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Logistics Proposal for the Competitiveness and Development of the Supply Chain Bakery and Pastry Sector

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Abstract

The significant amount of finished product waste is a critical deficiency in the supply chain of the pastry and bakery sector because it generates negative economic, environmental and social impacts. The objective of this research was to design and validate a logistics proposal that arises from the interaction between the key factor, the control mechanisms for production planning, and two key stakeholders: owners and workers in the sector. The chosen proposal consists of adjusting the demand forecast through the analysis of the Pareto Chart and documenting standardized processes, including monitoring indicators. Therefore, a non-experimental design of descriptive scope with a four-phase methodological structure was used and each phase was validated by ten experts of the sector who were chosen intentionally rather than probabilistically and following selection criteria. First, system dimensions were detected using a Root Cause Tree, then key factors were identified with the Cross-Impact Matrix. Subsequently, stakeholders were prioritized through the Power-Interest Grid and finally, the proposals were prioritized using the Importance-Governance Matrix. The main findings identify customers, owners and workers as key stakeholders, and inventory rotation, control mechanisms and quality culture as key factors, and when interrelated, strategies were proposed and then prioritized to select the final proposal.

Keywords
Logistics, Supply chain, Continuous improvement, Wastage, Inventory management.

1. Introduction
The case study is bakeries and pastry shops, which are dedicated to the production of food such as biscuits, breads, cookies, cakes, among others. Therefore, these are included within the manufacturing sector, especially in the non-primary sector because it involves the transformation of raw materials (Sociedad Nacional de Industria 2022). Furthermore, globally, bread and its derivatives show an average market penetration of 81% (Mordor Intelligence 2023), which will continue to increase because the annual growth rate has been forecast at 3.44% from 2021 to 2026. Also, we must consider the strong presence of the bakery and pastry industry in European countries such as Germany with 14.6% (Informes de Expertos 2023). While, in Peru this sector represents 2.54% of the entire manufacturing industry because bread is one of the most consumed foods, (Huallpa et al. 2020).

The significant amount of finished product waste represents one of the most important problems facing the sector caused by inefficiencies in the supply chain and also in sales, generating unnecessary additional costs, economic losses for the company and impacting socially and environmentally; as an example of this, between 7% and 10% of the production of an average bakery is wasted (Gosh and Eriksson 2019). The motivation to deliberate the focus of study

is the high incidence of this problem in the sector, due to its abundance of numerical data and support in documentary review (Bhardwaj et al. 2023).

It is important to mention key indicators that reflect this problem in the sector at a global level. First, the percentage of defective breads, since the percentage of total bread production wasted in Europe is 8.74% due to poor baking or undesired shape and weight (Iakovlieva 2021). Second, the percentage of finished products that expire, since 21% of finished products in Asian bakeries are not sold before their expiration date, becoming waste (Aljohani 2023). Finally, the amount of monetary losses in finished products, since US$23,000 in losses of bakery and confectionery products were recorded in Italy (Cicatiello et al. 2017). Based on this, the main objective is to design and validate a logistics proposal aimed at improving demand planning and standardizing processes to reduce finished product waste, thus strengthening the competitiveness and development of the supply chain in the bakery and pastry sector in Peru.

Likewise, a PEST analysis of the studied system was conducted to better understand the opportunities and challenges that arise. Among the political and legal factors of the sector, government legislation and state support are distinguished. First, there is Law No. 30988, which promotes the reduction and prevention of food loss and waste, which encourages the development of projects or programs linked to the fulfillment of the stated objectives, as well as adequate training and encourages the application of good practices in food handling throughout the food chain activities (Diario El Peruano 2020). Regarding state support, the Ministry of Labor and Employment Promotion (MTPE) through its *Impulsa Perú* program, certified 100 people in the bakery and pastry profiles in districts of Lima through the NOVA Certification Center, officially validating their skills and knowledge, improving their employability and job quality (Gob.pe 2018). In relation to economic factors, the costs of inputs have increased, such as unprepared flour (9.1%), brown sugar (5.4%), white sugar (4.6%) and some fruits related to dessert decoration such as mango (50.1%), strawberry (39.2%) and blueberries (23.4%); in turn, in the last 7 years the price of a 50 kg sack of wheat flour has increased by 109% (Instituto Nacional de Estadística e Informática 2023).

Regarding the sector's turnover, ASPAN (National Association of Suppliers to the Baking Industry) reported that bakeries and pastry shops generated approximately US$ 5,268 million in annual sales and this has caused a notable increase in the cake market in Peru during 2023, so, thanks to these results, a compound annual growth rate of 3.30% is projected for the sector in general in the next 9 years (Informes de Expertos 2024). Regarding the Gross Domestic Product (GDP), the sector represents approximately 1.9% of the GDP and manufacturing production in the food and beverage sector, specifically in bakery, increased approximately 46.49% in the last 10 years (Banco Central de Reserva del Perú 2024).

On the other hand, when analyzing sociocultural factors, changes in consumption patterns were identified, mainly due to the trend towards healthier options (Deselnicu 2020). This has led companies in the sector to incorporate new and innovative products, offering a greater variety of artisan bread made with more natural and healthier ingredients to continue satisfying customers (Mendonça and Aires 2020). Furthermore, according to Sociedad Nacional de Industrias (2018), per capita bread consumption in Peru is 35 kg, which is already low compared to other Latin American countries, and a gradual reduction has been evident since 2009, going from 12 to 7 loaves per day per family (Pulso PUCP 2023). Regarding environmental awareness, according to a Sustainability study, the Peruvian Food Bank reported that the country loses 12.8 million tons of food annually, representing 47.6% of the total available (Bedoya and Piran 2021). This motivated the creation of the *Cirkula* mobile application focused on the commercialization of surplus food from around 100 Peruvian restaurants, cafes and bakeries that deal with this problem and seek to reduce their environmental impact caused by excessive CO2 generation (El Comercio 2021). Regarding the human capital of the sector, ASPAN mentions that, among the 20,000 bakeries and pastry shops in Peru, there are 300,000 jobs classified in A1 companies, progressive companies, follower companies and bad companies.

In relation to technological factors, the development of energy sources is an aspect to consider because most Peruvian bakeries and pastry shops are highly dependent on the use of petroleum, which represents a drawback for the future because fossil energy will be prohibited and migration to electric ovens that require electricity will be necessary (Expreso 2023). Regarding e-commerce, the market share of cakes in Peru is increasing substantially due to the increase in sales through e-commerce platforms (Informes de Expertos 2024). Additionally, the digital transformation in bakeries and pastry shops, exemplified by María Almenara, has been accelerated with artificial intelligence thanks to Azure Machine Learning, achieving a service without running out of stock, also called fill rate, of 99% and estimates were obtained of how much will be sold per store and per product by adjusting the production and shipping of precise

orders (Microsoft 2021). Figure 1 shows a summary of the PEST analysis and the most relevant factors that may influence the Peruvian bakery and pastry market.

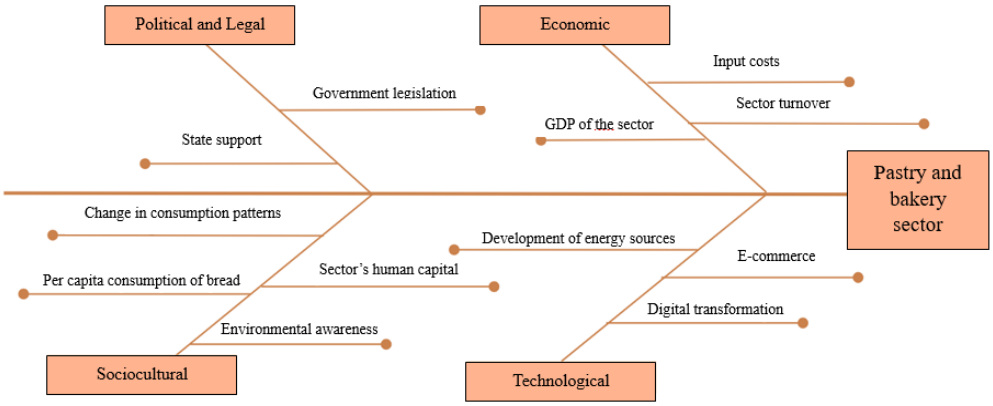

Figure 1. PEST analysis

1.1 Objectives

- Diagnose the current situation of the bakery and pastry sector, as well as the challenges and opportunities in its supply chain.
- Design a logistics proposal for the problem identified in the sector's supply chain using industrial engineering tools, in order to reduce expired and defective finished products.
- Validate the proposed solution and its sustainability to ensure the reduction of finished products in the bakery and pastry sector and the improvement of the sector's competitiveness.

2. Literature Review

2.1 Continuous improvement

It refers to a strategy that involves action programs designed to enhance aspects such as the quality, productivity, and competitiveness of business processes and services (Montesinos 2022). It is also carried out through the ongoing analysis and evaluation of a company's activities, which allows the identification of opportunities for improvement and optimization, enabling them to be carried out more efficiently (Vargas et al. 2018).

2.2 Inventory management

It involves the management of a constant quantity of elements such as raw materials and finished products (Mirza and Harahap 2021). This control is possible using techniques, tools, and productivity indicators, as well as considering production distribution analysis (Paes et al. 2019). Therefore, by ensuring that these aspects work together, customer expectations can be met and, consequently, the benefits perceived by the company can be maximized (Sunday and Jones 2022).

3. Methods

This research was categorized as a descriptive sectoral case study with a non-experimental design because variables are not manipulated, but rather the relationships between key factors and social actors are analyzed. Furthermore, this study employs non-probability sampling, as the experts who participated in the research were intentionally chosen, but also took into account selection criteria such as holding a senior position (manager or head) in production, logistics, and/or sales, possessing practical knowledge of the internal processes of the aforementioned areas, having at least ten years of experience in the field, and maintaining an active role in the industry. This ensures that the value of the information for the qualitative study lies in its high relevance and depth, rather than its statistical representativeness. To carry out the work, a methodological structure consisting of four sequential phases was established.

3.1 Phase 1: Identification of stakeholders, dimensions of the study system, and their associated factors

This consists of a literature review which purpose was to gain a better understanding of the problem. Based on this information, the related dimensions were identified, evaluated and filtered according to their relevance to the topic. To identify the factors and stakeholders, the procedure explained above was followed, and from this, a draft of the collected ideas was created. This phase was validated by the ten selected experts of the sector through structured interviews until the consensus was reached. In this way, the identification of thirteen factors and five stakeholders was supported by examples provided by the interviewees themselves.

3.2 Phase 2: Identification of key factors for the sector

To select the most relevant factors, a structural analysis was performed using the Cross-Impact Matrix. This tool allows various variables to be interrelated in order to analyze and determine the level of influence and dependence between the factors. This step is necessary to select those that are most relevant to the topic which makes it an essential resource for decision-making in this type of study. In this case, it was useful for determining three key factors based on the consensus among the selected experts.

3.3 Phase 3: Identification of Key Stakeholders in the Sector

To select the stakeholders related to the problem, a hierarchy was established using a Power-Interest Grid. The power level means their ability to influence decisions or the outcomes, and the interest level is related to the involvement in the matter of the study. In this way, key stakeholders are prioritized to define how efforts and resources should be managed.

3.4 Phase 4: Design and Validation of Strategic Proposals and General Manuals for the Bakery and Pastry Sector

After determining the key factors and key stakeholders in the two phases previously explained, a matrix was developed comprising nine proposed strategies, which emerged from the combination of a strategic stakeholder and a key factor. To prioritize the proposals, an Importance-Governance Matrix was developed to identify the ideal proposal based on expert opinion. This tool prioritizes actions and facilitates consensus based on two criteria: importance, which refers to their relevance to the future of the sector, and governance, understood as the degree of control the sector can exert over implementation. Also, this phase was supported by experts who rated the proposals, and their responses were consolidated and agreed upon according to the aforementioned criteria.

4. Data Collection

To collect information and ensure the study's validity, industry experts were recruited. They had to meet the following requirements:

- Holding a senior position (manager or head) in production, logistics, and/or sales.
- Having practical knowledge of internal processes in areas such as production, logistics, and/or sales.
- A minimum of 10 years of experience in the industry.
- Maintaining an active role in the industry.

During the first phase, a Protocol for the Identification and Validation of Critical Factors in the Bakery and Pastry Sector was developed, carried out using a structured interview. This protocol included general instructions with the estimated duration of the exercise, a section with general information about the participants, a section for defining the problem with guiding questions to confirm whether it is truly perceived as a problem in the sector, a section for identifying root causes in different dimensions, complemented by evidence and examples provided by the experts, and finally a section with recommendations. To define the key factors and actors, matrices were initially constructed manually and then delivered to the experts in an Excel file. In addition, complementary interviews were conducted to guide the experts through the process and ensure consensus on the information obtained.

5. Results and Discussion

5.1 Graphical Results

From the analysis of Phase 1 of the methodological design, five dimensions and thirteen root causes linked to the main problem were identified, which were considered factors for the study (see Figure 2). Similarly, five stakeholders

influencing the problem were listed. Both lists were prepared in collaboration with the ten experts and are detailed in the following tables (see Table 1 and Table 2).

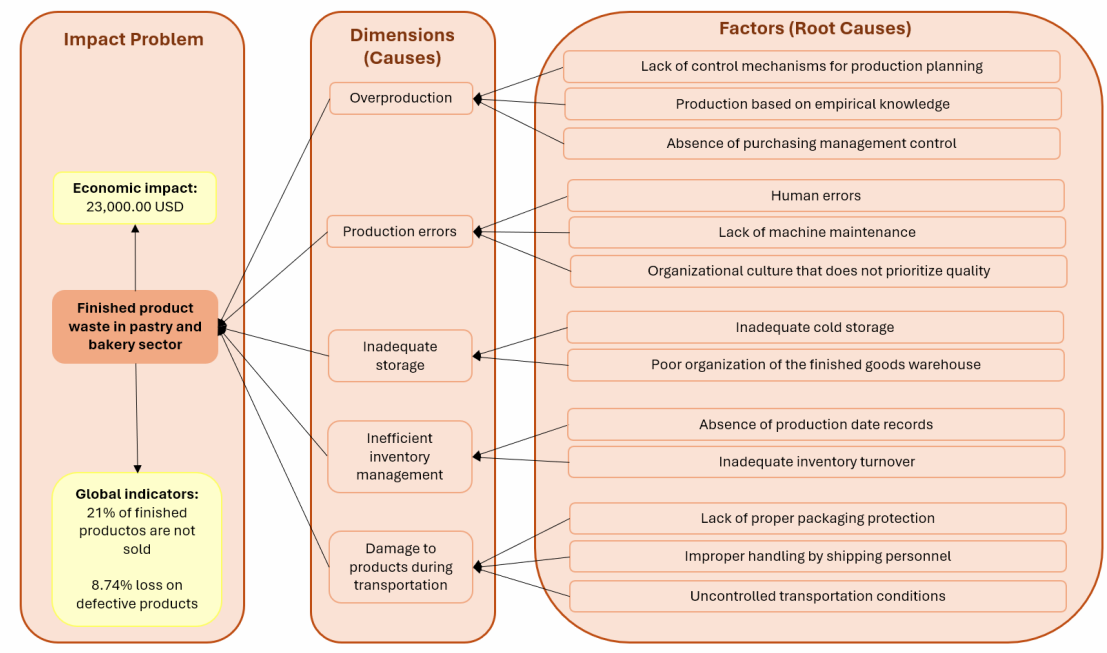

Figure 2. Root Cause Tree

Table 1. List of Factors

Code	Factors
F1	Control mechanisms for production planning
F2	Production based on empirical knowledge
F3	Purchasing management control
F4	Human errors
F5	Machine maintenance
F6	Organizational culture focused on quality
F7	Cold storage
F8	Finished goods warehouse organization
F9	Production date recording
F10	Inventory turnover
F11	Packaging protection
F12	Handling by shipping personnel
F13	Transportation conditions

Table 2. List of stakeholders

Code	Stakeholders
S1	ASPAN
S2	Bakery and pastry shop owners
S3	Bakery and pastry shop employees
S4	Customers
S5	Distributors

5.2 Numerical Results

Phase 2 consists of identifying key factors through the Cross-Influence Matrix, which was based on expert responses obtained through closed interviews in which they were asked questions to analyze the factors' dependence and driving force. It is worth noting that the rating scale ranged from zero (zero influence) to four (very high influence). To consolidate the scores and ensure consensus, it was determined that more than 60% of the ratings had to coincide and that the variance had to be less than 2 (VAR<2.0) to consider the most frequent rating, and the Table 3 contains the final results of the relationship between Influence and Dependence.

Table 3. Results of influence and dependence relationship to identify key factors

	Coordinates	
VARIABLE	X (DEP)	Y (INF)
F1	12.92%	10.59%
F2	3.66%	10.17%
F3	8.49%	7.19%
F4	3.78%	12.37%
F5	1.47%	6.19%
F6	19.94%	9.96%
F7	5.89%	4.68%
F8	10.60%	5.31%
F9	4.88%	6.52%
F10	11.25%	9.04%
F11	7.08%	7.08%
F12	5.85%	5.41%
F13	4.20%	5.51%
Total	100%	100%
Average (Σ/13)	7.7%	7.7%

Then the thirteen factors were distributed within the four quadrants of the Indirect Impact Matrix. Those located within the upper right quadrant, such as Control mechanisms for production planning (F1), Organizational culture focused on quality (F6), and Inventory rotation (F10), stand out. These factors have high driving force and dependence (see Figure 3).

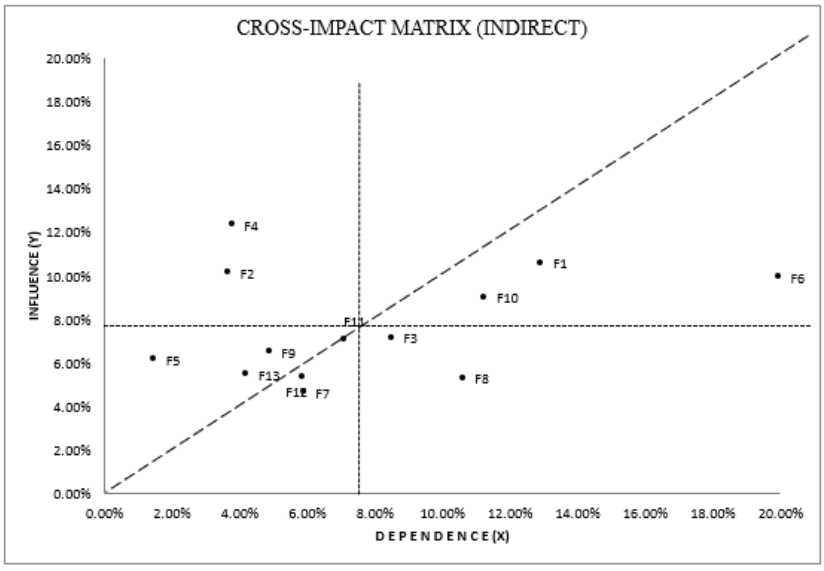

Figure 3. Indirect Cross-Impact Matrix for identifying key factors

Similarly, the participants' responses were integrated to obtain the final Power and Interest Matrix, which presents the positions of the five social actors in the four quadrants, considering the same consensus criteria used in the previous phase, and the Table 4 includes the final results.

Table 4. Results of influence and dependence relationship to identify key stakeholders

	Coordinates	
VARIABLE	X (DEP)	Y (INF)
S1	7.44%	3.69%
S2	35.10%	25.01%
S3	25.01%	21.27%
S4	25.01%	25.01%
S5	7.44%	25.01%
Total	100.00%	100.00%
Average (Σ/5)	20.0%	20.0%

From this, the following stakeholders were distinguished: Bakery and Pastry Shop Owners (S2), Bakery and Pastry Shop Workers (S3), and Customers (S4), who were placed in the upper right quadrant, as illustrated in Figure 4. This placement indicates that these stakeholders have a significant influence on the issue at hand. Therefore, it is crucial that the proposed solutions consider both the stakeholders and the previously identified factors to achieve an impact on the sector regarding the problem addressed.

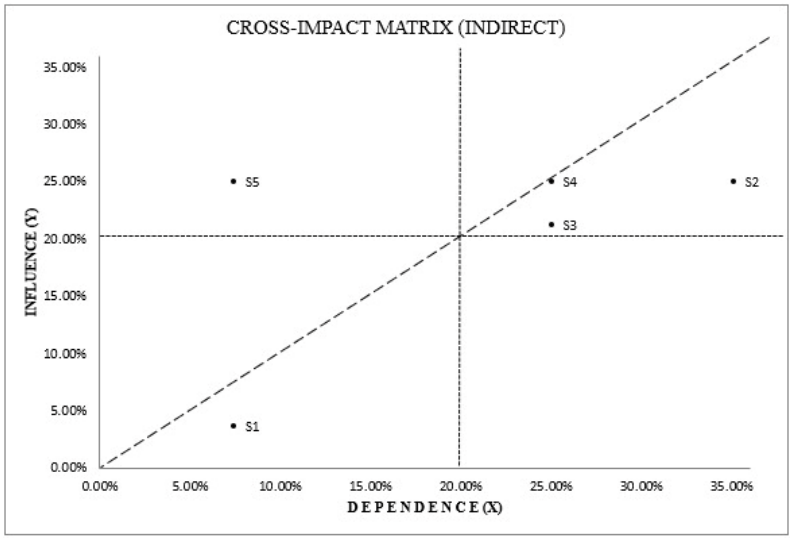

Figure 4. Indirect Cross-Impact Matrix for identifying key stakeholders

5.3 Proposed Improvements

After determining the key stakeholders and factors, a matrix was developed to facilitate the analysis and formulation of alternative solutions for each stakeholder-factor combination, thus efficiently addressing the problem. The matrix can be seen in Table 5.

Table 5. Matrix of proposal linking key actors and stakeholders

Key factors	Customer	Owners	Workers
Inventory turnover	P1: Promote products close to their expiration dates through tasting campaigns to increase sales and speed up inventory turnover.	P2: Create a stockout alert system in MS Excel that provides accurate and up-to-date information on inventory levels and allows for production adjustments, minimizing the risk of waste.	P3: Assign workers to keep products organized and accessible, placing products close to their expiration dates at the front of shelves/display cases and newer ones at the back according to the FEFO method.

Control mechanisms for production planning	P4: Implement customer surveys to gather preferences and adjust production planning, allowing the portfolio to be tailored based on direct feedback and aligned with new market trends and expectations.	P5: Record sales to create a Pareto chart that classifies products by revenue and based on this, determine which products require adjustments to the demand forecast to reduce waste due to overproduction.	P6: Document production processes to standardize work and define indicators to monitor performance, preventing defective products.
Organizational culture with a focus on quality	P7: Form a group of key customers to test and collect feedback on products before launch or at regular intervals to ensure quality and minimize the risk of unsold products.	P8: Develop, adapt, and customize new products to restore business relevance and maintain competitiveness through innovation.	P9: Identify areas where errors occur most frequently by collecting reports and establish regular procedures to improve quality from the start of operations and ensure food safety and security measures.

These proposals were also prioritized using the Importance-Governance Matrix (IGM), a tool that prioritizes actions and facilitates consensus based on two criteria: importance, which refers to their relevance to the future of the sector, and governance, understood as the degree of control the sector can exert over implementation. This phase was supported by experts who rated the proposals, and their responses were consolidated and agreed upon according to the aforementioned criteria.

As shown in Figure 5, the proposals were classified into four groups according to the quadrants: unnecessary (P4), less urgent (P3), challenges (P8 and P9), and immediate (P7, P1, P2, P6, and P5). From this, proposals 5 and 6 (P5 and P6) were selected because they have the greatest influence on achieving the desired results and are perceived as more manageable and executable within the organizational and operational context.

Figure 5. Importance-Governance Matrix

To provide greater detail on the steps required to implement the final proposal, which combines proposals 5 and 6 mentioned above, a manual was developed that includes all the essential aspects for its proper execution. Its general objective is to implement a sales record to create a Pareto chart, seeking to adjust and forecast demand and significantly reduce waste of finished products. To this end, resources such as a sales record manager, data analyst, production manager, external (temporary) consultant, MS Excel, training for the responsible staff, and support materials were included.

Phases were established for its implementation, starting with Phase 1, which consists of training key personnel on the concepts and relevance of the tools involved in the proposal. Then, Phase 2 addresses data collection and recording, which includes sub-stages such as sales registration implementation, collection and recording of information on production processes, continuous monitoring to ensure data accuracy, and finally, the creation of the Pareto Chart. This phase is related to what Dias de Menezes et al. (2023) mentioned, because of the fact that data recording facilitates obtaining relevant information to understand consumer behavior and achieve a certain degree of predictability that allows controlling stock levels, avoiding future losses or excess production.

Subsequently, Phase 3 is based on the proposals made by Huallpa et al. (2020), who explains that Peruvian bakeries and pastry shops need to prioritize training in their methods and tools to improve their performance. Therefore, this

phase focuses on process standardization, which requires the development of a procedures manual and the training of operators and supervisors, ensuring an understanding of quality standards and performance expectations.

Following that, Phase 4 is about analysis and adjustments, which involves analyzing the Pareto Chart and classifying products based on revenue, forecasting in MS Excel and identifying seasonality and trends, making adjustments to the forecast for Group A products considering the Pareto Chart to have better control over demand and production, and proceeding with the validation of results. The content presented in this phase is supported by what Maheshwari et al. (2023) mentioned, who emphasized that planning, monitoring, and control strategies for the forecast of the products sold are essential to improve the efficiency of the supply chain. Finally, phase 5 is called monitoring and optimization and consists of periodic adjustments. It is recommended to gradually expand the analysis focus to products in group B and subsequently to group C.

5.4 Validation

This study aims to reduce waste of finished products in the bakery and pastry sector through logistics proposals. Evidence suggests that proper waste management can generate significant economic benefits without the need for costly investments, as well as significantly improve production processes by reducing unnecessary losses. This idea is reinforced by what Glodmann et al. (2021) stated, who claim that waste reduction is key to environmental sustainability, improved food safety, supply chain optimization and, consequently, increasing business profitability and competitiveness.

The proposal consists of recording sales and creating a Pareto Chart based on it to classify products according to revenue and adjust the demand forecast, which shares similarities with Garay and Mejía (2023), who apply Lean Manufacturing methodologies such as MRP and MPS in bakeries to reduce defects and optimize production. However, unlike the previous case, whose focus is on standardization and defect reduction, the present work prioritizes more profitable products to make strategic adjustments in production. This adds value by linking sales with planning, that is, balancing production and demand, considering the commercial aspect.

As stated by Goldmann et al. (2021), waste reduction must be approached from a technical-operational perspective, identifying critical recovery points such as machinery failures, problems with hygienic conditions, and human errors that directly impact production. To avoid these problems, it is suggested to implement practices such as rigorous control of production conditions, preventive maintenance of machinery, and continuous training of personnel. In contrast, the present work optimizes production by prioritizing the adjustment of the demand forecast for more profitable products, focusing on the commercial aspect to reduce overproduction. However, the incorporation of critical recovery points within the operational phases of the present study would allow minimizing operational failures and increasing efficiency in the supply chain, which complements the proposal to achieve a more comprehensive and profitable approach.

As explained in Soni et al. (2022), the problem can also be addressed through monitoring systems, returns, and collaboration with charities for donations, as well as through staff training and analysis of the causes of waste at final stages. In contrast, the present study proposes a more direct logistics approach, focused on optimizing the supply chain from earlier stages to structurally reduce the waste of finished products.

Khan et al. (2023) agree that demand forecasting is essential for the bakery and pastry industry, as it allows them to remain competitive in a dynamic market by optimizing both production planning and inventory management using accurate and relevant information that contributes to strategic decision-making. Similarly, the proposal of this research involves keeping a constantly updated sales record as an information basis for analysis that seeks to identify aspects that need adjustments in order to improve operational performance (Gil et al. 2020).

On the other hand, Lara et al. (2023) indicates that preparing demand forecasts for companies in this sector is not a simple process, given that it is necessary to consider the perishability of products and fluctuations in consumer behavior due to factors such as trends, holidays, weather conditions, or other specific events which is also supported by Hübner et al. (2024). In contrast, the proposal seeks to make this process accessible and practical, given that a large number of companies in this sector rely on their experience and empirical knowledge. Therefore, they need to progressively move toward new methodologies such as those presented in the proposal of this work, which suggests

the use of tools such as the Pareto Chart and an implementation guide that includes an explanation of different types of forecasts and their execution.

Furthermore, the design of a demand forecasting model based on Machine Learning represents an effective alternative that has managed to align production with demand, impacting a 17.23% increase in profits and a 6.36% decrease in costs; however, one of its limitations was the lack of sufficient resources to acquire the platform, so the execution time was prolonged (Afanador et al. 2022). Therefore, the presented proposal aims to allow even those with limited resources to easily implement more analytical and data-driven practices in a short period of time, thus contributing to the growth of the sector.

6. Conclusion

This study involved a comprehensive diagnosis of the current situation in the bakery and pastry sector in Peru, focusing on the supply chain. Based on an analysis of the opportunities and challenges faced by companies in this sector, it was determined that the significant amount of finished product waste represented one of the most significant problems. Consequently, thirteen factors and five social actors were identified as influential in the problem, according to the opinions of ten sector experts, whose knowledge and assessments contributed to the development of the investigation.

To develop the proposed solution design, three key factors were identified using the Cross-Impact Matrix, and three social actors were identified using the Power-Interest Grid. From this, nine proposals were constructed based on the relationship between the key factors and key stakeholders, and their level of importance was determined using the Importance-Governance Matrix. Finally, two proposals were selected as the highest priority.

The final logistics proposal involves control mechanisms for production planning as a key factor and business owners and employees as key stakeholders. This strategy consists of adjusting the demand forecast through Pareto Chart analysis and documenting standardized processes, including monitoring indicators. To this end, an implementation guide was developed based on engineering tools such as the Pareto Chart, the RACI Matrix, and the Gantt Chart, providing a practical and effective approach to optimize operational performance.

Furthermore, it is suggested that this proposal could be transferred to other perishable food sectors, such as restaurants or cafes, which face similar challenges of overproduction and waste of finished products. This would allow them to optimize demand management and improve supply chain efficiency. In addition, it is considered essential that future research integrates tools related to predictive analytics and real-time monitoring technologies, which would contribute to reducing the margin of error in demand forecasting.

References

Afanador, M., Casadiegos, S., Campo, I., & Casallas, J., Diseño de un modelo de pronóstico de demanda basado en machine learning y un modelo multi-objetivo para planeación de la producción en una industria panificadora, Repositorio Institucional - Pontificia Universidad Javeriana, Pontificia Universidad Javeriana, 2022. http://hdl.handle.net/10554/59123

Aljohani, K., Optimizing the Distribution Network of a Bakery Facility: A Reduced Travelled Distance and Food-Waste Minimization Perspective, Sustainability, 15(4), 1-26, 2023. https://doi.org/10.3390/su15043654

Banco Central de Reserva del Perú, Manufactura no primaria - alimentos y bebidas – Panadería, 2024. https://estadisticas.bcrp.gob.pe/estadisticas/series/mensuales/resultados/PN02032AM/html

Bedoya, N., & Piran, G., Quantification of Food Losses and Waste in Peru: A Mass Flow Analysis along the Food Supply Chain, Sustainability, 13(5), 1-15, 2021. https://doi.org/10.3390/su13052807

Bhardwaj, A., Soni, R., Singh, L., & Mor, R., A Simulation Approach for Waste Reduction in the Bread Supply Chain, Logistics, 7(1), 1-13, 2023. https://doi.org/10.3390/logistics7010002

Cicatiello, C., Franco, S., Pancino, B., Blasi, E., & Falasconi, L., The dark side of retail food waste: Evidences from in-store data, Resources, Conservation & Recycling, 125, 273–281, 2017. https://doi.org/10.1016/j.resconrec.2017.06.010

Deselnicu, D., Bulboaca, M., Dumitriu, D., & Alexandrescu, L., Analysis of the bakery industry strategic groups in Romania, International Conference on Advanced Materials and Systems (INCAMS), 2020(8), 271-276, 2020. https://doi.org/10.24264/icams-2020.III.4

Diario El Peruano, Decreto Supremo que aprueba el Reglamento de la Ley Nº 30988, Ley que promueve la reducción y prevención de pérdidas y desperdicios de alimentos (Nº 003-2020-MINAGRI), 2020. https://faolex.fao.org/docs/pdf/per194774.pdf

Dias de Menezes, A., Barros, J., Bastos da Fonseca, B., Aguilera, M., & Sampaio, N., Demand forecasting and inventory management as requirements for quality assurance in a bakery company, Revista de Gestão e Secretariado (Management and Administrative Professional Review), 1(14), 15680-15694, 2023. http://doi.org/10.7769/gesec.v14i9

El Comercio, Cirkula, la app que lidia con el problema de desperdicio de alimentos en restaurantes, 2021. https://elcomercio.pe/provecho/tendencias/cirkula-la-app-que-lidia-con-el-problema-de-desperdicio-de-alimentos-en-restaurantes-noticia/?ref=ecr

Expreso, Aspan lamenta que no se haya aprobado ley: «No nos alcanzó dinero para comprar congresistas», 2023. https://www.expreso.com.pe/economia/aspan-no-nos-alcanzo-dinero-para-comprar-congresistas-noticia/972413/#google_vignette

Garay, M., & Mejía, D., Production Model Based on Lean Manufacturing, MRP, MPS and TPM to Reduce Losses in a MSE in the Bakery Sector, 4th South American International Conference on Industrial Engineering and Operations Management, 2023. https://doi.org/10.46254/SA04.20230005

Ghosh, R., & Eriksson, M., Food waste due to retail power in supply chains: Evidence from Sweden, Global Food Security, 20(2), 1–8, 2019. https://doi.org/10.1016/j.gfs.2018.10.002

Gil, M., Rodríguez-Marín, M., & Montoya, M. A., Demand planning on small and medium-sized enterprises in Mexico: A case study of a confectionery firm, Advances in Business Related Scientific Research Journal (ABSR), 11(2), 2020. https://www.researchgate.net/publication/347939137

Gob.pe, El MTPE a través del programa impulsa Perú certifica a 100 personas en los perfiles de panadería y pastelería, 2018. https://www.gob.pe/institucion/impulsaperu/noticias/215741-el-mtpe-a-traves-del-programa-impulsa-peru-certifica-a-100-personas-en-los-perfiles-de-panaderia-y-pasteleria

Goldmann, E., Gazdecki, M., Rejman, K., Cisowska, J., Laba, S., & Laba, R., How to Prevent Bread Losses in the Baking and Confectionery Industry? - Measurement, Causes, Management and Prevention, Agriculture, 11(19), 2021. https://doi.org/10.3390/agriculture11010019

Goldmann, E., Gazdecki, M., Rejman, K., Cisowska, J., Laba, S., & Laba, R., Magnitude, Causes and Scope for Reducing Food Losses in the Baking and Confectionery Industry—A Multi-Method Approach, Agriculture, 11(936), 2021. https://doi.org/10.3390/agriculture11100936

Huallpa, J., Vera, T., Altamirano, E., Raymundo, C., & Moguerza, J., Production Management Model for Increasing Productivity in Bakery SMEs in Peru, Advances in Intelligent Systems and Computing, 971(21), 477-485, 2020. https://doi.org/10.1007/978-3-030-20494-5_45

Hübner, N., Caspers, J., Coroamă, V. C., & Finkbeiner, M., Machine-learning-based demand forecasting against food waste: Life cycle environmental impacts and benefits of a bakery case study, Journal of Industrial Ecology, 2(4), 1–15, 2024. https://doi.org/10.1111/jiec.13528

Iakovlieva, M., Food waste in bakeries - quantities, causes and treatment, Journal Molecular Sciences, 32(1), 1-51, 2021. https://stud.epsilon.slu.se/17180/

Informes de Expertos, Mercado Global de Pastelería – Por Tipo (Fresco, Congelado); Por Producto (Productos de Panadería Artesanal, Productos de Panadería en Tienda); Por Sabor (Dulce, Sabroso); Por Uso Final (HoReCa, Minorista); Por Canal de Distribución (Hipermercados y Supermercados, Tiendas de Conveniencia, Tiendas Especializadas, En Línea, Otros); Por Región (América del Norte, Europa, Asia Pacífico, América Latina y Medio Oriente y África); Dinámica del Mercado (2024-2032) y Panorama Competitivo, 2023. https://www.informesdeexpertos.com/informes/mercado-de-pasteleria

Informes de Expertos, Mercado de Pasteles en Perú – Por Forma (Envasado, Sin Envasar/Artesanal); Por Tipo (Magdalenas, Bizcochos, Pasteles de Postre, Otros); Por Canal de Distribución (Servicio de Alimentos, Retail); Dinámica del Mercado (2024-2032) y Panorama Competitivo, 2024. https://www.informesdeexpertos.com/informes/mercado-de-pasteles-en-peru

Instituto Nacional de Estadística e Informática, En el 2023 los precios al consumidor de Lima Metropolitana aumentaron 3,24%, 2023. https://m.inei.gob.pe/prensa/noticias/en-el-2023-los-precios-al-consumidor-de-lima-metropolitana-aumentaron-324-14855/

Khan, S., Bukhari, R., Sadiq, F., & Ejaz, A., Factors affecting waste elimination: a case of confectionery food, South Asian Journal of Operations and Logistics, 2(1), 28-47, 2023. https://doi.org/10.57044/SAJOL.2023.2.1.2303

Lara, C., Leverenz, D., Hafner, G., Huang, J., Maurer, C., & Duelli, G., Comparative study of demand forecasting methods for efficient food waste reduction using real data from small and medium-sized bakeries in Germany,

Deutsche Gesellschaft für Abfallwirtschaft e.V, 2(5), 115-119, 2023. https://ulb-dok.uibk.ac.at/download/pdf/9357877.pdf

Maheshwari, P., Kamble, S., Belhadi, A., Venkatesh, M., & Zoynul, M., Digital twin-driven real-time planning, monitoring, and controlling in food supply chains, Technological Forecasting and Social Change, 195, 122799, 2023. https://doi.org/10.1016/j.techfore.2023.122799

Mendonça, M., & Aires, R., Modelo Multicritério de Gerenciamento do Sortimento de Produtos para o Setor de Panificação, Revista de Administração IMED, 10(2), 27-50, 2020. https://doi.org/10.18256/2237-7956.2020.v10i2.3617

Microsoft, María Almenara: The First Data-Driven Peruvian Bakery, 2021. https://news.microsoft.com/es-xl/maria-almenara-the-first-data-driven-peruvian-bakery/

Mirza, F., & Harahap, A., Application of Raw Material Inventory Control in Neko Neko Bakery and Cake with EOQ Method for Multi Item, Journal of Mathematics Technology and Education, 1(1), 47-62, 2021. https://talenta.usu.ac.id/jomte/article/view/7271/4825

Montesinos, S., Mejora continua para aumentar la productividad de las empresas, PROCEEDINGS. Primer Congreso Internacional Multidisciplinario "Ciencia, Tecnología e Innovación: Una mirada multidisciplinaria a los desafíos globales de la Agenda 2030", 197-201, 2022. http://doi.org/10.5281/zenodo.7482336

Mordor Intelligence, Mercado de Pasteles: Crecimiento, Tendencias, Impacto de Covid-19 y Pronósticos (2023 - 2028), 2023. https://www.mordorintelligence.com/es/industry-reports/pastries-market

Paes, S., Correa, B., Cunha da Silva, R., & Batista de Vilhena, M., Using the ABC curve as a tool for inventory management in a bakery and confectionery company, ITEGAM-Journal of Engineering and Technology for Industrial Applications, 5(17), 17-22, 2019. https://dx.doi.org/10.5935/2447-0228.20190002

Pulso PUCP, Consumo de pan por región, tipo y punto de venta, 2023. https://pulso.pucp.edu.pe/reportes-estadisticos/consumo-de-pan-por-region-tipo-y-punto-de-venta#:~:text=En%20la%20costa%20urbana%2C%20la,de%2021.4%20kg%20per%20c%C3%A1pita

Sociedad Nacional de Industria, Coyuntura Industrial – Febrero 2022, 2022. https://sni.org.pe/coyuntura-industrial-febrero-2022/

Sociedad Nacional de Industrias, Reporte Sectorial N° 07 –2018, 2018. https://www.sni.org.pe/wp-content/uploads/2018/10/Resumen_reporte-sectorial-de-panader%C3%ADa.pdf

Soni, R., Bhardwaj, A., & Jarangal, L., Bread Waste and Mitigation Strategies: A Review, International Conference on Materials Science and Engineering (ICMSE 2022), 12(48), 2022. https://doi.org/10.1088/1757-899X/1248/1/012010

Sunday, M., & Jones, E., Inventory Management Practices and Organizational Productivity in Nigerian Manufacturing Firms, Journal of Entrepreneurship and Business, 10(2), 1-16, 2022. https://doi.org/10.17687/jeb.v10i2.863

Vargas, J., Muratalla, G., & Jiménez, M., Sistemas de producción competitivos mediante la implementación de la herramienta Lean Manufacturing, Ciencias Administrativas, 11, 81-95, 2018. https://www.redalyc.org/articulo.oa?id=511654337007

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