Hindawi
Journal of Electrical and Computer Engineering
Volume 2023, Article ID 9792710, 1 page
https://doi.org/10.1155/2023/9792710

Retraction

Retracted: E-Commerce Logistics Intelligent Warehousing System Solution Based on Multimedia Technology

Journal of Electrical and Computer Engineering

Received 15 August 2023; Accepted 15 August 2023; Published 16 August 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] H. Liu, Z. Hu, and J. Hu, "E-Commerce Logistics Intelligent Warehousing System Solution Based on Multimedia Technology," *Journal of Electrical and Computer Engineering*, vol. 2022, Article ID 1754797, 12 pages, 2022.

Hindawi
Journal of Electrical and Computer Engineering
Volume 2022, Article ID 1754797, 12 pages
https://doi.org/10.1155/2022/1754797

Research Article

E-Commerce Logistics Intelligent Warehousing System Solution Based on Multimedia Technology

Huajin Liu,[1] Zhenlong Hu ,[2] and Jianhua Hu[2]

[1]*Zhejiang Yuexiu University, Shaoxing 312000, Zhejiang, China*
[2]*Jiyang College of Zhejiang A&F University, Zhuji 311800, Zhejiang, China*

Correspondence should be addressed to Zhenlong Hu; 20208120@zafu.edu.cn

Received 22 February 2022; Revised 18 March 2022; Accepted 1 April 2022; Published 29 April 2022

Academic Editor: Wei Liu

In recent years, with the integration and development of the internet and various industries, the social economy has begun to develop toward diversification. The rise of e-commerce logistics has driven the transformation and upgrading of the manufacturing industry and injected new vitality into e-commerce. It also promotes the new development of cargo warehousing as one of the important components. Traditional warehousing began to gradually develop toward intelligent informatization, relying on emerging science and technology. Smart warehousing also brings valuable development opportunities and challenges to the manufacturing industry. On the basis of the existing achievements, this paper proposes a solution of an intelligent warehousing system for e-commerce logistics based on multimedia technology. It, firstly, introduces the structure of the intelligent warehousing system in detail, and then, it analyzes the requirements for the functions of the intelligent warehousing system based on multimedia technology. It includes user management, receiving business, storage business, tally business, and outbound business. In the end, the intelligent warehousing system based on multimedia technology and the traditional intelligent warehousing system are compared and tested for system function and experience. The test results show that the work efficiency of the intelligent warehousing system based on multimedia technology is significantly higher than that of the traditional intelligent warehousing system. In terms of user experience, the performance of the intelligent warehousing system based on multimedia technology has reached 8 points and above. It proves its usefulness and effectiveness.

1. Introduction

As one of the important components of e-commerce logistics, warehousing has irreplaceable value and status in the supply and circulation of the entire commodity production and manufacturing. With the rapid improvement of the level of economic development, the traditional warehousing system with a single model has obviously been unable to meet the development needs of the modern e-commerce logistics industry because of its inherent defects (low production efficiency, insufficient intelligence, etc.). For enterprises with a wide range of manufacturing and huge daily supply, the traditional warehousing system not only cannot maintain the normal operation of logistics but also affects the speed and efficiency of manufacturing. Under the development background of efficient management, the traditional e-commerce logistics warehousing system is facing transformation and upgrading. As a result, the intelligent warehousing system based on modern technology has ushered in a new development opportunity. For the manufacturing industry with e-commerce as the core, the intelligent warehousing system can not only reduce the logistics cost to a certain extent but also effectively integrate the resources of logistics and warehousing. It realizes efficient logistics management, improves the overall production efficiency of the enterprise, and realizes the sustainable development of the manufacturing industry. However, at the current stage, there are still many deficiencies in the development of intelligent warehousing systems. For example, the informatization of management operations, warehousing data, and warehousing decision-making is insufficient. It shows that the intelligent warehousing system needs to continuously solve the existing development problems and achieve further improvement.

The development of science and technology has driven the continuous maturity and improvement of multimedia technology. In the economic system of the whole society, multimedia technology is also playing an increasingly important role. If it is combined with the intelligent warehousing system, the information and data of products in the warehousing system can be more accurate and effective, errors can be automatically reduced, and the circulation efficiency of inventory products can be accelerated. It can also realize the connection and cooperation of each link of the logistics process and the responsible departments to ensure the authenticity of product data. In addition, the existing informatization problems of intelligent warehousing system can be solved by relying on multimedia technology. It guides the application of multimedia technology in the intelligent storage system, which can accelerate the development of the intelligent storage system as a whole.

At present, there are few pieces of research on the solution of e-commerce logistics intelligent warehousing system in the field of multimedia technology. This paper proposes a novel intelligent warehousing system solution based on multimedia technology. This research direction can effectively solve the existing development problems of intelligent warehousing system. It provides a perfect and improved development suggestion for the logistics operation of e-commerce and can also provide new ideas for the research of intelligent warehousing system.

2. Related Work

In recent years, many scholars have carried out research on e-commerce logistics. Overstreet K discusses the emerging role of collaborative robots and warehouse picking strategies. He believes that e-commerce is changing the face of the typical warehouse, with collaborative robots becoming a more viable picking solution than the forklifts in traditional warehouses that move large pallets. An e-commerce warehouse can involve hundreds of SKUs and many employees picking products to fulfill small orders in the shortest possible time [1]. Zhang et al. considered a model and algorithm to solve the problem of goods localization in retail e-commerce warehouses. He abstracted the problem as storing goods on three-dimensional shelves and designed an artificial swarm algorithm to solve the proposed model. Finally, his computational experiments on warehouses show the effectiveness of the proposed method [2]. Khalyn, to develop logistics in storage and cargo handling systems, studied technologies with significant potential for improving the efficiency of logistics processes. He also investigated consumer behavior market and shipping market trends in warehouse services. The survey results show that it can effectively simplify management and optimize costs by combining various market entities and objects and target groups and logistics process parameters through automation on an electronic platform [3]. Liu et al. took the mobile e-commerce information system as the research object and expounded the theory of industrial clusters and the manifestations of e-commerce industrial clusters, as well as the concept and technical framework of the Internet of Things. They proposed the sequential relationship analysis method and the fuzzy comprehensive evaluation method and conducted experiments in the form of questionnaires. Finally, their experimental results showed that there was a significant positive correlation between e-commerce information systems and supply chain cooperation [4]. Ma et al. discussed the choice of e-commerce logistics service model. They modeled four modes based on the theory of polyoligopoly Cournot competition. The final results show that the improvement of logistics service management level and technological progress are the foundation. In mode selection, marginal service cost is the most important, followed by transaction cost and scale effect [5]. Hu and Haddud studied the development concept of e-commerce as a supply chain operation mode. They compared and discussed how aspects related to global supply chain management differed from similar practices a decade ago. They also used an online questionnaire to collect participants' online experience with e-commerce and their views on changes in supply chain management. The final study showed that there was a relationship between the two factors of globalization and technology use on the evolution of the global supply chain in the e-commerce industry [6]. To sum up, after several years of exploration, the application of e-commerce logistics and warehousing has been deeply studied by many scholars. However, there are not many studies on the e-commerce logistics intelligent warehousing system based on multimedia technology. Therefore, to further promote the development of the logistics industry, the practical research of e-commerce logistics intelligent warehousing system solutions based on multimedia technology is urgent.

3. Overview of Intelligent Warehousing System

3.1. Structure of Intelligent Warehousing System. The components of the intelligent warehouse system mainly include four categories: production process execution system, warehouse management system, warehouse control system, and programmable logic controller. It is shown in Figure 1.

The production process execution system mainly provides data management, production scheduling, production process control, and material tracking and distribution management for the production environment of the enterprise. The system automatically generates assembly line manufacturing tasks by importing the user's commodity list, and it tracks and manages the tasks. It can schedule manufacturing resources according to task progress. It cooperates with the on-site workshop management personnel to conduct quality inspection of the manufactured goods. It also controls the raw materials, processes, and production plans required in the production process, as well as assembly line scheduling [7]. The production process execution system is one of the most important systems in factory manufacturing. The production process execution system can generate the task kanban according to the task progress in manufacturing. It displays on-site data informatization and alerts on workshop faults, abnormal quality, and material shortage, and it cooperates with raw material warehouses to greatly improve the automation of production and manufacturing processes.

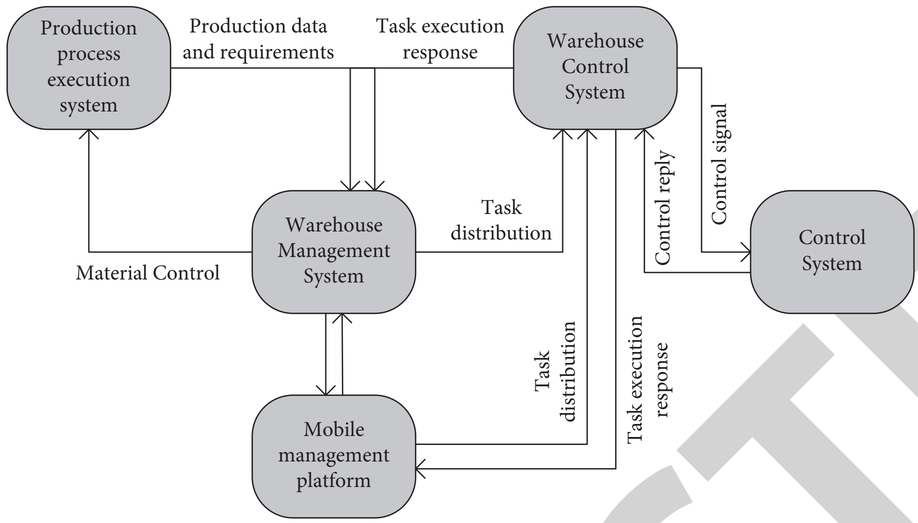

Figure 1: The composition of intelligent storage system.

Warehouse management system is a bridge for the integration of intelligent warehousing system. Through information transmission, the warehouse management system can be connected with the production process execution system and the warehouse control system. It manages the procurement of raw materials required by the production process execution system through information transfer. It accurately grasps raw material inventory data and uses advanced RFID or bar code technology to create a black box management system from commodity warehousing to warehouse delivery. The warehouse management system mainly deals with the functions of intelligent warehousing business. It includes receiving, quality inspection, shelving, inventory, and out-of-stock. The informatization of warehousing business can quickly and accurately obtain the quantity of goods in the inventory [8]. After setting the goods storage space in the system, it can exchange information with the warehouse control system so as to realize the task splitting and scheduling of goods receipt and delivery. The warehouse operation strategy of the warehouse management system can make the warehouse system run efficiently. By real-time docking with logistics, it can efficiently and accurately complete the delivery process of the warehousing system. It saves the labor cost of the enterprise in operation.

The warehouse control system is the management system between the warehouse management system and the PLC control system. The main function is to establish an interface protocol with various pieces of equipment in the warehouse. It is mainly responsible for receiving the instructions sent by the warehouse management system and sending the instructions to the PLC control system through the task splitting and scheduling of the warehouse control system. It, in turn, drives the normal work of intelligent warehousing equipment, such as conveyor belts, stackers, and related task sensors to complete warehousing operations. The warehouse control system encapsulates and integrates the PLC control system and the interface of the equipment used in the production environment. The warehouse control system does not directly control the movement of logistics equipment but only coordinates the work of various equipment. Each piece of equipment in the warehouse has its own PLC control module. The warehouse control system formulates a reasonable equipment scheduling strategy, mainly according to the characteristics of the business process. It reduces the communication volume of the entire intelligent storage system equipment and ensures the efficiency and reliability of equipment operation [9].

The PLC control system is a programmable logic controller. It is used to receive and transmit various types of electrical and electronic signals, and it enables one to control all kinds of mechanical and electrical equipment [10]. In the intelligent storage system, each equipment has its own independent PLC system. The PLC system mainly shakes hands with the warehouse control system and receives the control signals sent by the warehouse control system. It includes logic control, sequential control, and analog control. It has the advantages of convenient programming, high reliability, small size, and convenient maintenance.

3.2. Functional Requirements of Intelligent Warehousing System Based on Multimedia Technology. This paper mainly analyzes the functional requirements of the intelligent warehouse management system. Warehousing management is an information-based reconstruction process of the traditional warehouse business management process.

3.2.1. User Management Requirements. Users use handheld PDAs and smart tablets, both of which are currently the mainstay of the Android operating system and are likely to expand to iPads and other smart devices. Therefore, client system development needs to fully consider the cross-platform portability. Although the HTML hybrid development client can meet cross-platform requirements, it is not nearly as smooth as the native client. Therefore, the Flutter mobile UI framework was used to meet the client's cross-platform requirements [11].

Handheld mobile devices (PDAs) are used by smart warehousing business participants and warehouse administrators who have permission to use PDAs. Since the four modules of the intelligent warehousing system work together, user management no longer needs to be independently developed on the mobile terminal. Users can rely on the Web terminal of the intelligent warehouse management system to complete basic business [12]. The user scans the QR code of the current workstation on the login page, enters the login name and password, and sends the login request to the user management interface of the warehouse management system server. If the login user exists and has the corresponding permissions, log in to the system. The system administrator needs to manage the access rights on the web side to assign the access rights of different functions to different roles bound to users in different scenarios. The authorization of the menu authority on the PDA side is authorized or revoked by the warehouse administrator using the smart warehouse PC side to authorize or revoke the relevant bound roles. After logging in, the user can modify the password of the current user and use the logout operation, as shown in Figure 2.

The user uses the mobile client. The login interface scans the workstation and enters the username and password to log in. The user can modify the password and log out on the personal center page [12]. After the user fills in the relevant identity information using the client, the unified identity authentication system on the web side of the warehouse management system is called for user authentication.

Table 1 describes the description of the user management use case for the user management use case table. It mainly describes the user, event flow, and optional path of user management.

3.2.2. Receipt Business Process and Requirements. The intelligent warehousing system issues warehousing receipts through the production process execution system. The warehouse management system creates a goods receipt task according to the goods receipt issued by the production process execution system.

As shown in Figure 3, the receiving business participants are warehouse operators in the receiving area. It is a goods receipt task created from a goods receipt. In the warehouse receiving area, the receiving staff scans the barcode of the goods to receive the goods [13]. Since the vertical warehouse locations have different heights and bearing weights, warehouse workers need to use forklifts to place the goods on the altimetry and weight measurement equipment. The warehouse management system issues height and weight measurement tasks to the warehouse control system. The warehouse control system obtains the altimetry and weight measurement results by controlling the photogate sensor and the pressure sensor and returns the results to the warehouse management system.

After the goods are received by the warehousing operators and checked for the return prompt, the warehousing control system transmits the goods to the inspection area through the PLC-controlled conveyor belt and carries out

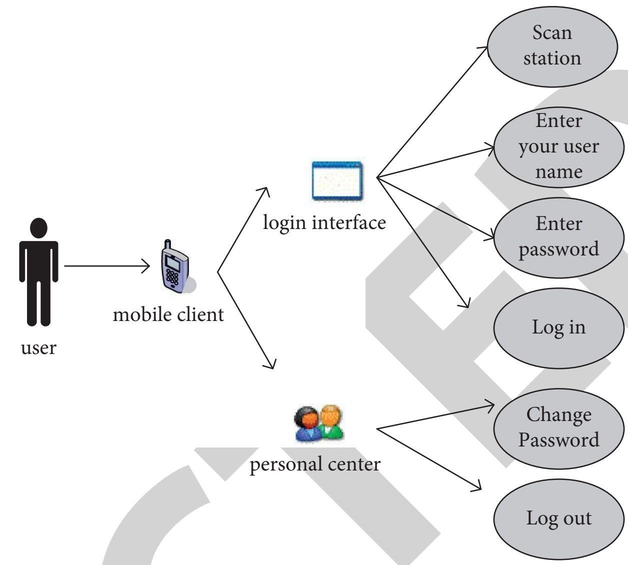

Figure 2: User management use case diagram.

Table 1: User management use case table.

Use case number	wms01	Use case name	User management
Use case description	Implement client login and log out		
User	Warehouse worker		
Precondition	WMS-web terminal for unified authentication platform to assign login permissions		
Postcondition	Enter the main menu of smart warehousing		
Importance	Important		
Event stream	1. The warehouse staff uses the mobile device to open the smart warehouse management system. 2. The user scans the QR code of the workstation with the client, enters the username and password, and clicks to log in. 3. Using the WMS-Web unified authentication platform authentication, the login successfully enters the main interface. 4. After entering the main interface, click the personal center at the bottom to change the password and log out.		
Optional path	1. The login username and password do not correspond, and the username or password is incorrect. Please contact the administrator. 2. If the workstation is not scanned or the username or password is not filled in, please fill in the username or password.		

the subsequent IQC inspection and confirmation process [14].

Figure 4 shows the use case diagram for receiving goods. In the main menu, through the receiving module, warehouse operators can click to view the receiving tasks. By scanning or entering the receipt barcode posted on the goods, they can view the specific cargo information and task details. It clicks the receipt confirmation button to complete the receipt. The

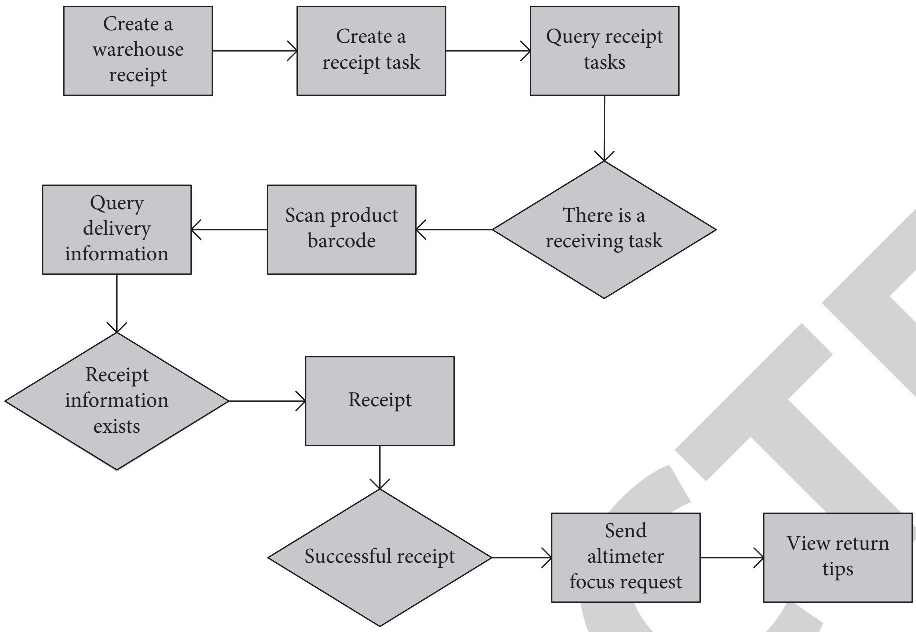

Figure 3: Receipt activity diagram.

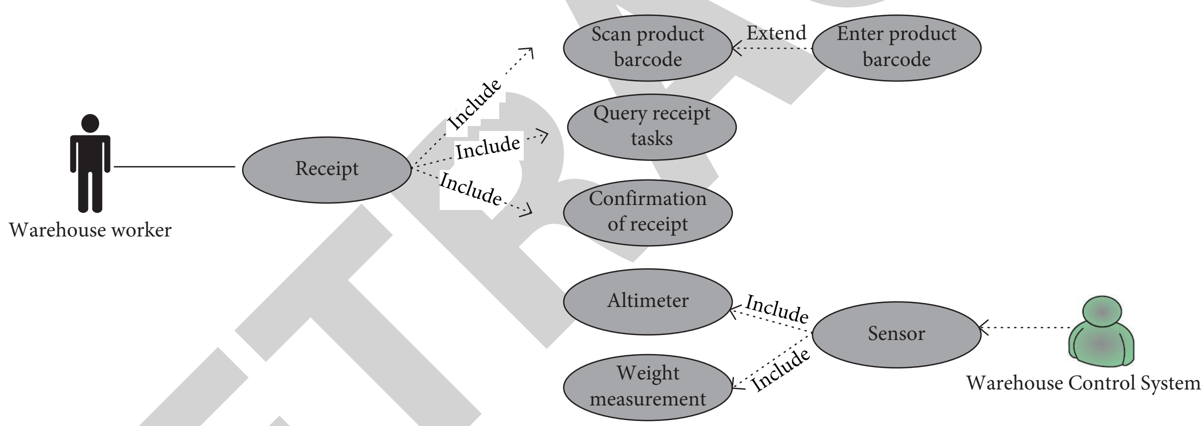

Figure 4: Receipt use case diagram.

warehousing control system sends the altimetry-focused task request to the altimetry-focused sensor, and the warehouse operator's receiving operation is completed [15].

Table 2 is the receiving use case table. It describes the description of the user management use case, mainly describing the user of the goods receipt, the detailed event flow and optional paths of the goods receipt function, etc.

3.2.3. Storage Business Functions and Requirements. The storage business mainly manages the goods stored on the shelves in the current vertical warehouse, flat warehouse, and spare parts area. This function is aimed at high-level managers. Based on the discriminant principle and method of quantization theory I, this paper quantifies the subjective storage requirements. It mainly includes four functions: inventory query, inventory adjustment, storage area performance optimization, and frozen commodity management. It builds a relationship model between storage requirements and functional metasolutions and finds the functional relationship between the two [16]. It sets the functional element as the independent variable x (qualitative variable) and the storage demand as the dependent variable (quantitative variable).

In the quantitative one-class theory, qualitative variables are called items, and item modeling is called categories. It is set to have m items. The first item x_1 has c_1 categories of $x_{11}, x_{12}, \cdots$, the second item x_2 has c_2 categories of $x_{21}, x_{22}, \cdots$, and the m^{th} item x_m has c_m categories of $x_{m1}, x_{m2}, \cdots$. Then, the total number of categories is as follows [17]:

$$\sum_{j=1}^{m} C_j = p \lim_{x \longrightarrow \infty}. \qquad (1)$$

It is called $\delta_i(j,k)$ $(i = 1, 2, \cdots, n; j = 1, 2, \cdots, m; k = 1, 2, \cdots, c_j)$ as the response of the j^{th} category of the item in the k^{th} sample, and the formula [18] can be obtained as follows:

Table 2: Receipt use case table.

Use case number	wms02	Use case name	Receipt
Use case description	Realize the receiving operation of warehousing		
User	Warehouse worker		
Precondition	The production process execution system issues a warehouse receipt, and the warehouse operators log in to the mobile terminal system.		
Postcondition	Detect		
Importance	Important		
Event stream	1. Warehousing staff must log in to the mobile terminal management system and have relevant information before using the receiving function. 2. The warehouse management system executes the goods receipt issued by the system according to the production process and creates a goods receipt task. 3. The warehouse operator scans or enters the goods according to the receiving task created by the warehouse management system. The QR code can query the current product information and quantity. 4. Click receipt to execute the goods receipt operation. Send the task of measuring height and weight to the warehouse control system. 5. The warehouse control system returns the height measurement and weight measurement information and controls the conveyor belt to send the goods to the IQC inspection area. 6. In the PC management background, one can query the goods to be tested by IQC in the current receiving stage.		
Optional path	1. Click submit without scanning the code, and prompt to scan the QR code of the material first. 2. The goods-receiving task is not found in the scan, and it prompts that the harvesting task is not found. Please contact the administrator after confirmation.		

$$\delta_i(j,k) = 1. \tag{2}$$

Or,

$$\delta_i(j,k) = 0. \tag{3}$$

In formulas (1) and (3), when the qualitative data of the item in the i^{th} group of samples j is the k^{th} category, $\delta_i(j,k)$ is 1. When in other forms, $\delta_i(j,k)$ is 0.

The order matrix $n \times m$ composed of $\delta_i(j,k)$ is recorded as follows:

$$X = \{\delta_i(j,k)\}_{n\times m}, \tag{4}$$

where $(i = 1, 2, \ldots, n;\ j = 1, 2, \ldots, m;\ k = 1, 2, \ldots, c_j)$, and it is assumed that there is a linear relationship between the evaluation of storage requirements and the solution of each functional element. Then, a mathematical model can be established as follows [19]:

$$y_i = \sum_{j=1}^{m}\sum_{k=1}^{c_j}\delta_i(j,k)a_{jk} + \varepsilon_i. \tag{5}$$

Among them, a_{jk} refers to the constant of k categories depending on the j^{th} item, and ε_i is the random error of the i^{th} sampling. In this way, the minimum estimated value $\overline{a_{jk}}$ of the coefficient can be obtained using the n sets of samples and the principle of least squares so that,

$$Q = \sum_{i=1}^{n}\varepsilon_i^2, Q = \sum_{i=1}^{n}\left[y_i - \sum_{j=1}^{m}\sum_{k=1}^{c_j}\overline{a_{jk}}\delta_i(j,k)\right]^2, Q = \sum_{i=1}^{n}\left(y_i - \overline{y}\right)^2. \tag{6}$$

If the value reaches a very small value, the partial derivative $\overline{a_{jk}}$ is obtained with respect to the coefficient [20].

$$\overline{a_{jk}} = 0. \tag{7}$$

Then, it is sorted as follows:

$$\sum_{j=1}^{m}\sum_{k=1}^{c_j} f(uv, jk)\overline{a_{jk}} = \sum_{i=1}^{n} y_i\delta(u,v), \tag{8}$$

where $(i = 1, 2, \ldots, n;\ j = 1, 2, \ldots, m;\ k = 1, 2, \ldots, c_j)$, and,

$$f(uv, jk) = \sum_{i=1}^{n}\delta(u,v)\delta(j,k). \tag{9}$$

The solution of the system of equations can obtain the least squares estimate of a_{jk}, $\overline{a_{jk}}$. Thus,

$$\overline{y_i} = \sum_{j=1}^{m}\sum_{k=1}^{c_j} a_{jk}\delta(j,k) + \overline{y}, \tag{10}$$

The average value of the storage requirement evaluation is as follows:

$$\overline{y} = \frac{\sum_{i=1}^{n} y_i}{n}, \tag{11}$$

a^*_{jk} has also become a standard coefficient, and it has a relationship with coefficient $\overline{a_{jk}}$.

$$a^*_{jk} = \overline{a_{jk}} - \frac{1}{n}\sum_{k=1}^{c_j} n_{jl}\overline{a_{jl}}, \tag{12}$$

where n_{jl} represents the number of reactions of type l in the j^{th} item in all n groups of samples [22].

$$\sum_{l=1}^{c_j} n_{jl} = n. \tag{13}$$

To measure the accuracy of the model, a complex correlation coefficient of R is used. Its value can be solved as follows:

$$R = \left[\sum_{i=1}^{n} \left(\frac{\overline{y_i} - \overline{y})^2}{\sum_{i=1}^{n} \left(y_i - \overline{y} \right)^2} \right) \right]^{1/2}. \tag{14}$$

The model accuracy M_a is generally expressed as follows:

$$M_a = R^2. \tag{15}$$

To measure the contribution of each functional element to the storage demand evaluation, the partial correlation coefficient needs to be calculated. Firstly, the correlation matrix between the storage demand evaluation value and the functional element is B, i.e.,

$$\mathrm{B} = \begin{bmatrix} 1 & \mathrm{b}_{\mathrm{y}1} & \mathrm{b}_{\mathrm{y}2} & \cdots \\ \mathrm{b}_{1\mathrm{y}} & 1 & \mathrm{b}_{12} & \cdots \\ \mathrm{b}_{2\mathrm{y}} & \mathrm{b}_{21} & 1 & \cdots \\ \vdots & \vdots & \vdots & \vdots \\ \mathrm{b}_{\mathrm{my}} & \mathrm{b}_{\mathrm{m}1} & \mathrm{b}_{\mathrm{m}2} & \cdots \end{bmatrix}. \tag{16}$$

It records its inverse matrix as B^{-1}, i.e., [23]

$$\mathrm{B}^{-1} = \begin{bmatrix} \mathrm{b}_{\mathrm{yy}} & \mathrm{b}_{\mathrm{y}1} & \mathrm{b}_{\mathrm{y}2} & \cdots \\ \mathrm{b}_{1\mathrm{y}} & \mathrm{b}_{11} & \mathrm{b}_{12} & \cdots \\ \mathrm{b}_{2\mathrm{y}} & \mathrm{b}_{21} & \mathrm{b}_{22} & \cdots \\ \vdots & \vdots & \vdots & \vdots \\ \mathrm{b}_{\mathrm{my}} & \mathrm{b}_{\mathrm{m}1} & \mathrm{b}_{\mathrm{m}2} & \cdots \end{bmatrix}. \tag{17}$$

Then, the partial correlation coefficient between the storage demand evaluation value y and the j^{th} functional element is as follows [24]:

$$R_{yj} = \frac{-b_{jy}}{\sqrt{b_{jj} b_{yy}}}. \tag{18}$$

The contribution of the j^{th} functional element to the demand evaluation y is R_{yj}.

Through the mathematical model established by the quantitative theory I, it explores the mathematical relationship between the user's storage requirements and the functional structure of the intelligent warehouse users. The partial correlation coefficient represents the degree of correlation between each functional element and storage requirements. The standard coefficient represents the contribution of each selected category in the functional element to the user's storage demand. Generally, in the process of product design, categories with larger standard coefficients will receive greater attention. The size of the final determination coefficient indicates the accuracy of the model built.

3.2.4. Tally Business Process and Demand Analysis. Warehouse tally operators need to regularly check the warehouse goods. The main scene of the tally business is storage and bulk cargo shelves. The tally clerk needs to regularly check whether the shelf maintenance category is consistent with the commodity category code according to the tally task. The warehouse administrator issues tally tasks through the warehouse system or the system regularly initiates tally tasks. According to the tally task list received by the current handheld device, the tally clerk scans the bar code of the shelf and the bar code of the commodity on the shelf. It determines whether the current shelf maintenance item is consistent with the currently placed item. If it is inconsistent, it is necessary to revise the shelf maintenance category to ensure its consistency to ensure the correctness of the picking and outbound process.

Figure 5 is a diagram of the tally use case. The tally operator can use the tally page to query the current shelf maintenance information by scanning the shelf barcode. It can confirm the consistency between the shelf and the product information, and after confirming or correcting it, the submission and tally are completed.

The tally use case table is shown in Table 3. It describes the functional description, user, event flow, and optional paths of the tally use case.

3.2.5. Outbound Business Process and Demand Analysis. The outbound operator mainly handles the outbound operation of parts in the user's order. According to the outbound task issued by the warehouse management system, the outbound operator scans the goods on the loose shelf to carry out the picking and outbound operation. The outbound use case table is shown in Table 4.

As shown in Figure 6, the outbound operator clicks the outbound function on the menu interface to query the outbound task. The staff scans the barcode of the product to query the information corresponding to the product number and clicks the OK button to complete the delivery operation. The outbound operator can query the current outbound task through the outbound module. They check out the current package by scanning or entering the item barcode.

4. Functional Test of Intelligent Storage System

To verify the effectiveness and practicability of the intelligent warehousing system based on multimedia technology proposed in this paper, this paper compares its function with the traditional intelligent warehousing system. The experimental research content is mainly to verify the work efficiency of the warehouse system and the management platform experience. The specific method of the experiment is to invite 6 practitioners related to warehouse management. The age gap of these 6 participants is relatively large, and the working years are 2–15 years, which can represent the vast majority of relevant practitioners. User specific information is shown in Table 5.

The experimental time was set to two days. On the first day, 6 experimenters were allowed to work normally in the operating environment of the traditional smart warehouse. On the second day, 6 experimenters used the intelligent warehouse based on multimedia technology to work. 5 test jobs were performed each day. To control the variables reasonably, they try to keep the 6 experimenters working the same time each time and keep the work content basically the same.

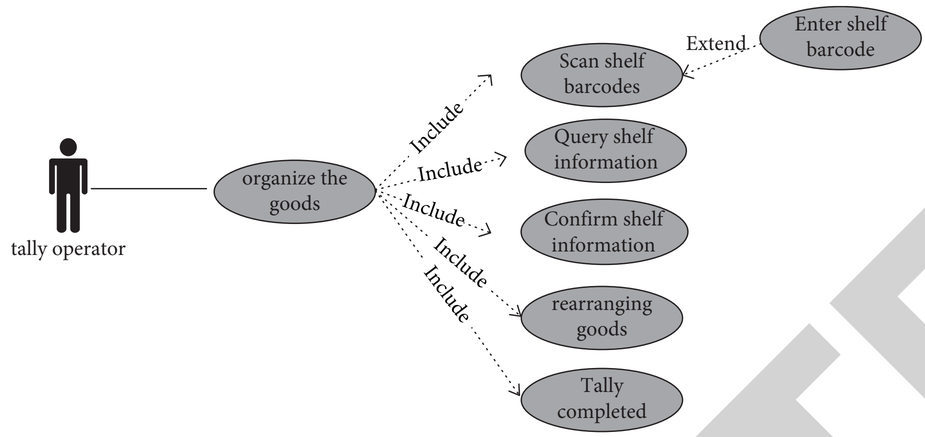

Figure 5: Tally use case diagram.

Table 3: Tally use case table.

Use case number	wms03 Use case name Tally
Use case description	Keep shelf maintenance information consistent with items
User	Tally operator, warehouse manager
Precondition	Carry out shelf and replenishment operations on the shelves in the spare parts area, and issue tally tasks from the warehouse management system
Postcondition	None
Importance	Important
Event stream	1. Before using the tally function, the tally operator must log in to the mobile terminal management system and have the corresponding permissions. 2. The tally operator can scan the shelf information to view the commodity information bound to the current shelf. 3. The tally operator needs to judge the consistency between the shelf information and the products on the shelf. 4. Confirm the consistency of the products on the shelf and complete the tally. 5. If there is inconsistency, one needs to change the shelf information (quantity) or the location of the goods, and the tally is completed. 6. One can check the current tally completion status in the PC management background.
Optional path	Click submit if the shelf information has not been scanned. Please scan the shelf number first.

Table 4: Outbound use case table.

Use case number	wms04 Use case name Out of stock
Use case description	Outbound packaged goods
User	Outbound operator
Precondition	Issue library tasks according to user orders
Postcondition	None
Importance	Important
Event stream	1. The outbound operator needs to log in to the mobile terminal management system and have corresponding permissions to use the outbound. 2. The outbound operator uses the outbound function to scan the barcode of the packaged goods and can query the corresponding product information and status. 3. Click outbound to carry out the outbound operation for the current packaged goods. 4. Warehouse administrators can use the PC-side frozen outbound management to query the details and change the password and cancel the account in the personal center at the bottom.
Optional path	None

It uses the form of tracking observation to record the work content of two days. The main inspection contents include the in-out time of the goods, the inquiry and arrangement of the goods, and the troubleshooting of the three aspects. It finally compares the data values monitored by the 6 experimenters. The unit of monitoring data is seconds. The test results are shown in Figures 7 to 9.

It can be seen from Figure 7 that the overall average time consumed by the intelligent warehousing system based on multimedia technology is 8.92 seconds, and the overall average time consumed by the warehouse is 8.04 seconds. The overall average time for goods in the traditional intelligent warehousing system is 13.98 seconds, and the overall average time for outbound time is 11.80 seconds.

It can be seen from Figure 8 that the overall average time spent by the multimedia technology-based intelligent warehousing system to query goods is 4.48 seconds, and the overall average time spent sorting goods is 13.14 seconds. The traditional intelligent warehousing system takes 6.92 seconds to sort out the goods, and the overall average time for sorting out the goods is 19.50 seconds.

It can be seen from Figure 9 that the overall average time spent on troubleshooting the intelligent warehousing system

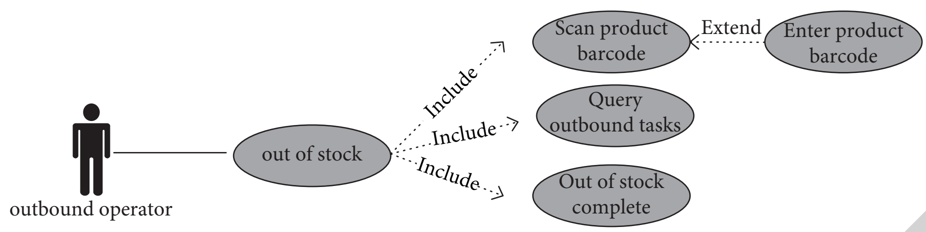

Figure 6: Outbound use case diagram.

Table 5: User specific information.

	User 1	User 2	User 3	User 4	User 5	User 6
Age	26	22	35	41	47	50
Length of service	4	2	8	10	12	15
Usage of intelligent equipment	Frequently	Frequently	Generally	Occasionally	Generally	Occasionally

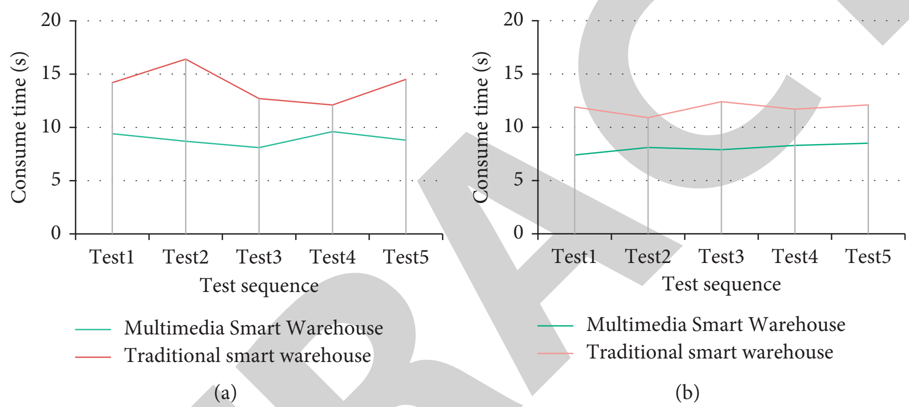

Figure 7: Smart warehousing in and out time. (a) shows the time it takes for each warehousing system to enter the warehouse. (b) shows the time it takes for each storage system to leave the warehouse.

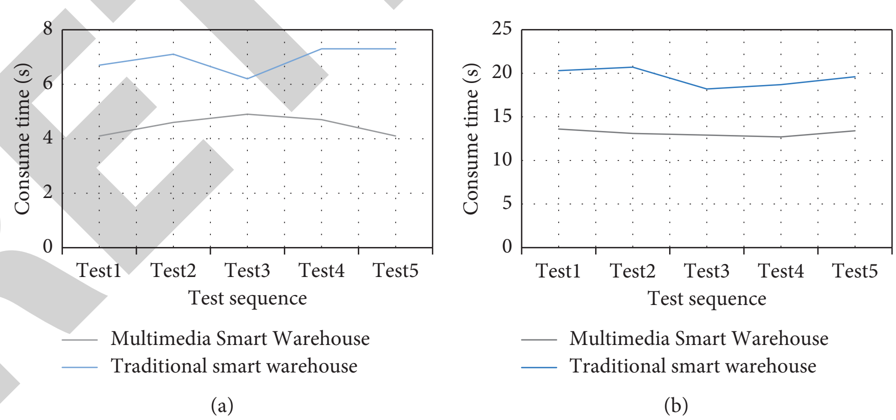

Figure 8: Intelligent warehousing inquiry and sorting of goods time. (a) shows the time it takes for each warehousing system to inquire about goods. (b) shows the time it takes for each warehousing system to sort out the goods.

based on multimedia technology is 5.52 seconds. The troubleshooting time of the traditional intelligent warehousing system is 8.14 seconds.

After the experiment, a brief interview was conducted with the evaluators. It evaluates and analyzes the experience of using the integrated equipment of 6 experimenters and asks them about the different problems they encounter in their work and the corresponding solutions. It invites the subjects to score the storage equipment and score the equipment's intelligence, use comfort, completeness of use functions, easy to understand, easy to operate, and overall satisfaction. Its total is 1–10, where 10 means very satisfied and 1 means very dissatisfied. The statistical results are shown in Figure 10.

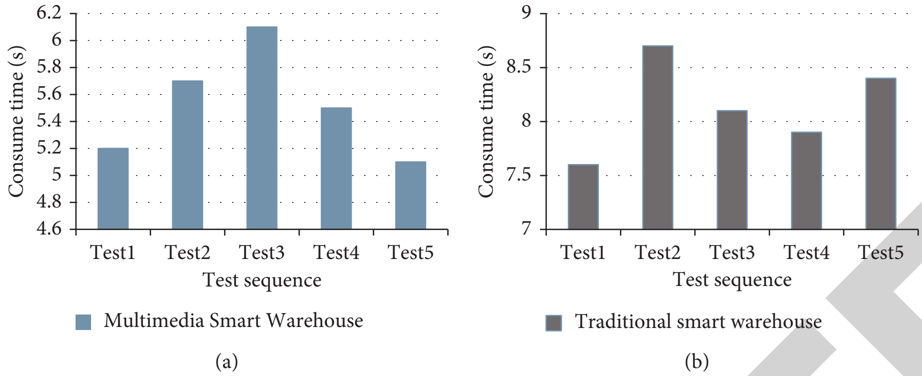

FIGURE 9: Intelligent warehousing troubleshooting time. (a) shows the time spent on troubleshooting the intelligent storage system based on multimedia technology. (b) shows the time taken to troubleshoot the traditional intelligent storage system.

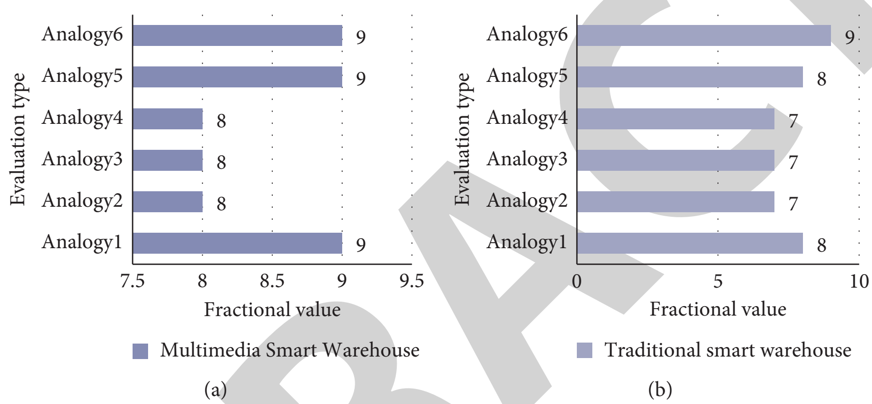

FIGURE 10: Experience scoring results. (a) is the experience score of the intelligent warehousing system based on multimedia technology. (b) shows the experience score of the traditional intelligent warehousing system.

It can be seen from Figure 10 that the overall average experience score of the intelligent warehousing system based on multimedia technology is 8.50 points. The overall average score of the experience of the traditional intelligent warehousing system is 7.66 points.

5. Discussion

By comparing the test data between the intelligent storage system based on multimedia technology and the traditional intelligent storage system, the conclusions drawn are as follows:

(1) At the level of goods in and out of the warehouse, the overall average time spent in the intelligent storage system based on multimedia technology is 5.06 seconds less than the overall average time spent in the traditional intelligent storage system. The overall average time taken for goods out of the warehouse is 3.76 seconds less than the overall average of the traditional intelligent warehousing system;

(2) At the level of goods inquiry and arrangement, the overall average time spent inquiring goods in the multimedia technology-based intelligent warehousing system is 2.44 seconds less than the overall average time spent inquiring goods in the traditional intelligent warehousing system. The overall average time spent sorting goods is 6.36 seconds less than the overall average of the traditional intelligent warehousing system;

(3) At the level of system troubleshooting, the overall average of the time spent in troubleshooting the intelligent storage system based on multimedia technology is 2.62 seconds less than the overall average of the time spent in troubleshooting the traditional intelligent storage system.

(4) At the experience level of the system, the overall average experience score of the intelligent storage system based on multimedia technology is 0.84 points higher than the overall average experience score of the traditional intelligent storage system.

The entire comparative experimental data shows that, while keeping other experimental conditions the same, the intelligent warehousing system based on multimedia technology performs better in terms of system function and user experience. It shows that compared with the traditional intelligent warehousing system, the intelligent warehousing system based on multimedia technology can meet the needs of users and improve the user experience while achieving higher work efficiency.

6. Conclusion

The rapid improvement of economic level has brought more intense market competition. How to improve the circulation of products in the traditional manufacturing industry to achieve high-efficiency production and achieve sustainable development under this market structure is becoming more important. The emergence of intelligent warehousing has improved the backward phenomenon of traditional warehousing because of the waste of human resources and low production efficiency. However, for the further development of enterprises, traditional intelligent warehousing is still far from meeting the high requirements of enterprise development for production circulation and real-time inventory management. Compared with the traditional intelligent warehousing system, the intelligent warehousing system based on multimedia technology has more efficient work efficiency. It can not only realize the optimal layout of the warehousing system but also quickly and accurately organize and analyze the cargo information, making the operations of sorting, assembling, and dispatching goods easier and smoother. Even in the peak production stage, it can effectively solve the problem of goods in and out of the warehouse and liberate manual labor to the greatest extent. Although this paper uses multimedia technology to conduct in-depth research on the intelligent warehousing system solution of e-commerce logistics, there are still many deficiencies. The depth and breadth of this research is not enough. In the process of this research, the selection and acquisition of experimental data are carried out under absolutely ideal conditions, and the completeness and validity are not enough. Some interfering factors involved in the system testing process are not considered, and the system experience scoring test is also restricted by many factors. The author's academic level research is also limited, and the research on intelligent warehousing system is still in the preliminary stage. In the future work, the author will study the solution of intelligent storage system from more perspectives based on the existing technology and level and continuously optimize the performance and quality of the system.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author declares that there are no conflicts of interest with any financial organizations regarding the material reported in this manuscript.

Acknowledgments

This research was supported by the National Social Science Fund of China under Grant No. 21BXW071, Jiyang College of Zhejiang A&F University under Grant No. RC2021A03, and the National Social Science Fund of China under Grant No. 17BGL232.

References

[1] K. Overstreet, "Cobots shine in e-commerce supply chain," *Packaging world*, vol. 26, no. 7, p. 17, 2019.

[2] S. Zhang, L. Fu, and R. Chen, "Optimizing the cargo location assignment of retail E-commerce based on an artificial fish swarm algorithm," *Mathematical Problems in Engineering*, vol. 2020, no. 5, pp. 1–14, 2020.

[3] V. G. Khalyn, "The significance of logistics in servicing growing volumes of E-commerce," *International Journal of Economics and Business Administration*, vol. VII, no. Special Issue 2, pp. 185–194, 2019.

[4] J. Liu, B. Pan, X. Zhang, and D. Li, "Mobile E-commerce information system based on industry cluster under edge computing," *Mobile Information Systems*, vol. 2021, no. 1, pp. 1–11, Article ID 7930799, 2021.

[5] L. Ma, C. Jin, and Y. Huo, "Selection of logistics service modes in e-commerce based on multi-oligopolies Cournot competition," *Nternational Journal of Shipping and Transport Logistics*, vol. 11, no. 4, pp. 354–383, 2019.

[6] J. Hu and A. Haddud, "Exploring the impact of globalization and technology on supply chain management: a case of international E-commerce business," *International Journal of Operations Research and Information Systems*, vol. 8, no. 4, pp. 1–22, 2017.

[7] S. Bhaskaran and B. Santhi, "A review on intelligent e-learning based recommender system in competitive environment," *Journal of Advanced Research in Dynamical and Control Systems*, vol. 9, no. 7, pp. 57–61, 2017.

[8] V. Veglio and N. Gordini, "Customers churn prediction and marketing retention strategies. An application of support vector machines based on the AUC parameter-selection technique in B2B e-commerce industry," *Industrial Marketing Management*, vol. 62, no. Apr, pp. 100–107, 2017.

[9] N. Chung, H. G. Song, and H. Lee, "Consumers' impulsive buying behavior of restaurant products in social commerce," *International Journal of Contemporary Hospitality Management*, vol. 29, no. 2, pp. 709–731, 2017.

[10] Q. Wang, H. Chen, S. Zhang, L. Hu, and B. Palanisamy, "Integrating concurrency control in n-tier application scaling management in the cloud," *IEEE Transactions on Parallel and Distributed Systems*, vol. 30, no. 4, pp. 855–869, 2019.

[11] S. M. Jit, "Clickstream analysis methods and systems," *Asian Journal of Management Sciences & Education*, vol. 1, no. 3, pp. 57–65, 2017.

[12] E. Darta, M. Daulay, and W. Abdillah, "Antecedents to webste E-commerce satsfacton and loyalty," *Asia-Pacific Management and Business Application*, vol. 009, no. 2, pp. 123–136, 2020.

[13] H. Pan and X. Yang, "Management model on electronic commerce data based on cloud computing," *Wireless Communications and Mobile Computing*, vol. 2021, no. 8, pp. 1–10, 2021.

[14] R. Jain and A. K. Singh, "Technological approaches for E-content development and deployment: a qualitative analysis from experts' perspective," *International Journal of Information and Communication Technology Education: An Official Publication of the Information Resources Management Association*, vol. 16, no. 3, pp. 92–112, 2020.

[15] E. Utami, "Multi criteria software quality assessment of open source content management system," *Journal of Theoretical and Applied Information Technology*, vol. 95, no. 7, pp. 1513–1523, 2017.

[16] A. Calma, "The long and winding road," *International Journal of Educational Management*, vol. 31, no. 4, pp. 418–429, 2017.

[17] S. Maurya, M. Nautiyal, B. Ahmad, and D. Sharma, "Impression of cloud computing environment on E- commerce industry," *Test Engineering and Management*, vol. 83, no. May 2020, pp. 12627–12635, 2020.

[18] S. Bravo, A. Donado, R. P. Pulido, and S. E. Duran, "The associated and non-associated MSMEs: an approach to its management in innovation and technological development Contenido," *Espacios*, vol. 38, no. 59, pp. 20–37, 2017.

[19] N. Xu, Y. Hu, T. Wang, and J. Chen, "Countermeasures and current situation of urban agri-food quality and safety supervision based on e-commerce," *IPPTA: Quarterly Journal of Indian Pulp and Paper Technical - A*, vol. 30, no. 5, pp. 499–506, 2018.

[20] H. T. Thanh and T. D. Thanh, "Proposing simulated electronic markets for training and research on e-commerce," *Science & Technology Development Journal - Economics - Law and Management*, vol. 3, no. 1, pp. 1–12, 2019.

[21] L. Vanneschi, D. M. Horn, M. Castelli, and A. Popovic, "An artificial intelligence system for predicting customer default in e-commerce," *Expert Systems with Applications*, vol. 104, no. aug, pp. 1–21, 2018.

[22] M. Song, R. Fisher, and Y. Kwoh, "Technological challenges of green innovation and sustainable resource management with large scale data," *Technological Forecasting and Social Change*, vol. 144, no. JUL, pp. 361–368, 2019.

[23] L. Wei and E. Turkina, "Common supplier tactics in buyer-supplier-buyer relations," *Human Systems Management*, vol. 36, no. 1, pp. 57–72, 2017.

[24] N. Khadijah, S. Z. Abidin, G. Zandi, and M. A. Mohammad, "E-commerce logistic and supply chain management: evidence from Indonesian perspectives," *Journal of Supply Chain Management*, vol. 7, no. 6, pp. 2051–3771, 2018.