BPM and cycle counting in the design of a model to increase the perfect order: a case study in a company in the commercial sector

Fernandez Lopez, Kevin Scott[1], Monte Barahona, Karim[2], and Altamirano Flores, Ernesto[3]
[1]Peruvian University of Applied Sciences, Peru, u201718540@upc.edu.pe
[2]Peruvian University of Applied Sciences, Peru, u201625886@upc.edu.pe
[3]Peruvian University of Applied Sciences, Peru, pcinealt@upc.edu.pe

Abstract*– This paper aims to evaluate the level of delivery compliance in an industrial tools trading company in Metropolitan Lima, based on the decrease in sales observed in the year 2020. For this reason, a quantitative and qualitative diagnosis of the company was carried out, where a low level of delivery compliance was observed, which is generating an economic impact of about 15% of the company's annual income. Furthermore, this problem is measured through the technical gap of the percentage of perfect deliveries, which is currently 64.5%, below the current market. In this sense, a model was proposed to increase the percentage of perfect orders through the implementation of Cyclic Counting, 5S, AHP and BPM in order to increase the Inventory Record Accuracy (IRA), avoid confusion in the selection of products, make an adequate selection and evaluation of suppliers and identify those activities that do not add value. In this way, the simulation of the model will be carried out and a decrease in late and incomplete deliveries will be observed, obtaining a value of 74.3% of perfect orders and a 25% increase in sales.

Keywords*-- supply, perfect order, BPM, 5S, retail, cycle counting, AHP.

I. INTRODUCTION

In recent years, Peru has presented an increase in MYPEs, which have played an essential role in the Peruvian economy and its development, because this represents more than 99% of national business units, promote 85 % of job creation and contribute almost 40% to GDP [1]. Furthermore, commerce is the group that represents the highest percentage in MYPEs in 2020 with 48.3%, which shows that it is highly significant compared to the other productive sectors [2]. However, its growth was impacted by the pandemic caused by COVID-19. In addition, retail trade was the subsector that had the greatest impact, obtaining a value of -18.97%, considerably affecting the MYPEs dedicated to this business category [3]. Indeed, retail trade was the economic activity that presented the greatest number of companies discharged with 34.8%, which shows that there were several companies that decided to end their operations [4].

In this sense, this research is aimed at increasing the level of fulfillment of order deliveries in an industrial equipment distributor. Based on the literature, a case seen in an Indonesian cutting tool dealer is presenting problems of inventory inaccuracy, which is solved by implementing a software algorithm supported by a cyclical count, obtaining a 75.99% decrease in lead times stock verification and inventory update and registration times were minimized by 99.57% [5]. On the other hand, there is an investigation of 204 companies in the retail sector that had an excess of processes that did not add value, so BPM was applied and the processes were redesigned, achieving an increase in organizational performance by 35% [6].

For these reasons, the contribution of this article consists of the combination of the techniques and tools used in the model, supported using diagrams, graphs and indicators that allow the analysis of information, as well as the definitions clearly described in the theoretical framework built, which allowed to facilitate the understanding of the concepts mentioned throughout the work related to the management of suppliers, purchases and inventory. Likewise, the objective of this study is to reduce the economic impact and comply with order deliveries, which are key metrics in a company in the retail sector.

Therefore, the development of this research project will be divided into 5 chapters. In the first chapter, the state of the art will be analyzed while in the second chapter, the current situation of the case study will be studied to identify the causes that affect the level of fulfillment of order delivery. The third chapter shows the solution model and its development. On the other hand, in the fourth chapter, the validation of the model will be carried out through simulation. Finally, in the fifth chapter, the conclusions of the investigation will be mentioned and recommendations will be provided.

II. STATE OF THE ART

A. *The 5S methodology in the Retail sector*

In recent years, it has been shown that ordering and cleaning the warehouse favors a better identification of the products, which reduces errors and unnecessary time in the warehouse [7]. In this sense, there is a case study whose company presented high numbers of errors during the dispatch process and by applying 5S in the workspace that made up the warehouse, a reduction in customer complaints was obtained from 64 to 10 claims and the operating cost was reduced from 62 million to 50 million [7]. On the other hand, a case was reviewed where 5S was applied in a pallet trading company,

Digital Object Identifier (DOI):
http://dx.doi.org/10.18687/LEIRD2022.1.1.45
ISBN: 978-628-95207-3-6 ISSN: 2414-6390

obtaining results of an increase in the productivity index from 1.17 to 2.05 and total waste was reduced from 65% to 43% [8].

B. *Analytical Hierarchy Process (AHP)*

The analytical hierarchy process (AHP) is a tool that allows decision making and in recent years it has been seen that it has been used as part of a supply management improvement model, since it has been of the utmost importance when you want to achieve an efficient selection of suppliers in a company, which leads to a decrease in waiting times related to supply and therefore, to a greater fulfillment of order deliveries [9].

In this sense, there is an investigation using the AHP technique, in which the results showed that the company carried out and increased the scope and learning capacity on the different supplier selection criteria, since at first it was not considered a role important in the company, achieving better organizational performance [9].

On the other hand, there is another investigation in which it is indicated that the AHP together with the support of decision-making software to reduce the degree of variability allows a better selection of suppliers in order to reduce problems related to availability and flexibility in the face of unexpected changes on the elements that must be supplied, which led to a 12% decrease in operating costs [10].

C. *Business Process Management (BPM)*

In recent years, the BPM methodology has been having a high interest and relevance in the retail sector due to its level of flexibility, since it integrates the exchange of information between the different processes, thus generating value for both the client and the organization. [11]. In this sense, there is a study in 2020 on retail in Indonesia, in which it was observed that a good BPM practice achieved an increase of up to 5% in productivity and a reduction of time by 11% in the retail organization. [12].

On the other hand, there is a study in Norway, in which it has been possible to observe that an important factor for the application of this technique is the commitment of the individual, since a resistance to the redesign of the processes would delay the project even more, in In this sense, it was appreciated that having a greater commitment of the personnel and a belief in the success of BPM in the company, a greater increase in sales was achieved by 7% and an increase in work efficiency by 10%, which shows that it is It is important to establish a relationship between the different areas in order to integrate human and technological resources to meet the objectives of the organization [13].

D. *Cycle counting*

In recent years, it has been appreciated that the cycle counting of the inventory has been applied to improve the accuracy of the inventory during the periodic counts carried out in the companies and the use of the traditional cycle counting has been stopped and it has been decided to implement it jointly. with an ABC inventory classification [14].

Based on the literature, there is a study carried out in a company in the retail sector in Indonesia, in which the application of cyclical counting with technological support to manage inventories of complex macroprocesses has achieved great improvements such as a reduction in times of 27.51 % in order preparation, a reduction in stock verification times by 75.99% and a decrease in inventory update and registration times by 99.57%[5].

On the other hand, another study carried out in Croatia has been appreciated, in which a synergy is observed in cycle counting, the Theory of Constraints (TOC) and BPM to increase inventory accuracy to 73% and achieve a decrease in incomplete deliveries. by 20%, because through a monitoring panel it is possible to send an alert to the operator to know the status of said item [15].

III. CONTRIBUTION

A. *Foundation of the Model*

The proposed model is developed based on the model based on the efficient selection of suppliers, on the which the appreciations of experts are used for the definition of criteria and the supplier database is taken into account to select all of them in an integral way [16]. Likewise, it is based on a process management model that implements the BPM methodology to increase the level of compliance in deliveries, in which activities that do not add value in order management are eliminated [17]. In the same way, there is the model made up of Lean techniques integrated mainly by 5S to increase productivity in the warehouse [18]. Finally, there is an inventory model in a supply chain based on cycle counting, in which a priority level is assigned in each segment, a counting system is established depending on the priority level and policies and programs are also established counting according to the established priority [19].

B. *Proposed model*

the research work aims to evaluate the level of delivery compliance in a company that sells industrial tools, in which it is observed that sales reduced 28% compared to 2019, having a 15% economic impact. Likewise, this problem is measured through the technical gap of percentage of perfect deliveries, which is currently 64.5%, being 10% below the current market.The design of the solution model is made up of 4 phases integrated by the techniques of, 5S, cycle counting, BPM and AHP. Likewise, this model is based on the continuous improvement cycle (PDCA) and the contribution lies in the fact that other studies have not covered these techniques together. Generally, when it comes to this problem, they focus only on warehouse and inventory and in other studies they focus only on supplier management or purchasing. The model is shown in figure 1.

consulting the purchase request and explaining said request, are eliminated. In addition, there will be a new assignment of activities and unnecessary roles will be eliminated, as seen in

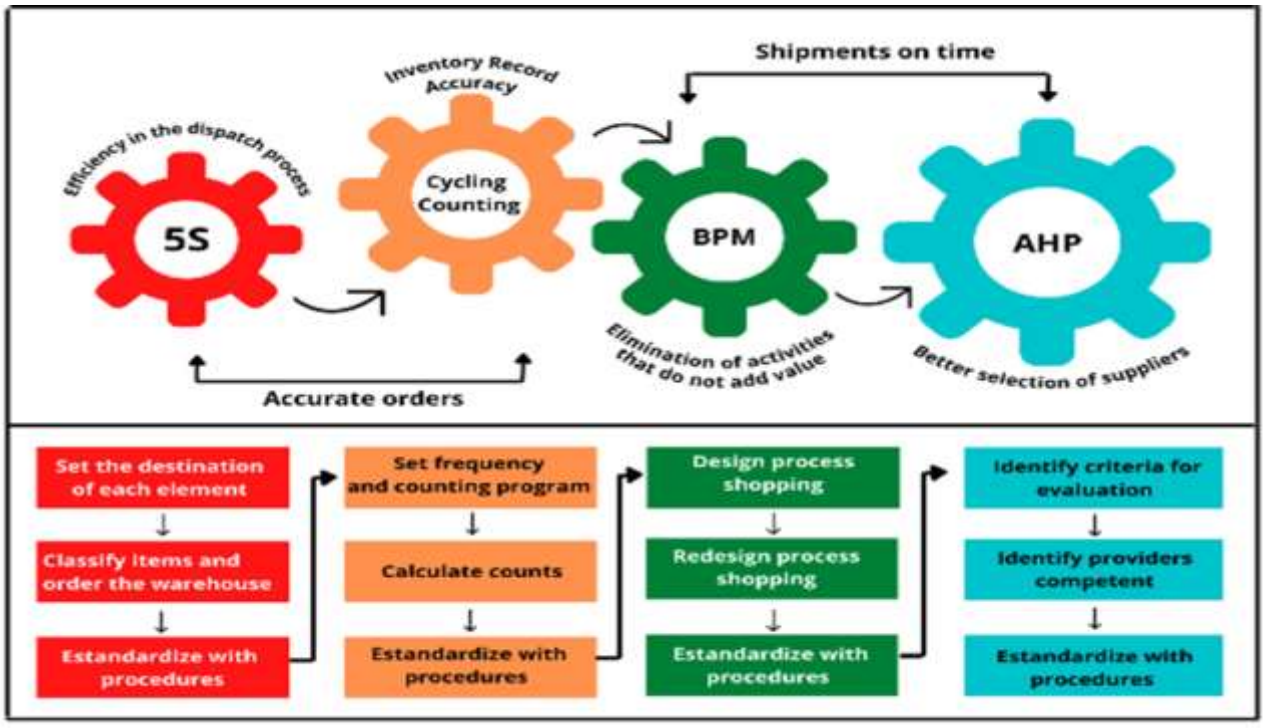

Fig.1. Solution model of the case study

C. *Model detail*

C.1. Component 1: 5S methodology

The destination of the elements is established in the warehouse. The options are remove, sell, repair and relocate with the use of red cards. Subsequently, the use of shelves and a card holder for order requests is proposed. This is supported by the 5S format, the order mix-up indicator sheet, cleaning schedules, and the red card usage procedure.

C.2. Component 2: Cycle counting

The ABC classification is made based on the turnover rate. Then, the counting percentage was found to obtain the number of items to be counted, which is 55 for category A, 17 for category B and 11 for category C. This is supported by the format and procedure of Cycle Count. In addition, the evaluation of the improvements is carried out using the inventory record accuracy indicator.

C.3. Component:Business Process Management (BPM)

In the third phase, the application of the BPM is carried out, in which it begins by identifying the processes that do not add value, within which the steps are taken in the approval of the purchase request and in the evaluation of the quotes, in addition, they come from roles outside the purchasing process, but which are maintained by policies and to save costs.

Based on this, the redesign is carried out in the TO BE scenario, where activities that are not necessary, such as the new purchasing process, the roles of general manager and head of operations have been eliminated and the role of purchasing assistant has been added. This change has been made on the basis that both the chief of operations and the general manager caused unnecessary approval and consultation times and that they were unrelated to the purchasing management in the company.

Likewise, monitoring will be carried out through the record of the average time indicators of the purchasing process, request approvals and the percentage of correct requests and the format of request requests and purchases will be standardized to automate these activities.

C.4. Component 4: Analytic Hierarchy Process (AHP)

Supplier evaluation criteria are identified, which are: time, quality, availability, cost and environmental impact [20]. Then, it is possible to define the qualification and the level of importance of the criteria was established to define the corresponding weights and perform the comparison matrix, within which it is observed that the most important are the time and flexibility that the providers have in deliveries according to their availability.

Afterwards, the evaluation of the suppliers is carried out with each criterion and from this the most competent suppliers are identified, in which, in this case, YANTEC comes out, which, although it is true, is the second in delivery time, in the

rest of the criteria is vastly better. Indeed, Yantec is the first option and Ibero Tools is the second option in case YANTEC is unable to manage orders efficiently.

Likewise, to verify the efficient implementation, it will be measured by means of the indicator sheet of the percentage of compliance with the supplier's delivery deadlines.

As the last development of the AHP, it is standardized with supplier selection and evaluation procedures, with the logistics manager and purchasing assistant as responsible.

D. Model Indicators

In order to be able to make a comparison between the As Is and To Be status of the company after having validated the proposal, the main indicators are proposed:

- *Inventory Record Accuracy (ARI):* This indicator is calculated by measuring the amount of physical stock of a product with respect to what is registered in the system. Likewise, it is expected to obtain a value of 90% in the case study [14] [5] [21].

$$\text{ARI} = \frac{\text{Number of exact counts}}{\text{Number of counts made}} * 100$$

- *Percentage of compliance with supplier delivery terms (CSD):* This indicator measures the delivery compliance of suppliers in sending products to the company. Likewise, a value of 95% is expected in the case study[20] [22] [23].

$$\text{CSD} = \frac{\text{Number of products within the deadline}}{\text{Number of products received}}$$

- *Percentage of confused order (PCO*): This indicator measures the number of orders that have suffered incorrect placement of products during dispatch. Likewise, a value of 4% is expected in the case study [24] [25] [12].

$$\text{PCO} = \frac{\text{confused orders}}{\text{total orders}} * 100$$

- *Average product purchase time (TAP):* This indicator measures the delivery time of suppliers in sending products to the company. Likewise, a reduction of 45% is expected in the case study [26] [25] [13].

$$\text{TAP} = \frac{\text{Total purchase delay time}}{\text{Number of purchases made}}$$

IV. VALIDATION

A. Theoretical framework

The validation method carried out was simulation in the ARENA software, for which a theoretical framework was developed about some important terms such as a model, the benefits of its implementation, goodness-of-fit tests, confidence levels and reasons for using simulation.

A.1. Model

A model can be defined as a simplified representation of a system whose objective is to show reality and predict the results of various indicators [27]. Furthermore, a model is designed to represent certain features of the system in order to gain a full understanding of the original system by replicating its properties [28]. On the other hand, a model is a set of relationships that interprets a part of empirical reality, facilitating its understanding and analysis, in addition, it is characterized by adaptability, functionality, realism, simplicity, among others, the latter two being the main ones. Although it is true that not all the properties of the original system will be met, the importance of a model lies in its simplification and that it can have a real impact on decision making [27].

A.2. Benefits of implementing a model

The model allows evaluating the performance of the system in various scenarios with the aim of improving working conditions and provides support in the validation and verification of a proposal when required [29]. On the other hand, the application of a model allows predicting the performance of the design of experimental or under construction systems, since the manipulation of the variables and properties of the model is cheaper than creating a complete system, allowing possible improvements of the real system. and contributes to reducing the risk inherent in decision-making [30].

A.3. Tests of goodness of fit

The Kolmogorov - Smirnov test allows to measure the degree of coincidence that exists in the distribution of a group of data, in addition to the fact that a histogram is not necessary, it is possible that it can be applied in small samples [31]. On the other hand, the chi square test is used to analyze variables that are nominal or qualitative since it identifies the independence between two variables through the use of a null hypothesis and an alternative [32].

A.4. Confidence Levels

The confidence level is defined as a probability that ensures that a parameter is within the confidence interval [33]. The values that usually include the confidence levels are 90%, 95% and 99%, so the estimates cannot be taken as real at 100% [34].

A.5. Reason for using simulation

Simulation lowers training costs and avoids reducing the impact of student decision-making in simulations, which is useful for emergency procedures, to examine production cycles or to train virtually [35], [36]. On the other hand, there is a success case in which the performance of a balance of lines was evaluated using hypothesis tests based on eight variables of the

system that allowed evaluating five hypothetical scenarios with the aim of facilitating production planning. of the company that belonged to the clothing industry [37].

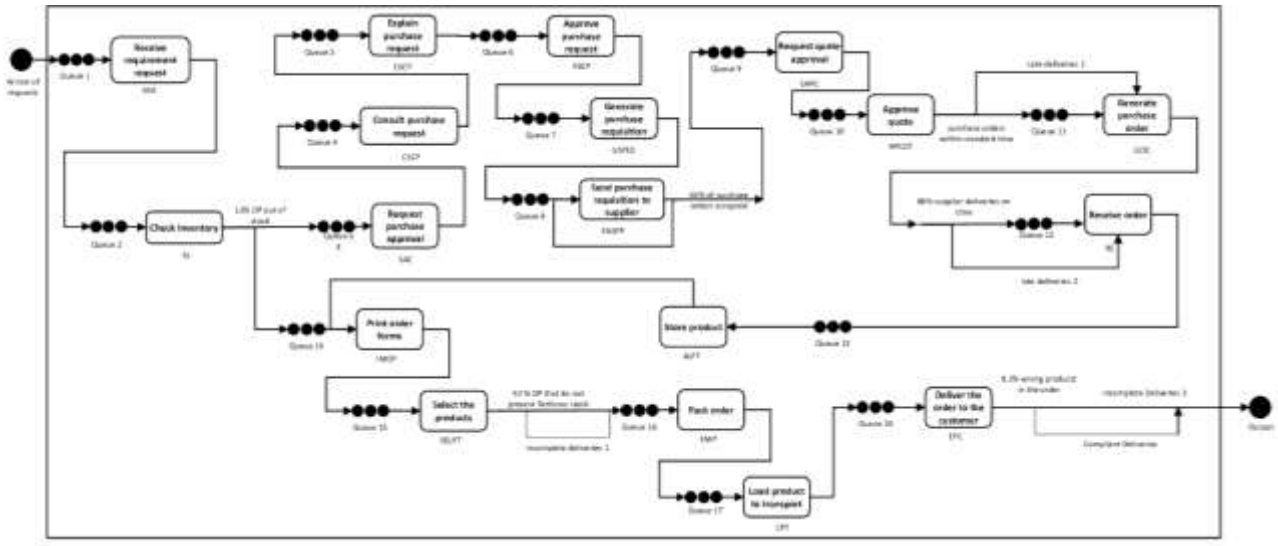

Fig.2. Graphic representation of the system

B. *Graphic representation*

For the simulation, the purchase and dispatch processes were considered. Then, the order requests are received, and it is verified if it has stock to print the order and dispatch. Otherwise, the purchase request is generated, the order is quoted, the product is received, stored, and dispatched. This is shown in figure 2.

C. Processing of input data

A time recording was made with a sample of 100 times for each process. Next, the distributions of each process were evaluated, obtaining that all the times of the processes follow a normal distribution.

D. Preparation of the simulator in ARENA

From the distributions obtained and the graphical representation made, the simulator is developed using the ARENA software, performing 217 runs for which four counters were used for each cause and whose results are shown in Figure 3.

Indicators	AS IS value	TO BE Values		
		Pessimistic scenario	Normal scenario	Optimistic scenario
Percentage of incomplete deliveries due to fictitious stock	7.33%	4.85%	4.01%	2.44%
Percentage of incomplete deliveries due to incorrect dispatch process	7.56%	5.07%	4.35%	2.11%
Percentage of late deliveries due to poor supplier selection and evaluation	11.00%	4.62%	3.79%	2.44%
Percentage of late deliveries due to incorrect purchasing process	8.00%	4.85%	3.90%	2.33%
Inventory Record Accuracy Percentage	92.00%	95.00%	96.00%	97.50%
Supplier delivery compliance percentage	94.00%	96.00%	97.00%	98.50%
Purchase time	202.04 min	72.22 min	66.59 min	62.44 min
Percentage of deliveries on time	81.00%	90.53%	91.64%	95.23%
Percentage of complete deliveries	85.11%	90.08%	92.31%	95.45%
Perfect Order	**64.20%**	**75.94%**	**78.77%**	**84.65%**

Fig.3. Simulation result in ARENA

From figure 3, it can be seen that after running the simulation in ARENA, a reduction in late and incomplete deliveries was obtained. This means that the percentage of incomplete deliveries due to fictitious stock and incorrect dispatch process has a decrease of up to 2.44% and 2.11% respectively in the most optimistic scenario. In addition, the percentage of late deliveries due to incorrect purchasing process and poor selection and evaluation of suppliers is 2.33% and 2.44% in the most favorable scenario. In addition, it is possible to observe that the percentage of Inventory Record Accuracy (ARI) has an increase of up to 6% approximately, reaching 97.50% and an increase in the percentage of supplier delivery compliance to 98.5%. Likewise, there is a decrease in

the time of the purchase process of up to 60%, reaching 62.44 minutes in the optimal scenario. In that sense, it is possible to see an increase in the percentage of deliveries on time to 95.23% and the percentage of complete deliveries to 95.45%, which achieve a notable improvement in the increase in the percentage of the perfect order that amounts to approximately 85%, achieving vastly exceed that of the current sector.

E. Economic validation

In order to determine the viability of the project of this research work, 2 main indicators have been used: Net Present Value (NPV) and Internal Rate of Return (IRR), in addition, there is the CBR indicator. To carry out the analysis of these indicators, the cash flow has been projected over a period of 5 years to assess the sustainability of the project. In the analysis of this flow, the savings in penalties for incomplete and late deliveries and the income from additional sales, which have a value of S/ 114,095, are taken as income. Table 1 shows the financial indicators below.

TABLE 1
ECONOMIC VALIDATION INDICATORS

Net Present Value (NPV)	S/ 38,375	Greater than S/ 0
Internal Rate of Return (IRR)	44.28%	Greater than COK (13.10%)
CBR	S/ 1.87	

From table 1, it can be seen that the value of the Net Present Value (NPV) is S/. 38,375, this indicates that the project does not generate losses since it is greater than S/ 0. On the other hand, the Internal Rate of Return (IRR) is 44.28%, which indicates that for each sol invested, S/. 0.4428, this value being greater than the COK. In this sense, it is evident that, considering the financial ratios, the project is economically viable to be implemented.

CONCLUSIONS

The proposal involved an investment of S/43,863 for the implementation of the 5S, AHP, Cyclic Counting and BPM tools, which made it possible to achieve the expected result of the perfect order percentage from an increase in the number of on-time and complete deliveries, Inventory Record Accuracy, fulfillment of the supplier's delivery terms and a decrease in the time of purchases. The value obtained from perfect orders was 85%, exceeding the percentage of the retail sector indicator, which is 75.5%. Likewise, it was identified that the proposal is economically viable since a Net Present Value (NPV) of S/. 38,375, which indicates that the project does not generate losses. On the other hand, the value of the IRR is 44.28%, thus indicating that for each sol invested, S/. 0.4428.

The proposal had a positive impact on the environment since the recycling of some elements identified in the warehouse was encouraged during the activities related to the application of the 5S tool, which also allowed avoiding packing and sending incorrect orders using material packaging and fuel inefficiently. Likewise, at the sociocultural level, the solution model allowed for better organizational culture and the company's personnel to acquire new skills and knowledge based on the training and increase their level of satisfaction from an improvement in working conditions. On the other hand, at a technological level, the implementation of the BPM tool involved the use of Oracle software, for which some platforms were established to carry out training for personnel that would impact the technological level of the company. Finally, there would also be an impact on citizens since the proposal can be taken as an example and applied to other companies in such a way as to improve sales and greater customer satisfaction, thus enhancing the retail sector and the level of competitiveness of the country's companies.

REFERENCES

[1] El Peruano, "Apuntando a las mypes," 2020. https://elperuano.pe/noticia/95072-apuntalando-a-las-mypes (accessed Jan. 20, 2021).

[2] Ministerio de la Producción, "Estadística MYPE," 2020. https://ogeiee.produce.gob.pe/index.php/en/shortcode/estadistica-oee/estadisticas-mipyme (accessed Jan. 22, 2021).

[3] INEI, "Informe Técnico Producción Nacional," 2020. Accessed: Jan. 19, 2021. [Online]. Available: https://www.inei.gob.pe/media/principales_indicadores/01-informe-tecnico-produccion-nacional-nov-2020.pdf.

[4] INEI, "Demografía Empresarial en el Perú: III Trimestre de 2020 ," 2020. Accessed: Jan. 20, 2021. [Online]. Available: https://www.inei.gob.pe/media/MenuRecursivo/boletines/boletin-demografia_empresarial.pdf.

[5] S. Ratanadewi and M. Bachtiar, "Inventory and Order System Development at PT.X," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 847, no. 1, May 2020, doi: 10.1088/1757-899X/847/1/012058.

[6] J. Pradabwong, C. Braziotis, J. D. T. Tannock, and K. S. Pawar, "Business process management and supply chain collaboration: effects on performance and competitiveness," *Supply Chain Manag.*, vol. 22, no. 2, pp. 107–121, 2017, doi: 10.1108/SCM-01-2017-0008.

[7] R. Sharma, J. Singh, and V. Rastogi, "The impact of total productive maintenance on key performance indicators (PQCDSM): A case study of automobile manufacturing sector," *Int. J. Product. Qual. Manag.*, vol. 24, no. 2, pp. 267–283, 2018, doi: 10.1504/IJPQM.2018.091794.

[8] B. Vargas, G. Miño, P. Vega, and J. Mariño, "Application of resource efficient and cleaner production through best management practice in a pallet manufacturer sawmill located in the city of Puyo-Ecuador," *Maderas Cienc. y Tecnol.*, vol. 21, no. 3, pp. 367–380,

2019, doi: 10.4067/S0718-221X2019005000309.

[9] A. Nikkhah, S. Firouzi, M. El Haj Assad, and S. Ghnimi, "Application of analytic hierarchy process to develop a weighting scheme for life cycle assessment of agricultural production," *Sci. Total Environ.*, vol. 665, pp. 538–545, May 2019, doi: 10.1016/j.scitotenv.2019.02.170.

[10] A. Awasthi, K. Govindan, and S. Gold, "Multi-tier sustainable global supplier selection using a fuzzy AHP-VIKOR based approach," *Int. J. Prod. Econ.*, vol. 195, pp. 106–117, Jan. 2018, doi: 10.1016/j.ijpe.2017.10.013.

[11] B. Dave, "Business process management - A construction case study," *Constr. Innov.*, vol. 17, no. 1, pp. 50–67, 2017, doi: 10.1108/CI-10-2015-0055.

[12] E. R. Mahendrawathi and D. Nurmadewi, "Analysis of business process management capability and information technology in small and medium enterprises in the garment industry (multiple case studies in East Java, Indonesia)," *Electron. J. Inf. Syst. Dev. Ctries.*, vol. 87, no. 1, Jan. 2020, doi: 10.1002/isd2.12154.

[13] M. Pejić Bach, V. Bosilj Vukšić, and D. Suša Vugec, "Individual's Resistance Regarding BPM Initiative: Case Study of the Insurance Company," *Naše Gospod. Econ.*, vol. 63, no. 4, pp. 29–39, Dec. 2017, doi: 10.1515/ngoe-2017-0021.

[14] K. Norazira, A. Anuar, and S. A. P. Salin, "Inventory control weaknesses – a case study of lubricant manufacturing company," *J. Financ. Crime*, vol. 34, no. 1, pp. 1–16, 2018, doi: 10.1108/JFC-11-2016-0077.

[15] E. Mahtamtama, A. Y. Ridwan, and B. Santosa, "Development of cycle counting monitoring dashboard with buffer time management for cocoa company," Jul. 2018, doi: 10.1109/TSSA.2018.8708782.

[16] L. F. de O. M. Santos, L. Osiro, and R. H. P. Lima, "A model based on 2-tuple fuzzy linguistic representation and Analytic Hierarchy Process for supplier segmentation using qualitative and quantitative criteria," *Expert Syst. Appl.*, vol. 79, pp. 1339–1351, Aug. 2018, doi: 10.1016/j.eswa.2017.02.032.

[17] M. Dumcius and T. Skersys, "Improvement and digitalization of business processes in small-medium enterprises," *CEUR Workshop Proc.*, vol. 2470, pp. 22–27, 2019, Accessed: May 31, 2021. [Online]. Available: https://epubl.ktu.edu/object/elaba:42610837/.

[18] E. Oey and M. Nofrimurti, "Lean implementation in traditional distributor warehouse - A case study in an FMCG company in Indonesia," *Int. J. Process Manag. Benchmarking*, vol. 8, no. 1, pp. 1–15, 2018, doi: 10.1504/IJPMB.2018.088654.

[19] A. G. Kök and K. H. Shang, "Evaluation of cycle-count policies for supply chains with inventory inaccuracy and implications on RFID investments," *Eur. J. Oper. Res.*, vol. 237, no. 1, pp. 91–105, Aug. 2017, doi: 10.1016/j.ejor.2014.01.052.

[20] A. Belhadi, F. E. Touriki, and S. Elfezazi, "Evaluation of critical success factors (CSFs) to lean implementation in SMEs using AHP: A case study," *Int. J. Lean Six Sigma*, vol. 10, no. 3, pp. 803–829, Aug. 2019, doi: 10.1108/IJLSS-12-2016-0078.

[21] L. Wijffels, V. Giannikas, P. Woodall, D. McFarlane, and W. Lu, "An enhanced cycle counting approach utilising historical inventory data," *IFAC-PapersOnLine*, vol. 49, no. 12, pp. 1347–1352, Jan. 2017, doi: 10.1016/j.ifacol.2016.07.748.

[22] A. Bianchini, A. Benci, M. Pellegrini, and J. Rossi, "Supply chain redesign for lead-time reduction through Kraljic purchasing portfolio and AHP integration," *Benchmarking*, vol. 26, no. 4, pp. 1194–1209, Apr. 2019, doi: 10.1108/BIJ-07-2018-0222.

[23] G. Pishchulov, A. Trautrims, T. Chesney, S. Gold, and L. Schwab, "The Voting Analytic Hierarchy Process revisited: A revised method with application to sustainable supplier selection," *Int. J. Prod. Econ.*, vol. 211, pp. 166–179, May 2019, doi: 10.1016/j.ijpe.2019.01.025.

[24] B. K. do A. Castro, A. Dresch, and D. R. Veit, "Key critical success factors of BPM implementation: a theoretical and practical view," *Bus. Process Manag. J.*, vol. 26, no. 1, pp. 239–256, 2019, doi: 10.1108/BPMJ-09-2018-0272.

[25] M. Andriani, T. M. A. A. Samadhi, J. Siswanto, and K. Suryadi, "Aligning business process maturity level with SMEs growth in Indonesian fashion industry," *Int. J. Organ. Anal.*, vol. 26, no. 4, pp. 709–727, Sep. 2018, doi: 10.1108/IJOA-08-2017-1215.

[26] M. E.R, B. T. Hanggara, and H. M. Astuti, "Model for BPM implementation assessment: evidence from companies in Indonesia," *Bus. Process Manag. J.*, vol. 25, no. 5, pp. 825–859, Sep. 2019, doi: 10.1108/BPMJ-08-2016-0160.

[27] P. Sridhar, C. R. Vishnu, and R. Sridharan, "Simulation of inventory management systems in retail stores: A case study," *Mater. Today Proc.*, May 2021, doi: 10.1016/j.matpr.2021.05.314.

[28] B. Estrada-Torres, M. Camargo, M. Dumas, L. García-Bañuelos, I. Mahdy, and M. Yerokhin, "Discovering business process simulation models in the presence of multitasking and availability constraints," *Data Knowl. Eng.*, vol. 134, p. 101897, Jul. 2021, doi: 10.1016/J.DATAK.2021.101897.

[29] C. Cardenas, A. M. Latifi, C. Vallières, S. Marsteau, and L. Sigot, "Analysis of an industrial adsorption process based on ammonia chemisorption: Modeling and simulation," *Comput. Chem. Eng.*, vol. 154, p. 107474, Nov. 2021, doi: 10.1016/J.COMPCHEMENG.2021.107474.

[30] M. J. McNulty, K. Kelada, D. Paul, S. Nandi, and K. A. McDonald, "Techno-economic process modelling and Monte Carlo simulation data of uncertainty quantification in field-grown plant-based manufacturing," *Data Br.*, vol. 38, p. 107317, Oct. 2021, doi: 10.1016/J.DIB.2021.107317.

[31] H. Hassani and E. S. Silva, "A Kolmogorov-Smirnov based test for comparing the predictive accuracy of two sets of forecasts," *Econometrics*, vol. 3, no. 3, pp. 590–609, Sep. 2015, doi: 10.3390/ECONOMETRICS3030590.

[32] S. Chouia and N. Seddik-Ameur, "A modified chi-square test for Bertholon model with censored data," *Commun. Stat. Simul. Comput.*, vol. 46, no. 1, pp. 593–602, 2017, doi: 10.1080/03610918.2014.972519.

[33] X. hua Xu, Z. jiao Du, X. hong Chen, and C. guang Cai, "Confidence consensus-based model for large-scale group decision making: A novel approach to managing non-cooperative behaviors," *Inf. Sci. (Ny).*, vol. 477, pp. 410–427, 2019, doi: 10.1016/j.ins.2018.10.058.

[34] A. Barbiero, "Least-squares and minimum chi-square estimation in a discrete Weibull model," *Commun. Stat. Simul. Comput.*, vol. 46, no. 10, pp. 8028–8048, 2017, doi: 10.1080/03610918.2016.1263733.

[35] A. Florescu and S. A. Barabas, "Modeling and simulation of a flexible manufacturing system—a basic component of industry 4.0," *Appl. Sci.*, vol. 10, no. 22, pp. 1–20, 2020, doi: 10.3390/app10228300.

[36] A. Yassine, B. Khalid, and E. Said, "Supply chain modeling and

simulation using SIMAN ARENA® a case study," *Int. J. Adv. Comput. Sci. Appl.*, vol. 10, no. 3, pp. 223–230, 2019.

[37] H. Sime, P. Jana, and D. Panghal, "Feasibility of using simulation technique for line balancing in apparel industry," *Procedia Manuf.*, vol. 30, pp. 300–307, 2019, doi: 10.1016/j.promfg.2019.02.043