Asia Information System Journal
Volume 2, Issue 2, (2023) 77-86
http://ejournal.radenintan.ac.id/index.php/AISJ/index

AISJ Asia Information System Journal
e-ISSN 2963-8593
p-ISSN XXXX-XXXX

WATERFALL METHOD OF WEB-BASED SYSTEM TO DEVELOP WAREHOUSE PACKING EFFECTIVELY

Muhamad Addrian Saopan
STMIK AMIK Bandung, Jl. Jakarta No.28, Kebonwaru, Kec. Batununggal, Kota Bandung, Jawa Barat 40272, INDONESIA

Article Info

Article history:

Received: June 5th, 2023
Revised: August 17th, 2023
Accepted: November 1st, 2023

Keywords:

Packing System,
Warehouse,
Waterfall Method,
Web Based

Abstract

This study aims to develop an efficient Warehouse Packing System for PT Luna Technology Group in order to improve operational efficiency and minimize packing errors in logistics processes. The research adopts the Waterfall Method, employing a systematic approach that encompasses requirements analysis, system design, implementation, and testing. Data was collected through qualitative observational methods, including interviews and direct observations of the existing packing processes. The findings demonstrate that the implementation of a web-based packing system significantly reduces packing times, mitigates errors in item selection, and lowers operational costs compared to the previous manual methods. The research concludes that embracing a structured software development methodology not only enhances the packing process, but also positions PT Luna Technology Group as a competitive player in the logistics industry, underscoring the need for continuous technological advancements in warehouse management.

To cite this article:

INTRODUCTION

In today's digital era, companies across various industries require efficient and up-to-date warehouse packing systems to optimize their operational performance[1]. PT Luna Technology Group is one of the logistics companies engaged in shipping services from company to company or can be called business to business. PT Luna Technology Group itself also receives goods from various countries and often receives goods originating from local e-commerce whose stores are abroad, therefore PT Luna Technology Group provides services as a bridge between logistics companies from abroad who will send their goods to Indonesia[2].

PT Luna Technology Group carries out procedures such as what the Indonesian government has set, starting from receiving goods from water and air cargo ships that are safe and by world standards, checking goods at immigration to checking customs, therefore PT Luna Technology is one of the companies that is trusted as a bridge between large companies such as Shopee and Tokopedia to send their goods purchased from overseas stores and arrive at the intended local branch safely, safely and quickly[3].

One of the services provided by PT Luna Technology Group is packing services in the warehouse. The manual packing process often experiences problems in terms of effectiveness and efficiency, such as errors in picking goods, long packing times, and high packing costs[4].

Therefore, improvements are needed in the Warehouse Packing System at PT Luna Technology Group to increase effectiveness and efficiency in the process of packing goods. A better Warehouse Packing System can help

• **Corresponding author:**
Muhamad Addrian Saopan STMIK AMIK Bandung, Jl. Jakarta No.28, Kebonwaru, Kec. Batununggal, Kota Bandung, Jawa Barat 40272, INDONESIA. ✉ bryan0204000@gmail.com

speed up packing time, reduce picking errors, improve packing quality, and reduce operational costs[5].

Therefore, research is needed to develop a Warehouse Packing System that is effective and efficient in data processing, so that PT Luna Technology Group can maintain its position as a leading logistics company in Indonesia and be able to compete with other logistics companies[6].

METHOD

Research is a gradual process that begins with identifying the problem or issue to be studied. After the problem is identified, it is followed by reviewing reading materials or literature. After that, determine and explain the objectives of the research. Continued with data collection and analysis. Then interpret the data obtained. This research culminates in reporting the results of the research. Readers will evaluate and use it. From problem identification to reporting, everything takes place in a gradual process that is sequenced regularly and systematically[7].

Furthermore, the research method used is an observational qualitative research method where this research is a search to explore the current system and understand a problem. To understand a problem, the researcher observes the processes and systems that are running at PT Luna Technology Group and collects information that includes how the system works and the advantages and disadvantages of the system. The information obtained from these observations is used as data to become the final result of the research and is outlined in the form of a written report[8].

In addition, the research methodology that can be used to develop a Warehouse Packing System for PT Luna Technology Group is Waterfall[9], with the following details:

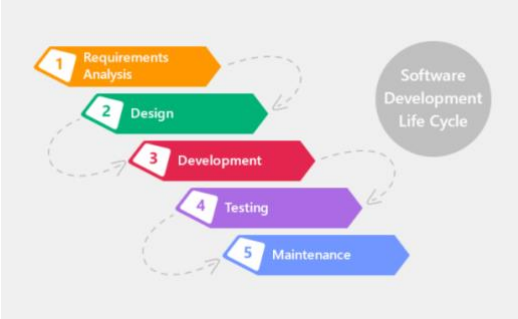


Figure 1. Waterfall Model

1. Requirements Analyst

   Before doing software development, a developer must know and understand how information on user needs for software. This information collection method can be obtained in various ways including discussions, observations, surveys, interviews, and so on. The information obtained is then processed and analyzed so that complete data or information is obtained regarding the specifications of user requirements for the software to be developed.

   At this stage the author uses the method of collecting information by interviewing the owner of PT Luna Technology, the conversation starts with how the system is running, the technology used at this time, the business process and what obstacles are experienced[10].

2. System Software and Design

   Information about requirement specifications from the Requirement Analysis stage is then analyzed at this stage and then implemented in the development design. The design of the design is carried out to help provide a complete picture of what must be done. This stage will also help developers prepare hardware requirements in creating the overall architecture of the software system to be created.

   At this stage, the author provides an overview to the Admin and Manager in the form of a design made in AdobeXD so that the Admin and Manager can feel the User Interface and User Experience directly together and can provide input when there is a User Interface and User Experience that is not suitable[11].

3. Implementation and Unit Testing (Development)

The implementation and unit testing stage is the programming stage. Software development is divided into small modules that will be combined in the next stage. In addition, this phase also tests and checks the functionality of the modules that have been made, whether they meet the desired criteria or not.

At this stage the author submits each completed feature to PT Luna Technology to be

tested first by the user, starting from Login, Logout, Managing item data, Managing company data, Managing box data, Managing vehicle data, Managing packing data to report generation[12].

4. Integration and System Testing

After all units or modules are developed and tested in the implementation stage, they are then integrated into the overall system. After the integration process is complete, then checking and testing the system as a whole is carried out to identify possible system failures and errors.

At this stage, the author uses Blackbox Testing and UAT to ensure whether each feature runs as it should or not, whether there are errors or not with the scenarios that have been determined in Blackbox Testing itself and ensure that users are satisfied when using these features. In Blackbox itself there are scenarios and expectations, scenarios are stages to achieve the intended testing and expectations are the results of the testing stages themselves. UAT (User Acceptance Testing) is useful for ensuring that users are satisfied or dissatisfied with the features that have been made, the scale is 1 - 5[13].

5. Operation and Maintenance

At the last stage in the Waterfall Method, the finished software is user-operated and maintenance is performed. Maintenance allows developers to make corrections for errors that were not detected in the previous stages. Maintenance includes error correction, improvement of system unit implementation, and improvement and adjustment of the system according to needs.

In this last stage, the author conducts periodic system maintenance, usually users ask for new features to be implemented in applications that are already running due to unexpected needs, besides that, periodic system maintenance is also carried out to ascertain whether the server used has problems during application operation, full memory and others[14].

a. System Architecture

In this sub chapter the author will provide an overview of the system architecture at PT Luna Technology Group. So when a client or admin wants to access the application, they must have a VPN that has been registered by PT Luna Technology Group itself, if it is connected to a VPN then the client or admin can access the Warehouse Packing System Web Application, For data retrieval here using the REST API which directly retrieves data to the database because the Warehouse Management System application that previously existed at PT Luna Technology Group will consume the API created by the author for confirmation needs that the Dus has arrived at the destination company. To facilitate understanding of the System Architecture, it can be seen in Figure 2 below[15].

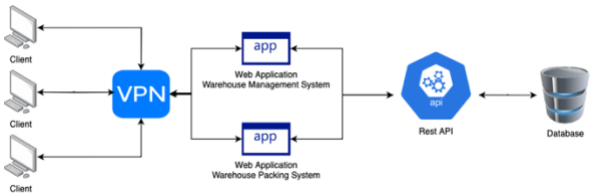


Figure 2. System Architecture

b. Ongoing System Analysis

In this sub-chapter, the author will provide the results of the analysis carried out on documents obtained from the admin of PT Luna Technology Group. The current process uses MS Excel for packing data processing. After the data is created, the admin will recap for making receipts and making monthly packing reports manually[16]. To make it easier to understand the analysis of the current system, it can be seen in Figure 3 below.

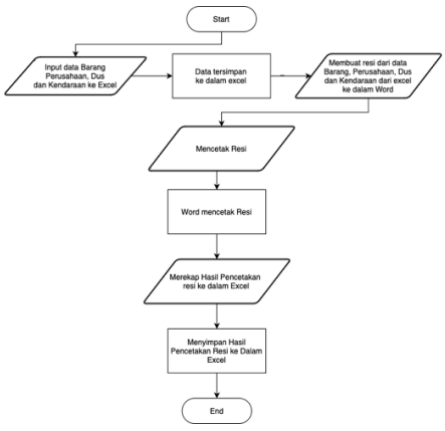


Figure 3. Ongoing System Analysis

c. Recommendation System Analysis

From the results of the analysis that the author did on the documents obtained, the author felt that there were stages that could be done automatically by the system. Stages that can be done are making receipts, packing reports, scanning goods through the system directly. From the analysis of the recommendation system below, it is assumed that the Goods, Company, Vehicle and Dus data are already contained in the system[17], the flow of the system that the author recommends can be seen in Figure 4 below.

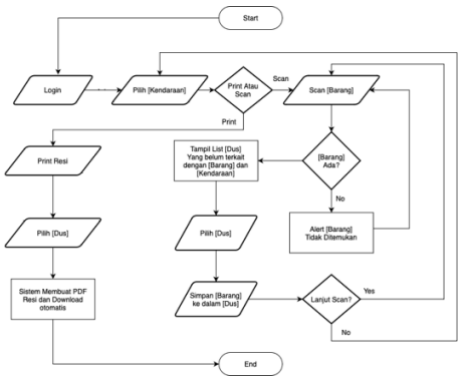


Figure 4. Recommendation System Analysis

RESULTS AND DISCUSSION

a. Login Page

In its implementation, the admin first accesses the Warehouse Packing System website and will be presented with a login page to enter the Warehouse Packing System system.

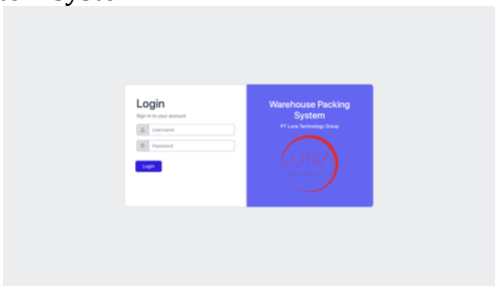


Figure 5. Login Page

b. Dashboard Page

In its implementation, the admin is presented by the Dashboard page when he has entered the login stage which shows that the admin has successfully entered the Warehouse Packing System application.

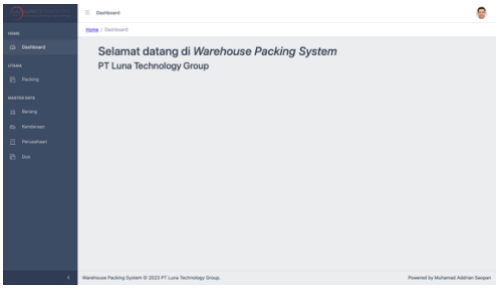


Figure 6. Dashboard Page

c. Item Page

In its implementation, the admin can view item data, search, add, change, delete and export item data.

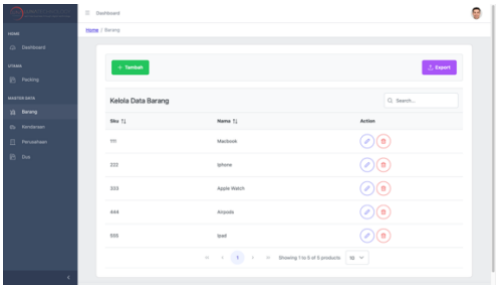


Figure 7. Item Page

d. Item Form

In its implementation, the admin can add and change item data which will later be used for the packing process.

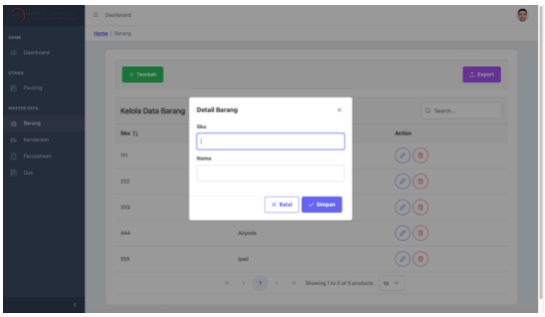


Figure 8. Item Form

e. Vehicle Page

In its implementation, the admin can view vehicle data, search, add, change, delete and export vehicle data.

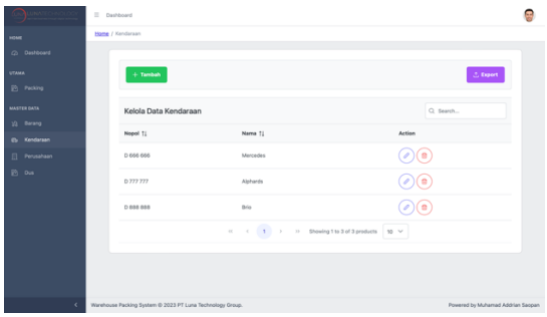


Figure 9. Vehicle Page

f. Vehicle Form

In its implementation, the admin can add and change vehicle data which will later be used for the packing process.

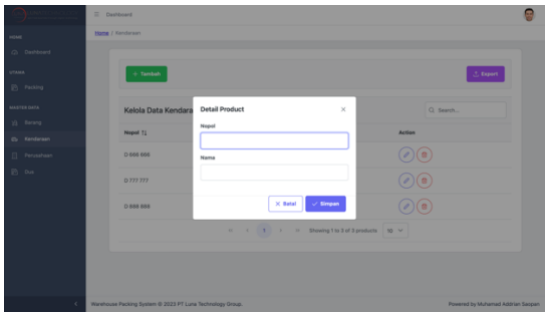


Figure 10. Vehicle Form

g. Company Page

In its implementation the admin can view company data, search, add, change, delete and export company data.

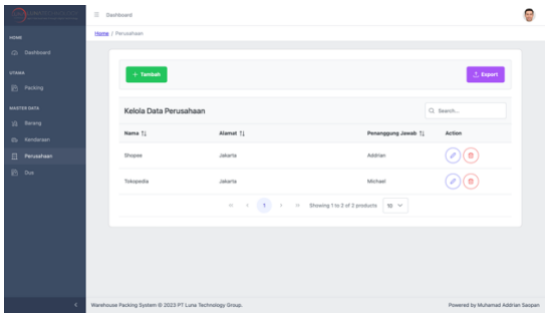


Figure 11. Company Page

h. Company Form

In its implementation, the admin can add and change company data which will later be used for the packing process.

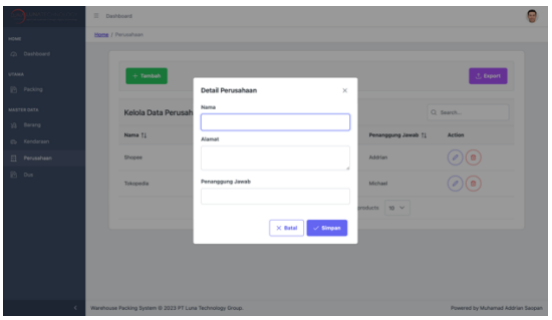


Figure 12. Company Form

i. Box Page

In its implementation, the admin can view Dus data, search, add, change, delete and export Dus data.

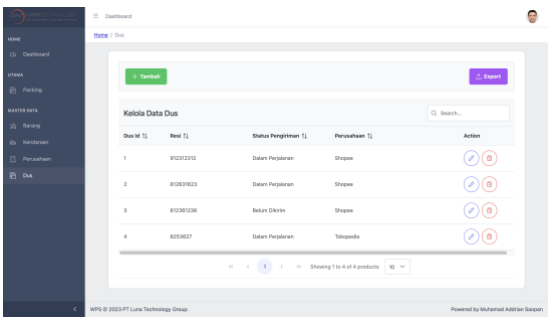


Figure 13. Box Page

j. Box Form

In its implementation, the admin can add and change box data which will later be used for the packing process.

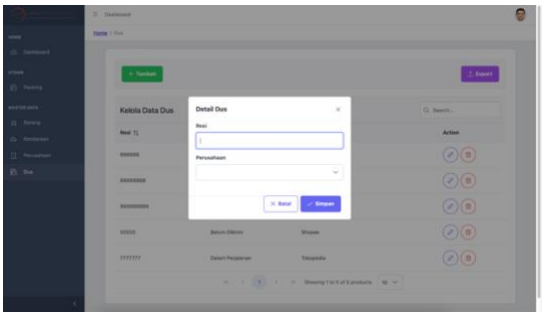


Figure 14. Box Form

k. Packing Page

In its implementation, the admin can view vehicle data, where this vehicle is the initial process of the packing process is to select the vehicle first, it can be seen that there are features Scan goods, Print

receipts, Add goods to the box, Delete boxes from the box and create packing reports.

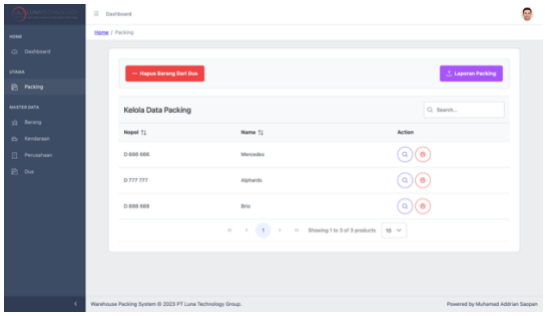


Figure 15. Packing Page

l. Item Scan Add into Box

In its implementation, the admin can scan items by entering the sku contained in the item, when the item is found it will display the Add Item Form to the Dus.

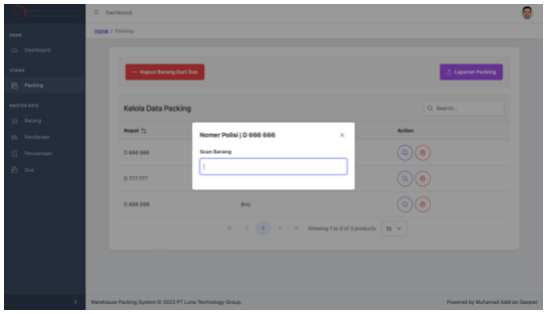


Figure 16. Item Scan Add into Box

m. Add Item into Box Form

In its implementation, the admin can scan items by entering the ID contained in the item, when the item is found it will display the Add Item Form to the Dus.

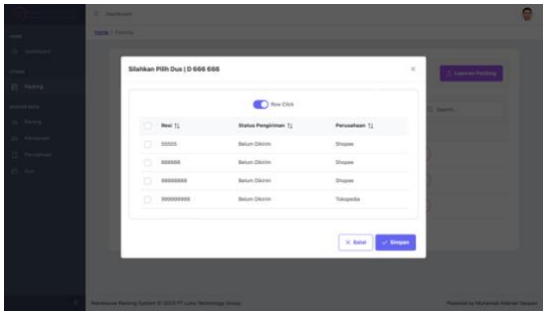


Figure 17. Add Item into Box Form

n. Item Scan Remove from Box

In its implementation, the admin can add goods to the boxes that have been scanned before, this process will enter the goods into the boxes and associate them with the selected vehicle.

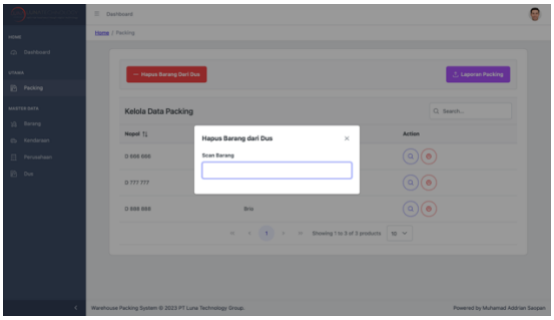


Figure 18. Item Scan Remove from Box

o. Remove Item from Box Form

In its implementation, the admin can add items to the boxes that have been scanned before, this process will remove items from the boxes along with the related vehicles.

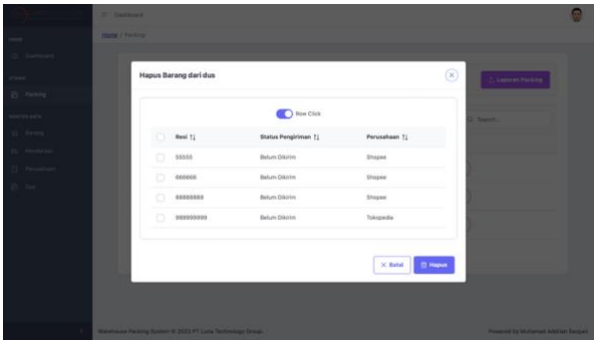


Figure 19. Remove item from box Form

p. Packing Report Form

In its implementation, the admin can print the selected packing data based on the receipt contained in the selected vehicle.

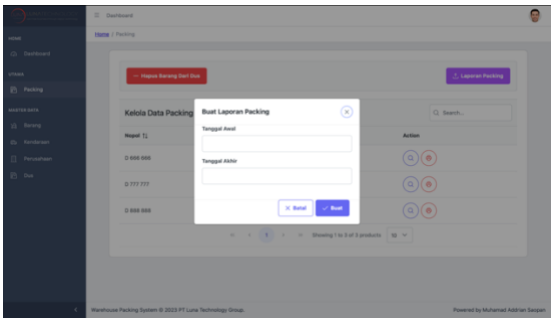


Figure 20. Packing Report Form

q. Print invoice Form

In its implementation, the admin can print the selected packing data based on the receipt contained in the selected vehicle.

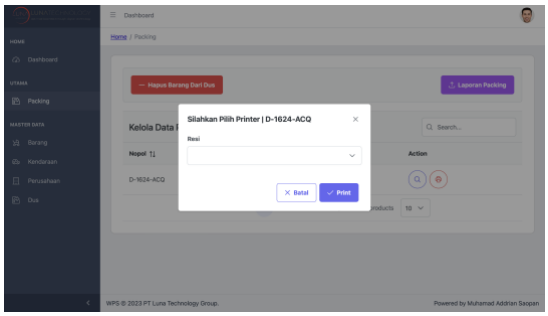
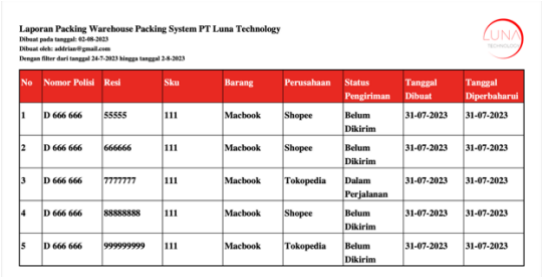


Figure 21. Print Invoice Form

r. Packing Report PDF

In its implementation, the admin will get a PDF file containing a packing report that is generated based on the start date and end date, this report is sorted by the date it was created.



Laporan Packing Warehouse Packing System PT Luna Technology

No	Nomor Polisi	Resi	Sku	Barang	Perusahaan	Status Pengiriman	Tanggal Dibuat	Tanggal Diperbaharui
1	D 666 666	55555	111	Macbook	Shopee	Belum Dikirim	31-07-2023	31-07-2023
2	D 666 666	666666	111	Macbook	Shopee	Belum Dikirim	31-07-2023	31-07-2023
3	D 666 666	7777777	111	Macbook	Tokopedia	Dalam Perjalanan	31-07-2023	31-07-2023
4	D 666 666	88888888	111	Macbook	Shopee	Belum Dikirim	31-07-2023	31-07-2023
5	D 666 666	999999999	111	Macbook	Tokopedia	Belum Dikirim	31-07-2023	31-07-2023

Figure 22. Packing Report PDF

s. Print invoice PDF

In its implementation, the admin will get a PDF file containing a packing receipt that is generated based on the selected vehicle and box, when it is printed, the delivery status in the box will change to being sent if the status has not been sent.

Dibuat pada tanggal: 06-08-2023
Perusahaan: Shopee
Dikirim ke: Jakarta
Penanggung jawab: Michael

No	Sku	Barang
1	111	asdasdasdasdasdas

812361236

Figure 23. Print Invoice PDF

This thesis concludes that a Warehouse Packing System application has been successfully developed that has important features to improve efficiency and accuracy in the process of packing goods. The implementation of this application is expected to overcome the obstacles that occur in the packing process carried out manually at PT Luna Technology Group[18].

The objective of this thesis has been achieved by successfully providing a Warehouse Packing System application that has the following features:

1. Feature of Putting Goods into Boxes
   This application allows the admin to put goods into boxes accurately, so as to minimize errors in the packing process and receipt printing. With this feature, the admin can ensure that each item has been put into the box correctly before further processing[19], [20].
2. Item Scan Process Feature
   This application also provides an item scan feature that helps the admin in knowing whether an item should be packed or not. By using this feature, the admin can avoid errors in the process of selecting items to be packed, thus increasing efficiency and accuracy in the process[21], [22].
3. Packing Report Generation Feature
   This application provides features for creating packing reports based on packing data recorded on the system. With this feature, admins can easily create precise and accurate reports without taking a long time. These reports can be used as a reference for evaluation and decision-making related to the packing process[23], [24].

The research on developing a Warehouse Packing System using the Waterfall Method has significant implications for both the logistics industry and software development practices. By implementing a structured

approach to system development, organizations like PT Luna Technology Group can enhance operational efficiency, reduce errors in packing processes, and improve overall service quality. The findings suggest that transitioning from manual processes, such as using MS Excel for data management, to a web-based system can lead to substantial improvements in accuracy and speed. This shift not only streamlines operations but also positions companies to better compete in the logistics sector, which is increasingly reliant on technology for efficiency and customer satisfaction.

Future researchers should consider exploring the integration of agile methodologies alongside the Waterfall Method to create a hybrid approach that allows for more flexibility in responding to user feedback during the development process. Additionally, investigating the use of advanced technologies such as artificial intelligence and machine learning could provide insights into predictive analytics for inventory management and packing efficiency. Researchers should also focus on user experience studies to understand how different user interfaces impact the effectiveness of warehouse management systems. Finally, longitudinal studies that assess the long-term impacts of implementing such systems on operational performance would provide valuable data for continuous improvement.

CONCLUSION

The development of a Warehouse Packing System through the Waterfall Method represents a critical advancement in the logistics industry, particularly for companies like PT Luna Technology Group. This research not only highlights the necessity of modernizing packing processes but also demonstrates the potential for technology to transform traditional practices into more efficient, accurate, and user-friendly systems. As the logistics landscape continues to evolve, embracing such innovations will be essential for maintaining competitive advantage and meeting the growing demands of the market. The findings underscore the importance of systematic approaches in software development while paving the way for future research that can further enhance operational efficiencies in the logistics sector.

REFERENCES

[1] D. Handoko, A. Asyhari, and M. F. Al Qusri, “DESIGNING A LEARNING INFORMATION SYSTEM BASED ON ANDROID (CASE STUDY OF JUNIOR HIGH SCHOOL 4 OF KOTA BUMI),” *AISJ*, vol. 1, no. 1, p. 21, May 2022, doi: 10.24042/aisj.v1i1.13623.

[2] alazs Gyo¨ rffy and H. Lage, “A Web-Based Data Warehouse on Gene Expression in Human Malignant Melanoma,” *Journal of Investigative Dermatology*, vol. 127, pp. 394–399, 2006, doi: 394–399. doi:10.1038/sj.jid.5700543.

[3] Y. Baalousha and T. Çelik, “AN INTEGRATED WEB-BASED DATA WAREHOUSE AND ARTIFICIAL NEURAL NETWORKS SYSTEM FOR UNIT PRICE ANALYSIS WITH INFLATION ADJUSTMENT / INTEGRUOTA INTERNETINĖ DUOMENŲ SAUGYKLOS IR DIRBTINIŲ NEURONINIŲ TINKLŲ SISTEMA, SKIRTA VIENETO KAINAI ANALIZUOTI ATSIŽVELGIANT Į INFLIACIJĄ,” *Journal of Civil Engineering and Management*, vol. 17, no. 2, pp. 157–167, Jul. 2011, doi: 10.3846/13923730.2011.576806.

[4] Zizhuo Yang, Jun Wang, Qianmin Su, and Bocheng Zhong, “The design of web-based warehouse management system,” in *Proceeding of the 11th World Congress on Intelligent Control and Automation*, Shenyang, China: IEEE, Jun. 2014, pp. 5077–5081. doi: 10.1109/WCICA.2014.7053577.

[5] X. Hong, L. Zai-wen, and M. Hai-yang, “Study and Realization of Supermarket BI System Based on Data Warehouse and Web Technique,” in *2008 International Conference on Computer Science and Software Engineering*, Wuhan, China: IEEE, 2008, pp. 482–485. doi: 10.1109/CSSE.2008.877.

[6] J. Zhang and F. Song, “Application of Web and Data Warehouse in MDSS Based on Multi-Agent Systems,” in *2009 International Conference on Management and Service Science*, Beijing, China: IEEE, Sep. 2009, pp. 1–4. doi: 10.1109/ICMSS.2009.5304405.

[7] Xiaofei Wang, Yunqiu Chen, and Yuliang Liu, "Web-oriented warfare command decision support system based on agent and data warehouse," in *2005 International Conference on Cyberworlds (CW'05)*, Singapore: IEEE, 2005, p. 6 pp. – 498. doi: 10.1109/CW.2005.98.

[8] B. Pande, S. Mishra, and S. Dhanusu, "A Study On Utility of Web-Based Drug Warehouse Management System (E-Aushadhi) In A Peripheral Hospital of Metropolitan City of Maharashtra," *Natl J Community Med*, vol. 13, no. 12, pp. 858–863, Dec. 2022, doi: 10.55489/njcm.131220222478.

[9] J. Yu and J. Xu, "Design and Implementation of Warehouse Management System Based on Web Technology," in *2018 3rd International Conference on Mechanical, Control and Computer Engineering (ICMCCE)*, Huhhot: IEEE, Sep. 2018, pp. 665–671. doi: 10.1109/ICMCCE.2018.00147.

[10] S. Yang, R. Tao, W. Tan, and W. Zhang, "Gateway of Internet of Things for Intelligent Warehouse Management System Based on Embedded Web Server," in *Proceedings of International Conference on Computer Science and Information Technology*, vol. 255, S. Patnaik and X. Li, Eds., in Advances in Intelligent Systems and Computing, vol. 255. , New Delhi: Springer India, 2014, pp. 213–220. doi: 10.1007/978-81-322-1759-6_26.

[11] Q. Zhang, K. Li, and J. Yu, "Application of Multi-AGENT System On WEB-BASED Data Warehouse for Pricing System of Power Supplier," in *2006 IEEE PES Power Systems Conference and Exposition*, Atlanta, Georgia, USA: IEEE, 2006, pp. 1464–1470. doi: 10.1109/PSCE.2006.296517.

[12] Liang Tan and Lihong Dong, "THe Design Of Web Dynpro Java Based Warehouse Management System," in *2011 2nd International Conference on Artificial Intelligence, Management Science and Electronic Commerce (AIMSEC)*, Deng Feng, China: IEEE, Aug. 2011, pp. 4470–4472. doi: 10.1109/AIMSEC.2011.6010046.

[13] R. Navigli and P. Velardi, "Learning Domain Ontologies from Document Warehouses and Dedicated Web Sites," *Computational Linguistics*, vol. 30, no. 2, pp. 151–179, Jun. 2004, doi: 10.1162/089120104323093276.

[14] J. M. Perez, R. Berlanga, M. J. Aramburu, and T. B. Pedersen, "Integrating Data Warehouses with Web Data: A Survey," *IEEE Trans. Knowl. Data Eng.*, vol. 20, no. 7, pp. 940–955, Jul. 2008, doi: 10.1109/TKDE.2007.190746.

[15] V. Nebot and R. Berlanga, "Building data warehouses with semantic web data," *Decision Support Systems*, vol. 52, no. 4, pp. 853–868, Mar. 2012, doi: 10.1016/j.dss.2011.11.009.

[16] J. Reich, R. Murnane, and J. Willett, "The State of Wiki Usage in U.S. K–12 Schools: Leveraging Web 2.0 Data Warehouses to Assess Quality and Equity in Online Learning Environments," *Educational Researcher*, vol. 41, no. 1, pp. 7–15, Jan. 2012, doi: 10.3102/0013189X11427083.

[17] B. Vrdoljak, M. Banek, and S. Rizzi, "Designing Web Warehouses from XML Schemas," in *Data Warehousing and Knowledge Discovery*, vol. 2737, Y. Kambayashi, M. Mohania, and W. Wöß, Eds., in Lecture Notes in Computer Science, vol. 2737. , Berlin, Heidelberg: Springer Berlin Heidelberg, 2003, pp. 89–98. doi: 10.1007/978-3-540-45228-7_10.

[18] K. Selma, B. Ilyès, B. Ladjel, S. Eric, J. Stéphane, and B. Michael, "Ontology-based structured web data warehouses for sustainable interoperability: requirement modeling, design methodology and tool," *Computers in Industry*, vol. 63, no. 8, pp. 799–812, Oct. 2012, doi: 10.1016/j.compind.2012.08.001.

[19] S. J. You and S. H. Ji, "Design of a Multi-robot Bin Packing System in an Automatic Warehouse:," in *Proceedings of the 11th International Conference on Informatics in Control, Automation and Robotics*, Vienna, Austria: SCITEPRESS - Science and and Technology Publications, 2014, pp. 533–538. doi: 10.5220/0005098505330538.

[20] L. Etcheverry, A. Vaisman, and E. Zimányi, "Modeling and Querying Data Warehouses on the Semantic Web Using QB4OLAP," in *Data Warehousing and Knowledge Discovery*, vol. 8646, L. Bellatreche and M. K. Mohania, Eds., in

Lecture Notes in Computer Science, vol. 8646. , Cham: Springer International Publishing, 2014, pp. 45–56. doi: 10.1007/978-3-319-10160-6_5.

[21] T. Sato and H. Katayama, “Bottleneck Management of Multi-stage Sorting-Packing Operations with Large-Scale Warehouse System,” in *Proceedings of the Eleventh International Conference on Management Science and Engineering Management*, J. Xu, M. Gen, A. Hajiyev, and F. L. Cooke, Eds., Cham: Springer International Publishing, 2018, pp. 1054–1066. doi: 10.1007/978-3-319-59280-0_87.

[22] Yan Zhu and A. Buchmann, “Evaluating and selecting Web sources as external information resources of a data warehouse,” in *Proceedings of the Third International Conference on Web Information Systems Engineering, 2002. WISE 2002.*, Singapore: IEEE Comput. Sci, 2002, pp. 149–160. doi: 10.1109/WISE.2002.1181652.

[23] N. Hamada, “Optimal scheduling of the packing system in an automated warehouse and its evaluation,” *Electrical Engineering Japan*, vol. 96, no. 6, pp. 145–153, Jan. 1976, doi: 10.1002/eej.4390960619.

[24] J. Leng *et al.*, “Digital twin-driven joint optimisation of packing and storage assignment in large-scale automated high-rise warehouse product-service system,” *International Journal of Computer Integrated Manufacturing*, vol. 34, no. 7–8, pp. 783–800, Aug. 2021, doi: 10.1080/0951192X.2019.1667032.