Perancangan dan Implementasi *E-Commerce Corrugated Carton Box* Menggunakan Metode *Rapid Application Development*

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Abstrak **— PT Hora Cipta Jaya merupakan perusahaan yang khusus menjual kotak karton bergelombang. PT Hora Cipta Jaya biasanya menggunakan kotak karton bergelombang untuk mengemas suatu barang atau produk untuk pengiriman. Karena kotak karton bergelombang kuat, tahan lama, dan mudah didaur ulang, banyak perusahaan industri menggunakannya untuk mengemas produknya. PT Hora Cipta Jaya masih melakukan proses penjualan secara manual, mulai dari transaksi, pemasaran, serta pencatatan dan pembuatan laporan. Karyawan tetap perlu merekap seluruh data perusahaan saat melakukan penjualan menggunakan excel. Kesalahan masih sering terjadi selama proses pembelian dan penjualan produk seperti kesalahan pada saat pencatatan dan perhitungan harga serta kesalahan pengisian data pesanan dan pengiriman. Tujuan dari penelitian ini adalah untuk membantu perusahaan dalam mengelola data dan merancang sistem yang menampilkan pemesanan online, pembayaran, pengiriman, pelaporan, dan promosi produk. Sistem pada penelitian ini dibuat dengan menggunakan metode RAD (Rapid Application Development), memanfaatkan bahasa pemrograman PHP (Hypertext Preprocessor), dan database MySQL (My Structured Query Language). Penelitian ini membagi proses pembuatan sistem ini menjadi empat tahap diantaranya analisis kebutuhan, desain sistem, implementasi sistem, dan analisis kelayakan aplikasi. Hasil dari penelitian ini menghasilkan sebuah sistem e-commerce yang dapat membantu perusahaan dalam pengelolaan data, kemudahan transaksi penjualan produk secara online dan pemasaran produk dengan cakupan yang lebih luas, serta pencatatan invoice dan laporan secara otomatis. Sistem ini telah berhasil diuji dan memperoleh peringkat kelas B dengan nilai skor sebesar 78 untuk bagian admin dan 79,5 untuk bagian pelanggan, yang mengonfirmasi semua fitur beroperasi (kategori baik).**

Kata kunci— **Corrugated Carton Box; E-commerce; Rapid Application Development; Website.**

Design and Implementation of E-Commerce Corrugated Carton Box using Rapid Application Development

Abstract ***— PT Hora Cipta Jaya is a company specializing in the sale of corrugated cardboard boxes. PT Hora Cipta Jaya typically uses corrugated cardboard boxes to package goods or products for shipping. Due to their strength, durability, and recyclability, many industrial companies use them to package their products. PT Hora Cipta Jaya still conducts sales processes manually, starting from***

transactions, marketing, to recording and reporting. Employees still need to manually record all company data during sales using Excel. Errors often occur during the purchase and sale of products, such as mistakes in recording and pricing calculations, as well as errors in order data entry and shipping. The aim of this research is to assist the company in managing data and designing a system that features online ordering, payment, shipping, reporting, and product promotion. The system in this study was created using the RAD Rapid Application Development) method, utilizing the PHP (Hypertext Preprocessor) programming language and MySQL (My Structured Query Language) database. This research divides the process of creating this system into four stages, including needs analysis, system design, system implementation, and application feasibility analysis. The research resulted in an e-commerce system that helps the company manage data, facilitates online product sales transactions and broader product marketing, and automatically records invoices and reports. The system has been tested successfully, achieving a class B rating of 78 for the admin section and 79.5 for the customer section, confirming all features are operational (good category).

Keywords— ***Corrugated Carton Box; E-commerce; Rapid Application Development; Website.***

I. INTRODUCTION

In today's era, product packaging is an important factor in the marketing process. Packaging is done to protect and minimize product damage when sent to customers [1]. Products are usually packaged using corrugated cardboard boxes or paper boxes. The corrugated cardboard box itself is made of paper that is jagged down the middle [2][3]. Corrugated carton boxes are the choice for product packaging because their layers can withstand strong impacts and pressure during the shipping process. Also, this cardboard is environmentally friendly, as it can be recycled after use. Currently, corrugated cardboard boxes are the most commonly used packaging to ship products such as food, clothing, and electronics [4][5]. According to a report from Smithers, the demand for corrugated carton box packaging materials has continued to increase since 2018, and it can increase by more than 3.5% per year. It is estimated that until 2025, demand will increase by more than 4% per year [6]. Then, in the Business Indonesia report, it was announced that Indonesia will rank 1st in revenue in the e-commerce business in 2022 of all countries in Southeast Asia, with a proportion of 52% and revenues of US $51.9 billion [7]. The rapid growth of transactions in e-commerce is one of the right choices for selling corrugated cardboard boxes through e-commerce. What's more, with the COVID-19 virus, people are increasingly using electronic applications to buy the things they need because they don't dare to leave the house [8]. Because more and more transactions occur, more and more corrugated carton boxes are needed to package products that will be sent later.

Technology is one of the most needed needs in the current era to overcome a complicated situation or achieve the desired goal. In the current digital era, technology is becoming increasingly sophisticated, and almost all human daily needs use technology, one of which is e-commerce [9][10]. E-commerce is trade or business transactions that occur online between sellers and buyers. use the internet network [11][12]. By using e-commerce, we can get the goods we need through online services without having to go to a shop or place the goods directly where they are sold [13][14]. In addition, by using e-commerce, we can compare prices and products that we want to buy more quickly and easily. Companies that already have an e-commerce system also find it easier to gauge customer satisfaction when buying their products [15][16].

In previous research regarding the topic of information system design using the RAD method, many studies have been carried out. The RAD method has several advantages that other methods do not have. According to research [17], making a system using the RAD method can carry out a testing process on each feature in the system at the design stage, so when one feature has been made, the testing process on that feature can be carried out immediately. In research [18], it was explained that the RAD method focuses more on the speed of system creation and user comfort when using the system. And in the last study, it was explained that using the RAD method can reduce the cost of making the system because the system made with the RAD method is pressed as fast as possible [19]. For research on the topic of designing e-commerce systems for corrugated carton box products, no one has made them yet.

As is the case with PT Hora Cipta Jaya in selling its products. The existing process at PT Hora Cipta Jaya itself is currently using a computer but still does not have a system for each process. Employees still use Ms. Office to carry out their duties, starting with managing data, ordering, and reports. At this time, the company does not yet have a data management system, so it still takes longer to search for data because the data storage is still separate and does not have a database. In the sales department, especially when ordering, customers must come directly to the company if they want to order their products, or they can contact the company by telephone. For the payment section itself, the company still has to record one by one customers who have paid off and who have not paid off using Ms. Office, where sometimes errors in recording can occur in the payment section. In the delivery department, the company still has to contact the customer when they want to send goods that have been ordered by telephone, so if the customer does not answer the telephone, the delivery process cannot be carried out. Then, for making transaction reports, it is still not effective because the company has to recap each transaction and combine them into one to make a report. The system feasibility analysis phase plays a critical role in evaluating the usability

and effectiveness of the system, ensuring it meets user expectations and operational standards through tools like the System Usability Scale (SUS) [20]. This study uses the SUS method as a system feasibility analysis.

The first contribution to this research is the application of the RAD method in designing e-commerce systems for Corrugated Carton Box products. The second is to analyze the feasibility of the e-commerce system that has been built using the System Usability Scale. And the last is an e-commerce system that is built to help companies manage data and make transactions online.

II. Research Methodology

Rapid Application Development or RAD is a software development process that emphasizes short development cycles. The first stage is requirements planning, which involves deep user needs identification. The second stage is user design, where interfaces and user interactions are built. The third stage is construction, where software is developed and tested incrementally. The final stage is cutover, where the developed software is moved and implemented into the production environment [21]. This method consists of four main stages which can be seen in Figure 1.

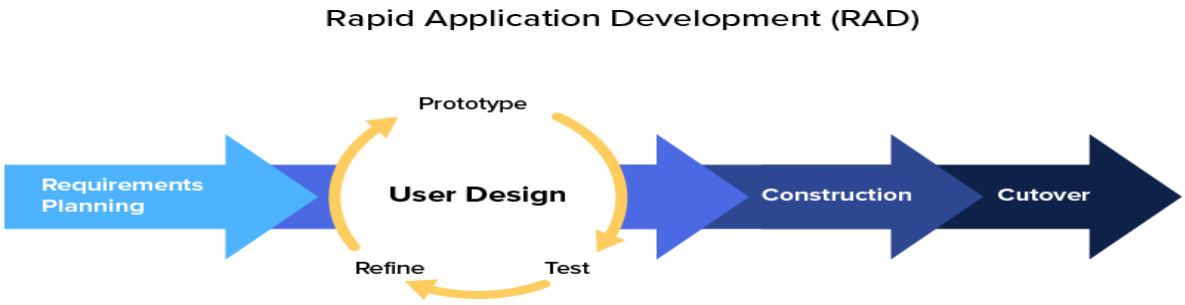

Figure 1. RAD Method [21]

The modified RAD technique employed in the research flow for designing the e-commerce corrugated carton box system at PT Hora Cipta Jaya comprises four key stages. These stages include requirements analysis, which involves gathering and documenting the functional and non-functional requirements of the system. The next stage is design, where the architecture and user interface of the system are planned and defined. Implementation follows, during which the actual development of the system takes place based on the design specifications. System feasibility evaluation is the final stage, assessing the practicality and viability of implementing the developed system within PT Hora Cipta Jaya's operational framework. In Figure 2, the research flow is depicted.

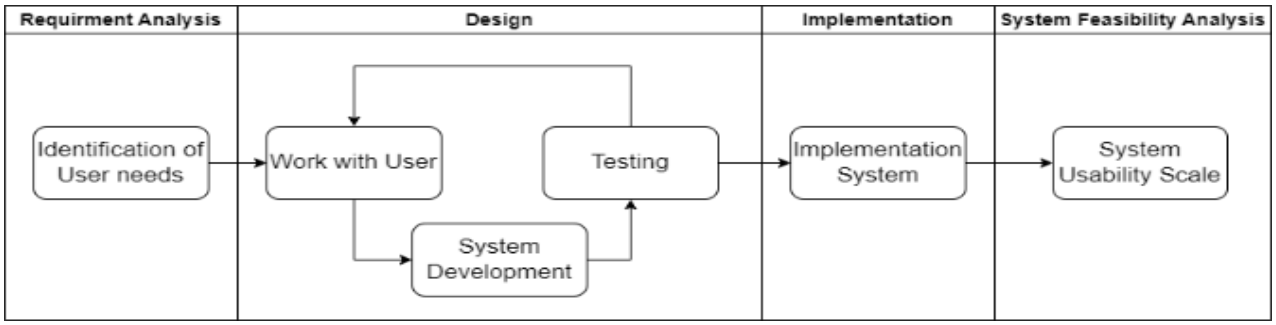

Figure 2. Research Flow

A. Requirement Analysis

In the Requirement Analysis phase, the focus is on identifying user needs to ensure the system meets their expectations and addresses specific requirements. Requirement Analysis is the initial stage where essential information needed for the design process is identified. This involves conducting thorough literature studies, as well as engaging in observations and interviews to gather pertinent details about the company. These activities provide a comprehensive understanding of the organization's needs and operational context, which are essential for effective design planning [22].

B. Design

The Design phase involves collaboration with users to conceptualize and develop the system, followed by testing to validate its functionality and ensure it aligns with the specified requirements. In this study, PHP and MySQL were used as the programming languages and database for system developmentThis study also utilizes the UML modeling method as a foundation for designing system features, defining database relationships, and mapping the flow of each feature. And for making the system using Visual Studio Code and XAMMP programs. Collaboration with users is also involved in the system design process to ensure flexibility in adding or modifying features based on user needs. After the feature has been created, the testing process can immediately be carried out at this stage so that the user can find out whether the feature is as expected or not.

C. Implementation

During the implementation stage, the system is deployed and made operational for users, allowing them to interact with its features. The e-commerce system, which has undergone development and testing phases, will be deployed for use by PT Hora Cipta Jaya employees in the administrative section. Additionally, customers interested in ordering company products online will utilize the system's functionality designed specifically for them. The deployment process involves training employees on how to effectively utilize the system for managing orders and transactions.

D. System Usability Scale

Finally, the System Feasibility Analysis phase evaluates the overall usability and effectiveness of the system using tools like the System Usability Scale, ensuring it provides a satisfactory user experience and meets performance standards. The feasibility of implementing an e-commerce system was assessed by administering a System Usability Scale questionnaire to employees with experience using the system. This scale serves as a tool to evaluate the usability of the e-commerce system developed for PT Hora Cipta Jaya [22][23]. The questionnaire will be filled out by 10 respondents who are company employees. The results will be processed using the SUS formula (1), which involves calculating the average score (2) derived from the sum of all SUS scores (2) divided by the number of respondents (3). The SUS score is determined according to specific rules during calculation:

1. For each of the odd numbered questions, subtract 1 from the score.
2. For each of the even numbered questions, subtract their value from 5.
3. Take these new values which you have found, and add up the total score. Then multiply this by 2.5.

$$\bar{x} = \frac{\sum x}{n} \quad (1)$$

$\bar{x} =$ average score (2)

$\sum x =$ Total SUS Score (3)

$n =$ Total respondent (4)

III. RESULT AND DISCUSSION

A. Result

1. Requirement Analysis

The user requirements outlined below describe the essential functionalities needed to support the system's operations for both customers and administrators. These requirements aim to ensure a seamless user experience for customers while enabling administrators to efficiently manage the system's core features. The functionalities are categorized based on the specific roles of the users. For customers, the system provides a range of features designed to enhance their shopping experience. Some user requirements for customers include:

a. Registration
   Customers should be able to register an account by providing their personal details (e.g., name, email, password, contact information).
b. Make an Order
   Customers should be able to browse the product catalog and add items to their shopping cart. Customers can update the quantity of items in the shopping cart.
c. Checkout
   Customers should be able to review their order details before confirming the purchase. A secure payment gateway should be integrated for online payments.

d. Confirm Payment
   Customers should be able to confirm their payments and view the status of the transaction.
e. View Invoice
   Customers should be able to view and download invoices for their completed orders.
f. Print Invoices
   Customers should be able to print invoices directly from the system.

The system provides administrators with a comprehensive set of tools to efficiently manage and oversee its operations. These functionalities are designed to streamline key administrative tasks, ensuring that the system operates smoothly and effectively. By offering robust management capabilities, the system empowers administrators to maintain control over product inventory, customer orders, and overall system performance while facilitating data-driven decision-making through reporting and analysis. Below is an outline of the specific functionalities available for administrators.

a. Manage Categories
   Admins should be able to create, update, and delete product categories.
b. Manage Products
   Admins should be able to add, update, and delete products within the respective categories. Admins can upload product images and provide descriptions, prices, and stock details.
c. Manage Orders
   Admins should be able to view all customer orders and update their status (e.g., pending, confirmed, shipped, completed).
d. Manage Customers
   Admins should have access to a list of registered customers and their order history. Admins can update customer details if necessary.
e. View Reports
   Admins should be able to generate and view reports, including sales, inventory, and customer activity.
f. Print Reports
   Admins should be able to print reports for record-keeping and analysis purposes.

2. Design

The output of the UML model for the e-commerce system includes use case diagrams, activity diagrams, class diagrams, and an ERD. The e-commerce system will be developed in accordance with the functions outlined in these four diagrams. Subsequently, testing will be conducted to ensure that the completed system aligns with the UML model created. The use case diagram is shown in Figure 3.

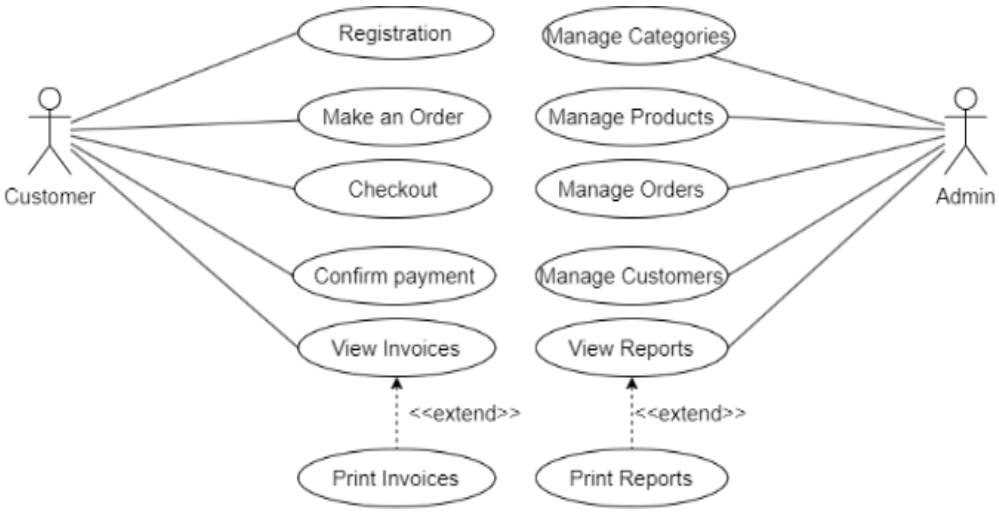

Figure 3. Use Case Diagram

The Use Case Diagram in this e-commerce system has 2 actors, namely the customer and the admin. Figure 3 describes the things that can be done by each actor [24]. Customers can register, order, view cart, checkout, view invoices, print invoices, and log out. For admins to log in, manage categories, products, orders, customers, and view sales reports and print them.

Activity diagrams are useful for showing each activity carried out by actors in stages [25]. An activity diagram with features in line with the use case diagram may be seen in the admin portion of Figure 4. To use these capabilities, administrators must first log in. An activity diagram for the customer area, which has features in line with the use case diagram, is shown in Figure 5. Customers can only order products packaged in corrugated carton boxes after logging into the system. The customer can complete the registration process to create an account in the system if they don't already have one. In UML, class diagrams are used to illustrate the intended system's organizational structure. where there is a connection between each table and its neighbors [26]. Figure 6 shows the class relationships on the e-commerce platform of PT Hora Cipta Jaya. These relationships describe the actions that took place.

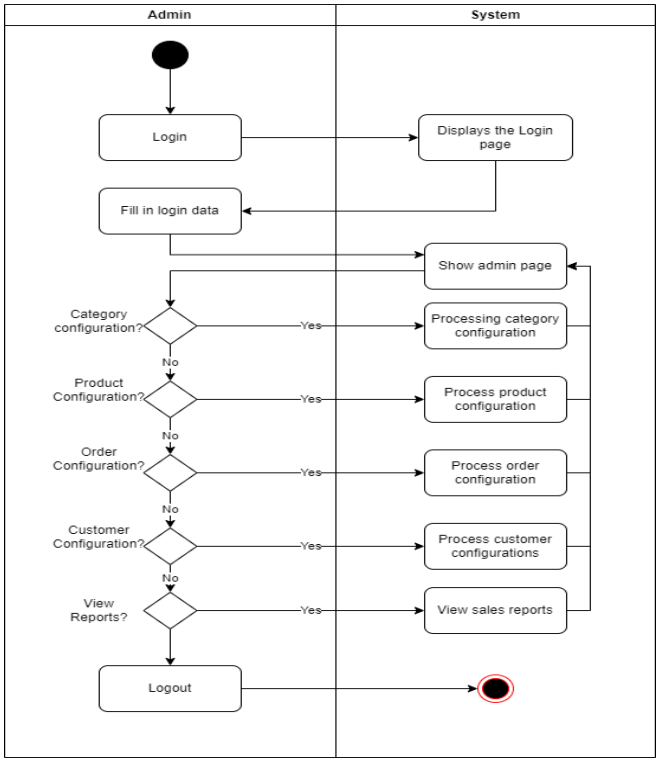

Figure 4. Activity Diagram Admin

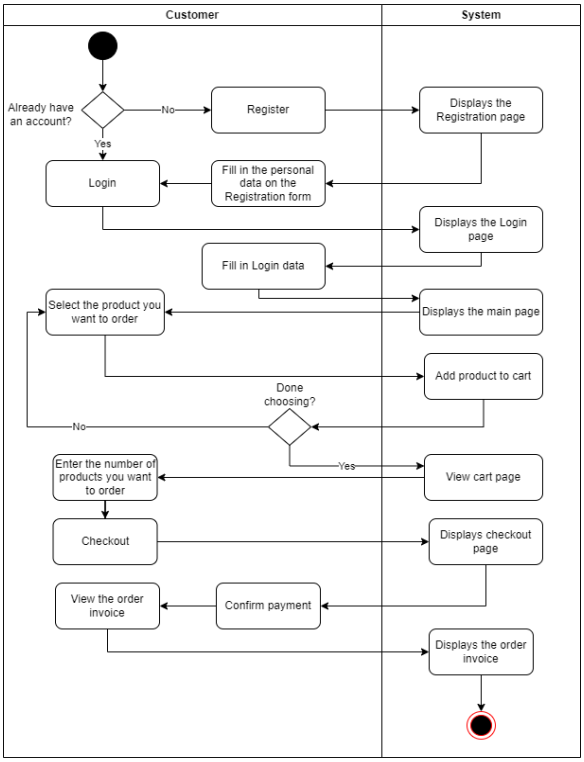

Figure 5. Activity Diagram Customer

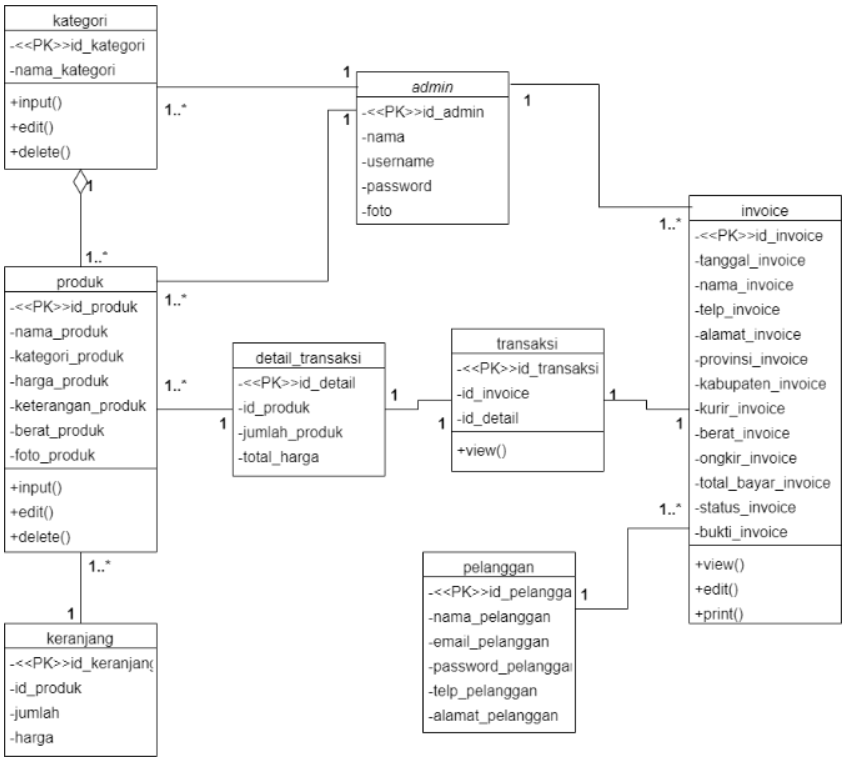

Figure 6. Class Diagram

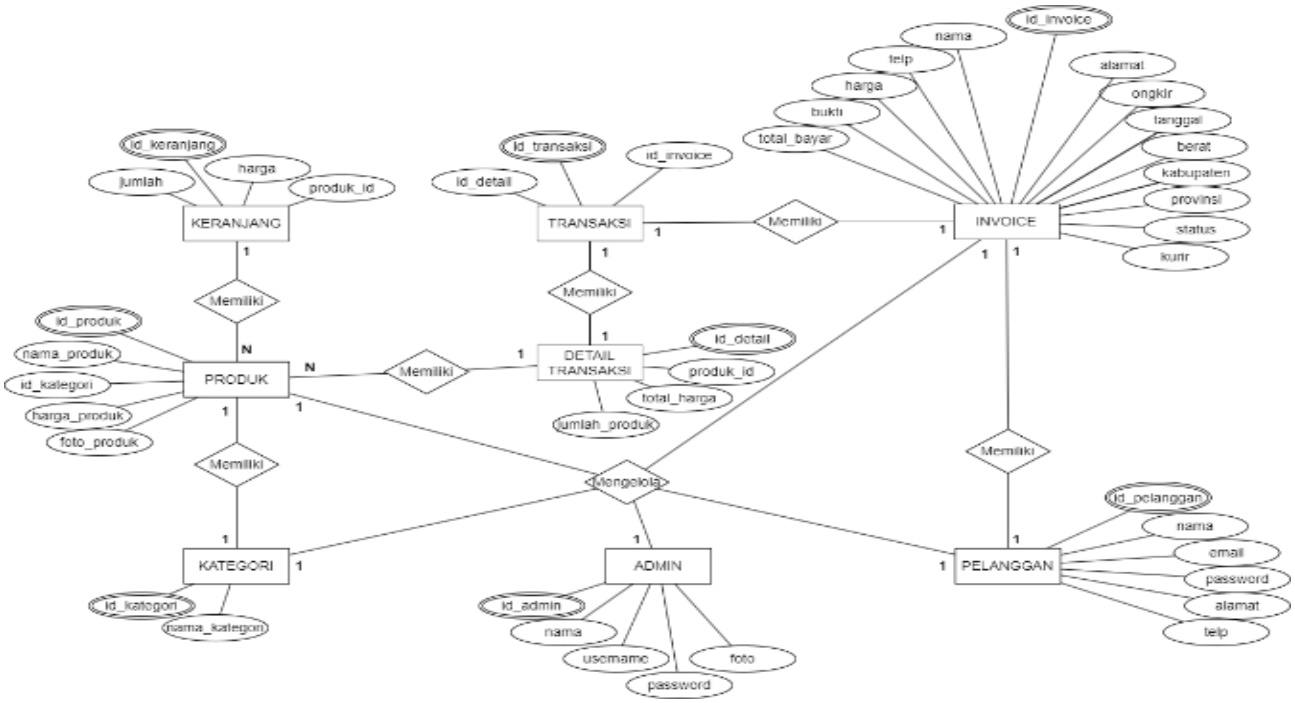

Figure 7. ERD

ERD is a collection of tools used to describe data or objects made based on entities and relationships between entities using several notations that have various types of forms [27]. The ERD diagram is used as a model in the database design stage in the e-commerce system of PT Hora Cipta Jaya. In the ERD e-commerce system there are 8 entities that have their respective attributes which can be seen in Figure 7. The cardinality values represented in the ERD are:

1. A product entity can only belong to one category, and a category can only have one product.
2. A shopping cart entity can contain multiple products.
3. A transaction detail entity can involve multiple products.
4. A transaction entity can only have one transaction detail.
5. An invoice entity can only have one transaction.
6. A customer entity can only have one invoice, and an invoice can only have one customer.
7. An admin entity can only manage categories, products, invoices, and customers.

3. Implementation

The display that the system produced has an interface as its outcome. The output of the customer section page and the admin page, each with their respective functionalities, from the e-commerce system of PT Hora Cipta Jaya is shown below. The outcome of the interface on the registration page, where a user registers to use the system, is shown in Figure 8.

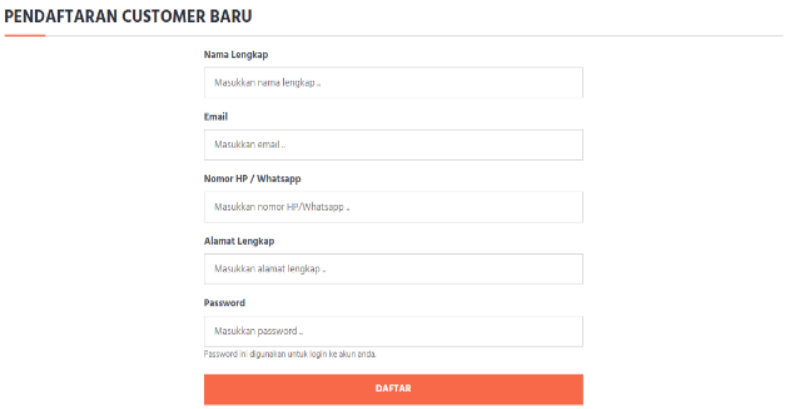

Figure 8. Registration Page

Customers are prompted to complete the registration page's form with their personal information. The customer then clicks the list button to allow the system to keep their information in the database so they can log in as customers and access the system. Customers can input their email address and password that have been registered in the database on the login page as shown in Figure 9.

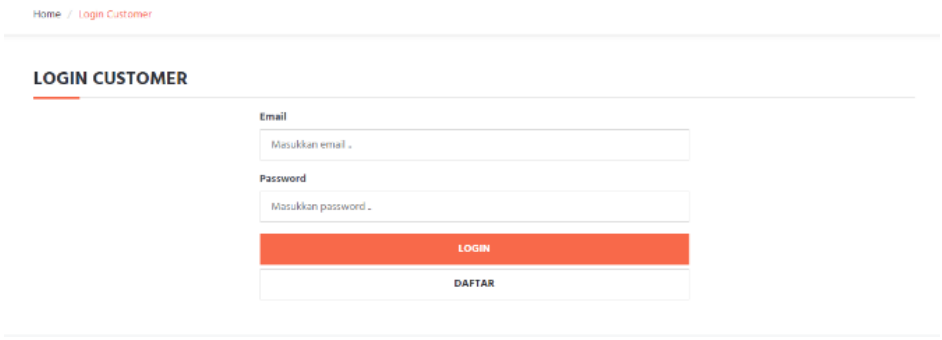

Figure 9. Login Page

Customers can click the login button to view the home page as a customer after entering their email address and password. Customers can register for an account by clicking the “List” button on the login page if they don't already have one. The main page interface designed for customers is illustrated in Figure 10.

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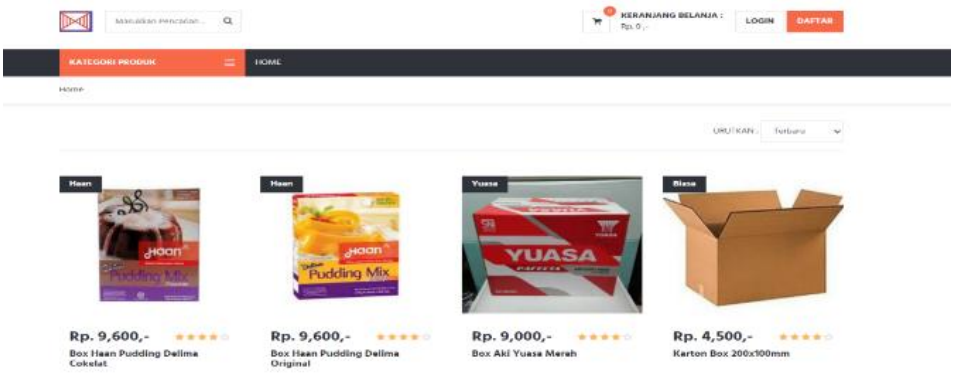

Figure 10. Main Page

It serves as a gateway where consumers can browse and purchase the company's products. When customers click on the product images displayed alongside their descriptions, they are able to access detailed information about each item. This functionality enhances the shopping experience by providing thorough insights into the products available. Additionally, the interface is user-friendly, ensuring that customers can navigate effortlessly through the offerings and make informed purchasing decisions. When a consumer is in the main menu, they see the product that has been added to their basket on the basket page, which is shown in Figure 11.

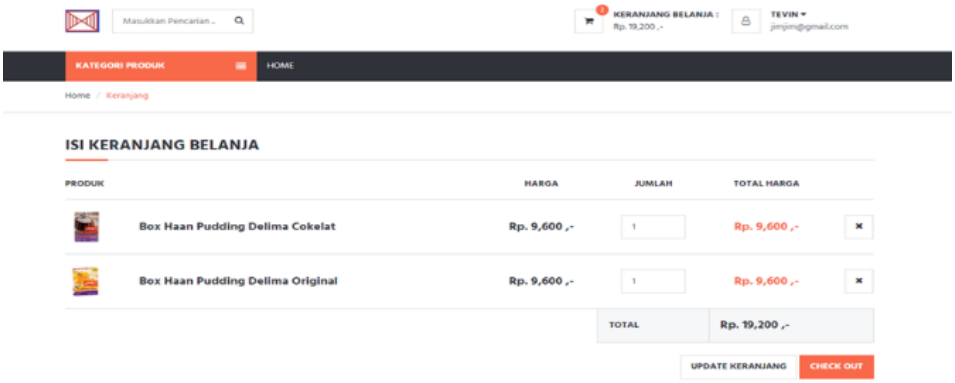

Figure 11. Cart Page

The customer can select the number of items he wants to purchase on the cart page and then click the cart update button. Customers may also remove items from their shopping carts by clicking the delete button. The customer can press the checkout button to continue placing their order once they're done.

In addition to reviewing their selections, customers must enter the recipient's information and select a shipping method and courier. Once a courier is chosen, the shipping price is automatically updated in real-time. This process ensures that customers have full visibility and control over their order details and shipping costs directly on the checkout page. The checkout page features an interface, displayed in Figure 12, where customers can review the items they intend to purchase.

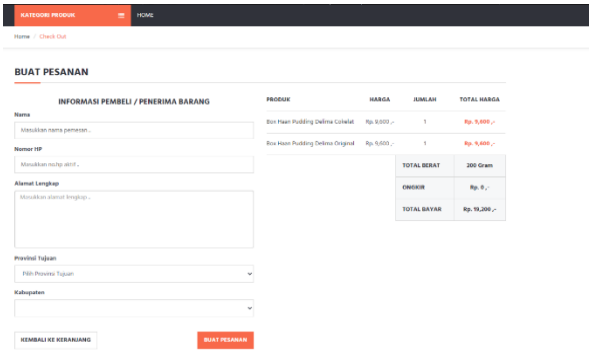

Figure 12. Checkout Page

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The invoice page, depicted in Figure 13, features an interface that enables consumers to easily access and view invoices for each order. These invoices are automatically generated by the system, ensuring accuracy and efficiency. Additionally, customers can print their invoices directly from the invoice page by selecting the print option. This functionality provides convenience and accessibility, allowing customers to maintain physical records of their transactions effortlessly. Overall, the invoice page simplifies the process of accessing and managing order-related documentation for users.

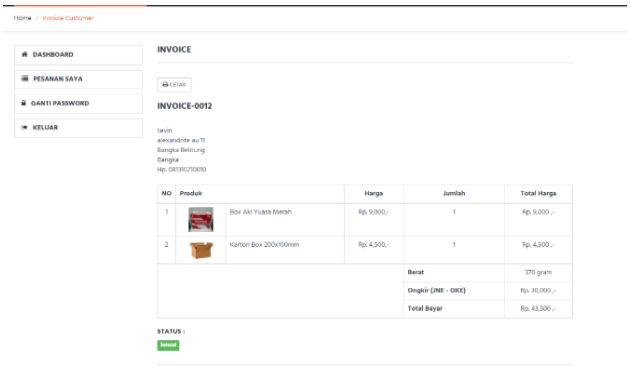

Figure 13. Invoice Page

The admin can log in to visit the admin page, as shown in Figure 14, which displays the admin's login page interface. According to the admin information recorded in the database, the administrator is prompted to provide the username and password. The administrator may then click the login button.

Figure 14. Admin Login Page

Figure 15 demonstrates the admin's ability to utilize the product management page interface for creating, updating, and deleting products. It provides a visual representation of these actions within the system. Administrators can perform tasks such as adding new products, modifying existing ones, and removing outdated items through this interface.

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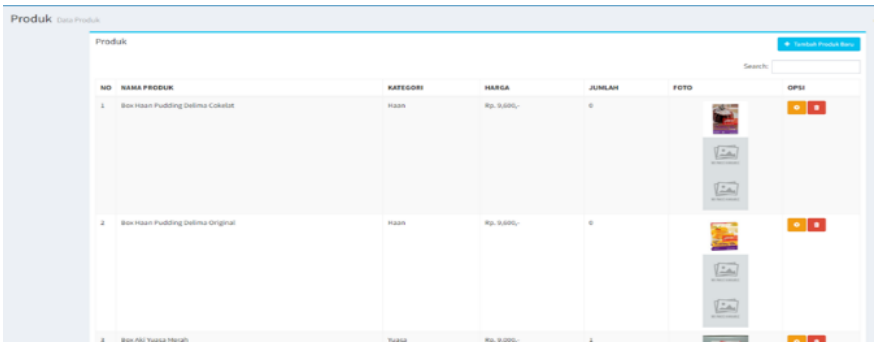

Figure 15. Manage Product Page

Figure 16 illustrates the category management page interface, where administrators can add, update, and delete categories according to their preferences. This visual representation showcases the tools and controls available for managing product categories within the system. Administrators can efficiently organize and modify categories as needed through this interface.

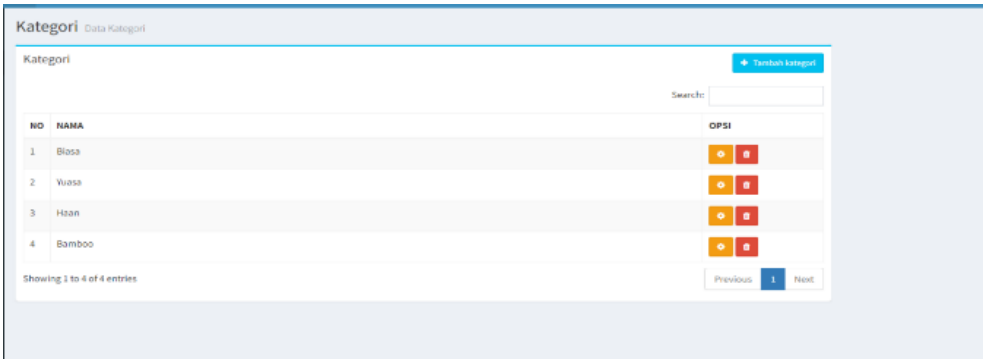

Figure 16. Manage Category Page

Figure 17 displays the interface of the customer management page, providing administrators with a comprehensive view of all registered customers within the e-commerce system. This interface enables admins to perform actions such as adding new customers, editing existing customer details, and deleting customer profiles as necessary. The illustration highlights the tools and functionalities available for effective customer management. It serves as a visual guide to navigate and utilize the features designed to handle customer information efficiently.

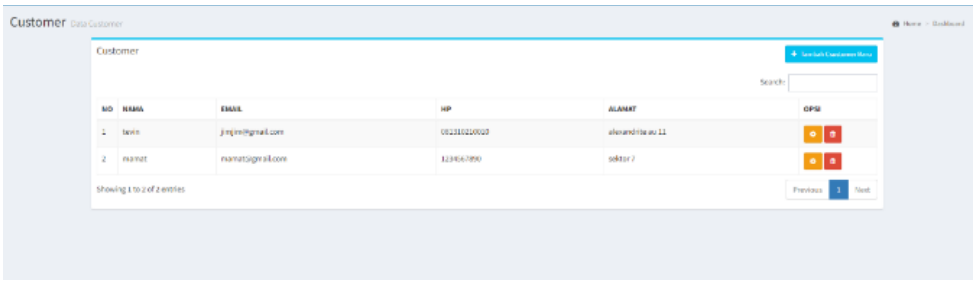

Figure 17. Manage Customer Page

Figure 18 depicts the interface of the administration page, showcasing functionalities such as order status alteration, payment documentation viewing, and order invoice viewing. Administrators can utilize this interface to manage and monitor the status of orders, access detailed payment records, and review generated invoices. The illustration provides a visual representation of the tools and controls available for administrative tasks related to order management and financial documentation within the system. It serves as a guide for administrators to navigate and utilize these features effectively.

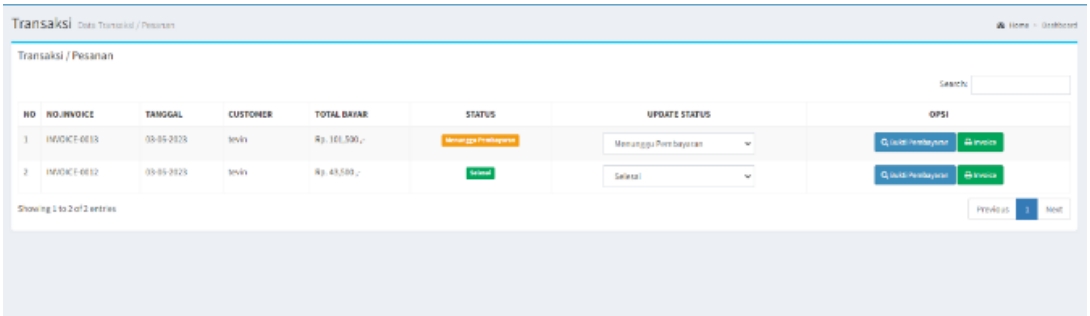

Figure 18. Manage Order Page

The UI of the report page, shown in Figure 19, allows the admin to view the company's sales report by entering the desired date. The report will then display the order according to the previously entered date after the admin presses the display button. By clicking the printing button on the website, admin can also print the report.

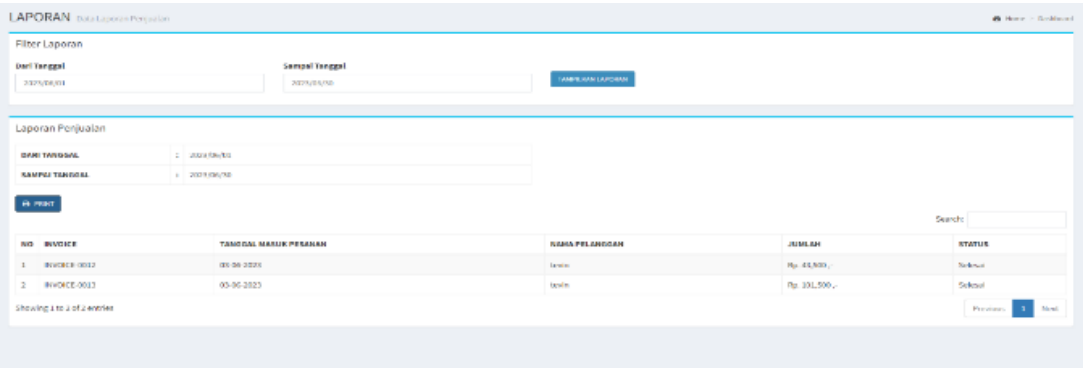

Figure 19. Report Page

4. System Usability Scale

Testing phase will use User Acceptance Test with the Black Box Testing method on the e-commerce system of PT Hora Cipta Jaya. UAT itself is used to ensure that the system is made to work properly while for Black Box Testing itself is a testing method where the user does not need to understand the structure of the code created and just making sure every feature goes with that planned [28][29]. Table 1 outlines seven feature tests for black box testing within the admin section. Table 2 details ten feature tests for black box testing from the customer's perspective. In the admin test table, all functionalities operate as expected, allowing administrators to manage category, product, order, and customer menus, and view product sales results in the report menu. Similarly, the customer test table confirms successful implementation of all features, ensuring customers can navigate the product purchasing process smoothly and without issues.

TABLE 1.
ADMIN SECTION TESTING

No	Test Name	Section	Result
1	Login Admin	Successfully logged into the system admin section	Success
2	Manage Category	Successful to manage category data	Success
3	Manage Product	Successful to manage product data	Success
4	Manage Order	Successful to manage order data	Success
5	Manage Customer	Successful to manage customer data	Success
6	View Report	Successful to view report	Success
7	Logout	Successful logout from system	Success

TABLE 2.
CUSTOMER SECTION TESTING

No	Test Name	Section	Result
1	Registration Customer	Successfully registered account into the system	Success
2	Login Customer	Successfully logged into as customer	Success
3	Sort Product	Successful to sort product by category	Success
4	View Detail Product	Displays product details along with their descriptions	Success
5	Insert Product to Cart	Successfully added the selected product to the cart	Success
6	View & Edit Cart	Successfully view the cart and update the price according to the number of products ordered by the customer	Success
7	Checkout	Successfully displays the total price of the order after selecting the shipping courier and successfully placing the order	Success
8	Confirm Payment	Successfully made payment	Success
9	View Invoice	Successfully view and print order invoice	Success
10	Logout	Successful logout from system	Success

The SUS questionnaire in this study was given and filled in by 10 respondents who is an employee of PT Hora Cipta Jaya in the admin section and customer section. Following results from questionnaire respondents is shown by Table 3 and Table 4. At this stage, the necessary information for the design process is identified. Literature studies, observations, and interviews were conducted to gather company information. From the Table 3 and Table 4 of calculation results for the SUS questionnaire, the final results for the admin section is 78 and for the customer section it is 81. The two figures will be averaged and the result is 79.5.

TABLE 3.
ADMIN SUS SCORE

Rsp	Result Score										Total	FS
	1	2	3	4	5	6	7	8	9	10		
1	3	4	3	4	4	4	3	4	2	3	34	85
2	3	3	3	3	4	3	4	3	2	2	30	75
3	4	3	3	3	4	3	3	3	2	2	30	75
4	3	4	2	4	4	3	3	3	2	2	30	75
5	3	3	3	3	4	4	3	3	3	3	32	80
6	4	3	2	3	3	3	3	4	2	3	30	75
7	3	4	2	2	3	3	3	4	3	2	30	75
8	3	3	3	4	4	4	4	4	3	2	34	85
9	4	4	2	4	4	4	4	3	2	3	33	83
10	3	4	2	2	3	3	3	3	2	3	28	70
Final Score												78

TABLE 4.
CUSTOMER SUS SCORE

Rsp	Result Score										Total	FS
	1	2	3	4	5	6	7	8	9	10		
1	4	4	2	4	3	3	4	3	1	1	29	73
2	3	3	3	3	4	4	4	3	2	2	31	78
3	3	4	3	4	3	3	3	4	2	3	32	80
4	3	4	3	4	4	3	4	3	1	2	31	78
5	4	4	3	3	3	4	4	4	2	2	33	83
6	4	4	4	4	3	3	3	4	2	3	34	85
7	2	3	4	3	4	3	4	4	1	3	31	78
8	3	3	4	4	4	4	3	4	1	3	33	83
9	4	4	4	4	4	4	4	3	2	3	36	90
10	4	4	4	2	4	4	3	4	2	3	34	85
Final Score												81

B. Discussion

These findings indicate that the e-commerce system application developed falls within the “good” range (B) on the SUS assessment chart, suggesting effective system usability [30]. PT Hora Cipta Jaya's e-commerce system can be considered successful as all desired features outlined in this study function well as per the problem statement. Moreover, this system is user-friendly for newcomers to e-commerce due to its intuitive interface. Previous studies on similar topics [31][32] did not analyze the usability of their e-commerce systems for practical use. Therefore, this research employs the SUS method to evaluate whether the developed e-commerce system meets the company's usability needs.

IV. CONCLUSION

The e-commerce system developed by PT Hora Cipta Jaya achieved a final score of 79.5 on the System Usability Scale, placing it within Grade B according to the SUS assessment. This system assists company employees in managing company data and streamlines product ordering transactions between the company and its customers. Customers can conveniently order company products online from anywhere at any time using this e-commerce platform. The system enables the company to monitor all incoming transactions efficiently, thereby expediting the product production process. Additionally, it automates the generation of invoices and company sales reports, enhancing the effectiveness of recording and reporting processes. The implementation of this e-commerce system also enables the company to expand its market reach, attracting new customers to purchase its products. However, there are limitations to this study; only 10 respondents tested the system, and none of the employees at PT Hora Cipta Jaya had prior experience using such a system. Future research should consider adding new features, such as QRIS-based payment methods and real-time order tracking capabilities.

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