowing the needs of the public, having qualified medical staff, and knowing how to communicate effectively with patients [2]. In the Peruvian health sector, a per capita expenditure of $51 is recorded, which is lower than in most Latin American countries [3]. It shows that the budget execution for the sector has been low, according to the Peruvian Foreign Trade Society [4]; this influences the management of resources since it would not be investing to cover gaps such as human capital, infrastructure, and equipment.

The problem identified was the low external user satisfaction in health centers in Peru; this indicator can be derived from factors such as the availability of medical equipment, inefficient distribution of medical personnel, delays in processes, and appointments rescheduled by the same personnel. This problem has been analyzed in another research. For example, in hospitals in Tamilnadu, there were not enough specialized personnel for each department, little understanding of the patient's needs, and poor time management of the customer care process, among other causes that generated a negative economic impact on the organization. To solve these problems, lean concept tools were implemented to improve service, standardization of the time of care for each patient, Lean tools, and identification of activities that do not add value [5]. Likewise, in another case study in a hospital, to identify and mitigate the causes of the problem, the 5 principles of lean were used so that under these conditions, the hospital could define its decisions [6].

In this context, on the importance of the user satisfaction indicator in medical centers in Peru, a case study was chosen to cover this problem. The wastes found are low availability and days of downtime due to failures of the machines needed to perform examinations and a number of canceled appointments, which caused substantial economic impacts to the company. To solve the problems described, a service model based on Machine Learning and Lean Service was developed through Total Productive Maintenance (TPM) and Standardization of work. This work references the success cases found in state of the art to develop the model whose objective is to provide a solution to the problems of the sector and contribute to the scientific community. The scientific article is divided into six sections: introduction, methodology, state of the art, proposed model, discussion, conclusions, and references.

2 STATES OF ART

2.1 Service model to increase user level in the sector

This sector requires innovative models that focus on the customer as a critical component to offering a better value proposition, lean management, and improved efficiency, thus, increasing the quality of service provided to patients [7]. Currently, it is typical for patient satisfaction evaluation to be based on a comprehensive model that identifies the characteristics and attributes of the service that generate the most significant impact on customer satisfaction [8]. One of these approaches to consider is the improvement of appointment systems so that health centers can manage and plan their services and save waiting times for patients [9].

2.2 Lean applications in the health sector

In research that applied Lean tools, a reduced hospital stay was achieved by 57%, and non-value-added activities were eliminated by 88% [10]. Likewise, it turned out that standardizing processes was one of the most important contributing measures to the variation of patient satisfaction with the disease. While the second factor was physician safety, following waiting time, which also influences patient satisfaction [11].

2.3 Total Productive Maintenance applications in the healthcare sector

This tool is helpful for service systems that must possess optimal operating conditions, such as medical equipment and instruments [12]. Therefore, it impacts the business performance of medical [13]. Preventive and autonomous maintenance has been further developed to reduce costs, and downtime, ensure quality standards and improve the operator's performance [14].

2.4 Machine Learning

The modernization of the health service has a positive impact on its management; this is shown in the streamlining of procedures to schedule appointments and be attended in the shortest possible time, supports specialists in making decisions, reduces the administrative work of staff that can be allocated this time to patient care [15].

Table 1 shows the most relevant papers for each component in order to find a suitable tool for each of them.

Table 1: Comparison table of the proposal components vs. state of the art

Objectives / Papers	Increase user level in the health sector	Reduction in appointment cancellations	Improve machine availability	Minimize failure stop time
Raja, M. et al. (2021) [11]	Lean Service			
Bataineh, O. et al. (2019) [16]			Lean Service-TPM	Lean Service-TPM
Moffatt, S. et al. (2022) [10]	Lean Service-Standardization			
Salazar, L. et al. (2022) [17]		Machine Learning		
Proposal	Lean Service-Standardization	Machine Learning	Lean Service-TPM	Lean Service-TPM

3 PROPOSED MODEL

The present model is composed of Machine Learning and Lean Service tools (Total Productive Maintenance, Work Standardization) which would contribute to the improvement of the level of satisfaction of the medical center under study.

3.1 Model Components

3.1.1 Data collection

Have all the necessary inputs to know and analyze the current personnel and machine management situation. For example, data such as number of doctors, technicians, receptionists, number of machines, frequency of machine use, operating time, time available during a period, managing time, and process flow are measurable and can calculate the proposed indicators.

After that, an analysis is performed through a VSM (Value Stream Mapping), with which it will be possible to have visibility of the improvement opportunities and create value, that is, to understand all the stages of the process with their respective indicators. With this information, the most critical problem is known, and all the possible reasons that cause it are evaluated. In order to prioritize these cases, a Pareto diagram is used; in this way, the magnitude of the impact of each one of them is determined, and the root causes of the main problem are studied in depth.

Finally, a problem tree is developed in which the main problem, economic impact, evidence, and root causes are shown. This will allow analyzing techniques and tools that can be alternatives to mitigate these problems.

3.1.2 Technical intervention

This second component is based on the application of the proposed techniques, such as Lean Service (Total Productive Maintenance and work standardization) and Machine Learning, which were selected in the tree diagram for each root cause.

In relation to Lean Service, the standardized work begins with the mapping of the general process of performing a tomography, through time taking and the preparation of an initial observation sheet to evaluate the activities. After that, the capacity of the process is analyzed, separating the time per machine and per operator's work. After that, the time study is compared to visualize if it exceeds the takt time value, as shown in Figure 1. Finally, the activities that do not generate value to the process are detected.

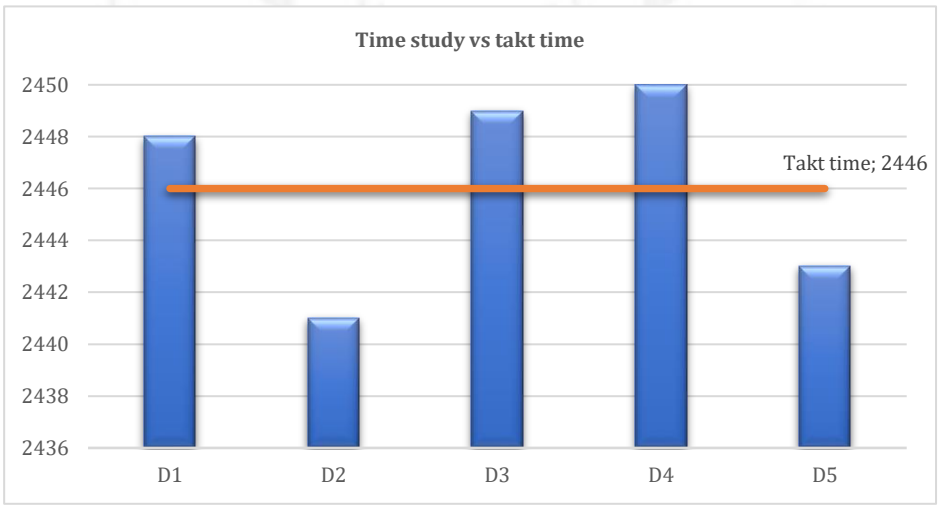

Figure 1: Time study vs take time

Furthermore, with respect to Total Productive Maintenance, some. of its pillars, such as Autonomous Maintenance and Preventive Maintenance, will be considered. For the execution and development of the maintenance plan, it is necessary to define the objectives, which are to avoid breakdowns in the tomograph and to protect it, since its parts are not easy to replace. In the same way, the integration of maintenance tasks to the personnel in charge of the operation of the equipment, through training to the technical personnel in charge. In addition, strengthen the autonomous maintenance plan. This consists of the steps shown in Figure 2.

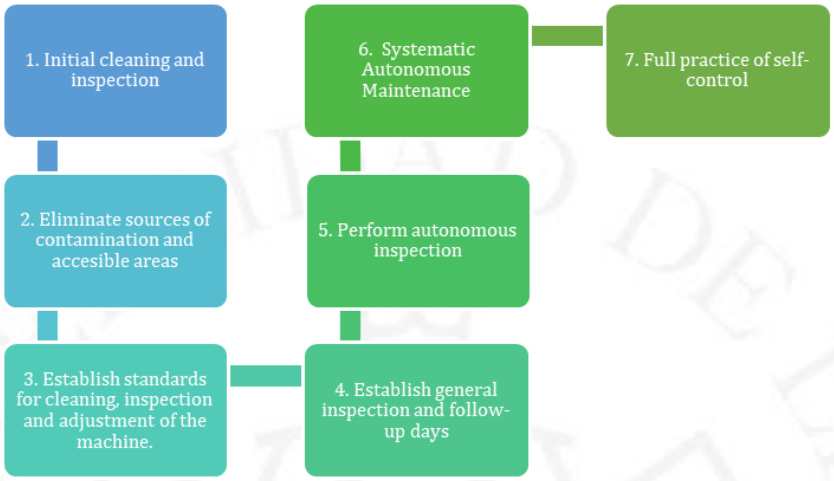

Figure 2: Autonomous maintenance plan

In addition to this, the systematic inspection consists of the operator performing inspections to the equipment before the start of the day in order to always keep the machine in good condition, thus detecting failures before they worsen and cause a stoppage of operations. Finally, with the training conducted, preventive maintenance can be implemented. This consists of policies, maintenance schedule, request for a specialized maintenance technician and purchase orders. The main policy is the periodic inspection to prevent the necessary spare parts in the event of a failure. The preventive maintenance schedule must be based on the following activities: Checking the electrical system, verifying the tightness of mechanical joints, checking external surfaces, inspecting the equipment for dirt, and checking lubrication of mechanical parts.

In the application of Machine Learning, it starts with the collection of relevant data, through transcription, for the problem of appointment cancellation. This is composed of the following inputs: rescheduled appointment, reason for rescheduling, cancelled appointment, reason for cancellation and basic health unit. Next, data cleaning and data preparation begins. In this process it is important to bring all the data into the same format in order to be able to perform an analysis. For example, for the attribute "Appointment cancelled" and "Appointment rescheduled" the value should be standardized: "Yes" or "No", to avoid data inconsistency. To enrich the dataset we take another database, the schedule of the doctors' agenda, and other related attributes such as the month and time of the appointment from the date of the appointment. This allows us to analyze whether there is an influence between the doctor's schedule, the month and time of the scheduled appointment and the cancellation of appointments. Next, according to Suk et al., the XGBoost algorithm proves to be the best performer as it is favorable for anticipating patient demand through the clinical history, it achieves an efficiency of 0.93% in the AUC test. [15]. It is based on the construction of decision trees so that the machine can learn from the results of the previous trees, correct errors and improve the prediction. The choice of this algorithm for the present work is convenient since it will be able to predict the number of patients and appointments scheduled, thus organizing the availability of doctors in an adequate way. Finally, for testing and predictions, at this stage the model is evaluated with the validation data, i.e., that which was not used for training. Once validated, the prediction step begins, which is based on entering new data into the model so that it continues to learn from the behavior of the data and improve the predictions.

3.1.3 Intervention development and implementation

For the development of the proposed model, a construct was elaborated as shown in Figure 3. This construct has as input the low level of patient satisfaction, which will be analyzed through value stream mapping, pareto chart and problem tree to find the root cause of the problem. Subsequently, the intervention stage begins, where the application of Machine Learning and Lean Service tools (Total Productive Maintenance, Standardization of work) will be explained. Finally, the development and implementation of the intervention are based on the re-evaluation of the indicators to compare the initial situation with the new implementation scenario. For this purpose, a simulation of the process will be carried out through the Arena software in order to evaluate the results and compare them with different scenarios.

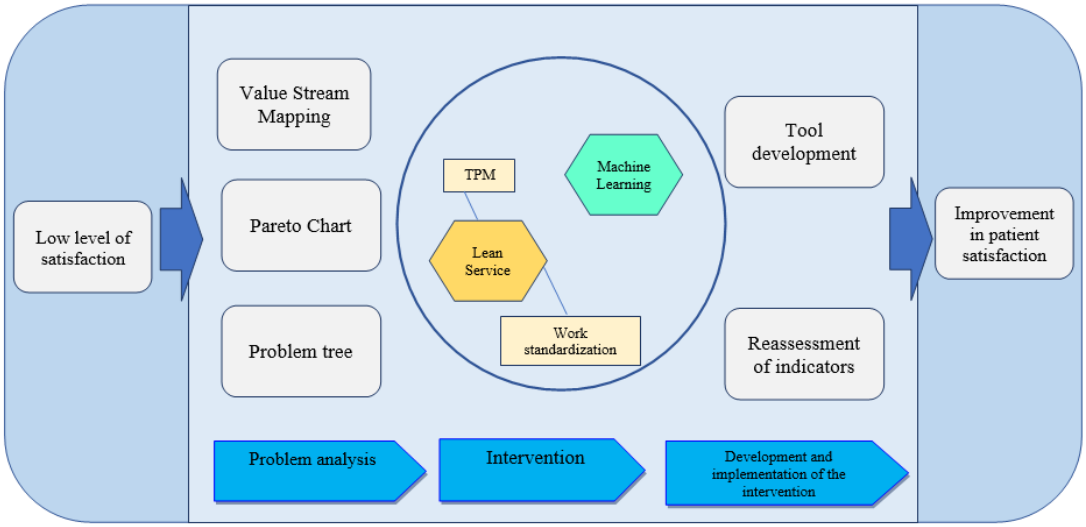

Figure 3: Model proposed

Table 2 details the "as-is" and "to-be" of each indicator in order to have a reference for the re-evaluation of the indicators after the implementation of the improvement.

Table 2: Comparison of As-Is vs. To-Be indicators

	Indicators	As-Is	To-Be	Improvement
Problem	Satisfaction of external user	68.40%	80%	11.6%
Machine Learning	Percentage of canceled appointments	12.50%	0%	-12.5%
TPM	Availability of the tomograph	88%	95%	7.0%
	Failure stop time	36 days	1 days	-35
Work Standardization	Time spent handling the tomograph	40 min	30 min	-10

As for the "to be" indicators, these are taken as goals. An investigation was carried out to determine the technical gap between the value of the indicators of the company under study and the ideal reference value. The 2021 goal for the percentage of satisfaction of users of the service established for the sector is 80% [18]. On the other hand, it is recommended that the availability of machines such as the tomograph should be greater than 95% [19] and the referential handling time of 30 minutes [20].

3.2 Validation

3.2.1 Initial Diagnosis

When analyzing the current situation of the company, it was observed that the main problem is the low satisfaction of the external user. This represents a loss of S/. 221,400.00, which is 14.3% of the annual turnover. The leading causes are the percentage of canceled appointments and stoppages due to tomograph failure. Likewise, there was little standardization of the processes for the use of the tomograph and an inadequate maintenance plan, which caused a low availability of the medical device. In addition to this, there is lean waste in customer service processes. In the flow of information, reprocesses were recorded in terms of rescheduled appointments due to the low availability of resources, some of which was finally canceled.

3.2.2 Validation Design and Comparison with the Initial Diagnosis

In this section, to quantify and validate the improvements of the proposed model, Arena software is used. The scenario that will be simulated consists of the medical care process of the external user. This starts with the scheduling of the appointment, reception of the patient, medical consultation, performance of the medical examination in the tomograph and the diagnosis of the examination. For the validation of the proposed model, the necessary data were collected for each process to identify the deviations and distribution through an Input Analyzer, for this purpose it is necessary to define the input variables, as shown in table 3. In addition, the simulation does not consider factors that may affect the implementation of the model so that the hypothetical results can be altered.

Table 3: Input variables

Controllable Variables	**Non-controllable Variables**
Working hours	Process time
Number of personnel	Percentage of cancelled appointments
Number of machines	Time between arrivals

In the same sense, model elements such as entities, attributes, resources, and activities are defined, shown in table 4.

Table 4: Entity interaction in the system

Entities	**Attributes**	**Resources**	**Activities**
Patients	Order number	Secretary	Log in to system
			Register appointment
			Patient reception
		Doctors	Attend consultation
		Technologist	Operate equipment
		Tomograph	Perform medical examination

In the first phase, the data of the company's current situation was entered and then compared with the improvements obtained. Secondly, machine learning, total productive maintenance (TPM), and work standardization tools were used to improve each process accordingly. That is, machine learning to reduce the percentage of canceled appointments, TPM to enhance the availability of the CT scanner and minimize downtime and time due to failure; and finally, work standardization to optimize the CT scanner handling time.

3.2.3 Improvement- Proposal Simulation

To perform the simulation in Arena considered, a confidence level of 95% and an average margin of error of 10% to calculate the optimal number of samples; likewise, the optimal number of replicates was calculated assuming a desirable margin of error of 5%, resulting in 43 replicates. With the implementation of the aforementioned tool, it was possible to improve the indicators presented, resulting in an increase in the level of patient satisfaction to 81.4%. Likewise, Figure 4 shows the process of the improved situation model, in this case the decision is eliminated if the appointments were cancelled. Table 5 details the improvement for each indicator after the first simulation of the model.

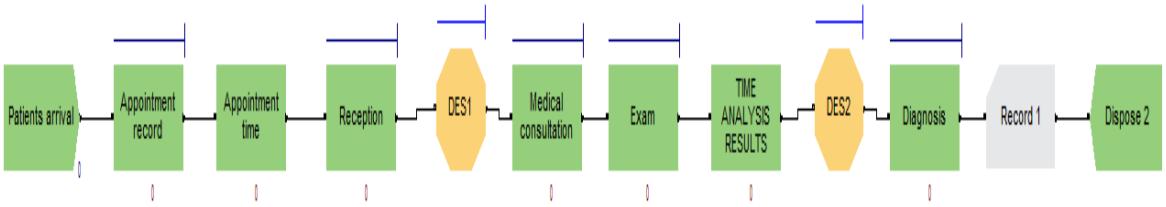

Figure 4: Model of the improved situation

Table 5: Improved situation

Problem	Actual	Objective	Improvement	Tools	Indicator	Actual	Improvement	Difference
Low level of satisfaction	68.40%	80%	81.40%	Machine Learning	Percentage of canceled appointments	12.50%	0%	-12.5%
				TPM	Availability of the tomograph	88%	97%	9.2%
					Failure stop time	36 days	1.3 days	-35
				Work standardization	Time spent handling the tomograph	40 min	30 min	-10

An analysis was made of the financial losses in the company's current situation vs. the situation with the improvement proposal. According to table 6, two important concepts were considered in relation to the company's economic losses related to canceled appointments and stoppages due to failures. Concerning the first concept, it was possible to reduce losses by 100% since canceled appointments caused by an inadequate establishment of appointment schedules were eliminated. On the other hand, the economic losses caused by tomograph downtime were reduced by 96.39%. All this made it possible to minimize losses by 98.47%.

Table 6: Economic impact

Economic losses (annual)	Current situation		Proposed improvement		Difference (%)
Appointments cancelled	S/	117,000.00	S/	-	100.00%
Stoppages due to tomograph failure	S/	86,400.00	S/	3,120.00	96.39%
Total	S/	203,400.00	S/	3,120.00	98.47%

4 DISCUSSIONS

The objective of this study is to improve the level of external user satisfaction as well as improve. The improvements were achieved by the implementation of lean tools (TPM and work standardization). In table

7, a comparative analysis based on 3 scenarios is shown. All indicators show an improvement, the most important being the satisfaction level with an average of 82.75%. In addition, it also shows the elimination of canceled appointments remaining at 0%, the availability of the tomograph at 98.05% on average. In relation to the times, on average, the downtime due to failure is reduced by 29.2 hours, while the device handling time shows a slight improvement of 29.3 min.

Table 7: Scenario Comparison

	E0	E1	E2	E3	Average
Satisfaction Level	81.4%	82.7%	82.9%	83.3%	**82.75%**
% Canceled appointments	0%	0%	0%	0%	**0%**
% Availability of the tomograph	97.3%	97.8%	98.2%	98.9%	**98.05%**
Failure stop time	32 hr	30 hr	28 hr	27 hr	**29.2 hr**
Tomograph handling time	30 min	30 min	28 min	29 min	**29.3 min**

It is essential to mention that for future work, it is advisable to develop a continuous improvement system to evaluate the progress of the implemented tools. In the same way, since the validation and scenarios were performed in Arena software, it has limitations. It means that the results may vary according to the characteristics of each company.

5 CONCLUSIONS

This study has led to an improvement in the level of service satisfaction in an SME in the health sector in Peru through Lean service and Machine learning tools. The results showed an improvement in the indicators proposed for the company's current situation. Using the Pareto diagram, Value Stream Map (VSM), and cause analysis, it was possible to identify the leading causes of low user satisfaction in the medical center, being the canceled appointments due to the assignment of medical appointment schedules; and the stoppages due to CT scanner failure, which represented 52.3% and 39% of the annual billing losses, respectively. Implementing Lean tools (TPM and Standardization of work) reduced the downtime due to failure to 1.3 days and the CT scanner handling time to 30 min. It also improved the availability of the CT scanner to 97%, and the Machine Learning tool eliminated the percentage of canceled appointments. In relation to the economic impact, the annual billing losses could be reduced by 98.47% due to the reduction of the tomograph downtime days to 1.3 days and 0% of canceled appointments.

REFERENCES

[1] Paredes Larios, C. (2020). Calidad de atención y satisfacción del usuario externo del centro de salud de zona rural peruana. Revista Científica de Enfermería. Obtenido de https://alicia.concytec.gob.pe/vufind/Record/REVCEP_4a93fe3b1229a15fc871d176c68ef2bf

[2] Alva, G. (12 de julio del 2018). Consideraciones para mejorar los servicios de salud del Perú. https://www.esan.edu.pe/conexion-esan/consideraciones-para-mejorar-los-servicios-de-salud-del-peru

[3] Instituto Peruano de Economía. (8 de febrero del 2021). Inversión de Pandemia. https://www.ipe.org.pe/portal/inversion-de-pandemia-salud/#:~:text=Con%20ello%2C%20seg%C3%BAn%20cifras%20del,de%20Chile%2C%20Brasil%20y%20Colombiahttps://revista.cep.org.pe/index.php/RECIEN/article/view/2/10

[4] Sociedad del Comercio Exterior del Perú (2019). Informe de Calidad del Gasto Público en Salud 2019. https://www.comexperu.org.pe/upload/articles/reportes/informe-calidad-001.pdf

[5] Balamurugan, R. & Vijayakumar, R. (2018). Performance Measures, Analysis and Improvements in Healthcare Sector By Implementing TQM Tools and Techniques. International Journal of Mechanical and Production Engineering Research and Development. Volumen 8. páginas 971-980. DOI: 10.24247/ijmperdapr2018112.

[6] Nino, V., Martínez, K. J., Gómez, K., & Claudio, D. (2021). Improving the registration process in a healthcare facility with lean principles. Journal of Industrial Engineering and Management, 14(3), 538-551. doi:10.3926/jiem.3432

[7] Miremadi, M. and Goudarzi, K. (2019), "Developing an innovative business model for hospital services in Iran: a case study of Moheb Hospitals," Leadership in Health Services, Vol. 32 No. 1, pp. 129-147. https://doi.org/10.1108/LHS-10-2017-0063

[8] Barrios-Ipenza, F., Calvo-Mora, A., Criado-García, F., & Curioso, W. H. (2021). Quality evaluation of health services using the kano model in two hospitals in Peru. International Journal of Environmental Research and Public Health, 18(11) doi:10.3390/ijerph18116159

[9] Xu, X. P. et al. (2019). An innovative medical consultation model in mainland china: Acceptance and perceptions. International Journal of Health Care Quality Assurance, 32(7), 1055-1071. doi:10.1108/IJHCQA-02-2017-0033

[10] Moffatt, S., Garry, C., McCann, H., Teeling, S. P., Ward, M., & McNamara, M. (2022). The use of the lean six sigma methodology reduces patient length of stay following anterior cruciate ligament reconstruction surgery. International Journal of Environmental

Research and Public Health, 19(3) doi:10.3390/ijerph19031588

[11] Raja M., et al. (2021). Six sigma in healthcare service: A case study on COVID 19 patients' satisfaction. International Journal of Lean Six Sigma, 12(4), 744-761. doi:10.1108/IJLSS-11-2020-0189

[12] Díaz-Reza, J. R., García-Alcaraz, J. L., Avelar-Sosa, L., Mendoza-Fong, J. R., Diez-Muro, J. C. S., & Blanco-Fernández, J. (2018). The role of managerial commitment and tpm implementation strategies in productivity benefits. Applied Sciences (Switzerland), 8(7) doi:10.3390/app8071153

[13] Alkhaldi, R. Z., & Abdallah, A. B. (2022). The influence of soft and hard TQM on quality performance and patient satisfaction in health care: Investigating direct and indirect effects. Journal of Health Organization and Management, 36(3), 368-387. doi:10.1108/JHOM-10-2020-0416

[14] Guedes, Micaela, et al. (2021). The role of motivation in the results of total productive maintenance. Production. 2021, v. 31, e20200057. ISSN 1980-5411. https://doi.org/10.1590/0103-6513.20200057.

[15] Kcomt-Ponce, E. J., Huamaní, E. L., & Delgado, A. (2022). Implementing machine learning in health management to improve the process of medical appointments in Peru. International Journal of Emerging Technology and Advanced Engineering, 12(2), 74-85. doi:10.46338/ijetae0222_09

[16] Bataineh, O., Al-Hawari, T., Alshraideh, H., & Dalalah, D. (2019). A sequential TPM-based scheme for improving production effectiveness is presented in a case study. Journal of Quality in Maintenance Engineering. Volumen 25(1), páginas 144-161. doi:10.1108/JQME-07-2017-0045

[17] Salazar, L. H. A., Leithardt, V. R. Q., Parreira, W. D., da Rocha Fernandes, A. M., Barbosa, J. L. V., & Correia, S. D. (2022). Application of machine learning techniques to predict a patient's no-show in the healthcare sector. Future Internet. Volumen 14(1). doi:10.3390/fi14010003

[18] Ministerio de Salud. (2017). Programación Multianual 2018-2020. http://www.minsa.gob.pe/presupuestales/doc2017/PMSS-2018-2020-OGPPM.pdf

[19] Emerson Process Managment. (2022). Disponibilidad. Retrieved from https://www.emerson.com/documents/automation/training-bussch-oee-102es-es-41724.pdf.

[20] La Sociedad Americana Contra El Cáncer. (2022). Tomografía por computadora y el cáncer. Retrieved from https://www.cancer.org/es/tratamiento/como-comprender-su-diagnostico/pruebas/tomografia-por-computadora-y-el-cancer.html#referencias.

E1

INFORME DE ORIGINALIDAD

9%	5%	6%	0%
INDICE DE SIMILITUD	FUENTES DE INTERNET	PUBLICACIONES	TRABAJOS DEL ESTUDIANTE

FUENTES PRIMARIAS

1	www.researchgate.net Fuente de Internet	2%
2	Juan Carlos Quiroz-Flores, Daniela Steisy Canales-Huaman, Karina Guiuliana Gamio-Valdivia. "Integrated Lean Logistics - Warehousing model to reduce Lead Time in an SME of food sector: A research in Peru", 2022 The 3rd International Conference on Industrial Engineering and Industrial Management, 2022 Publicación	2%
3	Daniela Acosta-Ramirez, Alvaro Herrera-Noel, Alberto Flores-Perez, Juan Quiroz-Flores, Martin Collao-Diaz. "Application of Lean Manufacturing tools under DMAIC approach to increase the NPS in a real estate company: A Research in Peru", 2022 The 9th International Conference on Industrial Engineering and Applications (Europe), 2022 Publicación	1%
	ijetae.com	