Lean Manufacturing Model to improve the order fulfillment in a company in the wine sector

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***Abstract*– The wine industry has grown in recent years causing many of the companies in the sector to improve their processes. When it comes to medium and large industrial facilities, there are always some well-known methodologies that are adopted to boost their growth and minimize logistics costs. While, in the case of PYMEs, there is no provision as such to apply any Lean Manufacturing or process management technique. The case study is Bodega Peru SAC, which presents difficulties in fulfilling the perfect order due to deficiencies in its logistics processes. The purpose of this study is based on properly managing the Supply Chain to increase its performance and reduce logistic costs. The processes that cause bottlenecks or have high error rates have been identified in the case study. Likewise, the study is based on information from researchers for the analysis of supply chain processes related to the industry.**

***Keywords--* Order Fulfillment, Perfect Order, Lean Manufacturing, Kaizen, Value Stream Mapping.**

I. INTRODUCTION

The importance of order fulfillment in the management of a good supply chain management is the development of small and medium-sized companies since it generates cost overruns and their competitive capacity [1][2]. Regarding the wine sector, this problem increased due to the events that took place in 2020 with the appearance of the COVID-19 virus, which affected sales by a margin of 13.7% in the sector. This provoked the collapse of several businesses due to losses caused by non-compliance and/or sales cancellations [3].

It is important to address the issue of order fulfillment in the Peruvian wine sector since the production of alcoholic beverages has been growing, as detailed in 2018, in which over a period of 6 years it increased at a rate of 2.2f the annual average contributing to the development of the country [4]. It should be noted that, at the moment, it has been estimated that in a few years the wine market and ready-to-drink (RTD) are projected to grow faster than the competition at a rate of 2.5% and 8.1% [3]. In order to develop the order fulfillment, initially in relation to the supply chain. In order to achieve such order fulfillment correctly, the flow of information must be optimally carried out to begin with, since it will control and inform about the capacity of the facilities, production rate and the quantity that is being handled in the system. This will allow cost reduction and profit improvement if added value is achieved in the process chain [5][6]. In the second case, the use of Value Stream Mapping (VSM) is proposed, which through the support of other tools such as A3, metrics and/or other methods, like time reduction, higher added value and finally improved order fulfillment are achieved [7][8]. Finally, the perfect order indicator is a means of defining the correct implementation of tasks with good operations practices in the areas of production, picking and storing [9][10].

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The goal of this research paper is to increase the competitiveness of the wine industry under study, since, in our country it is currently in an optimal development in productivity and profits in the last few years, in spite of the unforeseen event of the pandemic generated by COVID-19. For this particular case, we propose a management model in which tools of the Lean Manufacturing methodology allow us to improve the flow of processes in optimal conditions through which we guarantee the correct delivery of orders in the factors of quality, quantity, time and proper documentation.

This article consists of the following sections: Firstly, the literature review is performed in the State of the Art in relation to supply chain management, order fulfillment, perfect order, and the tools of the Lean Manufacturing methodology which will be addressed throughout this work. Secondly, the structure of the contribution and the respective operation of its components for the solution of the problem in the field of study will be detailed. Thirdly, the validation of the results where the limitations, variables, and results obtained through the proposed contribution are specified. Finally, the respective discussion is carried out based on the obtained results, where the motives for certain values are encouraged and new questions and/or research topics are generated with respect to the problems of the sector under study.

II. LITERATURE REVIEW

A. Lean

Lean is a philosophy that seeks to improve business in different areas through the generation of value in the processes to ensure the proper use of resources and the minimization of waste [11][12]. It consists of 5 principles in the different Lean techniques it handles, these being the identification of value, flow mapping, flow improvement, elimination of waste and implementation and continuous improvement towards perfection [13][14][15]. In relation to waste, 7 wastes that alter the flow of information and/or products in the systems are recognized, such as lack of information transmission, inadequate inventory, bottlenecks, overproduction, transportation problems, unnecessary processes, and defects [16][17].

In the wine industry, Lean has been an appropriate paradigm because in this field there is an uncertainty in which

it is necessary to be competitive through the Lean culture that provides customer satisfaction, profitability, advanced processes, flexibility, continuous improvement, quality, and cost reduction [14][18][19].

B. Lean Manufacturing

Lean Manufacturing is a solution methodology based on Lean tools that focuses on the improvement of the manufacturing process. It consists of tools that identify and eliminate operations that do not add value to the product, service or process that will be classified as waste [20]. Unlike other Lean options, this one provides greater operational efficiency due to the reconfiguration of the processes, which will allow a reduction in the cost overruns generated in the production stage and ensure that those involved in the company achieve a new culture through daily practice that manages to resolve and implement the change in any sector that needs it [13] [21][22][23]. In relation to logistics in supply chains, companies should implement Lean for the optimization of material flows to successfully obtain the right times and adequate quality through policies, procedures, among other factors that add value [24].

C. Lean Tools

The implementation of various Lean Manufacturing tools should prioritize that the agents involved in the process can choose this system as a daily practice where the tools that represent it allow them to improve the flow of materials throughout the production process [25].

1) Kaizen

According to [21], such an approach is "a form of continuous improvement measure adopted by early Japanese companies that include Kanban, which can be referred to as just-in-time (JIT) and as POKA-YOKE". The objective of this is to eliminate waste generated throughout the production stage and standardize the process and document the ideas for improvements so that they can be evaluated for possible future implementation since this tool seeks continuous improvement as a competitive advantage with respect to the improvement in production, quality and processes. Where those involved in the company must get used to the principle to avoid high costs and work revolutions [11][13][22][24].

2) Value Stream Mapping

The Value Stream Mapping (VSM) method consists of a mapping of the flow of materials and information in the production system to identify the activities that are not adding value, as a method of solution to scenarios where there are processes where waste must be eliminated with the purpose of a correct application of the tasks before the design of the process, unnecessary movement, quantity, quality and among other work factors [11][13][22][23][24][26][27][28].

3) Standardization

The standardization method has the following steps under the established parameters for correct execution of the process in order to increase production efficiency and simplify the work process based on time and productivity [12][17][19]. Another way of looking at this standardization in relation to other agents in the supply chain could be presented in the selection of suppliers in which quality, stability, delivery efficiency and the ability to deliver what is demanded, in order not to present problems to the end customer are guaranteed [29].

4) Visual Control

This tool comprises the control of process quality parameters to optimize the company's production process. Regarding the visual control and other Lean Manufacturing tools, these contribute to the reduction of material and greater sustainability, improving productivity, highlighting the variants that clearly affect the task and/or being able to propose an enhancement in the system [18][22][30][31].

5) Order Fulfillment

Order fulfillment and perfect order are related terms regarding customer satisfaction. As stated by [32], “for order fulfillment based on perfect order, it begins through the whole process of consumer acquisition where the factors of on-time delivery, out-of-stock and among other factors are involved”. In order to achieve the objectives of a good delivery, we link both technology and information management for the fulfillment of different factors such as time, quantity, quality, and documentation [6][9][33][33][34][35][35][36][37][38]. In order to achieve order fulfillment, strategic planning must be carried out where the capabilities and limitations of the company allow the necessary performance to ensure the requirements of production, transportation, storage, distribution, and marketing to ensure order fulfillment by the interaction of the chain and the behavior of the market in which it must obtain the loyalty needed to ensure a stable demand value [39].

As stated above, planning is an important stage for order fulfillment, for which application methods such as supplier management, which specifically selects and evaluates suppliers in order to provide a good service and/or good [28][40][41][42] and demand forecasting looks for the approximate estimate to satisfy the customer based on the order and the company's costs and production [43].

III. METHODOLOGY

A. Order Fulfillment Model

The presented model aims at reducing the non-fulfillment of the perfect order of the studied wine company. In this case, order fulfillment is influenced by the non-standardization of processes and the lack of control in the planning, production, and delivery processes. This results in cost overruns and loss of prestige for the warehouse. This has been prepared based on

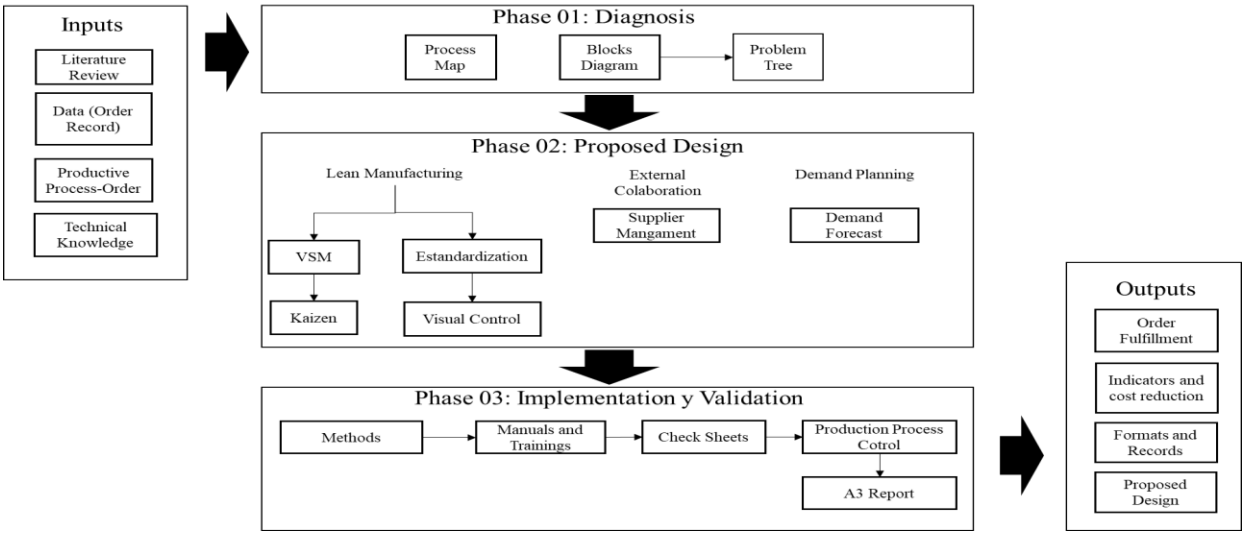

Fig. 1 Proposed Model

specialists such as Buonamico, Lee and García as can be seen in Figure 1 [44][45][46].

Firstly, phase 1 diagnosis, in charge of performing the respective analysis of the company to obtain the necessary information and identification of the problem.

Secondly, phase 2 of the proposed design, which highlights the Lean Manufacturing tools, supply chain management and solution planning.

Thirdly, phase 3 of implementation and validation, where results on performance and cost indicators will be obtained, leading to the outputs.

The main indicators of the model are focused on the contribution to the solution of the problem in which we want to develop an improvement for the company. As shown in Table 1, the main outputs are order fulfillment, which is expected to reach 92.3%, Forecast Accuracy at 95% and Percentage of Defects between 10%-15%.

B. Development Lean Manufacturing

On the one hand, engineering tools are used in relation to the Lean Manufacturing methodology where production performance will improve regarding the effectiveness and efficiency of the processes through the elimination of waste and the creation of value.

Moreover, the management of the supply chain was necessary to employ in relation to our suppliers as they present the evaluation and monitoring for the correct supply for the final presentation of the location where the wine is placed.

Finally, planning based on demand forecasting, due to the necessity to relate the production to be carried out with possible sales to be obtained during the year and thus achieving a small variation that allows reducing production costs, storage and/or opportunity costs.

IV. CASE STUDY

In the present research, the study will be developed in the wine sector with the company "Bodegas Perú S.A.C." where it is included in the production of Vinos, Pisco and other grape products derivates. The company has more than 24 years of experience in the Peruvian market. It is a family business that combines winemaking tradition with modernity in the production of wines and pisco in the Cañete; for which they have a great variety of traditional grapes for the production.

TABLE I
ORDER REGISTRATION AND ORDER FULFILLMENT RATE

Month	Total order	Order Fails
January	279	98
February	204	71
March	185	65
April	209	73
May	275	96
June	295	78
July	270	105
August	255	89
September	250	104
October	335	117
November	254	65
December	352	92
Total	3163	1053
Proportion	66.71%	

Through what is represented in Table 1, it is diagnosed that the present company has a 66.71% fulfillment of orders, in which it is below the competitive level of the Peruvian wine sector with a value of 92.3%. For which, it is necessary to develop the solution proposal based on the detailed tools of

the Lean Manufacturing practices together with the management and planning for the correct fulfillment of the order as detailed in the model of Figure 1.

V. VALIDATION

A. *Simulation System*

In order to obtain the results of the research project, the simulation method was developed to obtain the current state against the scenario to be reached like to see in the Table 2. The Figure 2 shows the system of the production process and delivery of the warehouse to achieve the fulfillment of the order.

VI. DISCUSSION

After the respective run carried out in the Arena, it was possible to obtain the results of the different outputs specified in Table 1. An improvement in the final values obtained is demonstrated, in which we can highlight the most important ones that were defined in the model indicators. with respective improvements in Order Fulfillment to 85.8%, Forecast Accuracy to 90.1% and Failure Rate to 14.2%. However, as can be seen in the output of the bottles, a significant reduction is shown in relation to the reduction of errors by the supplier and the production process. Therefore, it is to be expected that the queue size and waiting time with respect to the supplier have decreased satisfactorily and have increased by part of the production process, which is not negative since it is considered that, being a supply, it can remain in stock for the productivity of the company. It should be noted that the results have had a good perception of being able to get as close or as expected despite the limitations found in the Arena application.

TABLE II
ACTUAL STATE VS IMPROVEMENT STATE

Output	Actual	Future
Number of non-compliant bottles	39.7	9.8
Number of bottles without specifications	12.4	6.66
Number of reprocesses	4.87	5.07
Order Fulfillment	64.4	85.8
Forecast Accuracy	59.9	90.1
Successful orders	22.3	40.1
Percentage of defects	35.6	14.2
System timeout	16.4	18
Bottling size of row 1	11	0.541
Bottling size of row 2	1.03	5.61
System Time	3.78	3.89
Bottling queue time 1	1.03	0.0497
Bottling queue time 2	0.138	0.516

Because of this and for future research in the wine sector with respect to order fulfillment, it can be expanded regarding the delivery process in relation to transportation to final customers or in the productive area in the processes that have schedules measured in days for the development of winemaking. They could also evaluate other variables that affect this problem on the production side or at some point in the supply chain in order to improve and complement the research in the wine sector, which is an important sector in our country.

VII. CONCLUSIONS

Some improvement was obtained in the main indicators, such as order fulfillment going from 64.4% to 85.8%, Forecast Accuracy from 59.9% to 90.1% and a decrease in the defect rate from 35.6% to 14.2%.

The obtained results demonstrate the viability of the project focused on the use of Lean Manufacturing tools and applications aimed at perfect order fulfillment, such as the supplier management process and planning through resource

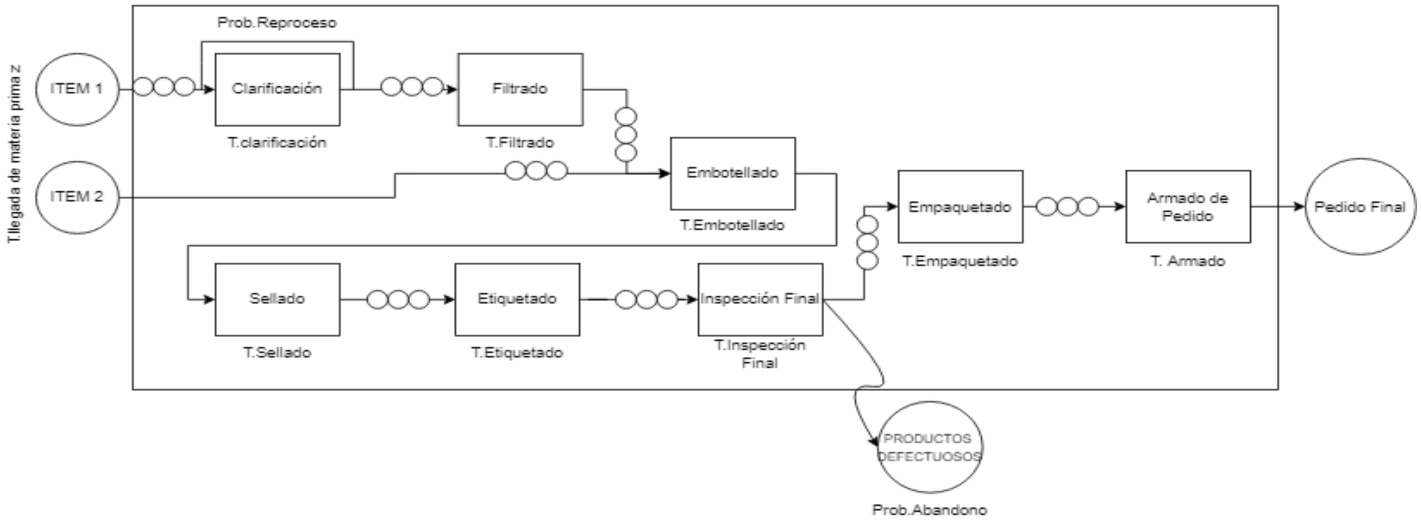

Fig. 2 Graphic Representation of Process

estimation.

Order fulfillment in various work sectors can expand the research in a general approach in the processes of supply chain management to complement and / or achieve a more centralized analysis.

REFERENCES

[1] Fritz, M. M., Ruel, S., Kallmuenzer, A., & Harms, R. (2021). Sustainability management in supply chains: the role of familiness. *Technological Forecasting and Social Change*, *173*. https://doi.org/10.1016/J.TECHFORE.2021.121078

[2] Praharsi, Y., Jami'in, M. A., Suhardjito, G., Reong, S., & Wee, H. M. (2021). Supply chain performance for a traditional shipbuilding industry in Indonesia. *Benchmarking*. https://doi.org/10.1108/BIJ-05-2020-0232

[3] Henriquez, E. (2021a). Alcoholic Drinks in Peru. In *Lima (Peru)* (Issue January). https://euromonitor.upc.elogim.com/portal/analysis/tab

[4] Ministerio de la Producción. (2019). *Estadística Sectorial*. https://ogeiee.produce.gob.pe/index.php/en/shortcode/estadistica-oee/estadistica-sectorial

[5] Fragoso, R., & Figueira, J. R. (2021). Sustainable supply chain network design: An application to the wine industry in Southern Portugal. *Journal of the Operational Research Society*, *72*(6), 1236–1251. https://doi.org/10.1080/01605682.2020.1718015

[6] Sharma, R. K. (2020). ISM and fuzzy logic approach to model and analyze the variables in downstream supply chain for perfect order fulfillment. *International Journal of Quality and Reliability Management*, *38*(8), 1722–1746. https://doi.org/10.1108/IJQRM-09-2020-0294

[7] Liu, Q., & Yang, H. (2020). An improved value stream mapping to prioritize lean optimization scenarios using simulation and multiple-attribute decision-making method. *IEEE Access*, *8*, 204914–204930. https://doi.org/10.1109/ACCESS.2020.3037660

[8] Pérez-Pucheta, C. E., Olivares-Benitez, E., Minor-Popocatl, H., Pacheco-García, P. F., & Pérez-Pucheta, M. F. (2019). Implementation of Lean Manufacturing to Reduce the Delivery Time of a Replacement Part to Dealers: A Case Study. Applied Sciences, 9(18), 3932. https://doi.org/10.3390/app9183932

[9] Jacyna-Gołda, I., Kłodawski, M., Lewczuk, K., Łajszczak, M., Chojnacki, T., & Siedlecka-Wójcikowska, T. (2019). Elements of perfect order rate research in logistics chains. Archives of Transport, 49(1), 25–35. https://doi.org/10.5604/01.3001.0013.2771

[10] Luo, H., Yang, X., & Kong, X. T. R. (2019). A synchronized production-warehouse management solution for reengineering the online-offline integrated order fulfillment. Transportation Research Part E: Logistics and Transportation Review, 122(July 2018), 211–230. https://doi.org/10.1016/j.tre.2018.12.010

[11] Ghosh, S., & Lever, K. (2020). A lean proposal: development of value stream mapping for L'Oreal's artwork process. *Business Process Management Journal*, *26*(7), 1925–1947. https://doi.org/10.1108/BPMJ-02-2020-0075

[12] Patil, A. S., Pisal, M. V., & Suryavanshi, C. T. (2021). Application of value stream mapping to enhance productivity by reducing manufacturing lead time in a manufacturing company: A case study. Journal of Applied Research and Technology, 19(1), 11–22. https://doi.org/10.22201/icat.24486736e.2021.19.1.1488

[13] Kumar, S., Dhingra, A. K., & Singh, B. (2018). Cost reduction by value stream mapping using Lean-Kaizen concept: a case study. International Journal of Productivity and Quality Management, 24(1), 12–32. https://doi.org/10.1504/IJPQM.2018.091166

[14] Sunder M, V., Ganesh, L. S., & Marathe, R. R. (2019). Lean Six Sigma in consumer banking – an empirical inquiry. International Journal of Quality and Reliability Management, 36(8), 1345–1369. https://doi.org/10.1108/IJQRM-01-2019-0012

[15] Ufua, D. E., Papadopoulos, T., & Midgley, G. (2018). Systemic Lean Intervention: Enhancing Lean with Community Operational Research. European Journal of Operational Research, 268(3), 1134–1148. https://doi.org/10.1016/j.ejor.2017.08.004

[16] Salah, S. A., & Mustafa, A. (2021). Integration of energy saving with lean production in a food processing company. *Journal of Machine Engineering*, *21*(4), 118–133. https://doi.org/10.36897/jme/142394

[17] Singh, J., Singh, H., & Singh, G. (2018). Productivity improvement using lean manufacturing in manufacturing industry of Northern India. *International Journal of Productivity and Performance Management*, *67*(8), 1394–1415. https://doi.org/10.1108/IJPPM-02-2017-0037

[18] Alkunsol, W. H., Sharabati, A. A. A., AlSalhi, N. A., & El-Tamimi, H. S. (2019). Lean Six Sigma effect on Jordanian pharmaceutical industry's performance. *International Journal of Lean Six Sigma*, *10*(1), 23–43. https://doi.org/10.1108/IJLSS-01-2017-0003

[19] Domínguez, R. A., Espinosa, M. D. M., Domínguez, M., & Romero, L. (2021). Lean 6S in Food Production: HACCP as a Benchmark for the Sixth S "Safety." *Sustainability*, *13*(22), 12577. https://doi.org/10.3390/su132212577

[20] García Alcaraz, J. L., Martínez Hernández, F. A., Olguín Tiznado, J. E., Realyvásquez Vargas, A., Jiménez Macías, E., & Javierre Lardies, C. (2021). Effect of Quality Lean Manufacturing Tools on Commercial Benefits Gained by Mexican Maquiladoras. *Mathematics*, *9*(9), 971. https://doi.org/10.3390/math9090971

[21] Adeodu, A., Kanakana-Katumba, M. G., & Rendani, M. (2021). Implementation of Lean Six Sigma for production process optimization in a paper production company. *Journal of Industrial Engineering and Management*, *14*(3), 661. https://doi.org/10.3926/jiem.3479

[22] Garza-Reyes, J. A., Kumar, V., Chaikittisilp, S., & Tan, K. H. (2018). The effect of lean methods and tools on the environmental performance of manufacturing organisations. *International Journal of Production Economics*, *200*, 170–180. https://doi.org/10.1016/j.ijpe.2018.03.030

[23] González-Reséndiz, J., Arredondo-Soto, K. C., Realyvásquez-Vargas, A., Híjar-Rivera, H., & Carrillo-Gutiérrez, T. (2018). Integrating Simulation-Based Optimization for Lean Logistics: A Case Study. *Applied Sciences*, *8*(12), 2448. https://doi.org/10.3390/app8122448

[24] Ramos, E., Mesia, R., Alva, C., & Miyashiro, R. (2020). Applying lean maintenance to optimize manufacturing processes in the supply Chain: A Peruvian print company case. *International Journal of Supply Chain Management*, *9*(1), 264–281.

[25] Pérez-Pucheta, C. E., Olivares-Benitez, E., Minor-Popocatl, H., Pacheco-García, P. F., & Pérez-Pucheta, M. F. (2019). Implementation of Lean Manufacturing to Reduce the Delivery Time of a Replacement Part to Dealers: A Case Study. *Applied Sciences*, *9*(18), 3932. https://doi.org/10.3390/app9183932

[26] Orynycz, O., Tucki, K., & Prystasz, M. (2020). Implementation of lean management as a tool for decrease of energy consumption and CO2 emissions in the fast food restaurant. *Energies*, *13*(5). https://doi.org/10.3390/en13051184

[27] Gavriluță, A. C., Nițu, E. L., & Gavriluță, C. A. (2021). Algorithm to Use Some Specific Lean Manufacturing Methods: Application in an Industrial Production Process. *Processes*, *9*(4), 641. https://doi.org/10.3390/pr9040641

[28] Yang, L., Li, H., & Campbell, J. F. (2020). Improving Order Fulfillment Performance through Integrated Inventory Management in a Multi-Item Finished Goods System. *Journal of Business Logistics*, *41*(1), 54–66. https://doi.org/10.1111/jbl.12227

[29] Milewski, D. (2022). Managerial and Economical Aspects of the Just-In-Time System "Lean Management in the Time of Pandemic." *Sustainability (Switzerland)*, *14*(3). https://doi.org/10.3390/su14031204

[30] Daneshjo, N., Pajerská, E. D., Klimek, M., & Danishjoo, E. (2018). Software support for optimizing layout solution in lean production. *TEM Journal*, *7*(1), 33–40. https://doi.org/10.18421/TEM71-05

[31] Seth, D., Seth, N., & Dhariwal, P. (2017). Application of value stream mapping (VSM) for lean and cycle time reduction in complex production environments: a case study. *Production Planning & Control*, *28*(5), 398–419. https://doi.org/10.1080/09537287.2017.1300352

[32] Nguyen, D. H., de Leeuw, S., & Dullaert, W. E. H. (2018). Consumer Behaviour and Order Fulfilment in Online Retailing: A Systematic Review. International Journal of Management Reviews, 20(2), 255–276. https://doi.org/10.1111/ijmr.12129

[33] Jin, M., Li, G., & Cheng, T. C. E. (2018). Buy online and pick up in-store: Design of the service area. European Journal of Operational Research, 268(2), 613–623. https://doi.org/10.1016/j.ejor.2018.02.002

[34]Lawson, B., Pil, F. K., & Holweg, M. (2018). Multi-Modal Order Fulfillment: Concept and Application. Production and Operations Management, 27(2), 269–284. https://doi.org/10.1111/poms.12801
[35]MacCarthy, B. L., Zhang, L., & Muyldermans, L. (2019). Best Performance Frontiers for Buy-Online-Pickup-in-Store order fulfilment. International Journal of Production Economics, 211, 251–264. https://doi.org/10.1016/j.ijpe.2019.01.037
[36]Rofin, T. M., & Mahanty, B. (2019). Fulfillment mode selection for Indian online sellers under free and flat rate shipping policies. In Electronic Commerce Research (Vol. 21, Issue 2). Springer US. https://doi.org/10.1007/s10660-019-09348-5
[37]Patak, M., Branska, L., & Pecinova, Z. (2020). Perfect order and its components: Application for deliveries of fast moving consumer goods to retail stores. *Engineering Economics*, *31*(2), 233–242. https://doi.org/10.5755/j01.ee.31.2.22480
[38]Ikatrinasari, Z. F., Harianto, N., & Yuslistyari, E. I. (2020). Improvement of supply chain performance of printing services company based on supply chain operation references (Scor) model. *Uncertain Supply Chain Management*, *8*(4), 845–856. https://doi.org/10.5267/j.uscm.2020.6.001
[39]Heydari, M., Lai, K. K., & Zhou, X. (2020). Creating sustainable order fulfillment processes through managing the risk: Evidence from the disposable products industry. In Sustainability (Switzerland) (Vol. 12, Issue 7). https://doi.org/10.3390/su12072871
[40]Awan, U., & Khan, S. A. R. (2021). Mediating role of sustainable leadership in buyersupplier relationships: An supply chain performance: An empirical study. *Logforum*, *17*(1), 97–112. https://doi.org/10.17270/J.LOG.2021.546
[41]Karadayi-Usta, S., & SerdarAsan, S. (2020). A conceptual model of medical tourism service supply chain. *Journal of Industrial Engineering and Management*, *13*(2), 246. https://doi.org/10.3926/jiem.3008
[42]Portna, O. (2021). Economic Business Partnerships Within Industry 4.0: New Technologies in Management. *Montenegrin Journal of Economics*, *17*(1), 151–163. https://doi.org/10.14254/1800-5845/2021.17-1.11
[43]Gallego-García, S., & García-García, M. (2020). Predictive Sales and Operations Planning Based on a Statistical Treatment of Demand to Increase Efficiency: A Supply Chain Simulation Case Study. *Applied Sciences*, *11*(1), 233. https://doi.org/10.3390/app11010233
[44]Buonamico, N., Muller, L., & Camargo, M. (2017). A new fuzzy logic-based metric to measure lean warehousing performance. *Supply Chain Forum: An International Journal*, *00*(00), 1–16. https://doi.org/10.1080/16258312.2017.1293466
[45]Gallego-García, S., & García-García, M. (2020). Market-oriented procurement planning leading to a higher service level and cost optimization. *Applied Sciences (Switzerland)*, *10*(23), 1–31. https://doi.org/10.3390/app10238734
[46]Lee, C. K. M., Lv, Y., Ng, K. K. H., Ho, W., & Choy, K. L. (2018). Design and application of internet of things-based warehouse management system for smart logistics. International Journal of Production Research, 56(8), 2753–2768. https://doi.org/10.1080/00207543.2017.1394592