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Simulation-Based Optimization of the Outbound Warehouse Dispatch Process to Minimize Risk of Delivery Discrepancies

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Abstract

Warehousing is an essential part of manufacturing supply chains, especially in high-volume product settings. Here, the accuracy of outbound dispatch directly impacts customer satisfaction and operational costs. This study uses a simulation based Lean Six Sigma DMAIC approach to examine and improve the outbound warehouse dispatch process for a tissue manufacturing company in the Philippines. The researcher analyzed historical dispatch records, conducted direct observations, and conducted interviews to find the root causes of delivery errors. The results showed that manual loading activities and the lack of real-time verification were the main causes of dispatch mistakes, leading to significant financial losses. The researcher designed and evaluated a digital dispatch verification system that uses barcode scanning and structured loading controls through simulation modeling. The simulation results show an 82.35% decrease in dispatch discrepancies and an 83.48% drop in related costs. These findings indicate that simulation-driven digital verification offers an effective and scalable way to improve warehouse dispatch accuracy.

Keywords
Warehouse dispatch, simulation modeling, DMAIC, barcode verification, logistics.

1. Introduction
Outbound warehouse dispatch accuracy plays a vital role in ensuring reliable supply chain performance. In manufacturing firms handling a wide range of stock keeping units (SKUs), errors during dispatch can lead to shipment discrepancies, customer complaints, and increased logistics costs. Despite advances in warehouse management systems, many organizations still rely on manual verification during outbound operations, increasing the likelihood of human error. This study addresses these challenges by integrating simulation modeling with Lean Six Sigma DMAIC methodology to systematically improve outbound dispatch processes.

2. Problem Formulation
The case company experienced persistent discrepancies between items recorded for dispatch and those physically loaded onto delivery trucks. These discrepancies resulted in an estimated loss of ₱8 million in 2024 across all branches, with ₱3 million attributed to the Tanauan site. Root causes included the absence of digital traceability, lack of real-time verification, and dependence on manual loading checks. These issues necessitated a structured and data-driven intervention.

3. Methods
Applied research design was employed using the DMAIC framework. The Define phase utilized deployment flowcharts to map the existing dispatch process. The Measure phase applied bar charts, control chart and Pareto analysis to quantify error frequency and cost impact. Root causes were identified using Why-Why analysis during the Analyze phase. Improvement alternatives were developed through a digital dispatch verification system, while the Control phase focused on FMEA and a structured control plan.

4. Data Collection

Data were gathered through semi-structured interviews with warehouse staff and supervisors, direct observation of dispatch activities, and analysis of historical dispatch records. These data sources provided qualitative and quantitative inputs necessary for accurate simulation modeling and evaluation.

5. Results and Discussion

Simulation results demonstrated substantial improvements in dispatch accuracy following the implementation of digital verification controls. Both numerical and graphical analyses confirmed the effectiveness of the proposed system.

5.1 Numerical Results

Monthly dispatch discrepancies decreased from an average of 51 cases to 9 cases after system implementation, representing an 82.35% reduction. Correspondingly, monthly losses were reduced from ₱54,031 to ₱8,928, equivalent to an 83.48% reduction in cost.

Table 1. Project Charter

Business Case	**Problem Statement**
The warehouse management system utilized by the company for tissue products depends significantly on manual dispatch procedures, resulting in frequent discrepancies between the items recorded and those loaded. This situation has resulted in operational inefficiencies and an estimated loss of ₱8 million in 2024 across all branches, with ₱3 million attributed to the Tanauan site. The company lies in the lack of digital traceability, verification, and automation, which affects both inventory accuracy and the reliability of dispatches.	In 2024, the company faced losses of about ₱8 million. The Tanauan branch accounted for ₱3 million of that. This happened because manual dispatch procedures in the warehouse led to frequent miscalculations, wrong item selections, and no accountability with regards to loading of items.
Objective /Goal Statement	**In Scope**
This project aims to: 1. To define the existing issues in the outbound warehouse dispatch workflow by employing a deployment flowchart. 2. To measure the occurrence of different warehouse problems along with their associated costs through a bar chart and a Pareto diagram. 3. To analyze the primary issue using a why-why analysis. 4. To improve outbound dispatch by designing and simulating a digital verification system that prevents mismatches and false “item not loaded” errors. 5. To implement a Control Plan supported by real-time monitoring and FMEA actions to sustain dispatch accuracy and prevent discrepancies.	Warehouse dispatch processes for tissue products at Tanauan branch. **Out of Scope** Production operations, procurement processes, billing, logistics process and other branches.
Timeline	**Project Team**
Define: March - April 2025 Measure: June- September 2025 Analyze: June- September 2025 Improve: August - September 2025 Control: October 2025 up to present	Team Leader: N. Cueto Adviser: Dr. Ryan Curbano

The project charter presents the formal structure of the improvement initiative for the warehouse dispatch system. It identified the business need, states the problem, outlines the goals of the project, and specifies the scope and limitations. It also defines the timeline based on the DMAIC methodology and lists the project team members responsible for the study. Overall, the Table 1 shows the guiding document that clarifies what the project is all about. This approach is backed by Serdyuk (2024), who showed how a Project Charter guided process improvements in warehouse operations with the DMAIC method. It helped reduce inventory errors by clarifying goals and directing efforts toward specific problem areas. Similarly, Singh and Rathi (2020) highlighted that the Project Charter is crucial in Six Sigma projects. It ensures clear communication, keeps the project scope on track, and brings stakeholders together toward a shared goal.

Table 2. Comparison of Warehouse Dispatch Errors Before and After System Implementation

Warehouse Issue	**Before QTY(Average)-1 month**	**Before Cost ₱**	**After QTY (1 Month)**	**After Cost ₱**	**QTY Reduction %**	**Cost Reduction %**
Item Not Loaded	37	₱42,103	5	₱5,680	86.49%	86.51%
Wrong/No Additional Printed Barcode	8	₱5,203	2	₱1,298	75.00%	75.05%
Fulfilled but No Actual Stocks	3	₱2,669	1	₱900	66.67%	66.28%
Inventory Discrepancy	2	₱2,546	1	₱1,050	50.00%	58.76%
Wrong Picked of Item	1	₱1,510	0		100.00%	100.00%
Nearly Expired Items	0		0			
Damaged Items	0		0			
TOTAL	51	₱54,031	9	₱8,928	82.35%	83.48%

Table 2 compared warehouse dispatch errors before and after the digital dispatch verification system was utilized. The "Before" column displays the average number of errors recorded each month when the warehouse used a manual dispatch process. The company counts dispatch quantities in cases rather than individual packs or pieces Therefore, each error indicates a misplaced, missing, or incorrectly verified case. The exact number of pieces in a case varies depending on the SKU, such as rolls, tissue packs, or napkins. This highlights the need for case- level scanning and validation. After one month of using the digital verification system, the total number of discrepancies fell from 51 cases to 9 cases. This represents an 82.35% reduction in errors. Similarly, monthly costs dropped from ₱54,031 to ₱8,928, which is an 83.48% reduction in financial losses.

Among all warehouse problems, "Item Not Loaded" showed the biggest improvement, decreasing from 37 cases to 5 cases, an 86.49% reduction. This change is due to the mandatory barcode scanning and final loading confirmation before truck release, which stopped unverified cases from being dispatched. Errors related to wrong or unprinted barcodes and “fulfilled but no actual stocks” also decreased significantly. The system prevented dispatch transactions from being completed without a successful scan. Some issues, like wrong items picked and damaged goods, were completely resolved during the month. Barcode validation blocked incorrect SKU scanning automatically, and better handling during scanning reduced physical damage.

Table 3. Control Plan

Process No.	Process Name	How to Check	What to Do
1	Login	Check if the user can log in using the correct username and password.	If the user cannot log in, call the system admin or supervisor to reset or fix the account.
2	Delivery Receipt	Open the Delivery Receipt page and check if the DRs for the day are showing and correct.	If a DR is missing or wrong, call the supervisor to update the details.
3	Manage SKU	Check if the SKU name, barcode, and packaging match the actual product in the warehouse.	If the SKU info is wrong or packaging has changed, call the supervisor or system admin to correct it in the system.
4	Manage User Accounts	Check if users listed in the system are actual warehouse staff and active.	If a user needs to be removed or added, call the system admin to update the account.
5	Barcode Scanning	While loading, check if all items are scanned and the count matches the DR.	If scanning does not match, rescan. If the issue continues, call the supervisor to verify items.
6	DR Completion	After scanning, check if the DR shows “Completed” in the system.	If it still shows “Pending,” find and scan the missing items. If still not fixed, call the supervisor.
7	Scan History	Open Scan History and check if scans show time, date, and user.	If a record is missing or the scanner stops working, call IT or the system admin for help.

The control plan explains essential steps for using the digital dispatch system. It specifies how workers should check each step every day. The Table 3 details what to monitor, including logging in, checking the Delivery Receipt, managing SKUs and user accounts, scanning items, completing the DR, and reviewing Scan History. It also provides instructions for addressing issues and identifies who is responsible for handling them. For instance, if a login fails or a DR needs correction, the supervisor or system admin takes care of it. If scanning discrepancies occur or a device malfunctions, staff can reach out to the supervisor or IT for assistance. This Table 4 effectively guides warehouse staff by ensuring the process is clear and organized. The control plan is crucial during the Control phase because it is when the improved process must continue to function correctly. Even with improvements in place, errors can reappear if workers do not follow the right steps. The control plan prevents the warehouse from reverting to manual checks or guesswork. It maintains consistency by ensuring items are scanned, DRs are completed, records are saved, and only authorized personnel can edit critical data. This approach helps avoid shortages, wrong deliveries, and customer complaints. In short, the control plan ensures that the improved dispatch process remains accurate, stable, and effective in daily operations.

Table 4. Cost Benefit Analysis

Cost Benefit Analysis (1 Month)	
System Development Cost	₱60,000
Monthly Cost Before Implementation	₱54,031
Monthly Cost After Implementation	₱8,928
Monthly Maintenance Cost	₱5,000
Net Monthly Cost After Implementation	₱13,928
Net Monthly Cost Savings (Benefit)	₱40,103
Cost Reduction	74.23%
Payback Period	1.50 months
Monthly ROI	66.84%

The Table 4 shows the revised cost–benefit results after including a monthly system maintenance cost of ₱5,000. The Digital Dispatch Verification System required a one-time development cost of ₱60,000. Prior to implementation, average monthly dispatch-related losses amounted to ₱54,031. After implementation, direct dispatch losses decreased to ₱8,928. When the monthly maintenance cost is included, the total post-implementation monthly cost becomes ₱13,928. This results in a net monthly savings of ₱40,103, equivalent to a 74.23% reduction in dispatch-related costs. Based on this net savings, the system achieved a payback period of approximately 1.50 months and a monthly ROI of 66.84%, indicating that the investment was recovered shortly after deployment.

5.2 Graphical Results

The deployment flowchart outlines the current dispatch procedure involving Billing, Logistics, and Warehouse (Figure 1). The main issue is clearly shown at the "Load actual items" stage, marked by a problem symbol. This part of the process is done manually and does not use any digital system to verify that the right items are loaded. As a result, mistakes like incorrect quantities or wrong products happen often. Previous tasks, such as route setting and task monitoring, are also done manually, increasing the chances of unnoticed errors. This matches the background findings, where the company stated it lost around ₱8 million because of delivery discrepancies. The flowchart clearly shows that manually loading items is the key problem causing these delivery issues. According to Adeodu et al. (2023), the

Define phase in a Lean Six Sigma project must fully map the warehouse process to identify non-value-added activities. Their study on improving warehouse efficiency used a deployment/process flowchart to pinpoint critical bottlenecks, such as manual handling and unverified loading procedures. These issues are directly reflected in your organization's dispatch process.

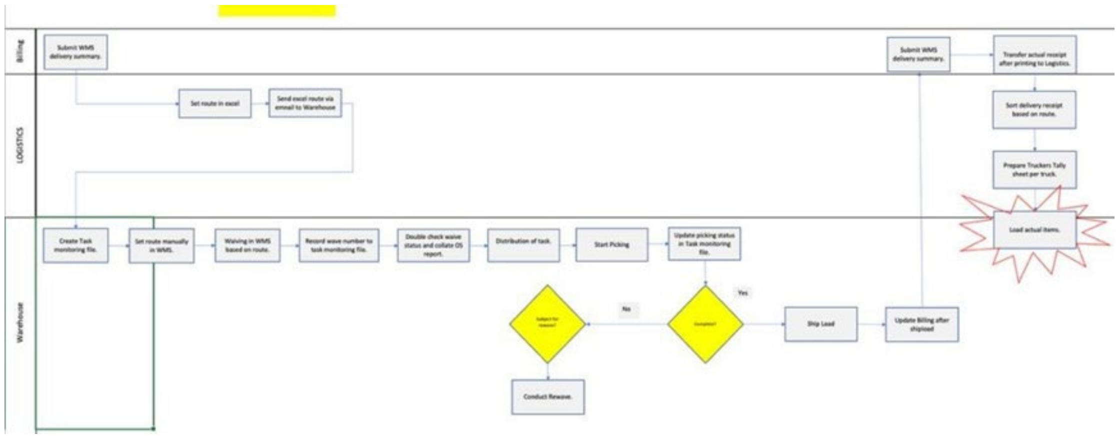

Figure 1. Deployment Flowchart

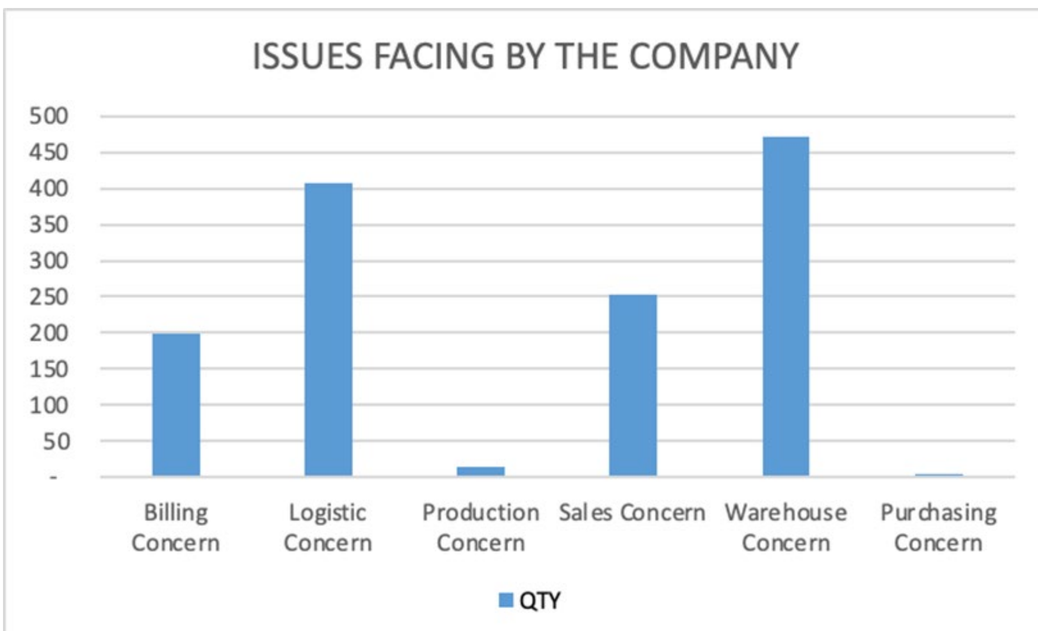

Figure 2. Distribution of operational issues encountered across different functional areas of the company

Figure 2 above presents the distribution of operational issues encountered across different functional areas of the company. Warehouse- related concerns show the highest frequency, followed by logistics and sales concerns, while billing issues are moderate and production and purchasing concerns are minimal. A bar graph was utilized because it clearly compares categorical data, making it easier to visualize the volume of issues per department. This representation supports analysis by identifying which areas require immediate operational attention and corrective action.

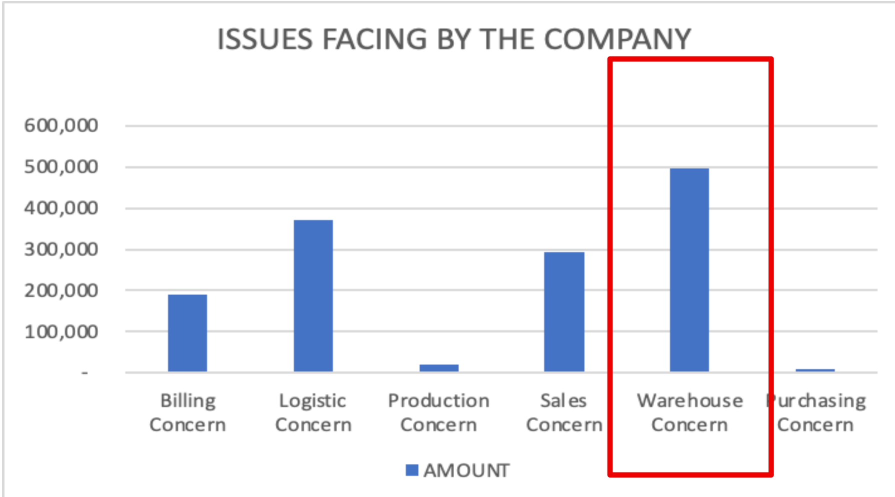

Figure 3. Bar Graph

The bar graph (Figure 3) shows the financial impact of operational issues the company faced this year, covering Quarter 1 to Quarter 3. Warehouse-related problems cause the largest financial loss, around ₱500,000. Logistics issues follow, with losses of about ₱380,000, and sales problems at roughly ₱300,000. Billing issues have a moderate cost impact, while production and purchasing problems result in only slight losses. Using a bar graph makes it easy to compare cost distribution across different areas, helping to identify the main sources of financial inefficiency. The results show that warehouse and logistics operations happen most often and lead to the highest monetary losses. This highlights the need for urgent corrective actions.

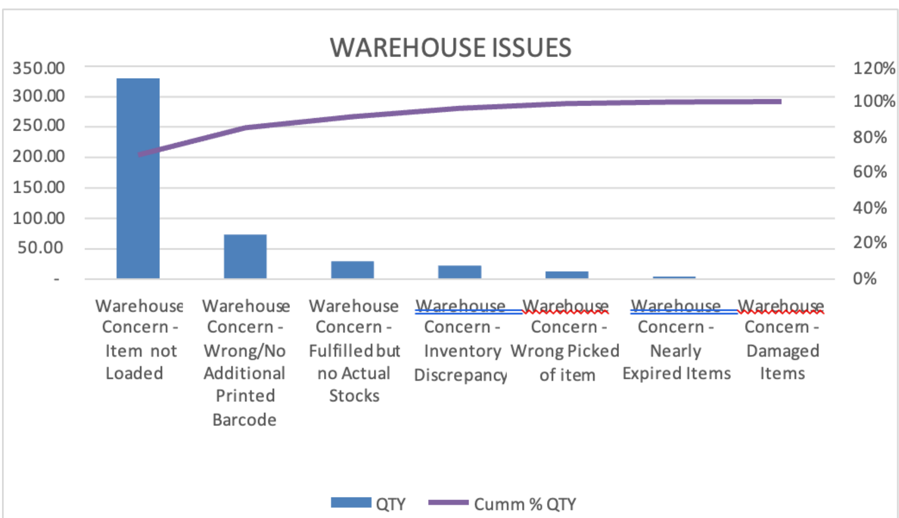

Figure 4. Pareto Diagram

The chart (Figure 4) shows that "Item Not Loaded" is the biggest warehouse issue, accounting for the most recorded cases. This problem alone represents the largest share of total errors, showing that most discrepancies happen during the loading stage, not during picking or inventory preparation. The next issue, "Wrong/No Additional Printed Barcode," occurs much less often but still affects verification and scanning accuracy. Other problems, like inventory discrepancies, wrong items picked, nearly expired items, and damaged items, happen in much smaller numbers and add little to the total count. The cumulative line rises sharply after the first category, meaning that most warehouse losses are due to one major issue. This is why a Pareto diagram is used; it shows that a small number of causes lead to most of the errors. By focusing on improving the top issues, the warehouse can reduce the largest portion of losses with less effort.

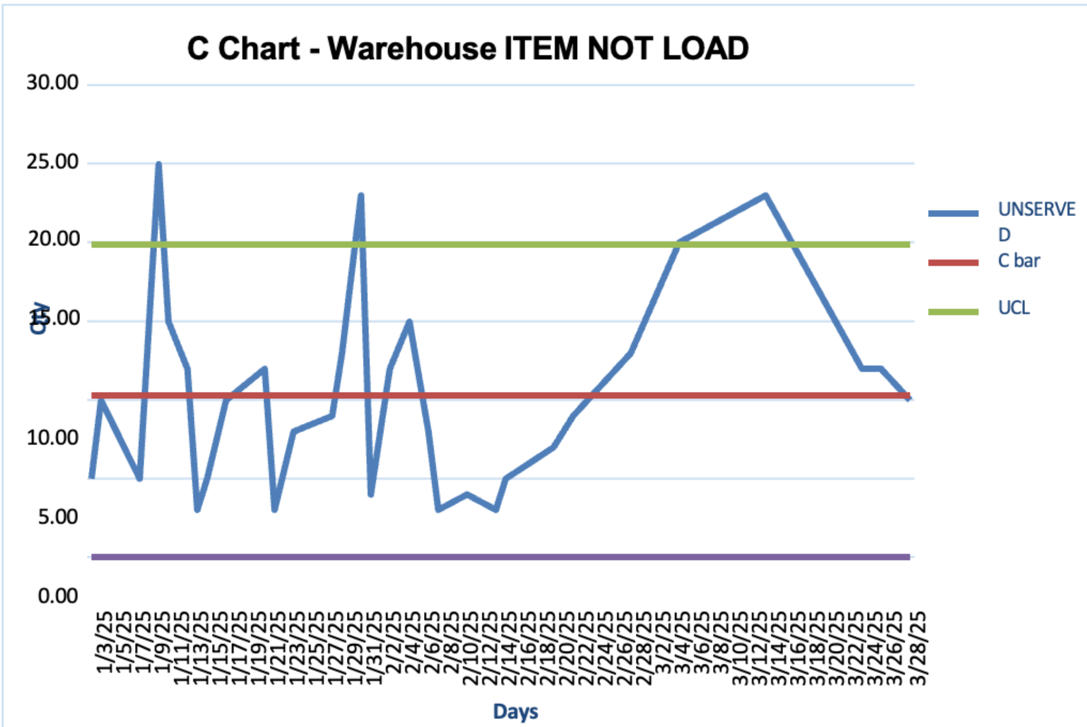

Figure 5.C-Chart

The C-chart shows (Figure 5) the daily number of "item not loaded" incidents in the warehouse dispatch process. The center line ($\bar{C}$) indicates the average number of incidents per day. The upper and lower control limits define the expected range for natural process variation. Several key observations suggest that the process is out of control: First, multiple data points go above the Upper Control Limit (UCL). This indicates special-cause variation. These spikes reflect unusual dispatch conditions that cannot be explained by random variation alone. In Lean Six Sigma terms, this clearly shows that the process is uncontrollable under the current manual system. Second, the chart reveals large swings around the average, including sudden increases and decreases in the number of "item not loaded" incidents. This level of variability points to inconsistent execution of loading and verification tasks. These inconsistencies stem mainly from checks that rely on human performance and the lack of real-time validation. Third, a consistent upward trend appears in the later part of the chart. Several consecutive points stay at or above the process average and approach or exceed the UCL. This trend indicates a worsening process condition, further reinforcing that the problem is systemic rather than one-off. Overall, the C-chart shows the current outbound dispatch process does not have effective control measures and does not maintain statistical stability. The recurring out-of-control signals highlight the need for a system-based solution, specifically a Digital Dispatch Verification System. By using barcode validation, real-time confirmation, and automated checks, the proposed system tackles the root causes of "item not loaded" incidents and is essential for restoring the process to statistical control.

5.3 Proposed Improvements

The proposed digital dispatch verification system integrates barcode scanning, structured loading, and mandatory confirmation prior to truck release. This system prevents incomplete shipments by enforcing real-time validation and accountability (Figure 6).

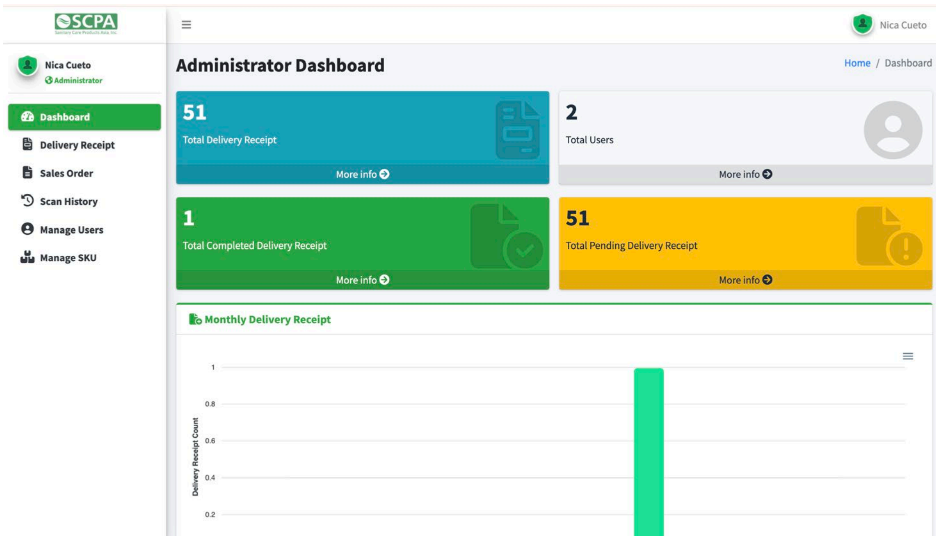

Figure 6. Warehouse Design Verification System

In the dashboard, users, especially administrators, can easily see an overview of the dispatch activity. It displays key data such as the total number of delivery receipts, how many are pending, how many are completed, and the total number of system users. This provides a quick snapshot of the delivery performance. Below, there is a Monthly Delivery Receipt graph to visually monitor trends. The left-side menu lets users navigate to other functions like managing delivery receipts, sales orders, barcode scan history, users, and SKUs.

5.4 Validation

Validation was conducted through comparative analysis of baseline and improved simulation models. The results confirm statistically and operationally significant improvements in dispatch accuracy and cost performance (Figure 7).

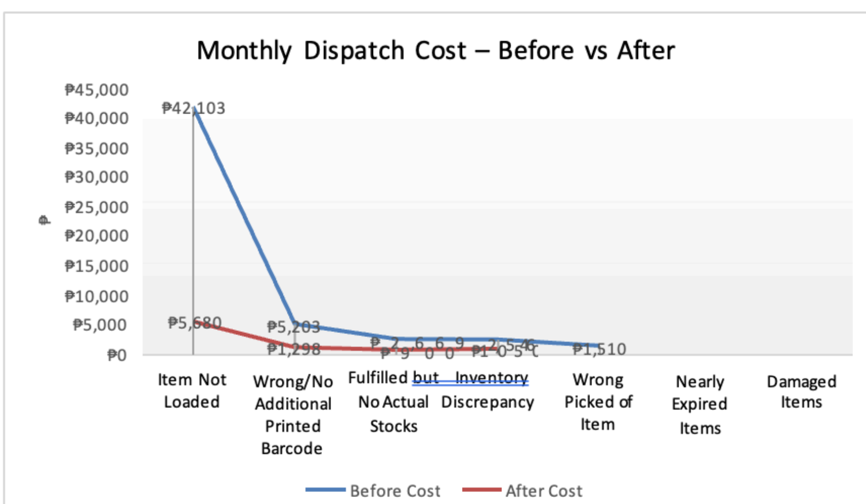

Figure 7. Comparison of Warehouse Dispatch Costs Before and After Automation

The line graph shows the monthly financial impact of warehouse dispatch errors before and after the digital dispatch verification system was put in place. Before the system was deployed, the company faced total monthly costs of₱54,031 due to issues like loading mistakes, barcode problems, stock mismatches, and picking errors. The biggest cost came from "Item Not Loaded," which alone drained ₱42,103 in one month. This reflects the high costs of returns, re-delivery, and product reconciliation when shipments were sent out incomplete or inaccurate.

6. Conclusion

This study found that the repeated dispatch errors at the Tanauan branch resulted mainly from manual loading procedures, a lack of verification checkpoints, and no real-time confirmation system in outbound operations. Analysis using bar graphs, Pareto charts, and Why-Why analysis revealed warehouse-related issues, especially "Item Not Loaded" incidents and barcode failures, as the main causes of discrepancies. This shows that a few key problems led to most operational errors. By using an applied research approach, the study created a digital dispatch verification system that combines real-time item validation, barcode confirmation, and automated accountability. This system showed promise in reducing loading errors, lessening manual effort, and preventing dispatch losses. Additionally, the Control Plan, backed by monitoring tools and preventive actions based on FMEA, helps maintain improvements and supports ongoing efficiency and accuracy in the outbound warehouse process.

References

Agyapong, G. A., & Adjei, E. Development of an improvement framework for warehouse processes using lean six sigma DMAIC approach: A case of third-party logistics (3PL) services. *Heliyon, 9*(5), e15525. 2023. https://doi.org/10.1016/j.heliyon.2023.e15525

Aravindaraj, K., & Chinna, P. R. A systematic literature review of integration of Industry 4.0 and warehouse management to achieve Sustainable Development Goals (SDGs). *Cleaner Logistics and Supply Chain, 3*, 100045. 2022. https://doi.org/10.1016/j.clscn.2022.100045

Autry, C. W., & Sanders, N. R. Supply chain security: A dynamic capabilities approach. In *Supply Chain Risk: A Handbook of Assessment, Management, and Performance* (pp. 301–320). Springer. 2009.

Ayoola, V. B., Osam-Nunoo, G., Umeaku, C., & Awotiwon, B. O. IoT-driven smart warehouses with computer vision for enhancing inventory accuracy and reducing discrepancies in automated systems. 2024.

Becerra-Fernandez, M., & Romero, O. R. Assignment-simulation model for forklifts in a distribution center with aisle constraints. *Simulation Modelling Practice and Theory*. 2024. https://doi.org/10.1016/j.simpat.2024.102952

Belter, J., Hering, M., & Weichbroth, P. Motion trajectory prediction in warehouse management systems: A systematic literature review. *Applied Sciences, 13*(17), 9780. 2023.

Bett, D. K., Ali, I., Gheith, M., & Eltawil, A. Simulation-based optimization of truck appointment systems in container terminals. *Logistics, 8*(3), 80. 2024. https://doi.org/10.3390/logistics8030080

Brahim-Djelloul, S., & Estampe, D. Product-oriented transportation using RFID technology: A simulation-based study. In *2013 International Conference on Industrial Engineering and Systems Management*. IEEE. 2013.

Chen, Y., & Wang, C. Constructing Six Sigma DMAIC improvement model for manufacturing process quality enhancement. *Mathematics, 10*(5), 814. 2022. https://doi.org/10.3390/math10050814

Gallardo, P., Murray, R., & Krumdieck, S. A sequential optimization-simulation approach for planning the transition to the low carbon freight system. *Energies, 14*(11), 3339. 2021. https://doi.org/10.3390/en14113339

Gattuso, D., & Cassone, G. C. Micro-simulation model supporting the management of a logistic platform. *Procedia - Social and Behavioral Sciences, 54*, 1296–1306. 2012. https://doi.org/10.1016/j.sbspro.2012.09.828

Gheorghe, I. G., & Ionescu, C. Implementation of Lean Six Sigma-DMAIC methodology in logistics processes. *Proceedings of the International Conference on Business Excellence, 18*(1), 81–90. 2024. https://doi.org/10.2478/picbe-2024-0009

González-Reséndiz, J., Arredondo-Soto, K. C., et al. Integrating simulation-based optimization for lean logistics: A case study. *Applied Sciences, 8*(12), 2448. 2018. https://doi.org/10.3390/app8122448

Gu, J., Goetschalckx, M., & McGinnis, L. F. Research on warehouse design and performance evaluation. *European Journal of Operational Research, 203*(3), 539–549. 2010. https://doi.org/10.1016/j.ejor.2009.07.031

Helm, M., Malikova, A., & Kembro, J. Order fulfilment errors: A multiple case study. 2024.

Henry, T., & Nasir, W. Optimizing manufacturing operations through simulation-driven human-centric scheduling strategies. 2024.

Holtschulte, A. Use cases for the Internet of Things. In *Digital Supply Chain and Logistics with IoT* (pp. 145–170). Springer. 2022. https://doi.org/10.1007/978-3-030-89408-5_7

Ilie-Zudor, E., Kemény, Z., Van Blommestein, F., Monostori, L., & van der Meer, J. A survey of applications and requirements of unique identification systems and RFID techniques. *Computers in Industry, 62*(3), 227–252. 2011. https://doi.org/10.1016/j.compind.2010.10.004

Irshad, R. R., Hussain, Z., Hussain, I., & Hussain, S. Enhancing cloud-based inventory management: A hybrid blockchain approach with generative adversarial network and elliptic curve Diffie-Hellman techniques. *IEEE Access*. 2024.

Jeon, H., Ebrahimi, A., & Lee, G. A simulation-based experimental design for analyzing energy consumption and order tardiness in warehousing systems. *Sustainability, 15*(20), 14891. 2023.

Kamińska, M. Improvement of warehouse processes by implementation of lean six sigma in global supply chain. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, (154), 81–94. 2021. https://doi.org/10.29119/1641-3466.2021.154.7

Kang, Y. S., Kim, H., & Lee, Y. H. Implementation of an RFID-based sequencing-error-proofing system for automotive manufacturing logistics. *Applied Sciences, 8*(1), 109. 2018.

Kumar, M., & Singh, R. The performance improvement analysis using Six Sigma DMAIC methodology in rubber weather strip manufacturing. *Heliyon, 9*(4), e14485. 2023. https://doi.org/10.1016/j.heliyon.2023.e14485

Liberatore, M. J., & Miller, T. Outbound logistics performance and profitability. 2016.

Lorenc, A. Cross-docking layout optimization in FlexSim software based on cold chain 4PL company. *Sustainability, 16*(22), 9620. 2024.

Minashkina, D., & Happonen, A. A systematic literature mapping of current academic research connecting sustainability into the warehouse management systems context. *Current Approaches in Science and Technology Research, 3*(1), 44–59. 2021.

Mohamed, M. Smart warehouse management using hybrid architecture of neural network with barcode reader 1D/2D vision technology. *International Journal of Intelligent Systems and Applications*. 2019.

Mohamud, I. H., & Kafi, M. A. The role of warehouse layout and operations in warehouse efficiency: A literature review. *Journal Européen des Systèmes Automatisés*. 2023.

Mwizerwa, G., & Akumuntu, J. Warehousing management on supply chain performance. 2024.

Nerkar, O. Case study on enhancing customer experience by reducing order picking errors in service parts distribution warehouse. 2024.

Ou, S., Ismail, Z. H., & Sariff, N. Hybrid genetic algorithms for order assignment and batching in picking systems: A systematic literature review. *IEEE Access*. 2024.

Park, K., Kim, M., & Bae, H. A predictive discrete event simulation for container terminal operation times. *IEEE Access, 12*, 42033–42047. 2024. https://doi.org/10.1109/ACCESS.2024.3400179

Pinto, A. R. F., Nagano, M. S., & Boz, E. A classification approach to order picking systems and policies: Integrating automation and optimization for future research. *Results in Control and Optimization, 13*, 100083. 2023. https://doi.org/10.1016/j.rico.2023.100083

Plakantara, S. P., Karakitsiou, A., & Mantzou, T. Managing risks in smart warehouses from the perspective of Industry 4.0. In *Disruptive Technologies and Their Applications in Manufacturing* (pp. 1–18). 2024.

Saderova, J., Rosova, A., Kacmary, P., & Sofranko, M. Modelling as a tool for planning transport system performance. *Sustainability, 12*(19), 8051. 2020. https://doi.org/10.3390/su12198051

Saniuk, A., Špirková, S., & Straka, M. VR simulation and implementation of robotics. 2024.

Şerifoğlu, O., Dursun, M., Özcan, T., & Konyalıoğlu, A. K. A simulation modelling for warehouse management design in retail industry. In *Advances in Production Research* (pp. 523–532). 2022.

Shadkam, E., & Irannezhad, E. Simulation optimization methods in supply chains. 2025.

Siregar, R. A., Siregar, R. H., & Siregar, R. R. Lean Six Sigma DMAIC implementation to reduce total lead time in receiving process. In *Proceedings of the 11th Annual International Conference on Industrial Engineering and Operations Management* (pp. 394–403). 2021.

Smith, D., & Srinivas, S. A simulation-based evaluation of warehouse check-in strategies. *Simulation Modelling Practice and Theory, 96*, 101933. 2019. https://doi.org/10.1016/j.simpat.2019.101933

Souza, M. J. F., Assis, P. S., & Martins, A. G. An integrated simulation and optimization tool for short-term mining planning. *Computers & Industrial Engineering*. 2024. https://doi.org/10.1016/j.cie.2024.109608

Tubis, A. A., & Rohman, J. Intelligent warehouse in Industry 4.0—Systematic literature review. *Sensors, 23*(8), 4105. 2023. https://doi.org/10.3390/s23084105

Turban, E., Outland, J., King, D., Lee, J. K., Liang, T. P., & Turban, D. C. Order fulfillment along the supply chain in e-commerce. In *Electronic Commerce 2018* (pp. 519–540). 2018.

Turban, E., Whiteside, J., King, D., & Outland, J. Electronic commerce payment systems and order fulfillment. In *Introduction to Electronic Commerce* (pp. 323–350). Springer. 2017. https://doi.org/10.1007/978-3-319-50091-1_11

Zaman, S. I., Khan, S. A., & Zaman, S. A. A. A grey decision-making trial and evaluation laboratory model for digital warehouse management in supply chain networks. *Decision Analytics Journal, 7*, 100133. 2023. https://doi.org/10.1016/j.dajour.2023.100133

Biography

Engr. Nica D. Cueto is an Industrial Engineer and a full-time instructor at the University of Batangas, Lipa Campus. She teaches professional courses in Supply Chain Management, Operations Management, Product Design and Development, and Work Study Measurement. She earned her Bachelor of Science in Industrial Engineering from the University of Batangas, Lipa Campus, and is currently pursuing a Master of Engineering with a major in Industrial Engineering at Lyceum of the Philippines University, Laguna. Before entering academe, she worked as a Staff Engineer at EPSON Philippines. Her focus was on purchasing, inventory analysis, and improving processes using Industrial Engineering tools. She holds certifications in Lean Six Sigma, safety management, and project management. Additionally, she has attended seminars and training sessions related to quality management systems, artificial intelligence, occupational safety and health, and sustainable development through international collaboration programs. Her professional interests include process improvement, operations management, and engineering education. She is dedicated to industry-relevant learning and continuous improvement.