

DA NANG UNIVERSITY  
DA NANG UNIVERSITY OF TECHNOLOGY  
FACULTY OF PROJECT MANAGEMENT

## **CAPSTONE PROJECT**

**MAJOR: FACULTY OF PROJECT MANAGEMENT**  
**SPECIALIZATION: INDUSTRIAL MANAGEMENT**

**TOPIC:**

### **MOBILE APPLICATION FOR WAREHOUSE MANAGEMENT AND CONTROL OF PACKAGING COMPANY**

**ỨNG DỤNG DI ĐỘNG QUẢN LÝ KHO VÀ KIỂM SOÁT  
CÔNG TY BAO BÌ**

Instructor's Name: **PhD. HUYNH NHAT TO**

Student's Name: **TRAN QUANG VINH**

Student's ID: **118200182**

Class: **20QLCN1**

**Da Nang, 06/2025**

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## **SUMMARY**

This thesis analyzes the development of a mobile warehouse management application aimed at improving employee productivity and optimizing warehouse processes at Tan Long Packaging Co., Ltd. in the context of digital transformation in the packaging manufacturing industry.

To address this research question, the team applied the Design-based Research (DBR) method, combining surveys and interviews with 10–15 warehouse staff and analyzing current workflows to design, test, and refine a warehouse management application running on the Android platform, allowing users to create and modify warehouse zones as needed.

The research results show that the mobile application helps increase employee productivity by at least 20%, reduce inventory errors to below 3%, and decrease excess inventory to below 8%. At the same time, it provides real-time inventory information, supports business management in making timely decisions, reduces storage costs, and improves customer service quality.

From a practical perspective, the study emphasizes the necessity of integrating Industry 4.0 technologies and personalizing technology solutions for each enterprise to further enhance warehouse operations efficiency in the context of industrialization and globalization of supply chains.

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## GRADUATION PROJECT ASSIGNMENT

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Major: Industrial

1. *Project Title: mobile application for warehouse management and control of packaging company*
2. *The project is subject to:*

*Intellectual property agreement signed for the project results*

3. *Initial data and information:*

*The data and information were collected from Tan Long Company*

4. *Contents of explanations and calculations*

a. *Chapter 1: INTRODUCTION*

b. *Chapter 2: OVERVIEW AND CURRENT SITUATION AT TAN LONG PACKAGING CO., LTD*

c. *Chapter 3: THEORETICAL BASIS*

d. *Chapter 4: MOBILE APPLICATION SOLUTIONS FOR INVENTORY MANAGEMENT AND CONTROL*

e. *Chapter 5: EVALUATING AND COMPARING SOFTWARE PERFORMANCE*

5. *Drawings and Charts (specify types and sizes of drawings):*

*The relevant drawings, images, and charts were created by the author with appropriate references provided.*

6. *Instructor's name: Dr. Huynh Nhat To*

7. *Date of assignment of project tasks: 17/02/2025*

8. *Project completion date: 16/06/2025*

Da Nang, June 15, 2025

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## **PREFACE**

First of all, I would like to express my deep gratitude to PhD. Huynh Nhat To - a dedicated lecturer who has directly guided, instructed and accompanied me throughout the process of implementing this essay with all my enthusiasm and precious care. I would also like to express my sincere gratitude to the teachers of Industrial Management, who have constantly inspired and equipped me with a solid foundation of knowledge and necessary skills throughout my learning journey. Although I have tried my best to improve the article, I am aware that due to the limitation of experience and knowledge, this graduation project is difficult to avoid shortcomings. Therefore, I am looking forward to receiving valuable comments from teachers so that the content of the topic is more complete and rich.

In the context of globalization and the strong development of e-commerce, warehouse management has affirmed its core role in the supply chain, becoming a decisive factor for operational efficiency and competitiveness of businesses. For packaging companies, the importance of warehouse management is further enhanced by the variety of products, strict quality requirements, and the pressure to meet fast delivery times. However, the reality shows that many businesses in the industry are still facing major challenges such as errors in inventory tracking, delays in order processing or difficulties in product quality control. These problems not only waste time and resources but also increase operating costs, negatively affecting the reputation and profitability of the business. In the face of these challenges, mobile technology has emerged as a breakthrough solution, providing real-time data access, optimizing internal communication, and automating management processes. With the goal of taking advantage of this technology, the thesis focuses on the development of a specialized mobile application, specifically designed to manage and control warehouses for a packaging company. The application aims to overcome specific difficulties of the industry, and at the same time improve overall operational efficiency, contributing to creating a sustainable competitive advantage for businesses.

With the spirit of seeking and the desire to improve, I look forward to receiving comments and comments from teachers so that this topic can be improved and developed. I look forward to receiving your comments to further enrich the content of the topic: mobile application for warehouse management and control of packaging company.

## **ENSURES**

The author undertakes that this thesis is an independent research product conducted by himself, not copied from any other person's research work to make his own product. All secondary information used in the thesis is clearly sourced and fully cited in accordance with academic regulations. The author is fully responsible for the authenticity, originality and truthfulness of the content presented in this thesis.

Author

Tran Quang Vinh

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## **LIST OF SYMBOLS AND ABBREVIATIONS**

**KÝ HIỆU:**

**CHỮ VIẾT TẮT:**

- CRM: Customer Relationship Management
- ERP: Enterprise Resource Planning
- QC: Quality Control
- UI: User Interface
- UX: User Experience
- WMS: Warehouse Management System
- MDM: Mobile device management
- SQL: Structured Query Language
- TMS: Transportation Management System
- DBR: Design-based Research

## **INTRODUCTION**

In recent years, warehouse management has become a critical factor that directly influences the operational efficiency and competitiveness of businesses, especially in the manufacturing sector. Tan Long Packaging Co., Ltd., operating in the packaging industry, has encountered numerous challenges in inventory control, warehouse operations, and real-time data processing due to traditional manual processes.

This thesis focuses on designing and developing a mobile application solution for inventory management and control aimed at improving warehouse operations at Tan Long Packaging Co., Ltd. The solution leverages modern mobile technology combined with warehouse management principles, user interface (UI) and user experience (UX) design, and data management systems to optimize inventory operations, reduce errors, improve processing time, and enhance overall productivity.

The structure of the thesis consists of five main chapters:

- Chapter 1: Introduction

This chapter presents the research motivation, practical context, research significance, objectives, scope, and research methodology applied throughout the study.

- Chapter 2: Overview and Current Situation at Tan Long Packaging Co., Ltd

This chapter provides a comprehensive overview of Tan Long Packaging Co., Ltd., including its history, business activities, organizational structure, production premises, warehouse layout, and current challenges in warehouse management that serve as the basis for developing the proposed solution.

- Chapter 3: Theoretical Basis

This chapter reviews theoretical foundations related to inventory management, mobile application development, UI/UX design, software architecture, and data management, which form the theoretical framework for building the solution.

- Chapter 4: Mobile Application Solutions for Inventory Management and Control

This chapter presents the detailed design and development of the mobile application solution, including process improvements, system design, functional modules, interface design, architecture, technologies used, development process, deployment, user guidance, and training programs.

- Chapter 5: Evaluating and Comparing Software Performance

This chapter evaluates the performance of the developed mobile application through various criteria such as API response time, resource usage, stability, user experience, and overall productivity improvements compared to manual operations.

The outcomes of this thesis are expected to not only enhance the efficiency of warehouse operations at Tan Long Packaging Co., Ltd., but also serve as a reference model for applying mobile technology in inventory management across similar manufacturing businesses.

## **CHAPTER 1: INTRODUCTION**

### **1.1 Motivation for the Thesis Formation**

#### **1.1.1 Practical Context**

##### *a. Economic Context*

In recent years, both the global and domestic economies have witnessed significant transformations due to integration and globalization. Some specific aspects include:

- *Economic Structure Shift:* Many countries, including Vietnam, are transitioning from traditional manufacturing-based economies to knowledge-based and service-oriented economies. This trend drives the rapid development of high-tech industries, especially information technology.
- *Growth and Diversification of Customer Base:* The strong development of the consumer market, along with the trend of international integration, has opened many opportunities for businesses to expand their scale and access new customer groups. The application of information technology, particularly digital platforms such as e-commerce websites, social media, and CRM systems, allows businesses to easily analyze consumer behavior, personalize customer experiences, and expand service coverage to various market segments. As a result, businesses not only increase revenue but also build a rich customer ecosystem, maintain sustainability, and diversify revenue streams

##### *b. Information Technology Context in Enterprises*

Alongside the economic development trend, information technology is gradually becoming a key factor in enterprise operations with the following notable features:

- *The Need to Digitize Internal Processes:* In the context of increasing competition, businesses are shifting from traditional management models to digitizing processes such as management, production, logistics, and customer service. The application of information technology helps optimize processes, minimize costs, and enhance operational efficiency.
- *Development of Software Solutions and Management Systems:* Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) systems, and data analytics solutions have become standard for pioneering businesses in digital transformation. These tools not only enable rapid data collection and processing but also support decision-making based on accurate data analysis.

#### **1.1.2 Necessity of the Research Topic**

##### *a. Practical Situation: Low Employee Performance*

Currently, the company is facing a situation where employee performance does not meet expectations. This is reflected in specific manifestations such as labor productivity failing to meet set targets, low work quality, and employees lacking motivation and

proactiveness in their work. In addition, issues such as lack of creativity, delays in task processing, and even high turnover rates are clear signs that performance is not yet optimal. These problems not only hinder daily operations but also have far-reaching impacts on the company's strategic objectives.

*b. Impact on Company Revenue and Profit*

Low employee performance has a direct and negative impact on the company's revenue and profit. When employees fail to achieve the desired productivity, production costs increase due to wasted time and resources, while the output and quality of products/services decline. This leads to a loss of competitiveness in the market, difficulties in retaining customers, and challenges in expanding market share. As a result, revenue decreases, profit margins shrink, and prolonged poor performance may even lead to financial losses. In the long term, poor performance threatens the sustainable development of the company, making survival in a fiercely competitive environment a significant challenge.

### **1.1.3 Expected Benefits of the Research**

- *Optimizing warehouse management operations:* The mobile application helps automate and simplify warehouse management processes such as inbound/outbound operations and inventory control. This minimizes errors caused by manual handling and significantly reduces processing time.
- *Reducing operating costs:* Thanks to process automation, the application minimizes labor costs and expenses caused by management errors. Additionally, accurate inventory management helps prevent surplus or shortage of goods, optimizing resources.
- *Improving employee performance:* Employees can access warehouse information anytime, anywhere through mobile devices. This supports flexible working, real-time data updates, and enhances work efficiency.
- *Enhancing data quality and information accuracy:* The application provides accurate and timely data on inventory status, improving demand forecasting capabilities and supply chain management of the company..
- *Strengthening control and information security:* Through security features and access control, the application ensures the safety of data and information related to warehouse operations, minimizing risks of data loss or errors.

## **1.2 Research Objectives and Methods**

### **1.2.1 Research Objectives and Methods**

*a. Research Objectives and Methods*

Employee performance is a core factor that determines the productivity and quality of business operations. Improving performance not only helps optimize resources, but also enhances employee satisfaction and engagement with the organization. To achieve this, the project proposes the implementation of stricter work processes and audits, combined with the application of modern performance management tools such as KPI evaluation systems or work progress tracking software. The specific goal is to increase

employee productivity by at least 20% within 12 months and reduce the error rate at work to less than 3%, thereby improving the quality of each individual's output.

*b. Improve warehouse and inventory workflows*

Warehouse and inventory workflows play an important role in ensuring a smooth flow of goods and minimizing operating costs. A suboptimal process can lead to excess inventory, increase order processing time, and waste resources.

The project will focus on the application of technology solutions that are management software to eliminate unnecessary steps in the process. The specific goal is to shorten the order processing time, and at the same time reduce the excess inventory rate to less than 8% compared to the current level, thereby improving logistics efficiency and the ability to meet market demand.

These two objectives have a close supportive relationship that improves employee performance, through training and support tools, which will facilitate the implementation of more efficient warehouse and inventory processes. On the contrary, an optimized workflow will reduce the pressure on employees, allowing them to focus on high-value tasks, thereby improving personal performance. The result of this combination not only improves internal efficiency but also brings a sustainable competitive advantage to the business.

**1.2.2 Scope of study**

*a. Object of study*

- The research is limited to Tan Long Packaging Co., Ltd., at the company's finished product warehouse A, finished product warehouse B and finished product warehouse C of the company
- Warehouse managers: People who are directly in charge of monitoring, testing, and making decisions based on data from the warehouse management system.
- Warehouse operators: Workers who are responsible for carrying out the work of importing, exporting, inventorying, and moving goods in the warehouse.
- Leadership and senior management: Users of management reports and results from the app to make strategic decisions for the business.
- Relevant departments: Departments such as operations, accounting, and sales can also be involved, especially when data from the warehouse management system has an impact on overall business operations.

*b. Functional range of the application*

- Inventory Management: Inbound, Outbound, Stocktaking, Transfer.
- Real-time Tracking: Full/Missing status of each type of goods, displaying the status of the product.
- Order & Quality Control: Internal and customer order management, goods quality inspection (QC).
- Reporting & Analytics: Inventory reports, performance reports, custom reporting criteria.

- System Notifications & Alerts: Real-time notifications, quality or safety alerts.
- c. *Scope of technology*
- Mobile software technology:
  - Development platform: uses the Android operating system using Java with the Android Studio tool for app development.
  - User Interface (UI/UX): Design the optimal interface for screen types based on Google's Material Design standards
  - Mobile device management (MDM): Use Microsoft Intune MDM solutions to manage and secure mobile devices, keeping data safe in your inventory.
- Warehouse Management System (WMS): Based on the material learned from Inventory Management and combined with some knowledge of cloud WMS (SaaS) solutions such as SAP EWM to increase availability and reduce deployment costs
- Database:
  - Database type: Relational databases (SQL) use MySQL to store structured data such as inventory, order, and employee information, ensuring consistency and ease of querying.
  - Data synchronization: Use WebSockets real-time data synchronization mechanisms to ensure data on mobile apps is always up to date, which is especially important in dynamic warehouse environments.
- System Integration:
  - Integration with ERP: Use REST APIs to connect to a company's existing ERP system, allowing for data sharing such as packaging material production and distribution information.
  - Integration with TMS (Transportation Management System): Link with TMS to optimize logistics, ensure on-time transportation and reduce costs.
- Barcode scanning technology: Use barcode scanning devices to confirm products and packaging materials during picking and packing, increasing accuracy.
- Data analysis and reporting:
  - Analytics tools: Use Power BI tools to analyze inventory data and generate detailed, decision-making reports.
  - Real-time dashboard: Displays key performance indicators (KPIs) such as material utilization rates or average packaging time
- Security and Compliance:
  - Data Security: Uses encryption for data in transit (SSL/TLS) and at rest (AES), ensuring the safety of sensitive data.
  - Regulatory compliance: Ensure compliance with GDPR standards for personal data security or ISO 27001 for information security management.

### 1.2.3 Research Methodology

#### a. Design-based Research

The study will use Design-based Research as the overall research framework for the software development process. DBR is suitable for both application development and impact assessment in a real-world environment. Reasons to choose DBR: DBR is a suitable research method for technology development projects, especially in the corporate context where it is necessary to both develop a practical product and study its impact. DBR consists of four main parts:

- Practical Problem Analysis
- Solution Development
- Evaluation and testing in practice
- documenting and reflecting.

This method is suitable for designing and developing mobile applications while at the same time evaluating its effectiveness in a physical warehouse environment.

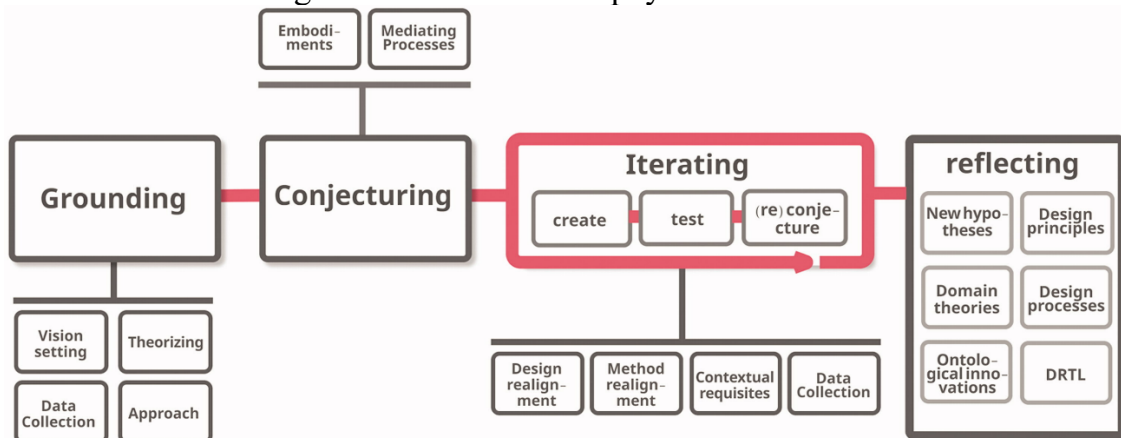


Figure 1.1: A process model for DBR

#### b. Data Collection Methods

- Surveys and interviews:
  - Conduct surveys and interviews with warehouse employees and warehouse managers at the company to understand current issues such as errors in inventory, delays in order processing, or lack of supporting tools.
  - The number of participants is expected to be around 20-30 people, including staff and management, to ensure representativeness.
- Literature Study:
  - Review documents related to warehouse management systems (WMS), mobile applications in logistics, and supporting technologies such as barcode scanning
  - Resources include scientific papers, industry reports, and materials from technology companies
- Current Process Analysis:

- Observe and document a sample packaging company's warehouse workflows, including import, storage, picking, and packaging, to identify bottlenecks and opportunities for improvement.
- c. *Software development methodology*
  - **Sprint Planning:**
    - Focus on developing specific features such as: real-time inventory tracking, order management, barcode scanning integration, self-creation of storage areas.
    - The product backlog will be built based on the requirements from the DBR analysis phase, including user stories
  - **Development and testing:** In each sprint, use the Android Studio tool, Figma to design and program the app.
  - **Get feedback:**
    - After each sprint, conduct a Sprint Review to present the product to actual users (warehouse staff and managers), gathering feedback on availability and efficiency.
    - This feedback will be integrated into the Product Backlog to adjust for the next sprints, in line with the DBR principle of continuous evaluation.

### **1.3 Practical significance of the topic**

#### **1.3.1 Meaning for Tan Long Packaging Co., Ltd.**

- a. *Enhance warehouse management efficiency*
  - The mobile application solution allows employees to check inventory and update real-time data through the mobile application, reducing the time spent searching and processing manually. For Tan Long Packaging Co., Ltd., this is especially useful when managing a wide range of materials such as paper, cartons, tapes, and labels, ensuring that there is always enough material for production. This system helps to speed up warehouse operations, especially in a dynamic and continuous working environment such as the Company's warehouse
  - When it is necessary to prepare raw materials for a carton box production batch, employees can use the app to instantly check the number of carton paper available, eliminating the need for manual records or physical searches.
- b. *Reduce errors and optimize processes*
  - In the packaging industry, errors in warehouse management (such as material confusion or quantity errors) can lead to waste and production delays. The mobile application solution automates processes such as picking, packing, and inventory, helping to minimize human errors and optimize work time.
  - The app can integrate with barcode scanning technology to accurately confirm the material, ensuring that the correct type of paper or cardboard is used for each order.

- For the Company, this helps to reduce raw material waste and ensure product quality, especially when serving industries such as pharmaceuticals or food, where precision is highly required.

*c. Provide real-time information and support decision-making*

- The WMS mobile application solution provides real-time reports on inventory status, order status, and warehouse staff performance. This makes it easy for the management of Tan Long Packaging Co., Ltd. to monitor warehouse operations and make quick decisions.
- For jobs that require importing more materials or adjusting personnel assignments or serving many different customers, having accurate and timely information is very important to meet the requirements of diverse customers.

*d. Cost savings and resource optimization*

- By automating the process and reducing processing time, the WMS mobile application solution helps reduce labor costs and waste. The application can optimize the picking route, reducing the travel time of employees in large warehouses.
- In addition, accurate inventory management helps to avoid overstocking or shortages, reducing storage costs and emergency purchases. For the Company, this is especially important when managing expensive raw materials such as printing inks or specialty paper.

*e. Improving the quality of customer service*

- With this Solution, the Company can ensure that orders are processed correctly and delivered on time, thereby increasing customer satisfaction. This is especially important when the company serves a variety of industries, where packaging requirements can be very specific and demanding.

### **1.3.2 Development orientation and further research**

*a. Expanding the integration of 4.0 technology*

- Applying the Internet of Things (IoT): Integrating IoT sensors to monitor the storage conditions (temperature, humidity, light) of goods in the warehouse in real time. This not only helps ensure product quality but also optimizes the storage process.
- Deploy artificial intelligence (AI) and machine learning (Machine Learning): Analyze data on inventory, goods circulation speed, and import-export activities to forecast demand, thereby making ordering suggestions and optimizing the warehouse management process. AI can also help identify errors or anomalies in the operational process.

*b. AI application for demand forecasting and inventory optimization*

- AI can help forecast demand for raw materials and finished products more accurately, reduce inventory costs, and avoid shortages or excesses. In order to

reduce storage costs, avoid overstocking or shortages, and increase competitiveness.

- Use machine learning models such as LSTM or ARIMA to analyze historical data. Further research may focus on collecting the Company's order history data and building a suitable forecasting model.

*c. System Integration and Synchronization*

- Connect to existing ERP systems: Develop integrated APIs and modules so that data from mobile applications can be synchronized with your ERP system, supporting financial management, orders, and aggregated reporting.
- Integration with logistics and transportation systems: Consider expanding the management function by integrating more modules to track and manage the delivery and transportation process, as well as coordination between the warehouse and sales department to ensure a seamless flow of goods.

## **CHAPTER 2: OVERVIEW AND CURRENT SITUATION AT TAN LONG PACKAGING CO., LTD**

### **2.1 Company Overview**

#### **2.1.1 Overview**

- Company name: TAN LONG PACKAGING CO., LTD
- Date of establishment: December 2018
- Office address: 213 Hung Vuong, Hai Chau District, Da Nang City, Vietnam.
- Address of Tan Long Paper and Packaging Factory: Lot H, Street No. 03, Hoa Khanh Industrial Park, Lien Chieu District, Da Nang City.
- Tax code: 0401938185
- Phone: 02363 732 430 - 0913 441 117.
- Email: [nguyenthithuha@giaytanlong.com.vn](mailto:nguyenthithuha@giaytanlong.com.vn)
- Website: <http://baobitanlong.com.vn/>



*Figure 2.1: Tan Long Packaging Co., Ltd.*

#### **2.1.2 History of establishment and operation**

- Tan Long Packaging Factory of Asia Architecture and Trading Co., Ltd. was established and put into operation since 2001, the company is one of the leading enterprises in Vietnam specializing in producing and supplying White Top Paper, Teslines, Medium corrugate and High Quality Cartons, Offset packaging for categories such as: Beer, beverages, leather shoes, toys, mattresses, dairy, textiles,.. not only for the Central market but also for the whole country and abroad with modern lines. Over the past 19 years, the company has grown tremendously. In December 2018, Tan Long Factory was officially established as an independent company named Tan Long Packaging Co., Ltd.

- Tan Long Packaging Company currently has 100 employees with many years of experience.
- Through a long-term operation, the company has gradually equipped modern, advanced and synchronous production lines, applying advanced technology of many countries around the world with a high capacity of about 10 million m<sup>2</sup>/year. Some of the company's existing machines such as: offset printing machines, 5/6/7 color flexo printing, molding machines, die machines, gluing machines, automatic staple stacking machines,...
- The company has always been in the top of the leading packaging manufacturing enterprises in Vietnam, constantly affirming its position with quality certifications and awards.



Figure 2.2: Achievements of the company

### 2.1.3 Business Scope

Carton Packaging Manufacturing includes:

- Chipboard, White top, Tesline, Medium corrugate

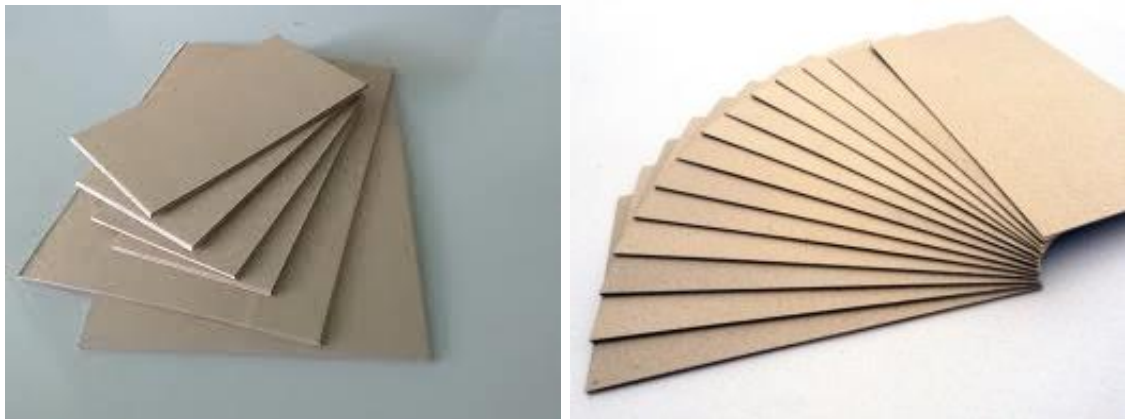


Figure 2.3: Chipboard Paper

- High Quality Carton



Figure 2.4: High-quality carton

- Carton In Flexo, Offset



Figure 2.5: Flexo-Printed Carton, Offset

- Paper braces



Figure 2.6: V paper brace, paper corner brace bar

- Large size cartoon box





Figure 2.7: Large 5-layer carton

### 2.1.4 Company motto

The company's motto is "Quality creates trust", so the company always attaches great importance to customers and puts them as the operating criterion, with the desire to bring customers the best products at competitive prices.

### 2.1.5 Company Clients

The company's customers are large corporations, multinational companies such as: Mc Donal's, HEINEKEN Vietnam, Carlsberg (Huda Beer), C.P Vietnam Livestock Joint Stock Company, Keyhings Toys, Associated VN, CocaCola Da Nang, Millennium Furniture, Daiwa,...

Customer	Industry	Product
<b>Mc Donal's</b>	Food and fast food production.	 <p>Offset Barrel</p>
<b>HEINEKEN Việt Nam</b>	Food production.	 <p>Color printing 3-layer carton</p>

<p><b>Carlsberg (Huda Beer)</b></p>	<p>Food production.</p>	 <p>Color printing 3-layer carton</p>
<p><b>Millennium Furniture</b></p>	<p>Manufacturing massage chairs and sofas for export.</p>	 <p>3-layer, 5-layer carton</p>
<p><b>Daiwa</b></p>	<p>Production of fishing rods, fishing rod reels.</p>	 <p>Offset Barrel</p>
<p><b>Keyhings Toys</b></p>	<p>Produce children's toys.</p>	 <p>Offset Barrel</p>

<p><b><i>Happy Furniture</i></b></p>	<p>Furniture production: Producing beds, cabinets, tables, chairs</p>	 <p>Large 5-layer carton</p>
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Table 2.1: Clients of the Company

## 2.2 Production organization structure

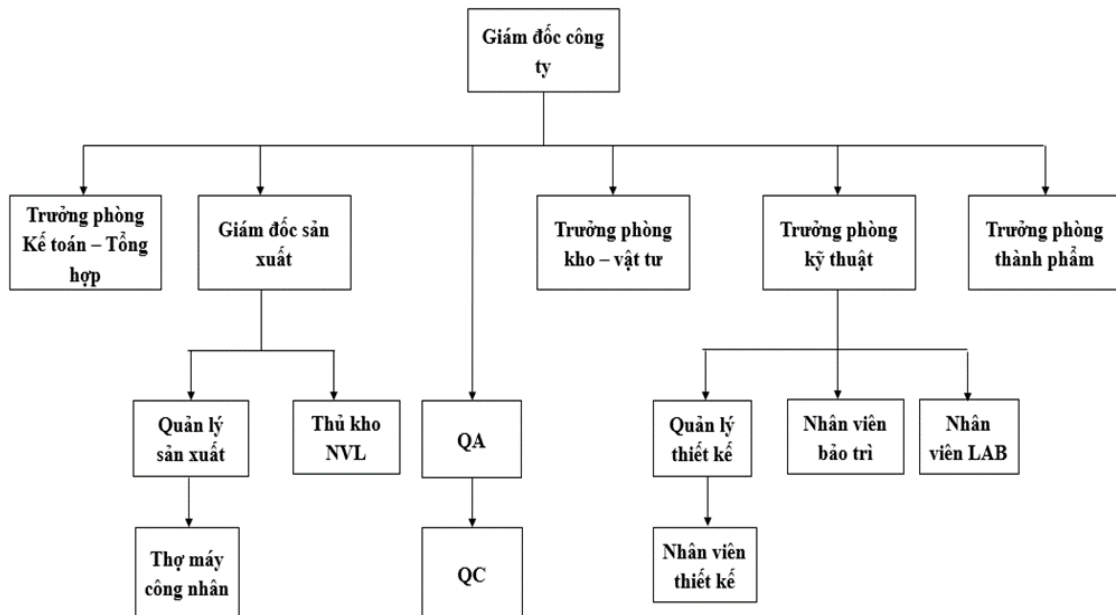


Figure 2.8: Organizational chart of the company

Part	Function
Company Director	Responsible for operating and making strategic decisions for the entire company's operations. Ensure that the company operates efficiently and achieves the set goals.
Head of Accounting Department – General	Financial management, accounting, preparation of financial statements and budget estimates. Track and control cash flow as well as the company's revenues and expenditures.
Production Manager	Manage the entire production process to ensure product efficiency and quality. Manage the team of workers and technicians to meet the production requirements.
NVL Warehouse Keeper	Manage the import, export and inventory of raw materials. Check the quality and quantity of raw materials when entering and leaving the warehouse. Store materials safely, arrange scientifically to avoid damage and loss. Periodic inventory, inventory reporting, and coordination with departments to ensure correct, sufficient and timely supply.
Production Management	Production planning, organization and supervision of production activities. Ensure the efficient use of raw materials and products that meet quality standards.
Mechanics and workers	Operating production machinery and equipment, maintaining machinery and ensuring production progress.

Head of Warehouse and Materials Department	Manage the import and export of raw materials (NVL warehousekeepers) and goods, ensure the supply of materials for production in the right quantity and quality.
Head of Technical Department	Responsible for technical, design and maintenance issues. Manage design, maintenance, and laboratory staff (LAB) teams.
Design Management	Conceptualize and design packaging samples according to customer requirements.
Design Staff	Implement detailed product design, ensuring that technical standards are met.
Maintenance staff	Perform maintenance and repair of machinery and equipment to ensure continuous production activities.
LAB Staff	Inspect the quality of raw materials and products, ensure that they meet technical and safety standards.
QA	Develop and implement quality standards for products, monitor the entire production process, ensure the quality of output products, and handle quality complaints from customers, analyze and improve.
QC	Carry out inspections at each stage of the production process, detect and handle product defects before moving on to the next stage, and make improvement proposals to improve product quality.
Finished Product Manager	Manage finished products after production, ensure products meet quality standards before shipment.

Table 2.2: Functions of each part

## 2.3 Production premises

### 2.3.1 Overall production site of the factory

The total area of the company is about 7,000 m<sup>2</sup>. Divided into many workshops to produce many different items.

The company's production floor plan is shown below:

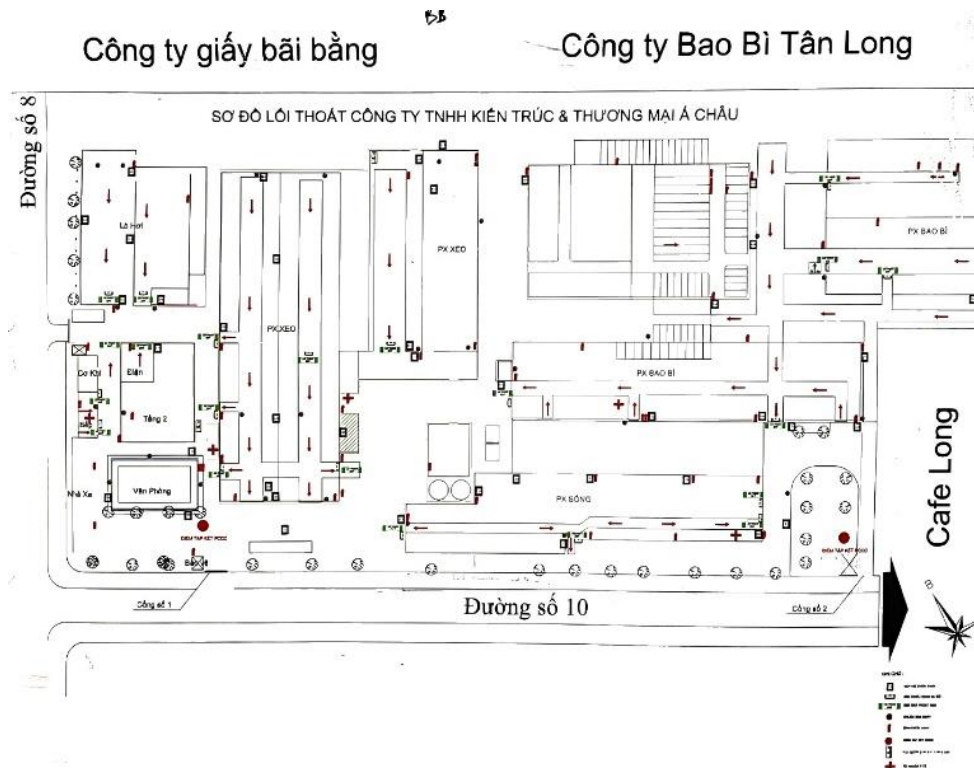


Figure 2.9: Overall floor plan of the factory

- The factory areas are designed spaciouly with conveniently arranged walkways to facilitate the process of moving in the factory.
- The company's electrical and fire protection systems are always focused on periodic maintenance investment.
- The production areas are located next to each other, helping to facilitate the process of moving goods to other stages, thereby minimizing waste of travel time and travel costs,... in production.
- However, the workshop is not ventilated because the factory as a whole is a large production cluster with relatively few ventilation windows or ventilation systems.

### 2.3.2 Overall floor plan of the finished product warehouse

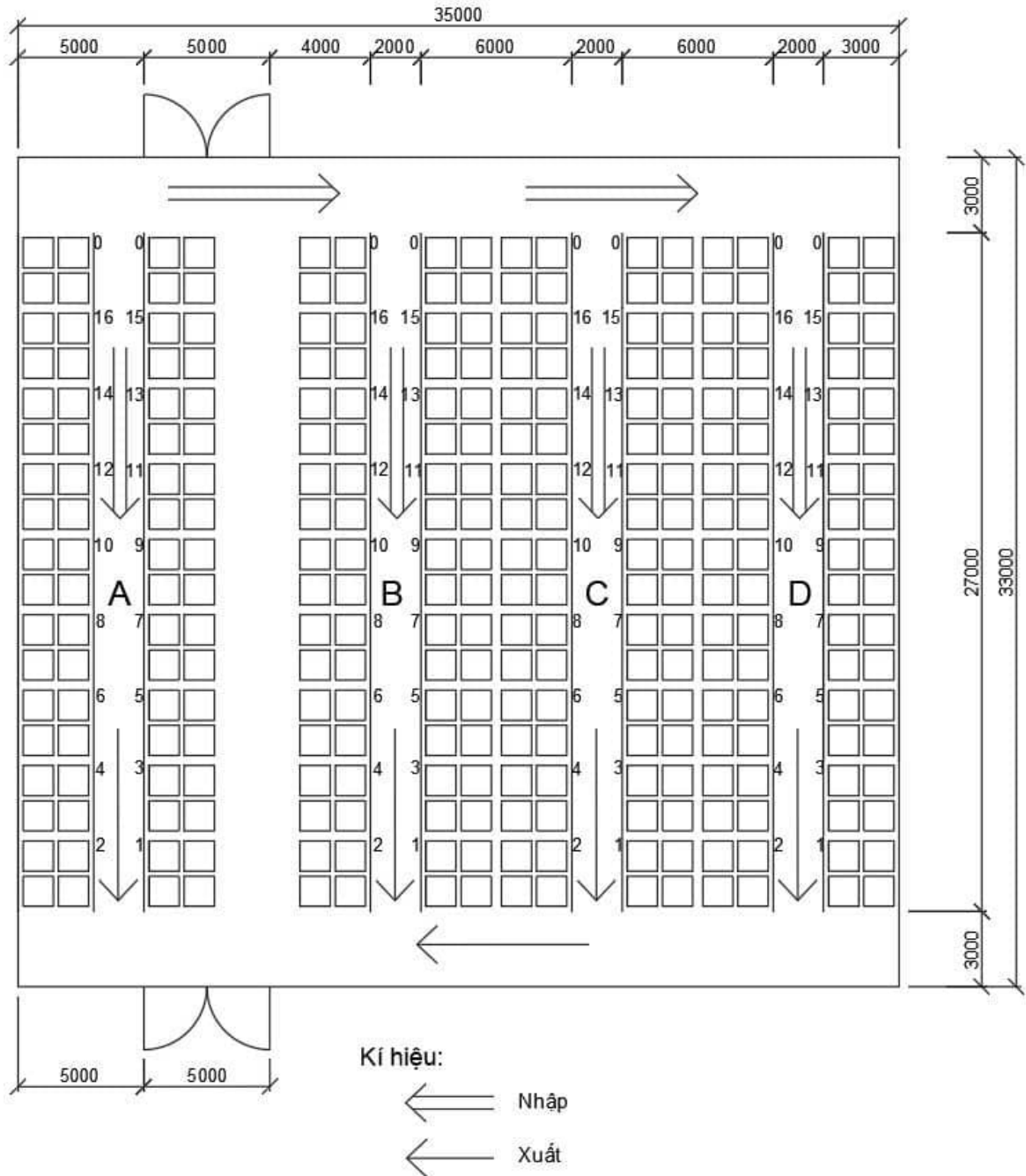


Figure 2.10: Overall current warehouse floor plan

## 2.4 Regulations on occupational safety

### 2.4.1 Corporate Culture

- The company works at 7:30, ends at 17:00. In addition, the company will have overtime days from after 17:00.
- Office workers do not have to wear uniforms.
- Employees are not allowed to bring anything from the company out as well as bring things from outside into the company (all items for work are prepared by the company).
- Regularly organize activities and events to connect people.

#### **2.4.2 Regulations on occupational safety**

- The Corporation ensures that it is fully equipped with labor protection equipment and working tools suitable for each specific job and task.
- Ensure the workplace in terms of space, airiness, light, environmental hygiene standards and environmental factors in accordance with the state's regulations and standards on labor protection. Annually conduct periodic inspection and measurement of the environment as prescribed.
- Employees absolutely comply with technical operations and technological processes, do not arbitrarily change or perform wrong processes that affect production. Absolutely do not move the location, shield the means and tools for fire prevention and fighting.
- Employees who are entitled to sick leave will have to write an application for permission to send it to their direct manager. In case they are working, if they are too tired, they are allowed to stop working to ensure the safety of people and materials and equipment, but they must report to the person directly managing them.

#### **2.4.3 Regulations on occupational hygiene**

- Employees must regularly clean machinery, equipment, workplaces, arrange tools, scraps and products neatly and in the right place, ensuring safety for production.
- Employees must well comply with regulations on epidemic prevention and hygiene, do not litter at the workplace, and put garbage in the garbage can in the right place.
- Employees when directly entering production must comply with the company's uniform.
- Kitchens and cafeterias must be cleaned, cleaned daily and ensure the right principles.
- All toilets must be cleaned and deodorized.
- All types of waste, hazardous garbage, and unusable scrap must be concentrated in the right place to be taken to the place of treatment according to regulations.

#### **2.4.4 Regulations on fire safety**

- Employees are assigned to be responsible for regularly inspecting fire safety, inspecting and maintaining fire fighting vehicles, tools, fire fighting water systems and the company's assets.
- All employees must learn how to use the fire fighting equipment equipped at the company, must know the escape system when a fire situation occurs. All employees must participate in fire drills.
- All emergency exits and emergency exits must have instructions and emergency exit indicator lights.

- All areas are equipped with strict fire protection systems.
- Before leaving, it is necessary to check the implementation of safety measures such as: turning off the electric circuit breaker, locking the faucet, checking and closing the entire system of that area. It is strictly forbidden to use fire-fighting equipment for other purposes

## CHAPTER 3: THEORETICAL BASIS

### 3.1 Theoretical basis of inventory

#### 3.1.1 Inventory Concept

- Definition: Inventory is all raw materials, semi-finished products, and finished products that are being held at an enterprise to serve the production, distribution, and sales process. Inventory acts as a "buffer" to help balance supply and demand.
- *"Inventory is an integral part of the supply chain, allowing businesses to continue operating even when there are fluctuations in demand or delays in the supply of raw materials."*

#### 3.1.2 The role of inventory with businesses

##### a. The main role of inventory

- Inventory is defined as the synthesis of goods, materials, and products in production that businesses keep for sale or use in production. This is the current asset on the balance sheet, which plays an important role in maintaining daily operations, directly affecting cash flow, revenue, and customer satisfaction.
- Inventory is a core factor in industries such as retail, manufacturing, and food service, where shortages of goods can cause great damage, while surplus can lead to damage, theft, or high insurance costs.

##### b. Specific benefits from inventory management

Role	Detailed Description	Illustrative example
Operational efficiency	Ensure enough stock to meet demand, avoiding shortages or excesses.	A retail store always has enough products.
Financial Management	Optimize cash flow, reduce storage costs, and improve supplier negotiability.	Apple reduces inventory time to 5 days with JIT.
Supply Chain Integration	As a bridge between production and distribution, ensuring a smooth flow of goods.	The factory produces components in time for assembly.
Customer satisfaction	Ensure customers receive products on time, avoid loss of revenue due to shortages.	The online store delivers on time.
Strategic Planning	Assist in forecasting demand, understanding market trends, and preparing for future demand.	Stock up for peak seasons such as Tet.
Risk Management	Reduce risks from supply chain disruptions, demand	Keep inventory safe to deal with shipping delays.

	fluctuations, and economic factors.	
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Table 3.1: Inventory management roles

c. *Specific benefits from inventory management:*

- Improve cash flow by identifying hot-selling items.
- Reduce shortages by anticipating demand.
- Increase customer satisfaction through on-time delivery.
- Reduce wasted goods by minimizing obsolete inventory.
- Reduce project delays by understanding supplier lead times.
- Improve prices from suppliers through regular bulk orders.
- Expand business insights through inventory analysis

### 3.1.3 Classification of the inventory of the enterprise

a. *Classification based on characteristics:*

- Source of materials: Including office supplies, oil, light bulbs, fuel, and machine cleaning materials. These are the supplies necessary for daily production activities, which are not directly involved in the final product.
- Raw materials: Includes materials that have not been processed, have been retained for future production or have been purchased and are on their way to the business.
- Semi-finished product: It is a product that has been put into production but has not been completed, or has been completed but has not passed the final inspection procedures.
- Finished product: It is a finished product and ready for sale.

b. *Classification based on commodity type*

- Goods purchased for sale: These are items purchased and sent in transit, real estate goods, goods sent for processing or processing. This type is popular in commercial enterprises, not engaged in production.
- Unfinished products: Products that are in the process of production and have not been completed, or have been completed but have not been warehoused according to regulations.
- Components and finished products: Includes products that have not been fully assembled (components) or final products that are ready to be sent for sale (finished products).
- Raw materials and materials: These resources are imported for use in production or for processing exports, as well as goods stored in the enterprise's tax-protected warehouse.
- Tools and Equipment: Includes tools and equipment used in manufacturing, which may be in stock, in transit, or sent for processing.

### 3.1.4 Inventory Management

a. Definition

- Inventory management is the process of monitoring and coordinating activities related to goods, materials, and products that businesses store for production or sales. Inventory management ensures that businesses have enough stock to meet customer needs without overstocking or shortages, thereby maintaining business continuity.
- Inventory management is an extremely important job, requiring close monitoring of business activities and predicting price fluctuations in the market. This helps businesses save input costs, ensure sufficient product supply, and increase competitiveness. Inventory usually accounts for a large proportion of the total asset value of a business, usually between 40% and 50%, so good inventory control is a vital issue.

b. Governance Practices

Full	Method	Description	Example
1	Just-in-Time (JIT)	Orders goods only when needed, minimizing inventory holding costs.	Toyota uses JIT to reduce production waste.
2	ABC Analysis	Categorizes inventory into A (high-value), B (moderate), C (low-value) for prioritized management.	A retailer focuses on high-demand electronics as A items.
3	Economic Order Quantity (EOQ)	Calculates optimal order quantity to minimize total inventory costs, assuming constant demand.	A company orders 500 units of a product to balance costs.
4	Materials Requirement Planning (MRP)	Uses sales forecasts to plan material needs for production, ensuring availability.	A bicycle manufacturer plans for tires and frames based on orders.
5	First-In, First-Out (FIFO) and Last-In, First-Out (LIFO)	FIFO sells oldest inventory first; LIFO sells most recent, affecting valuation.	A grocery store uses FIFO for perishable goods.
6	Dropshipping	Supplier ships directly to customer, reducing seller's inventory needs.	An online clothing store uses dropshipping to avoid warehousing.
7	Cross-Docking	Transfers goods directly from incoming to outgoing transport, minimizing storage.	A distribution center loads supplier goods onto delivery trucks immediately.
8	Safety Stock	Holds extra inventory to buffer against unexpected demand or supply issues.	A pharmaceutical company keeps extra drugs for supply delays.

9	Perpetual Inventory Management	Tracks inventory in real-time, updating records as items are added or removed.	An e-commerce platform updates stock levels with each order.
10	Lean Manufacturing	Reduces waste in production, including excess inventory, by optimizing workflows.	A car manufacturer minimizes materials wasted in production.
11	Six Sigma and Lean Six Sigma	Improves quality and efficiency, reducing defects and waste in inventory processes.	A company uses Six Sigma to reduce errors in inventory tracking.
12	Batch Tracking	Groups similar items to track expiration dates and trace defective items.	A food company tracks batches to manage expiration.
13	Bulk Shipments	Involves buying, storing, and shipping inventory in large quantities.	A retailer buys in bulk to reduce handling costs.
13	Consignment	Supplier retains ownership until product is sold; business pays after sale.	A boutique pays for clothing only after it's sold.
14	Demand Forecasting	Uses predictive analytics to predict customer demand, aiding inventory planning.	A retailer forecasts holiday demand to stock up.
15	Minimum Order Quantity (MOQ)	Orders minimum amounts from wholesalers to keep costs low.	A small business orders the minimum required units to save on costs.
16	Reorder Point Formula	Determines minimum stock level before reordering to manage inventory effectively.	A store reorders when stock drops to 100 units.
17	Cycle Counting	Counts a small subset of inventory regularly instead of a full stocktake.	A warehouse counts different sections each week.

Table 3.2: Warehouse management methods

c. *Benefits of Effective Inventory Management*

- Reduce costs: By optimizing inventory, businesses can reduce storage costs, transportation costs, and costs associated with damaged or obsolete goods.
- Meet customer needs: Make sure you have enough stock to sell when your customers need it, thereby increasing customer satisfaction and retention.
- Increase cash flow: Reduce the amount of capital stuck in inventory, helping businesses have more capital to invest in other areas.

- Improve operational efficiency: Optimized inventory management processes help reduce order processing time, reduce errors, and speed up customer service.
- Increased competitiveness: Businesses can react more quickly to market changes and customer demands, thanks to a flexible and efficient inventory management system.

## **3.2 Theoretical basis of mobile applications**

### **3.2.1 Theoretical Basis of Software Policy (Google Material)**

When developing a mobile software, following a specific software policy and design system is crucial to ensure consistency, high usability, and optimal user experience. Google Material Design is one of the most popular design systems today, widely used in Android apps and other platforms.

#### **3.2.1.1 Concept of Google Material**

Google Material Design is a design system first announced by Google in 2014. Its goal is to provide a unified framework for user interface (UI) design across a variety of platforms and devices. Material Design simulates real-world motion and materials, in order to create an intuitive and immersive user experience.

#### **3.2.1.2 Core Principles of Material Design**

- Material is a metamaterial: Design is based on virtual "material" elements that can move, change shape, and respond to user actions like real objects. These elements are clearly defined in terms of depth (through lighting, shadows, layering, etc.).
- Meaningful Movement: Animation is used to indicate, highlight change or action. Every movement should be clear on purpose, smooth, and not distracting.
- Adaptive interface: The design should work well on a wide range of screen sizes, from phones to tablets and desktops, with a flexible layout.

#### **3.2.1.3 Software policies according to Material Design**

- User Interface (UI) Policy:
  - Comply with standard layout grids, margins, and spacing.
  - Use colors, typography, icons, and UI elements according to the Material system.
  - The interface must be responsive, easy to see, and user-friendly.
- User Experience (UX) Policy:
  - Users need to easily understand and use the software from the first time.
  - Common actions need to be highlighted.
  - Feedback should be clear (e.g., ripple effect when a button is pressed).
- Compatibility and performance policies:
  - The interface should be smooth on multiple devices with different configurations.
  - Prioritize performance and save resources.

- Good compatibility with new and old Android versions.
- Security and Privacy Policy:
  - UI elements need to be transparent about behavior (e.g., notifications when accessing cameras, mics).
  - Design the access management interface in a clear and easy-to-understand way.

### **3.2.2 Theoretical Basis of Software Interface (UI Design)**

#### **3.2.2.1 Concept of Software Interface (UI Design)**

- UI (User Interface) Design is the process of designing the graphical interface of software to optimize the visual experience, helping users interact easily and effectively with the system.
- In mobile software development, UI plays a decisive role in the first user experience, affecting user retention and product success.

#### **3.2.2.2 Effective UI Design Principles for Mobile Software**

*a. Simple and straightforward:*

- Definition:
  - Mobile users are often in a "on the go" state, less patient than desktops. The cleaner and more intuitive the interface, the lower the barrier to access.
  - Each screen should only contain a maximum of one or two primary tasks. Avoid "cramming" too much information, buttons, or sub-menus into the same view.
- Principles of application:
  - Focus on primary task: "Login" screen, only 2–3 fields (email, password, "Login" button) along with the "Forgot password" or "Register" link located below/above.
  - Reduce steps: consolidate into a single screen instead of separating many steps, avoid forms that are too long, and break them down into clear steps.
  - Hide secondary actions: Keep only essential actions, less important actions can be placed in the "hamburger" or "drawer" hidden menu.
- Practical application:

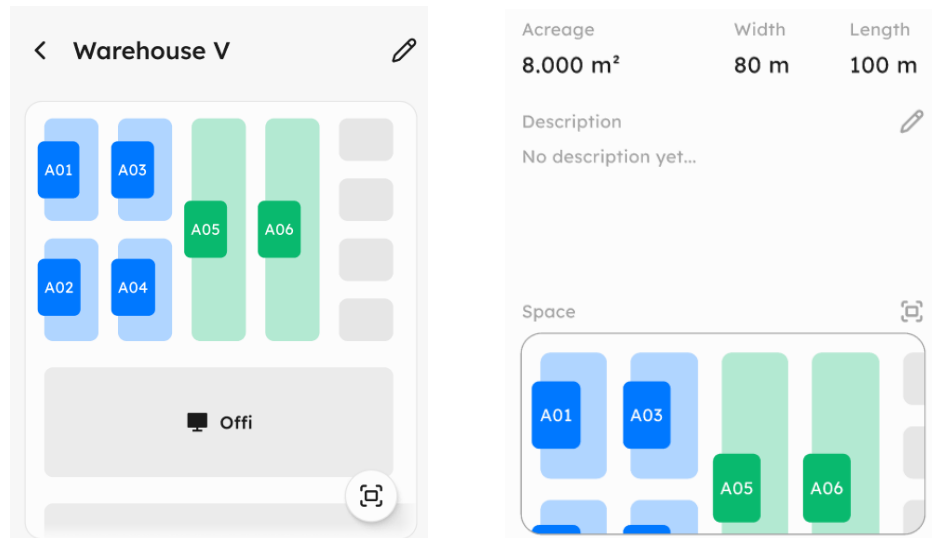


Figure 3.1: Essential action icons

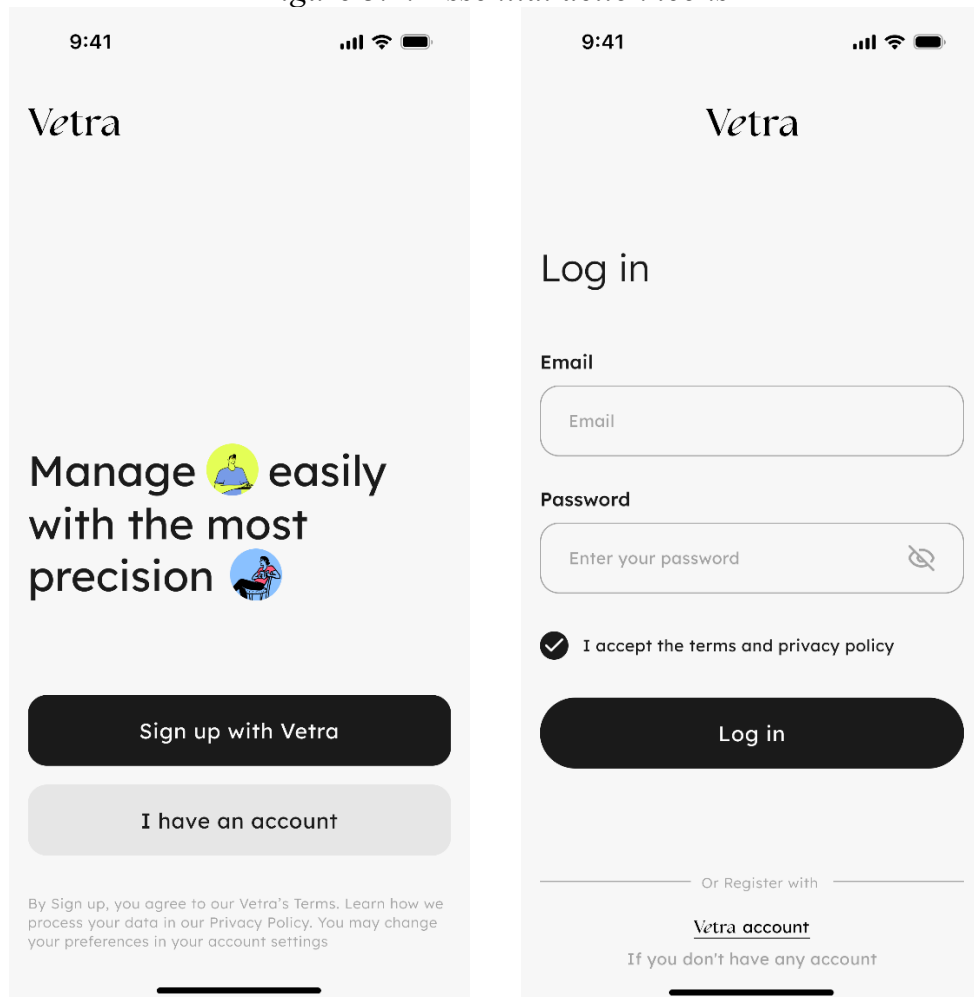


Figure 3.2: headline of no more than 5–7 words, short description

b. Consistency:

- Definition: Consistently helps users "learn" how to use the app faster, without having to guess what one button does, where the other button opens. Consistency is reflected in colors, typography, spacing, icons, how to place navigation buttons...

- How to implement: Build a document (Figma/Sketch/Adobe XD) that contains regulations on:
  - Color Palette: primary color, secondary color, background color, accent color for status (hover/pressed).
  - Typography: font-family, kích thước (h1, h2, body, caption), trọng số (regular/medium/bold).
  - Spacing Scale: for example, the basic spacing is 8px, 16px, 24px... to keep the standing/horizontal distance evenly.
  - Icon Set: only use the same set of icons (Material Icons, FontAwesome, or custom sets), avoid mixing different styles.
  - Pre-created components such as Button, Text Field, Card, Modal, Tab Bar... For developers to simply reuse, make sure every component looks the same.
- c. *Clear Response:*
  - Concept: Every interaction (tap, swipe, drag-and-drop, etc.) needs an instant response so that the user knows the system has "understood" their actions. Otherwise, they may click over and over again, causing errors or confusion.
  - Basic types of feedback:
    - Ripple/Pressed State: When the user clicks the button, there should be a "ripple" effect or change the background color, reducing the opacity to know the correct area has been touched.
    - Loading Indicator: If the action takes >0.3s to process (e.g. form submission, login, data loading), display spinner/bar loading on the spot.
    - Success/Error Message: Show a simple toast and then auto-hide. Error: Highlight wrong field, display red warning icon and explanatory text.
    - Haptic Feedback: With supported devices (iOS, Android), it can be slightly vibrated when the user completes an important operation.
- d. *Adaptability:*
  - Concept: "Responsiveness" here is not only understood to be suitable for many screen sizes (320px – 414px – 768px), but also the ability to run smoothly in different network conditions, capacity, and battery.
  - Expressed in the design:
    - Flexible Layout: Use Constraint-based Layout so that when the screen changes, the component automatically shrinks/expands appropriately. Avoid using the absolute "fix width/height" value, prioritize % dp/sp...
    - Adjust the interface for network statuses: Online/Offline Mode: If the network is lost, show the offline screen. Throttling Data: When the user is

in 3G, load the smaller image (low-res) first, then load the full version when the conditions are better.

- Multilingual support (Localization): Taking into account the region: Vietnamese (UTF-8) may be longer than English, so the design button/label must have enough room to display.

e. *Finger Manipulation Priority:*

- Concept: On touch devices, the targets (buttons, icons, inputs, links) must be large enough for the user to click correctly, avoiding "fat-fingering".
- Size Standard:
  - Minimum distance: 48×48 dp (about 9–10 mm on most screens) is the "cushion" size for easy touch.
  - Distance between targets: At least 8–16 px (make sure there is no overlapping of the click area).
- Button Design:
  - Reasonable padding: There should be at least 12px of horizontal padding and 8–12px of vertical padding around the text label to make the composition less cramped.
  - Button position: Important actions (CTAs) are placed in the easily accessible "thumb" area (below near the thumb when holding the phone horizontally or vertically). Refer to the "Thumb Zone" on mobile. Avoid placing the important action in the upper left corner (need to reach out or switch hands).
- Gestures:
  - Swipe: Allows swiping to switch pages, delete items, etc. but must be accompanied by clear "feedback".
  - Long Press: Used when the context menu needs to be displayed, but avoid abuse because sometimes users don't know there is a "long press".
  - Drag & Drop: In some cases, drag is supported to rearrange items, but a "handle" (three-tile icon) is required for the user to know where to pull it.

### 3.2.2.3 Basic UI Components in Mobile Software

Stt	UI Components	Description & Role	The right design direction
1	Button	Used to trigger actions: form submissions, page transfers, confirmations, etc.	- All statuses are required: Normal – Hover – Pressed – Disabled.
2	Input Field	Users enter information: name, email, phone number...	- Clear labels, specific descriptive placeholders.

3	Navigation Bar	Helps users switch back and forth between the main parts of the app	- Place above (top nav) or bottom (bottom nav).
4	Card	Used to group information such as articles, products, profiles, etc.	- There should be padding, shadow, and light corner radius.
5	Modal / Popup	Display alerts, action confirmations, or subforms	- Striking interface, blurring the background behind.
6	Tabs / Tab bar	Organize content into separate groups (e.g., Orders/Favorites/Settings)	- Usually placed at the bottom of the screen.
7	Toast / Snackbar / Alert	Short notifications, system responses (successes, errors, warnings)	- Automatically disappears after 2–3 seconds (or with a close button).
8	List / Scroll View	Display a list of data such as news, products, chats, etc.	- Supports swipe left/right, lazy load.
9	Search Box	Allow users to search for data in the app	- It should be placed in a conspicuous position (top).
10	Form	Includes many input fields to collect data (registration, payment, etc.)	- Clearly display required fields.

Table 3.3: Basic UI Components

### 3.2.2.4 UI design process for mobile apps

UI design for a mobile app isn't just about "drawing a beautiful screen," it's a rigorous process that includes user analysis, experience planning, and visual design creation. Here are the common steps in the UI design process:

*a. Step 1: Research users & define goals*

- Goal:
  - Understand who will use the app and what they need.
  - Identify the key tasks that the app needs to serve.
- Specific activities:
  - Interview potential users.
  - Competitor analysis.
  - Create a User Persona.
  - Xác định user goals, pain points.

*b. Step 2: Draw a user flow diagram*

- Objective: Map out the steps that the user will go through in the app to complete the task.
- Specific Activity: Create a diagram from the first screen → complete the main task.

*c. Step 3: Outline the interface frame (Wireframe)*

- Goal: Create basic interface layouts that are colorless, image-free—defining only the elements and structure.
- Specific activities:
  - Draw by hand, use tools (Figma, Balsamiq, Whimsical...).
  - Focus on layout: button position, input, tab bar, header...
  - Divide the layout by grid: ensure easy to see and balance.
- d. *Step 4: Design a detailed interface (Hi-fi UI)*
- Goal: Turn wireframes into real interfaces with colors, fonts, icons, images — ready to grow.
- Specific activities:
  - Apply Design System / Style Guide (if applicable).
  - Create components: button, form, tab, model...
  - Use tools: Figma, Adobe XD, Sketch to design pixel standards.
- e. *Step 5: Create a prototype (Interactive Prototype)*
- Objective: Allow real-world experience simulation to be tested and adjusted before being passed on to the programmer.
- Specific activities:
  - Use Figma / Adobe XD to connect screens together.
  - Set up operations such as pressing buttons, swiping, opening models...
  - Internal testing or with real users (User Testing).
- f. *Step 6: Communicate with the Developer Handoff*
- Goal: Ensure programmers understand the design and are easy to implement.
- Specific activities:
  - Use the "Inspect" feature in Figma/Zeplin to see the size, font, color code, padding, etc.
  - Export assets (SVG, PNG, icon...) correctly.
  - Cung cấp specs rõ ràng: spacing, font size, logic hiển thị...
- g. *Step 7: Post-release testing and improvement*
- Objective: Measure the actual performance of the interface after launch, improving according to user feedback.
- Specific activities:
  - Use analytics tools (Firebase, Hotjar) to view user behavior.
  - Collect user feedback.
  - Partial UI improvements based on A/B Testing.

### 3.2.2.5 Recommended tools and resources

Use 2 main tools for design and design standard systems:

- Figma— Professional UI design.
- Google Material Design – The standard design system for Android.

### 3.2.3 Theoretical Basis of Logic and User Feedback (UX Design)

### 3.2.3.1 Concept and role

- **Notion**

User Logic Flow is a sequence of actions and responses between a user and a software system, designed to:

- Users accomplish their goals.
- The operation process is continuous, reasonable, easy to understand, and non-disruptive.

- **Role**

a. *As a bridge between users and software:*

- UX is not just beautiful design but the entire experience that users feel when using the app.

- When the software has a good UX, users will:

- Understand how to use it the first time without instructions.
- Easily perform the desired action (order, pay, lookup, etc.).
- Don't get "lost" in the app.

b. *Makes the software user-friendly, easy to use, and time-saving*

- Good UX design focuses on:

- Logical flow.
- Easy-to-understand interface, simple language, easy-to-guess icons.
- Reduce the number of action steps so that users can complete their goals quickly.

c. *Increase User Retention*

- If the software is difficult to use, slow to respond, many cumbersome steps → users exit or delete the app.

- If the software is smooth, fast and predictable, → users will return to use it regularly.

- **High return rates → increase the long-term value of the product.**

d. *Support to reduce costs and development time later*

- Good UX from the start → few errors to use, no need to edit the interface after release.

- Reduced maintenance/modification costs.

- Avoid errors:

- The user does not understand the meaning of the button → must add instructions.
- Too many people don't complete the registration → have to revise the flow.

### 3.2.3.2 User Feedback / System Feedback

a. *Notion*

User feedback is all the signals or reactions that the system (app) sends back to the user to let them know that:

- Their actions have been documented.
- What is the state of the current system.
- The result (success, failure, processing...) of the action.

An unresponsive action is equivalent to "clicking the button doesn't know if it works"  
→ confusing and easy to exit the app.

*b. Common types of feedback*

Types of Responses	Describe	Illustrative example
Visual Feedback (Thị giác)	Transform the interface as soon as the user interacts	Button color change when pressed, ripple effect, rotating loading icon
Textual Feedback	Display a short message responding to the results	"Login successful", "Password is incorrect", "The system is processing..."
Haptic Feedback (Xúc giác)	Vibrate the phone slightly during an event	Vibrate slightly when scanning a QR code successfully or drag to refresh
Audio Feedback (Âm thanh)	Audio feedback (very limited in popular applications)	"ting" tone when sending a message or completing an order (in the sales app/kiosk)

Table 3.4: Common types of responses

*c. Response level and time*

Operation Type	How long should the response appear
Single action (button press)	≤ 100 ms
Actions with processing (sending data)	Instant spinner or notification in 300 ms <
Download long content (lists, photos...)	Use placeholder/skeleton while waiting for load

Table 3.5: Response level and time

Considerations when designing feedback in mobile software:

- Avoid overly complicated feedback: A simple effect like changing color, rendering text is enough.
- Don't abuse animations or vibrations: Can be annoying if used too much.
- Keep feedback concise and easy to understand.
- There is always a response for both error and success cases.

### 3.2.3.3 Core UX Design Principles

Core UX design principles help ensure that users can complete tasks easily, understand how to use the app without guidance, and feel satisfied after interaction. Here are 6 foundational principles:

*a. Empathy*

"Design is not just for software to work — it's for people to use it easily."

- It is necessary to understand the context of use, goals, worries and limitations of users.
- Put yourself in the user's shoes to design according to actual needs, not subjective speculation.

*b. Predictability & Control*

"The user needs to know in advance what will happen and have the right to navigate or stop the action."

- The system must respond clearly every time the user operates.
- Avoid unexpected changes without warning.
- Always give users the option to "Cancel", "Go Back", "Modify" instead of forcing them to continue.

*c. Immediate Feedback*

"Every action must have a clear and timely response, so that the user knows that the system is listening."

- Unresponsiveness → users lose control and suspect faulty software.
- Can respond with colors, tap effects, notification lines, icons, or slight vibrations.

*d. Reduce Cognitive Load*

"Users should not have to memorize too much when using the software. Everything should be clear right on the screen."

- Avoid technical terms and confusing words.
- Avoid presenting too many choices on one screen.
- Step-by-step instructions, with clear instructions.

*e. Consistency*

"All UI/UX elements need to stay the same, how they work throughout the app."

- Colors, icons, button positions, feedback behaviors... must be uniform across all screens.
- Use a standard design system to control consistency.

*f. Flexibility & Recovery*

"A good UX must assist users in recovering from bugs and allow for personalization if needed."

- It is possible to allow users to "undo", return to old operations, edit information, etc.
- Allows customization of the interface (dark/light mode, large and small fonts).

### **3.2.4 Theoretical Basis of Management & Database (Data)**

#### **3.2.4.1 Notion**

- Data governance includes processes and policies to ensure that data is always in the right conditions to support business operations. It is likened to the "backbone" that connects the entire information lifecycle in the system.
- Business data is considered a valuable resource, used to make smart business decisions, improve marketing campaigns, optimize operations, and reduce costs. Thanks to strict data management, the software system can ensure the consistency, reliability and availability of data, thereby helping users quickly retrieve and make accurate decisions.

#### **3.2.4.2 Common database models**

- Relational: Stores data in fixedly structured tables (rows and columns), using SQL for queries. The relationship model is intuitive, simple, and standardized, suitable for many traditional applications. RDBMS ensures integrity (ACID), suitable for complex relational data.
- Non-relational (NoSQL): Stores unstructured data (documents, key-values, wide columns, graphs, etc.). The NoSQL system allows for flexible scaling, storing JSON/BSON documents without the need for fixed schema definitions. NoSQL is often distributed (replication) to increase availability and fault tolerance, making it suitable for processing large volumes of non-relational data.
- Distributed: Data is stored on multiple nodes or servers to improve performance and reliability. Distributed systems allow for parallel access, replication, and sharding, ensuring that data remains available even if some nodes fail.

#### **3.2.4.3 Database management system commonly used in mobile**

- Firebase (Realtime Database / Firestore): Google's Cloud NoSQL database, which supports real-time data synchronization and automatic offline storage. Firebase has a free basic plan, which is easy to integrate and constantly updated. Cons: tied to Google Cloud infrastructure (not running on other clouds) and no SQL language (only saves JSON).

#### **3.2.4.4 Data synchronization between client (app) and server**

- Modern mobile applications often follow an "offline-first" model and need a data synchronization mechanism when there is a network. Firebase Realtime Database automatically caches recordings when offline and continues to send them to the server when the device reconnects. Firebase's disk persistence feature allows data to function properly even if the network is down, and then automatically pushes changes online
- On Android, the Sync Adapter mechanism is recommended to allow background data synchronization without interrupting the interface.

SyncAdapter is a plugin in conjunction with SyncManager, which can be scheduled or activated on demand to synchronize data between local and server SQLite. This mechanism saves battery and network by syncing on a schedule or when the data actually changes, and automatically retries when an error occurs

#### **3.2.4.5 Data retrieval performance management**

- **Indexing:** Creating indexes on frequently queried columns helps speed up searches.
- **Query optimization:** Avoid using SELECT\*, select only the columns that are necessary to reduce the amount of data returned and network load. Use an IN or EXISTS structure with columns that already have an index to help the optimizer make better use of metrics and reduce execution time. Avoid complex operations or functions on indexed columns (as they detract from the benefits of the index).
- **Caching:** Temporarily store query results or frequently used data at the client (in-application cache) or at the middleware layer (Redis, Memcached) to reduce the load on database access. This is especially useful for frequently repeated queries in mobile apps.
- **Normalization/Denormalization:** Data normalization helps eliminate redundant data, but in some cases denormalization (to replicate data) can be considered when fast queries are needed and controlled duplication is accepted. Considerations should be made based on retrieval requirements and updability to ensure data consistency.

## CHAPTER 4: MOBILE APPLICATION SOLUTIONS FOR INVENTORY MANAGEMENT AND CONTROL

### 4.1 Solutions for warehousing processes

#### 4.1.1 The purpose of improving the warehousing process

*a. Increase operational efficiency*

- Systematically improving processes reduces processing time, optimizes resources, and improves productivity. The warehouse management mobile app allows automation of tasks to minimize manual work and help businesses run faster.
- Improve accuracy with automated tracking that reduces errors in inventory management and order fulfillment.
- Meet regulations and ensure safety
- Suitable for the workflow of the recommendation software

*b. Standardize operations, reduce complexity*

- Build clear, sequential business steps so that each step corresponds to a screen/feature on the application.
- Eliminate redundant manual operations, helping warehouse staff quickly operate with just a few taps on their phones.

*c. Ensure real-time data*

- All import and export operations when scanning QR codes/Barcodes on the app are immediately synchronized to the server, avoiding the situation of "electronic on paper" and then re-entering into the system.
- Help leaders and managers instantly track warehouse data anytime, anywhere.

*d. Optimize the mobile user experience*

- Dark Design the process so that the app screens are intuitive, the buttons are large, the fonts are clear, suitable for the warehouse environment (poor lighting, glove manipulation,...).
- Limit the number of clicks, switch screens, and put on the "quick action" section for commonly used operations.

#### 4.1.2 New import and exit process

##### 4.1.2.1 Pre-Shipping Stage

*a. Order Receipt and Verification:*

- The sales department receives orders from customers
- Confirm the information and send the order to the Accounting Department who will check and confirm the payment before processing the order

*b. Inventory Inspection*

- Use WMS/Zalo to confirm orders with the warehouse department, which will confirm and update the quality and quantity of inventory

*c. Create a pickup list*

- Receive orders: the warehouse management department receives the list of goods required from the sales/accounting department to create an order that will be retrieved from the warehouse.
- Locating goods: using data from software to determine the location and quantity of goods
- Inventory Check:
  - Coordinate from other warehouses.
  - Proposal to produce more goods
  - Notify customers to change or adjust orders
- Making a picking list
  - Create a list including: Product code, product name, quantity, warehouse location, notes.
  - Printing slips include: 1 gim slip on the order, 2 slips for order tracking (1 for warehouse staff and 1 for manager), 1 slip for bookkeeping statistics

*d. Pick-up*

- Receive a picking list: The warehouse staff will receive the goods export slip from the warehouse manager
- Move to inventory location
- Check the goods information: Check the information on the shipping slip and the information on the gim slip on the order, compare the information and confirm.
- Pick-up and confirmation on the system: The information must be confirmed on the system for inspection and tracking.

*e. Quality Inspection*

- Bonded inspection, commodity code
  - Consider the goods for damage, scratches, dents, or defects. Check if the packaging is intact or torn.
  - For products that have been in stock for a long time, check the duration of inventory, consider whether the external quality exceeds the standards of use and handling.
- Check quantity
  - Recount the number of rows compared to the picklist to avoid errors and confirm the information on the system.
  - If there is a difference/damage that reduces the quantity, it must be reported immediately for handling.
- Check in detail

- For products that have been stored for a long time, the detailed inspection step will be undertaken by the QA/QC department and inspected according to the company's ISO 9001:2015 quality assurance process in terms of appearance, packaging material, size, weight, printing quality & information on the packaging, etc. waterproof, airtight, packaging & adhesive capability.
- For shipments that have just been produced or have a new production date, the warehouse staff will check according to the basic criteria in terms of appearance, packaging material, size, weight, printing quality, packaging & adhesive ability.
- Handling defective goods & confirming information
  - If defective goods are detected: Replace with another product present in stock. Report to the system and return the defective goods to the area to be handled
  - When the goods are satisfactory, the QA/QC staff confirms on the system.
  - Deliver qualified goods to the packaging and shipping area.

#### **4.1.2.2 Preparation and Shipping Phase**

##### *a. Packing Goods*

- Arrange goods into packaging so that they will not be displaced or damaged.
- Use plastic film to wrap the product

##### *b. Weighing and Dimensioning*

- Place the package on an electronic scale to determine the correct weight.
- Measure the length, width, and height of the package with a measuring tape.
- Record this parameter into the system to calculate the shipping rate.

##### *c. Label printing and shipping documents*

- Print shipping labels: Include customer information, order codes, barcodes for tracking scanning.
- Print the accompanying documents:
  - Packing List for the recipient to compare.
  - Invoice (if needed).
  - Special papers if they are goods that need to be inspected by customs.
- Apply the label to the package:
  - Make sure the label is not peeling.
  - Place the label in an easy-to-see location.

##### *d. Freight Forwarding*

- Prepare the means of transportation: Check the type of vehicle (truck, container, transfer vehicle) in accordance with the weight and size of the package.
- Loading & Loading
  - Arrange the package in order: heavy goods downwards, light goods upwards, avoid tilting when the vehicle moves.
  - Use pallets, wooden frames or steel frames to secure the goods, reducing shaking.
  - Use ligaments, air-bags, or load bars to insert into the gaps, keeping the package from moving.
- Track and monitor itinerary: Update the status of "Departure – On the way" to the order management system.
- Complete the dossier and close the order
  - When arriving at the warehouse or customer's address, the forwarder and the recipient compare the goods together
  - The recipient signs the delivery receipt on the system or on paper.
  - Update the "Delivered Successfully" status to the system data for storage. Store all shipping documents in the system for at least 03 months (or as prescribed by law).

#### **4.1.2.3 Post-shipping**

##### *a. Track*

- Order status updates: Because the shipping unit is a unit under the company, the continuous update of the status and route of the order must take place continuously and throughout the transportation journey in the system.
- Send status update notifications to customers

##### *b. Shipping Data Reporting & Analysis*

- Delivery Time: is one of the important KPIs in logistics activities and supply chain operations. It measures the amount of time between when an order leaves the warehouse and when a customer receives it.
  - Logistics performance measure: Helps businesses evaluate the efficiency of the delivery process. Identify the strengths/weaknesses of the supply chain.
  - Improve operating costs: Adjust production plans, manage inventory to match delivery speed.
- Distribution Cost per Weight: is a performance indicator (KPI) used in warehouse management and logistics to measure the average cost associated with distributing or transporting goods based on their weight. This is a way to evaluate the cost-effectiveness of the outbound and

shipping process, which is especially important for traditional goods manufacturing businesses, where product weight can have a major impact on logistics costs. Indicators help

- Cost Optimization: Helps businesses determine whether the cost of transportation is reasonable compared to the weight of the goods. If the cost per kilogram is too high, it may be necessary to reconsider the shipping method or packaging.
- Efficiency Comparison: Allows comparisons between shipments, carriers, or different time periods to find the most economical option.
- Shipping issues: Adjust the import plan, manage inventory to match the delivery speed.

#### 4.1.3 Conclusion

- The new import and export process consists of three main stages: Pre-Shipping, Prepare & During Shipping, and Post-Shipping. Each stage is closely organized, connecting many functional departments such as sales, accounting, warehouse, QA/QC, transportation, and customer care to ensure accuracy, safety, and efficiency in the entire supply chain.
- Benefit:

Benefit	Describe
Accuracy and transparency	Clear order information control from receipt – warehouse – delivery
Flexible operation	Good communication between the warehouse – transportation – QA department ensures a smooth flow of goods
Complete data – easy to analyze	KPIs such as delivery time, cost/kg, inventory to help adjust the strategy
Timely troubleshooting	Error reporting mechanism, handling of wrong goods, clear quantity difference
Increase professionalism with customers	Continuous flow of updated information, clear order status

Table 4.1: Benefits of the new process

- The new import and export process is optimally designed in the direction of strict control – multi-department communication – digitized data, helping businesses reduce errors, improve delivery efficiency and build trust with customers. The application of technology (WMS, validation system, data synchronization) is the key factor to the successful implementation of this process.

## 4.2 Solutions for warehouse management processes

### 4.2.1 Overview of warehouse management and control mobile application solution

#### 4.2.1.1 Solution overview

#### 4.2.1.1.1 Software capabilities in processes

a. This solution is built to support the entire warehouse operation cycle:

Stage	Supporting Functions
Pre-shipping	<ul style="list-style-type: none"> <li>– Receive orders and confirmations from sales and accounting departments.</li> <li>– Check inventory (real-time) via connection to WMS system.</li> <li>– Automatically create a picking list.</li> <li>– Locate inventory with digital maps/storage shelves.</li> <li>– Update information to check the quantity and quality of goods.</li> <li>– Manage QA/QC confirmation and handle defective goods right on the app.</li> </ul>
In transportation	<ul style="list-style-type: none"> <li>– Scale the package, update the measurement directly from the device (Bluetooth scale if available).</li> <li>– Create and print shipping labels (with barcodes/QR codes).</li> <li>– Take a photo of the package before delivery (compare later).</li> <li>– Real-time delivery status tracking.</li> <li>– Status update: "Left warehouse" – "On the way" – "Delivered".</li> </ul>
After Shipping	<ul style="list-style-type: none"> <li>– Send status notifications to customers (via app/Zalo/email).</li> <li>– Aggregate delivery data: time, cost, deviation.</li> <li>– KPIs report: Delivery Time, Cost/Weight.</li> <li>– Recording transportation incidents, supporting complaints.</li> <li>– Record storage and shipping data.</li> </ul>

Table 4.2: Software capabilities in warehouse management

b. Stocktaking / Inventory Audit

- Scan the commodity code for a quick count.
- Compare with system data by area/shelf.
- Automatically detect deviations, make inventory records.
- Support periodic or irregular inventory.

c. Inbound Logistics

- Receive import order notifications from the system.
- Bonded inspection – item code – expiration date.
- Record the results of QA for input inspection.
- Locate the putaway location and update it to the system.
- Create a goods receipt report.

d. Analysis Process & Operational Reports

- Dashboard tracks actual inventory – by region – by product.
- Average order processing time report.
- Compare the efficiency of shipments.
- Forecast inventory trends (AI-based if integrated).
- Analyze the reasons for late delivery/defective goods/return orders.

#### 4.2.1.1.2 Key user groups

##### a. Warehouse Staff:

- He is a person who directly manipulates goods in the warehouse: picking, inspecting, warehousing, ex-warehousing, arranging, and inventorying.
- Supported Functions:
  - Get a picking list.
  - Scan the product barcode/QR for verification.
  - Locate goods in the warehouse.
  - Confirm pickup and status updates.
  - Check the quantity, compare the list.
  - Simple error handling (error reports, notes).
  - Periodic inventory: scan – count – compare actual inventory.
- Powers:
  - Access orders and inventory.
  - Update the status of picking, warehousing, inventory.
  - There is no authority to approve or edit order information.

##### b. Sales & Accounting Staff

- *The accountant confirms the payment and manages the finances associated with the order.*
- *Sales is the focal point for receiving orders from customers and transferring them to the warehouse system.*
- Supported Functions:
  - Create/approve orders and send them to warehouses.
  - Check the payment status of your order.
  - Check the status of order processing in real time.
  - Create a single adjustment request (if needed).
  - View and print delivery notes, invoices, packing lists.
- Powers:
  - Create and confirm orders.
  - View customer-related import and export history.
  - There is no right to directly manipulate the inventory or check the quality.

##### c. Delivery Staff

- In charge of transporting goods from the warehouse to the customer.

- Supported Functions:
  - Receive a list of orders to be delivered.
  - Print/display waybills, delivery barcodes.
  - Update shipping status: "Delivering", "Delivery successful", "Delivery failed".
  - Sign electronically from customers or take photos for confirmation.
  - Record transportation problems if any.
- Permissions: Only have the right to update the delivery status, not edit the order or goods information.

*d. Warehouse Manager / Admin*

- As a person who oversees the entire operation of the warehouse: from orders, inventory, personnel, equipment to data analysis and decision-making.
- Supported Functions:
  - Track the progress of order processing in real-time.
  - Look up – analyze inventory, imports and exports, defective goods, personnel performance.
  - Create – edit – delegate user accounts.
  - Approve or cancel the order if there is a problem.
  - View KPIs reports: processing time, distribution costs, inventory deviations, etc.
- Powers:
  - Full access and monitoring of all system data.
  - Permissions to decentralize accounts, configure systems, and export data.

#### **4.2.1.1.3 Outstanding features of the solution**

- User-friendly interface and clear decentralization:
  - The app provides a user interface (UI) tailored to each role (accounting and sales), ensuring that it is easy to use and tailored to specific needs. Explicit decentralization prevents unauthorized access, allowing only each role to perform authorized functions.
  - The user-friendly interface applies UI/UX design principles, ensuring intuitiveness and efficiency, as discussed in mobile software development documents.
  - Increase transparency in the process, as each role only accesses relevant data.
  - Decentralization helps minimize the risk of error or abuse of authority
- Real-time tracking and reporting:
  - The app allows real-time tracking of order status and payments, providing instant information for both accounting and sales. In addition, it supports

the creation and printing of reports such as delivery slips, invoices, and packing lists, helping to manage documents effectively.

- Reduce document processing time, thereby saving operating costs
- Storing and searching for electronic documents:
  - All documents such as export notes, packing slips, invoices, delivery minutes... are all stored electronically on the system, instead of traditional paper versions.
  - Easy to control, compare and trace.
- Data analysis and decision support
  - The application not only records data but also synthesizes and analyzes it into KPIs for management.
  - Identify "bottlenecks" in the warehouse process and optimize costs and operational efficiency.

#### 4.2.1.2 The main functions of the mobile system

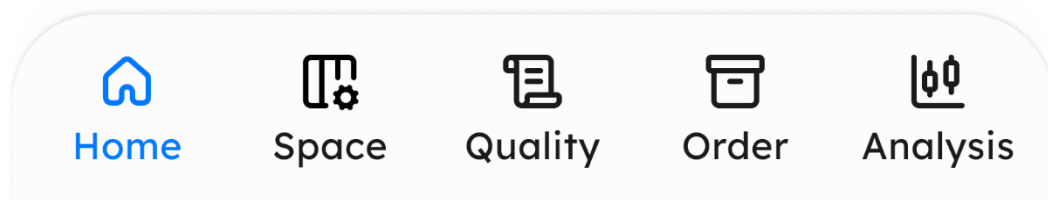


Figure 4.1: Bottom Navigation Function an app

##### 4.2.1.2.1 Home Screen

The "Home" tab is the home screen, which provides an overview of the system status through the house icon highlighted in blue (the active tab). Includes the main functions displayed:

*a. Header Section:*

- This section personalizes the user experience and provides basic information about device status and notifications.
- Design:
  - Greetings and usernames: "Good Morning!" along with the employee's name are printed in bold black letters, creating a friendly and personalized feel.
  - Profile picture: A circle with a user photo increases the visual connection and personalization of the interface that belongs to the user.
  - Notification icons: Bells and Emails with red dots signal unread notifications, allowing quick access to important updates.

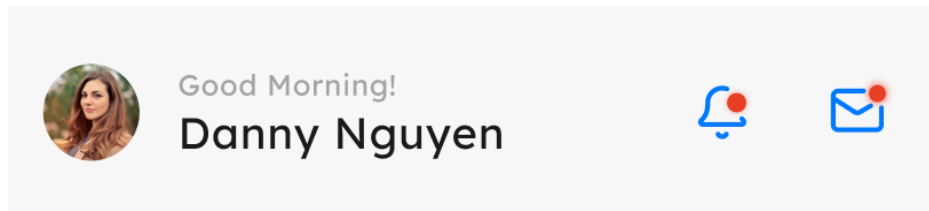


Figure 4.2: Header Section

b. Total Merchandise Section

- Provides an overview of key performance indicators (KPIs) such as the number of orders and revenue over time.
- Design:
  - Title and tab: "TOTAL MERCHANDISE" with two parameters mentioned in the chart: "Order quantity" and "Revenue".
  - Line Chart: A chart consisting of two lines:
    - The blue line indicates the number of orders, with marked circles, which fluctuate over the months.
    - The green line indicates revenue, which also fluctuates with the corresponding peaks.
    - The x-axis is the months, the y-axis ranges from 0 to 200.
  - Coloring area: The light blue and light green background area behind the lines highlights the data trend.
  - Right arrow: Suggests more detailed data or a different view when tapped.

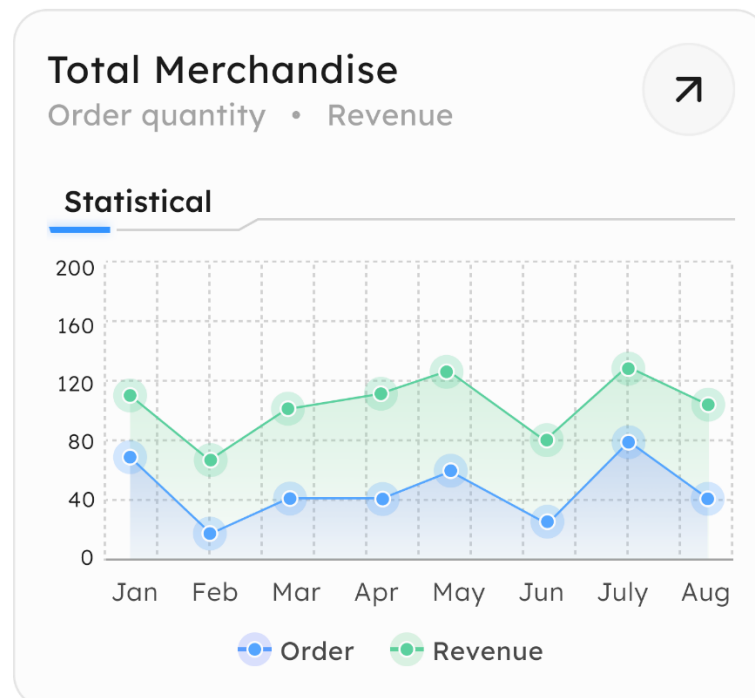


Figure 4.3: Total Merchandise in Home Page

c. Warehouse Status Section

- Provides real-time information on inventory status and current inventory capacity.

- Design:
  - Title and subtitle: "WAREHOUSE STATUS" with "Order in queue" and "Quantity".
  - Key statistics:
    - TOTAL: 321.6 Prod (represents the number of goods currently in stock), shown in bold black letters.
    - Empty: 21%, shown by the green progress bar, about 1/5 filled.
    - Status: Normal, green letters, indicating stable warehouse status.
- Update note: "TODAY 2nd Updated" indicates the data was last updated on the 2nd of the current month.
- Right arrow: Hints for more details.

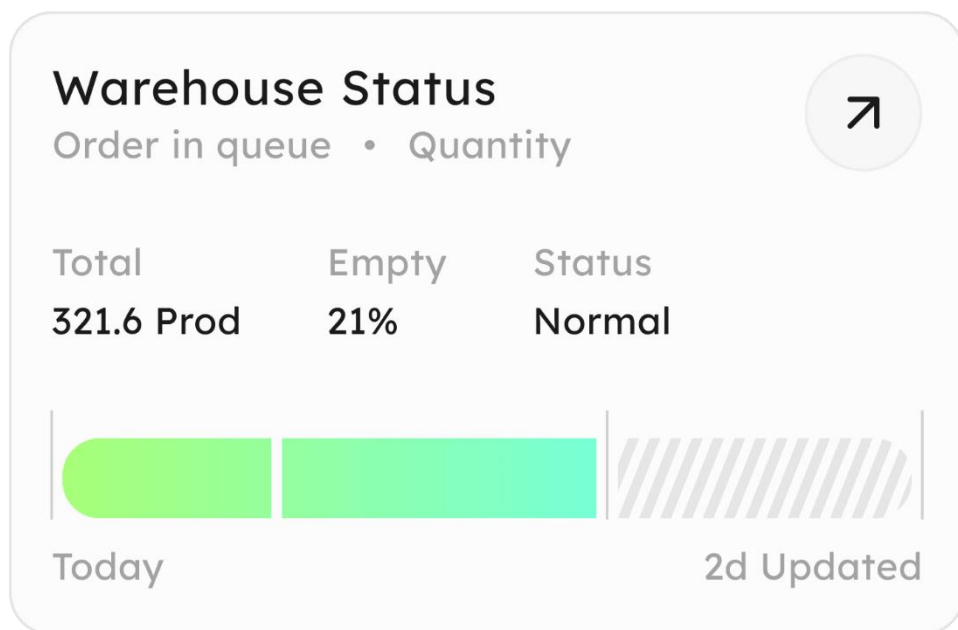


Figure 4.4: Warehouse Status in Home page

d. Shipping Section

- Track the status of outbound shipments, focusing on pending orders.
- Design:
  - Title and subtitle: SHIPPING with Order in queue and Quantity.
  - Processing stage: PICKING ORDER, indicates the current step in the process.
  - Quantity: 2 Order • 23 Items (2 orders, 23 items).
  - Illustration: The delivery truck icon shows what type of vehicle is about to move, the truck number, and the current status.
  - Right arrow: Hints with more shipping details.

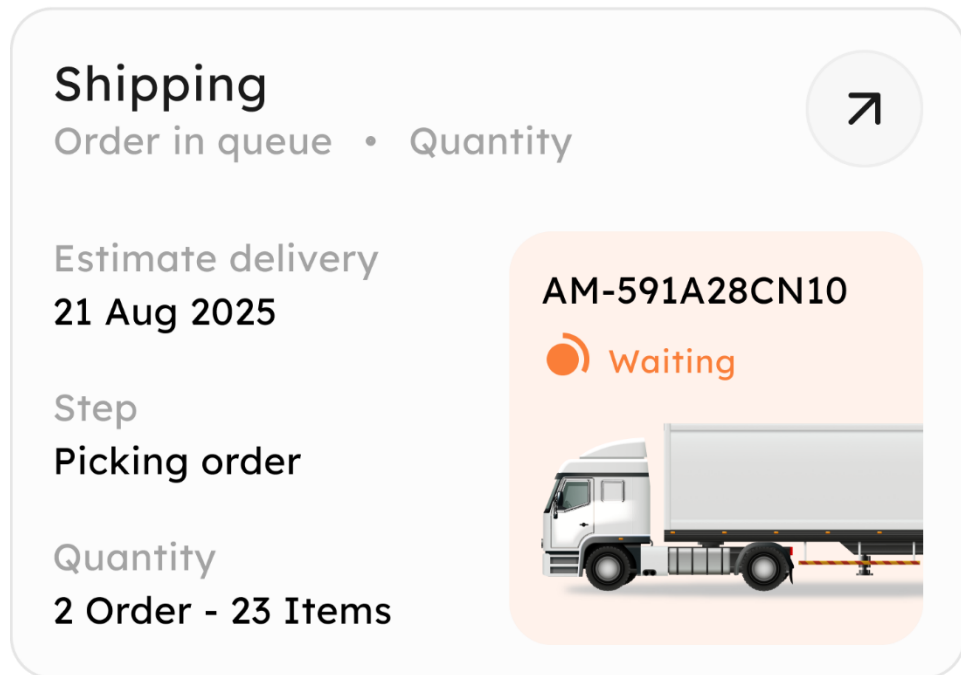


Figure 4.5: Shipping in Home Page

e. Analysis Section

- Provide information about order processing performance.
- Design:
  - Headings and subtitles: "ANALYSIS" and "Order in queue."
  - Progress Indicator: The progress circle shows "315/481" (315 out of 481 processed orders), the orange bar fills more than half a circle.
  - Status: A green tick and the word "Fast", indicating good processing speed.
  - Right arrow: Suggests more analytical data.

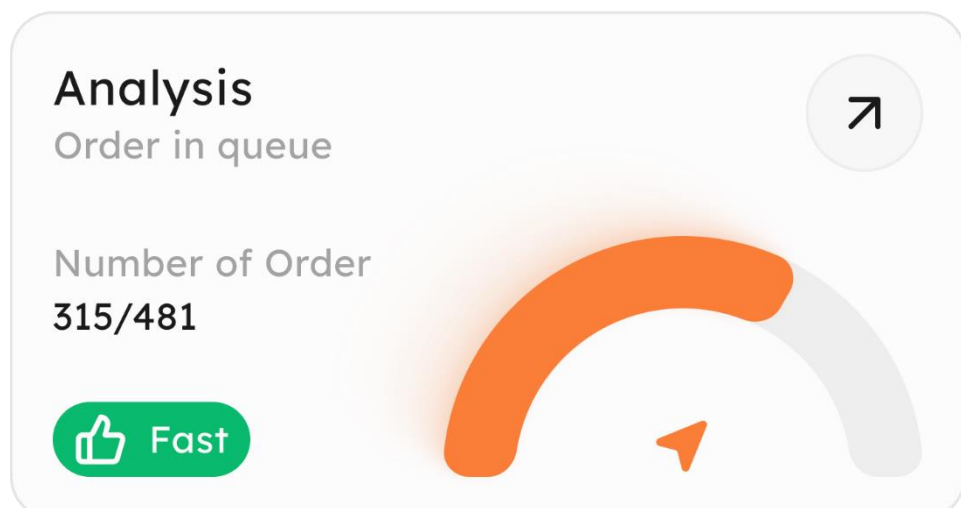


Figure 4.6: Analysis in Home Page

f. Resources Section

- Show and give information about human resources or machines in warehouse operations.

- Design:
  - Title: "RESOURCES."
  - Quantity: Displayed as avatars, symbolically displaying 4 avatars and the number of additional employees operating in the warehouse area
  - Right arrow: Suggests a full list or resource details.

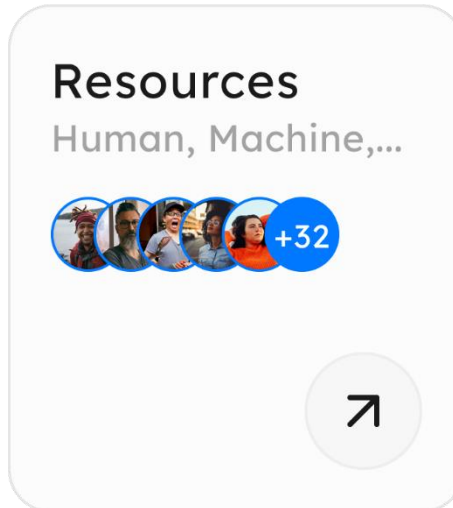


Figure 4.7: Resources in Home Page

g. Daily Report Section

- Support to create and print daily progress reports.
- Design:
  - Title and subtitles: "DAILY REPORT" with "Progress Report."
  - Action button: The green "Print report" button allows you to print or create a report.
  - Icon Document: represents viewing these report documents
  - Right arrow: Suggest more options or report details.

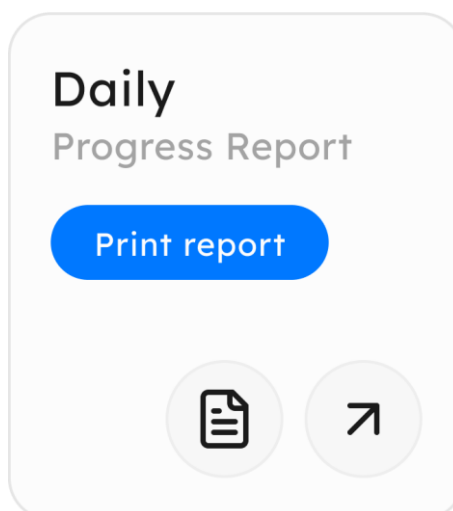


Figure 4.8: Daily in Home Page

#### 4.2.1.2.2 Space Screen Function

a. Overview of "Space"

- Main purpose: The Space screen helps users manage storage spaces by providing the ability to create new ones, view information, and track usage. It serves as a tool to support space optimization and ensure warehouse operational efficiency.
- Location in the app: As one of the five main tabs in the bottom navigation bar (including "Home", "Space", "Quality", "Order", "Analysis"), "Space" focuses on managing physical space, in addition to other functions such as order management or data analysis.

b. The main components of the "Space" stage

- Create New Space
  - Create a new space: Users can press the "+" button to start setting up a new storage space, such as a warehouse or warehouse area.
  - User Support: How-to materials and pre-made templates make it easy for users, especially newbies, to set up the space effectively.

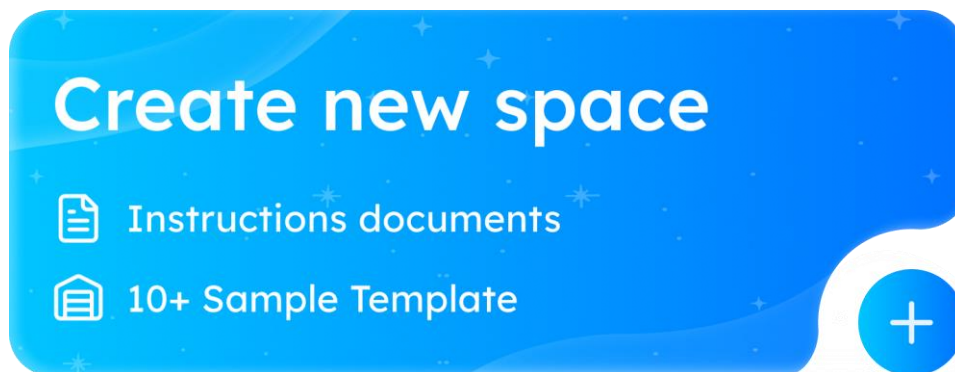


Figure 4.9: Create new space in Space Page

- Tutorial Instruction
  - Encourage optimization: This message encourages users to learn how to make the most of their storage space.
  - Additional Instructions: Buttons that lead to instructional documents or videos, assisting users in improving their management skills.

## Unlock the full potential of your space.

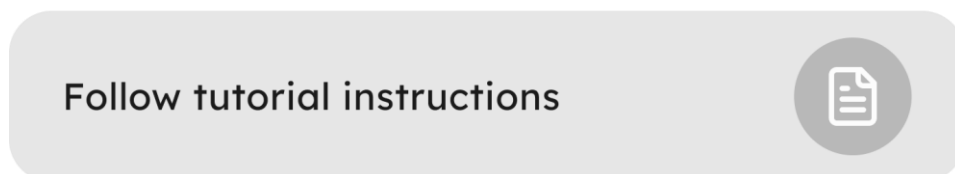


Figure 4.10: Tutorial Instruction in Space Page

- List of Spaces (Your Spaces)
  - The "Your Space" header shows the spaces you have created and are using in your inventory, and you can see all the spaces in the "See all" button.

The two spaces are displayed as colored cards and can be swiped horizontally to see more cards about the space.

- View spatial information: Display basic information such as name, area, number of goods, number of employees, and usage level.
- Track usage: The "Usage" progress circle provides a quick view of space usage.

## Your Spaces

See all

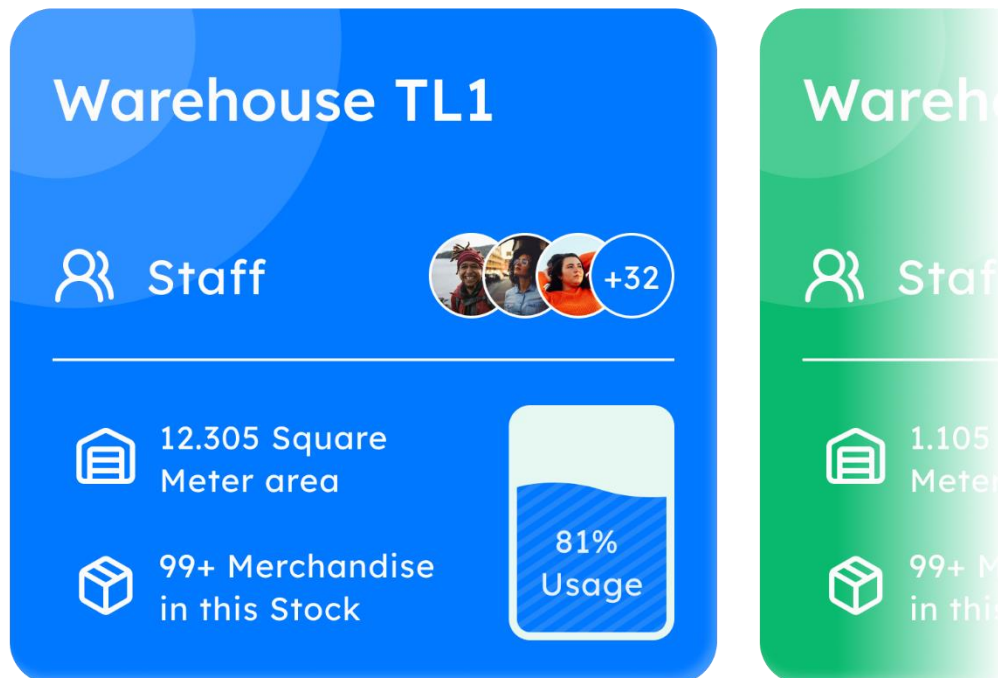


Figure 4.11: Your Space in Space Page

### 4.2.1.2.3 Quality Screen Function

#### a. Function

The Quality screen focuses on controlling and ensuring the quality of goods as well as warehouse operations. This is where users can monitor equipment status, schedule maintenance, and monitor the quality of goods to ensure the warehouse operates efficiently and meets standards.

#### b. Feature

- Schedule periodic maintenance: Users can plan maintenance for machines and equipment in the warehouse, ensuring they are always in stable operation. For example, schedule monthly machine inspections or repairs as needed.
- Machine Quality Monitoring: Monitor the performance and condition of machines, detecting problems such as failures or performance degradation early.

- Protection systems: Implement protective measures to prevent damage to equipment or goods, such as warnings when warehouse temperatures exceed thresholds.
- Goods quality monitoring and alerts: Check the condition of goods in stock (e.g., damaged, expired) and issue alerts if problems are detected.

#### **4.2.1.2.4 Order Screen Function**

##### *a. Function*

The Order screen is designed to manage and track orders, from order creation, in-stock processing, to delivery. It helps users to grasp the real-time order status and ensure on-time delivery.

##### *b. Feature*

- Create and approve orders: Salespeople can create new orders and send them to the warehouse for processing.
- Order Status Tracking: Shows details such as "waiting", "processing", or "delivered".
- Shipping management: Track delivery vehicles, schedule deliveries, and update status when goods reach customers.
- Manage order lists: Managers can view a list of pending orders, schedule pickups, or handle issues such as defective goods.

#### **4.2.1.2.5 Analysis Screen Function**

##### *a. Function*

The Analysis screen provides data analysis and reporting tools, helping users evaluate inventory performance, order trends, and inventory status. This is where real-world decision-making is supported.

##### *b. Feature*

- Inventory Tracking: Displays the quantity, value, and quality of goods in stock.
- Cargo flow statistics: Analyze import/export trends, identify bottlenecks or opportunities for improvement.
- Charts and reports: Provide line charts, pie charts, or dashboards to visualize data.
- Performance Analysis: Evaluate order processing speed, warehouse space efficiency, and other metrics.

#### **4.2.1.3 Overview architecture of the solution**

- System Architecture Overview:  
Client (Web App) → Server (Firebase hosting/ Firebase function/Firebase auth)  
→ Database (Firestore).
- The main components in the system:
  - Web App.
  - Backend Server.
  - Database (database management system).
  - External integrated systems (ERP, WMS, QA, Zalo...).

- Data Activity Flow in the System  
From the user → the system processes → stores → user feedback.

#### 4.2.1.4 Technology and usage data

- Mobile application development technology:
  - Tool: Nuxt
  - Programming Language: JavaScript / TypeScript
- Backend technology (business processing server):
  - Nuxt, Firebase
  - Communication API: RESTful API / Firebase SDK.
- Database Management System
  - NoSQL: Firestore
- Security and authentication technology
  - Firebase Authentication
  - HTTPS/TLS
- Hosting & Deployment Technology
  - Firebase Hosting / Firebase Function
- System monitoring and analysis tools
  - Firebase Analytics / Google Analytics.
- Management and processing of business data
  - Data Model: Space, Racks, Log, User.
  - Real-time data synchronization between client and server.

#### 4.2.2 Software Creation Process

##### 4.2.2.1 System design and user flow

###### 4.2.2.1.1 System Design

To ensure the principles of system design for the application, there are sets of principles and tools to comply with to ensure the following principles:

- Ensure consistency in interface and user experience across products.
- Save time and effort for the design and development team by reusing predefined components and rules.
- Enhance collaboration between stakeholders (design, programming, product management) through a standardized document.

And the standards to ensure the principles include:

– *Font*

- Primary font: The Lexend font is a modern typeface designed with the primary goal of improving readability and reducing eye strain, which is especially useful in contexts that require fast or long-term reading such as in mobile apps, e-books, and educational content.
- Weights: Minimum Light (300), Regular (400), Semi-Bold (600), Bold (700). Each weight corresponds to a different degree of emphasis:

- Bold for the main heading (H1).
- Semi-Bold / Regular for subheadings (H2/H3) and body.
- Light for captions, small captions.
- Type Scale:
  - Display (Large): 57px (usually used on the dashboard or welcome screen).
  - Headline: 34px, 24px for section titles.
  - Body (Content): 16px for the main text.
  - Caption: 12–14px for subtext, metadata information.
  - Line-height, letter-spacing: Each size has an optimal line-height and letter-spacing to enhance readability and spacing between characters.

## Lexend

Ag

ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz  
0123456789 !@#\$%^&\*()

*Figure 4.12: Lexend font*

- *Colour*
  - Primary color: The primary color is used to express the brand and key elements such as navigation bars, call-to-action buttons (CTAs), and primary icons. Build the shades of the main color: is navy blue with shades from Blue 100 → Blue 900 for Buttons/CTAs (mainly in Blue 500/600). Accent (use a lighter hue as a background or hover).
  - Secondary color: Supports the primary color, usually for secondary buttons, statuses, or highlights, as well as shades of blue but other tones

## Primary color

The main primary brand swatches is our official Blue

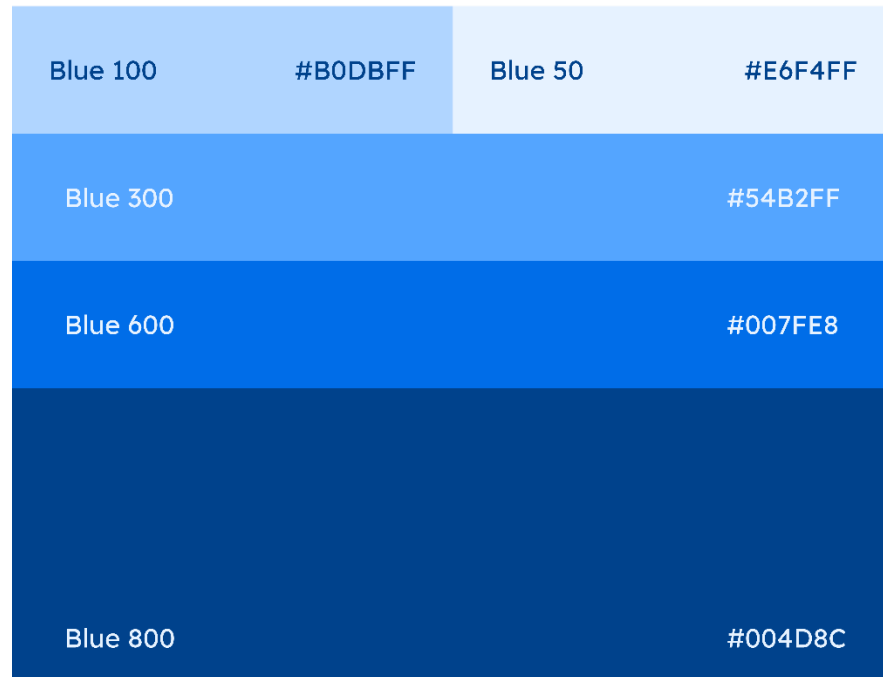


Figure 4.13: Primary color

- Background colors: Used for the entire background of apps, cards, consoles, etc. White 100–200 is used as the main background, White 300–400 is used as the secondary background, White 500–700 is used for borders and dividers.
- Text colors: Used for the entire color of the text (Black-500 hex#1a1a1a), lighter gray for descriptions or sub-information (Gray-900 hex#616161), and matte gray for disabled (Gray-500 hex#e6e6e6).

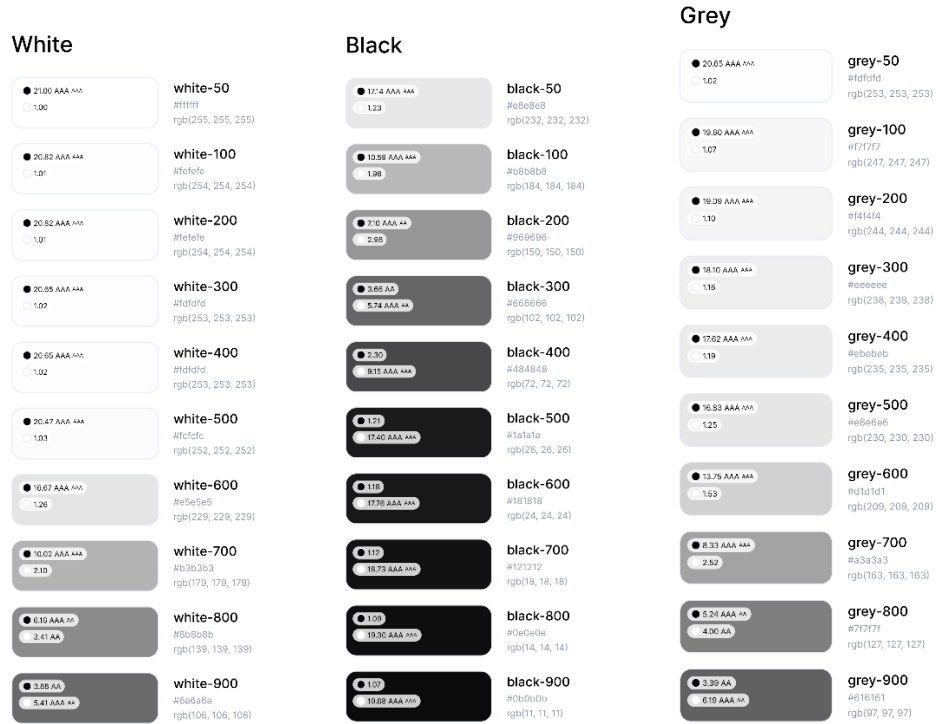


Figure 4.14: White-Black-Gray Palette

- Semantic colors: Used to convey status or user feedback:
  - Success: Green (Green-500 hex#009b96e)
  - Error: Red (Red-500 hex#e83f25)
  - Warning: Orange yellow (Orange hex#fa7e38)
  - Info: Blue hex#0078ff
- Consistency and extensibility: The color palette should be built according to the design system with color tones and variations (shades, tints) for easy reuse and expansion.



Figure 4.15: Color palette system

- Components
- Basic Components
  - Button:
    - Kích thước chuẩn (height 40–48px, horizontal padding 16px), border-radius 8px.

- States: Normal, Hover, Pressed, Disabled (decreased opacity).

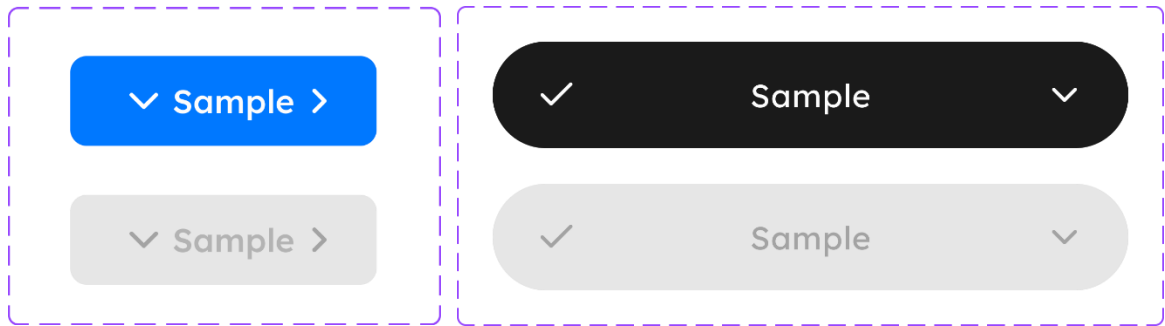


Figure 4.16: Normal and Large Button

- o Inputs / Forms:
  - Field height 48–56px, padding 12px, border 1px solid neutral.
  - States: Focus (discolored border), Error (red border + warning icon).

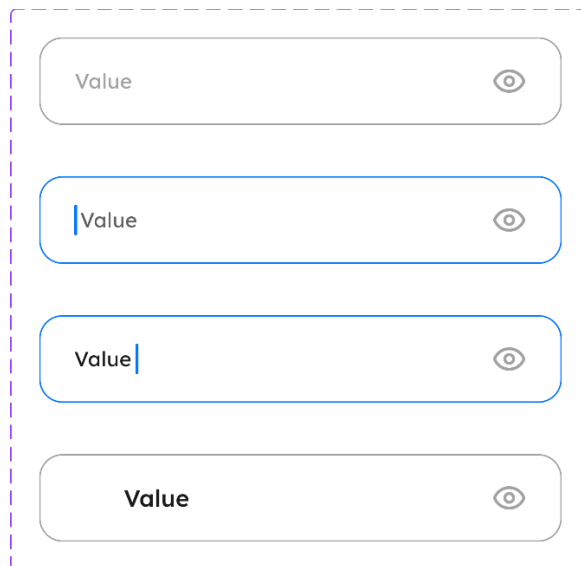


Figure 4.17: Text field input

- o Checkbox, Radio: Touch area size  $\geq 48 \times 48$ dp, clear icon, with label text attached.

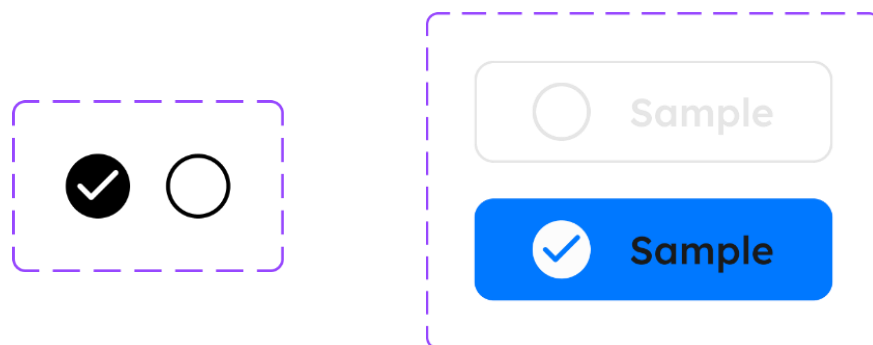


Figure 4.18: Checkbox & Radio

- Advanced Components

- Navigation Bars: Displays the possible and repetitive scenarios of the navigation bar

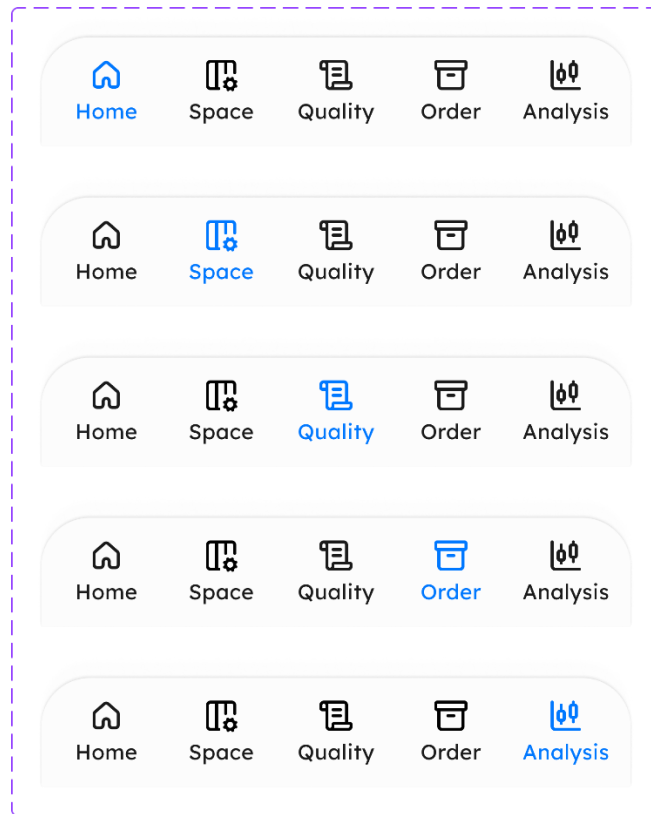


Figure 4.19: Bottom navigation

- Progress step: shows the process from the beginning to the last step of the stage

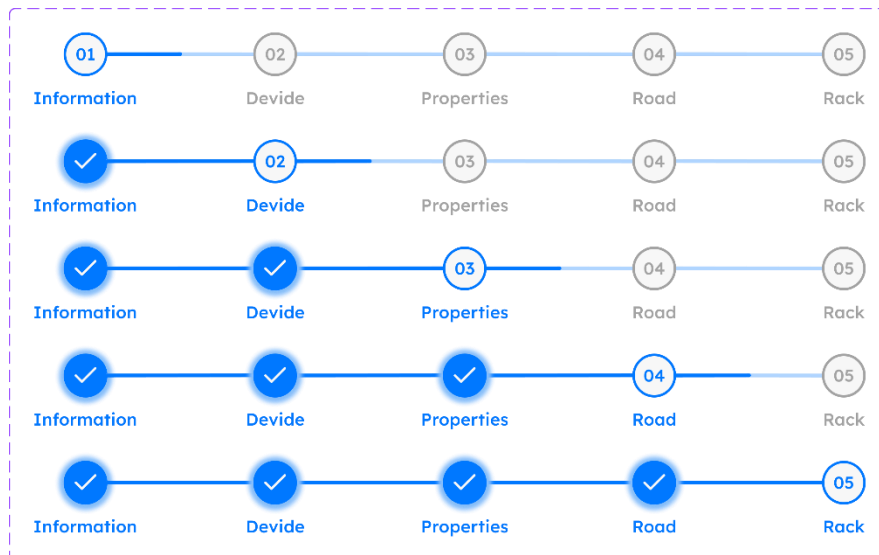


Figure 4.20: Progress step

- Grid & Spacing
  - Grid is an invisible grid system that helps elements (text, buttons, tags, forms, etc.) align evenly and have clear rules. Use 8px base grid: 8px is

the base unit → all distances, sizes are multiples and divisors of 8: 2, 4, 8, 16, 24, 32, 40, 48, 64, etc.

- Spacing scale is a standard set for margins, padding, and gaps between elements. The values used include:
  - 8px – a very small gap (between the icon and the text).
  - 16px – average spacing (between paragraphs, input fields).
  - 24px – large spacing (spacing between sections, groups of information).
  - 32px, 40px – for widescreen, outer padding.

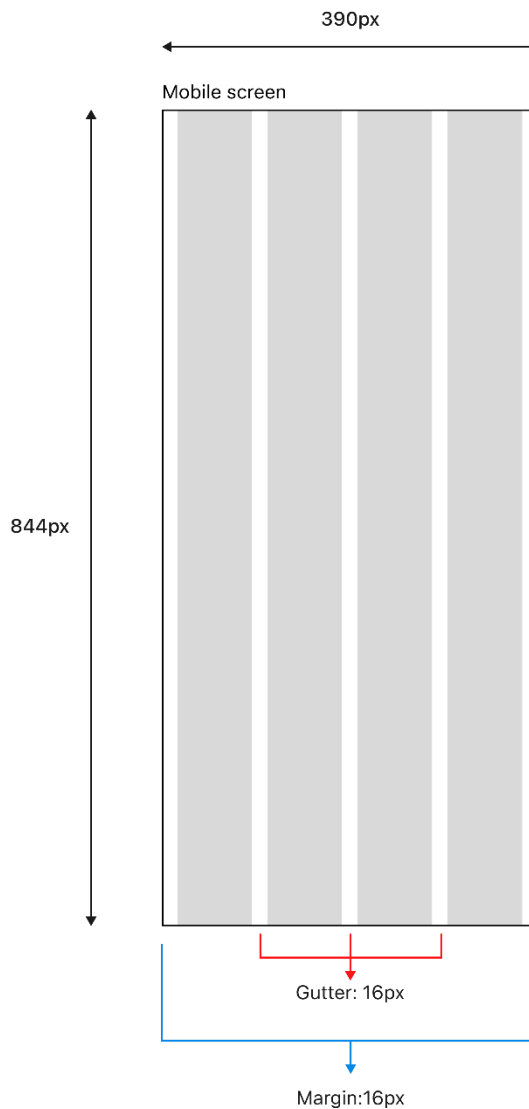
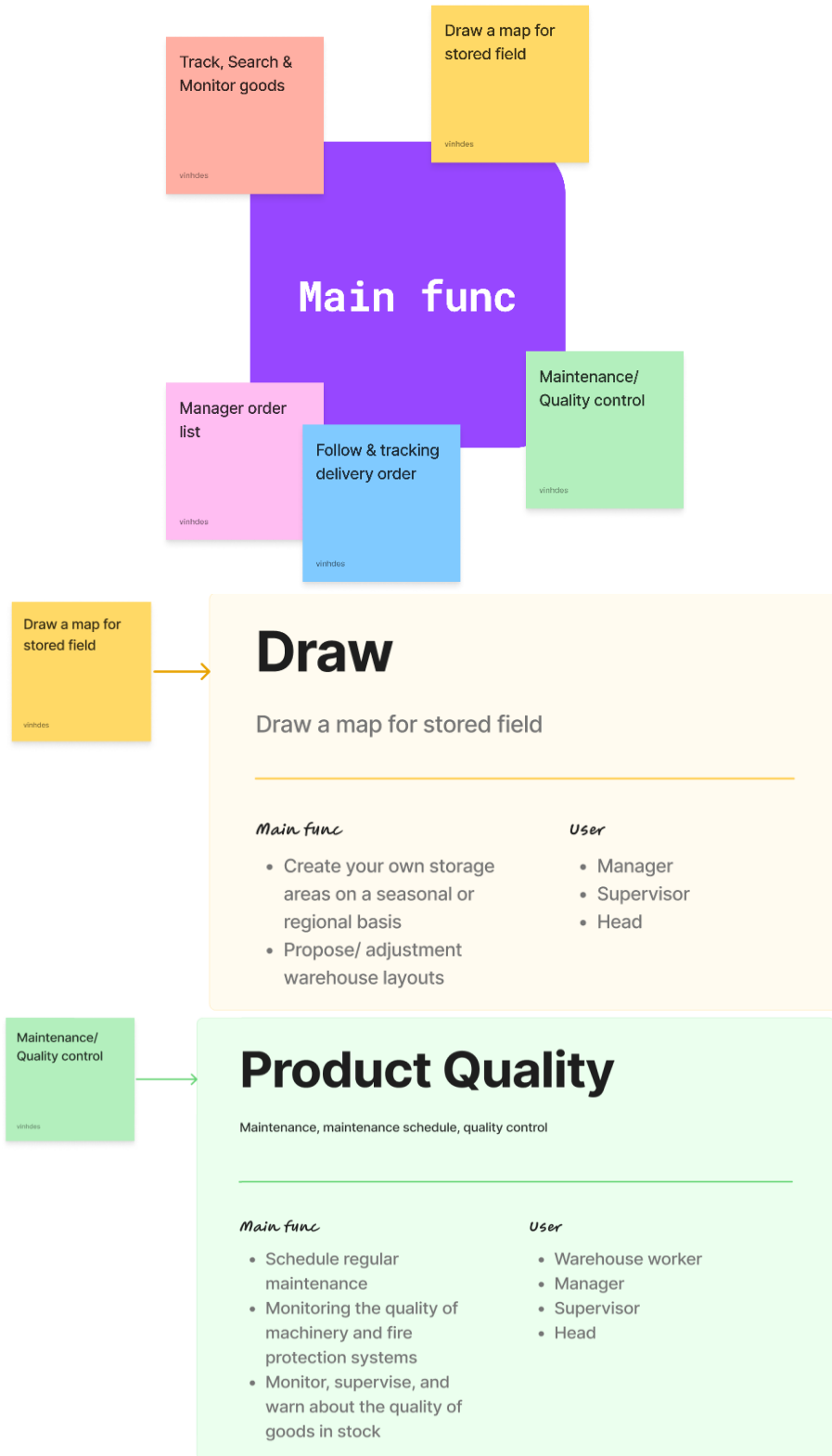


Figure 4.21: Grid and Spacing layout

#### 4.2.2.1.2 User flow

##### a. Functional Ideas



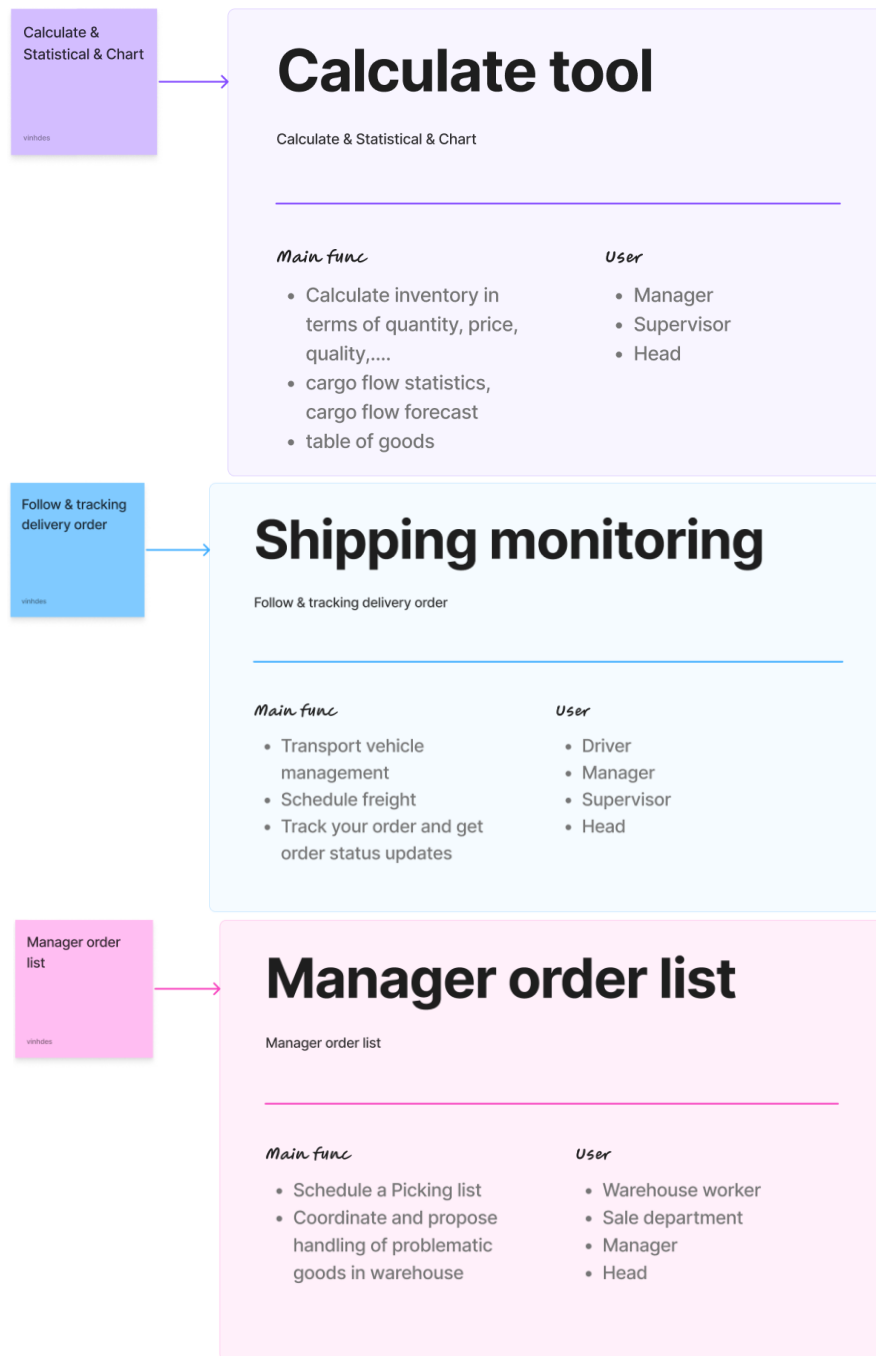


Figure 4.22: Initial Functional Concept

- The app is a multi-functional warehouse management tool that helps track goods, manage operations, map warehouses, control quality, and support decision-making through statistical reporting. Designed for multiple user groups in the supply chain to optimize performance and transparency during warehouse operations.
- b. *User usage flow*
  - To turn an idea into a flowchart, there are a number of specific analysis and design steps that need to be taken as follows:
  - *Step 1: Define the Idea*

- The app is designed to assist users in managing storage space, orders, quality, and statistics. This suggests that it is a warehouse management or storage space management tool, with the main goal of optimizing warehouse-related activities, improving operational efficiency, and providing insights to support decision-making.
- The purpose is a guideline to define the core features and values that the app brings. In this case, the application helps users organize storage space, track orders, ensure product quality, and analyze data effectively.
- If applied to a packaging company Tan Long Packaging Co., Ltd., the application can manage packaging types (carton boxes, plastic bags), track inventory counts, check product quality, and generate statistical reports to optimize production and distribution processes.
- Determine the input and output of the application:

<b>Input</b>	<b>Conclusion</b>
Information about storage space: The number, size, location of storage areas in the warehouse.	Inventory Report: The amount of goods available, the status of the storage space.
Order information: Product quantity, product type, delivery time.	Order statistics: Summarize orders that have been processed, are pending, or have issues.
Quality information: Quality standards, product inspection results.	Quality information: Reports on products that pass/do not meet standards.
This may include data from other sources such as IoT sensors (temperature, humidity) or enterprise management systems (ERP).	Data analysis: Charts, trends, or alerts when something goes wrong (e.g., low inventory, reduced quality).

Table 4.3: Application input and output criteria

- *Step 2: Identify Core Features*
  - List major functions: Features are divided into modules or groups of key functions, each focusing on a specific aspect. Then analyze the role of each function to understand how each function contributes to meeting user needs. And finally, prioritize by determining which features are must-haves and which features can be developed later (should-have, could-have).

<b>Stt</b>	<b>Function</b>	<b>Role</b>	<b>Priority</b>
1	Login / Register	Ensure that only authorized users access the app, and decentralize permissions	Must have (Bắt buộc)
2	Home page	As a control center, displaying important information such as	Must have (Bắt buộc)

		inventory status, pending orders, or alerts	
3	Create a space	Allows setting up storage areas (shelves, warehouse areas) to organize the warehouse as desired	Must have (Bắt buộc)
4	Space Management	Update storage space information (number of stocks, location, availability/full status) to optimize space usage	Must have (Bắt buộc)
5	Quality Tracking	Ensure goods meet standards, avoid defective products	Should have
6	Order Management	Integrate the process from order receiving, picking, packaging to delivery, helping to minimize errors and increase efficiency	Must have (Bắt buộc)
7	Data Analytics	Provide reports on inventory, order trends, or quality issues, supporting strategic decision-making	Could have
8	User Manual	Help new users quickly familiarize themselves with the app through documentation, videos, or FAQs	Should have

Table 4.4: Identify key functions and prioritize them

- Step 3: Define the User Flow
  - In a warehouse management application, the user flow needs to ensure employees can easily go from the login screen to checking inventory or processing orders quickly. To define a user flow, specific steps are typically taken as follows:
    - Step 1: Determine the start and end points
      - Starting point: the first screen the user sees, the welcome screen.
      - Endpoint point: Where a user completes a task, like viewing a report or updating inventory information.
    - Step 2: Intermediate Steps
      - Login Flow: Login → Authentication → Home Page Access.
      - New Creation Flow: "Space" → Select "Create Space" → Enter Information → Confirm → Success → Return to the "Space" screen.
      - View and edit streams: The "Space" screen → Select a → View details → Edit → Save.
    - Step 3: Conditional Branches
      - Login Flow: Start → Login Screen → Check Information (True/False) → If True: Go to the home page; If incorrect: Re-enter.

- New Creation Flow: "Space" screen → New User or not (true/false) → If true: go to the user manual; if false: create a space → Enter information → Confirm → Success → Return to the "Space" screen.
- View and edit streams: → Select an item → View details → Edit → Enter edit information → View details → Save.
- o Step 4: Draw a flow diagram

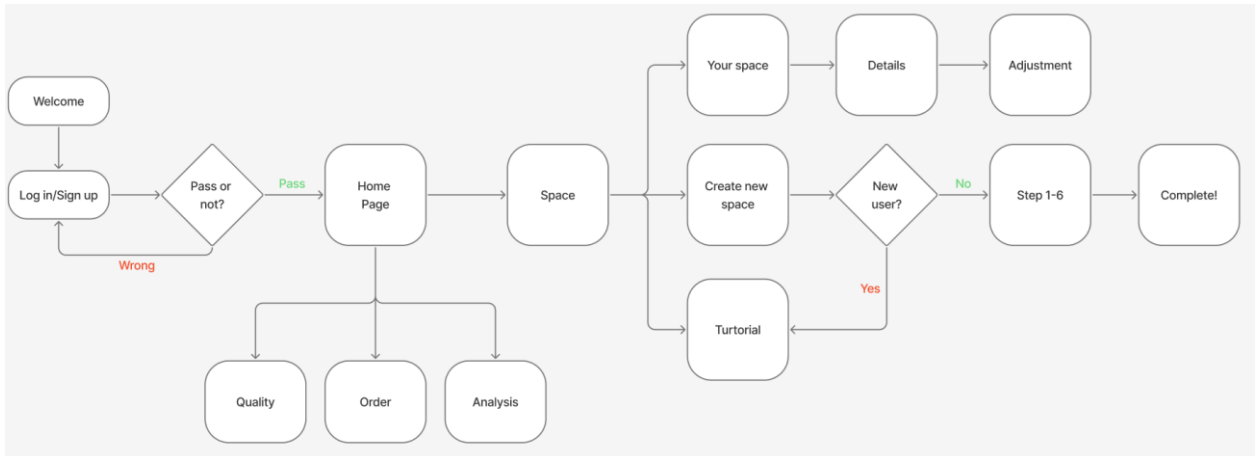


Figure 4.23: User Flow Diagram

- Step 4: Information Grouping
  - o Purpose: in a warehouse management application, this step ensures that warehouse staff can quickly find important features without having to navigate through multiple unrelated screens.
  - o Information grouping:
    - "Manage Spaces" page: create new spaces, view your spaces, edit spaces, and user guides.
    - Home: Total cargo, warehouse status, freight status, order quantity, resources, human resources, reports.
  - o Information stratification:

Home page	
Total cargo	Order
	Value
	Date
Warehouse Status	Total quantity
	Empty space
	Cargo Status
	Updated Date
Freight Status	Estimate
	Condition
	Amount

		Transport Vehicles
Order quantity		Amount
		Processing Speed
Human Resources		Amount
Report		Print Report
		Read the report
<b>Space</b>		
Create a new space		Information
		Create a new space
User Manual		Information
		Document
Your Space	Status of each warehouse	Manpower
		Area
		Amount of goods
		Empty space

Table 4.5: Information stratification

- Step 5: Flowchart Design (Flow Mapping)

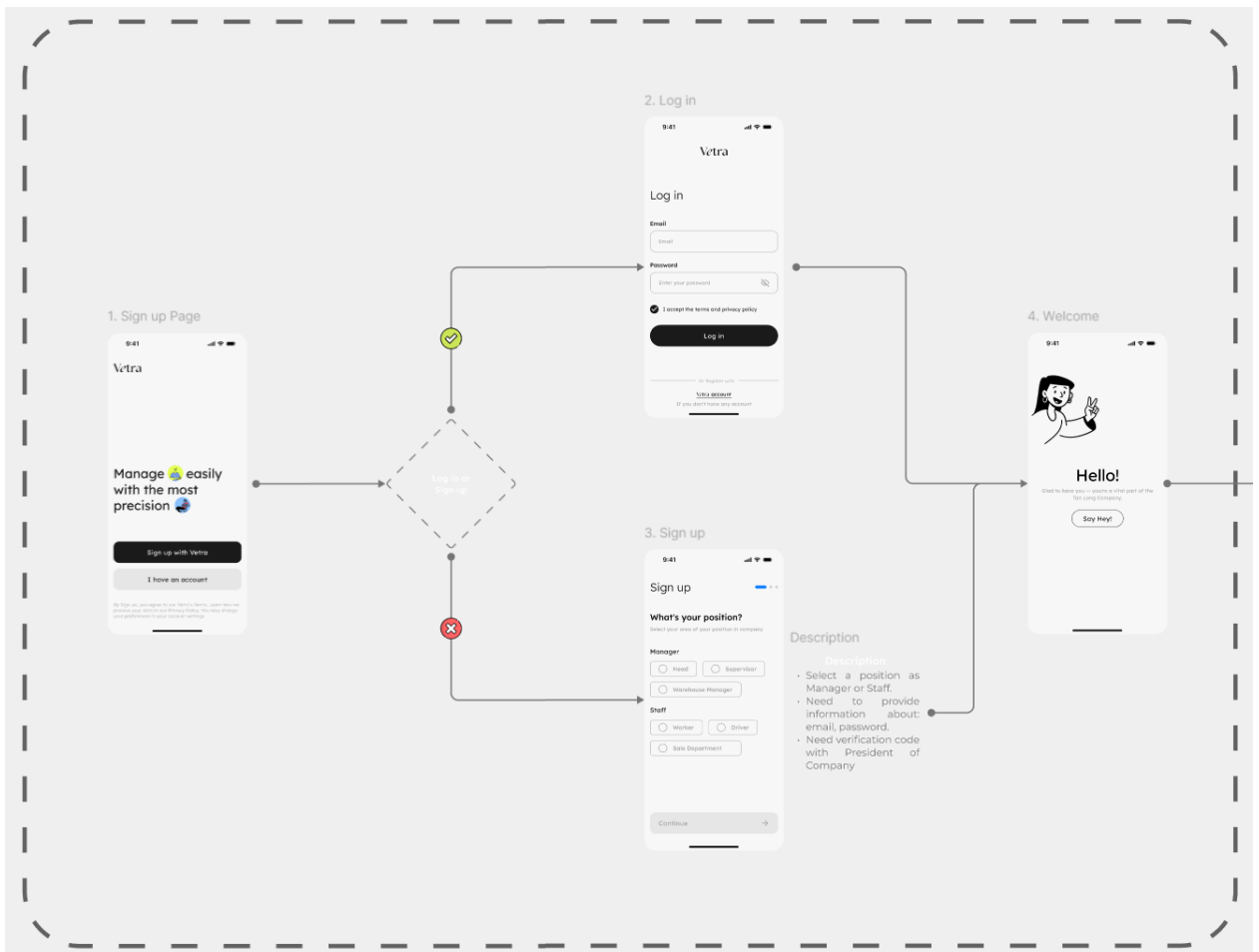


Figure 4.24: Flowchart Sign up/ Log in

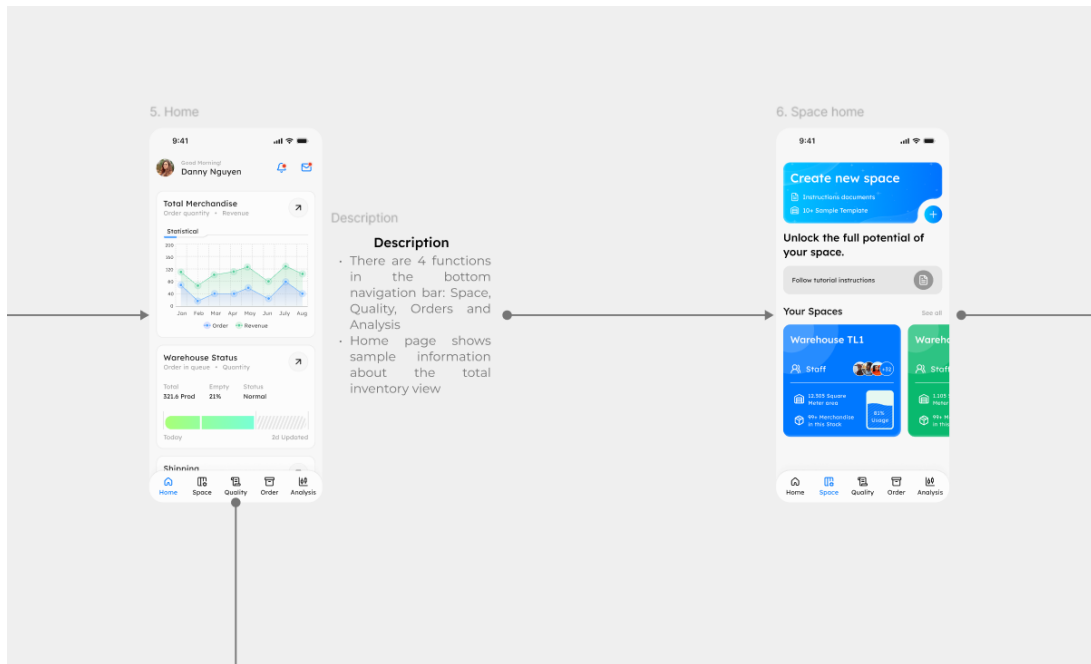


Figure 4.25: Flowchart Home – Space

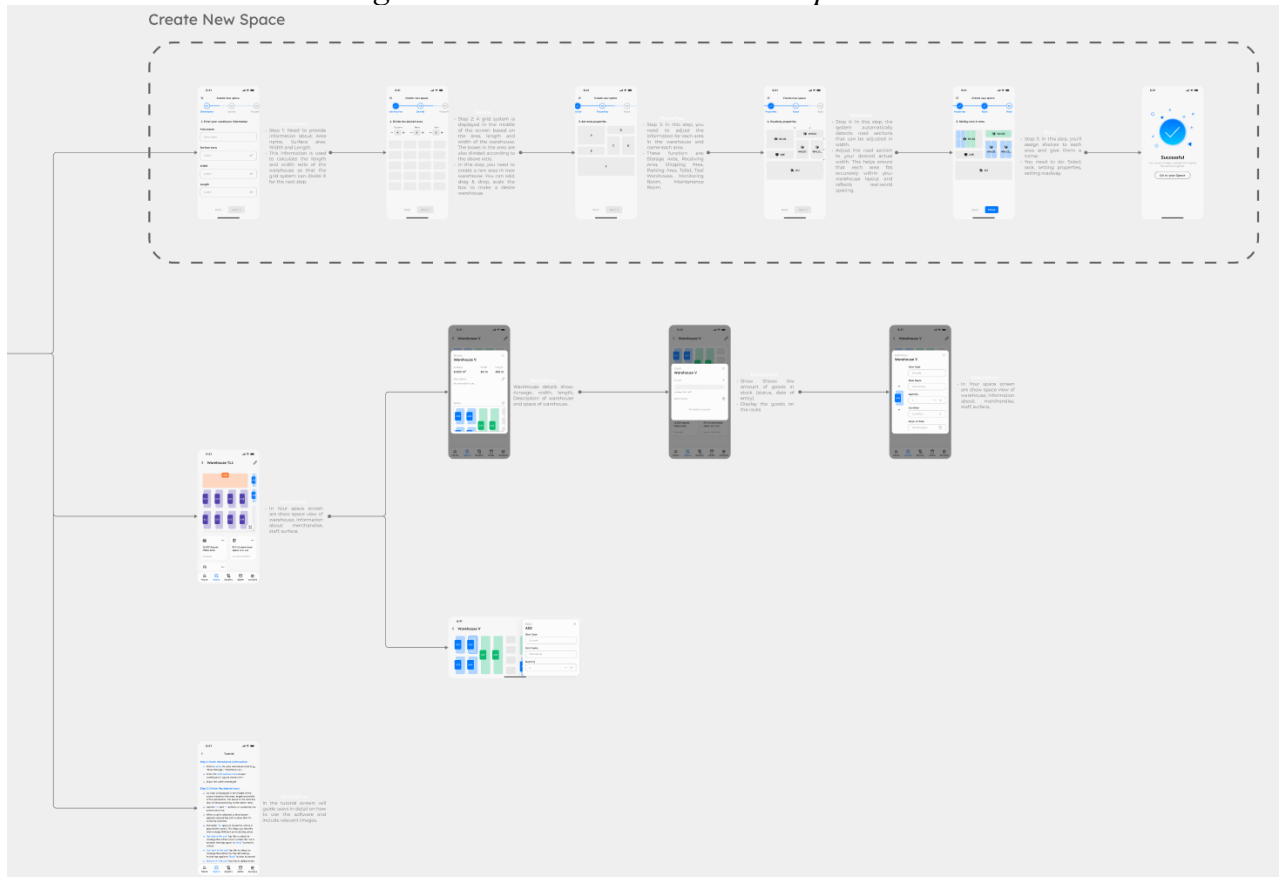


Figure 4.26: Flowchart Space

## 4.2.2.2 UI/UX Interface Design

### 4.2.2.2.1 Log in & Sign Up

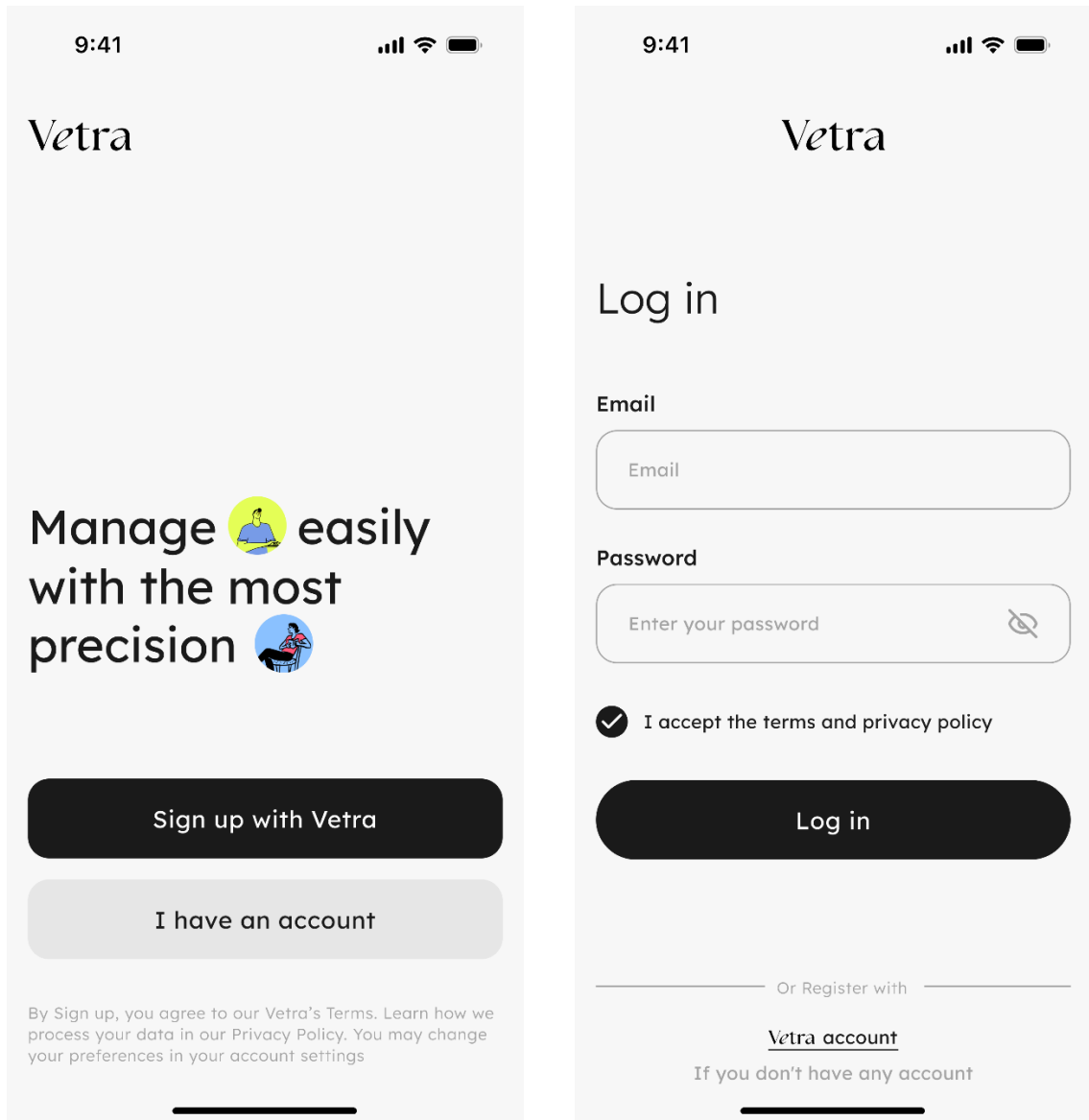


Figure 4.27: Log in & Sign up Screen

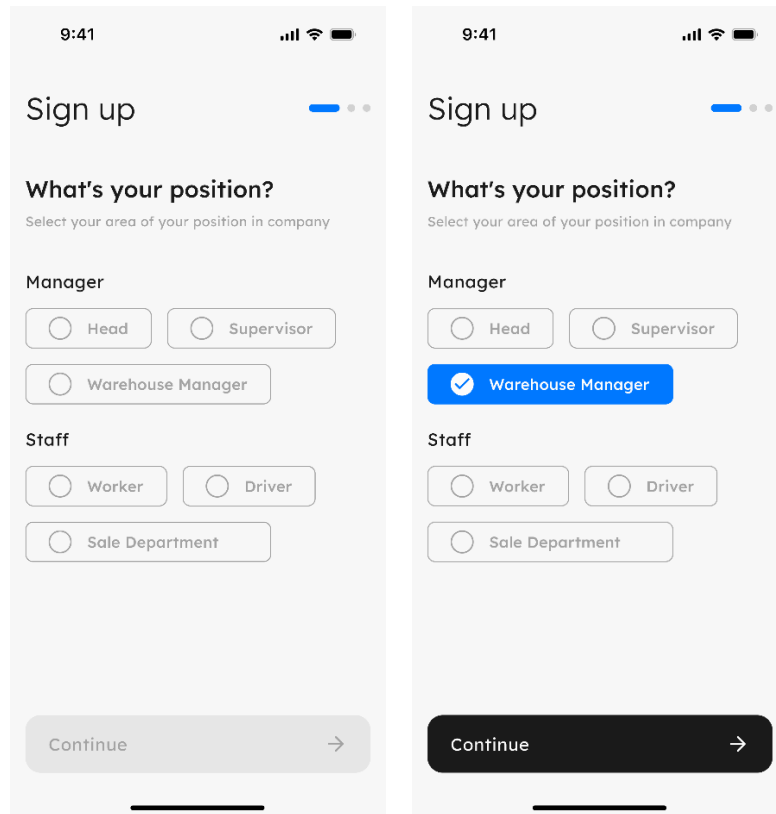


Figure 4.28: Step 1 in Sign up

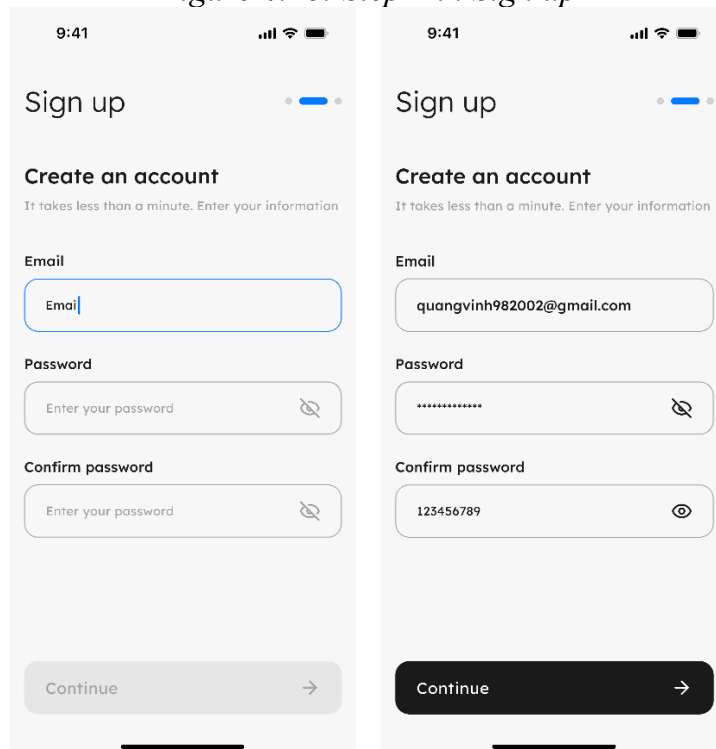


Figure 4.29: Step 2 in Sign up

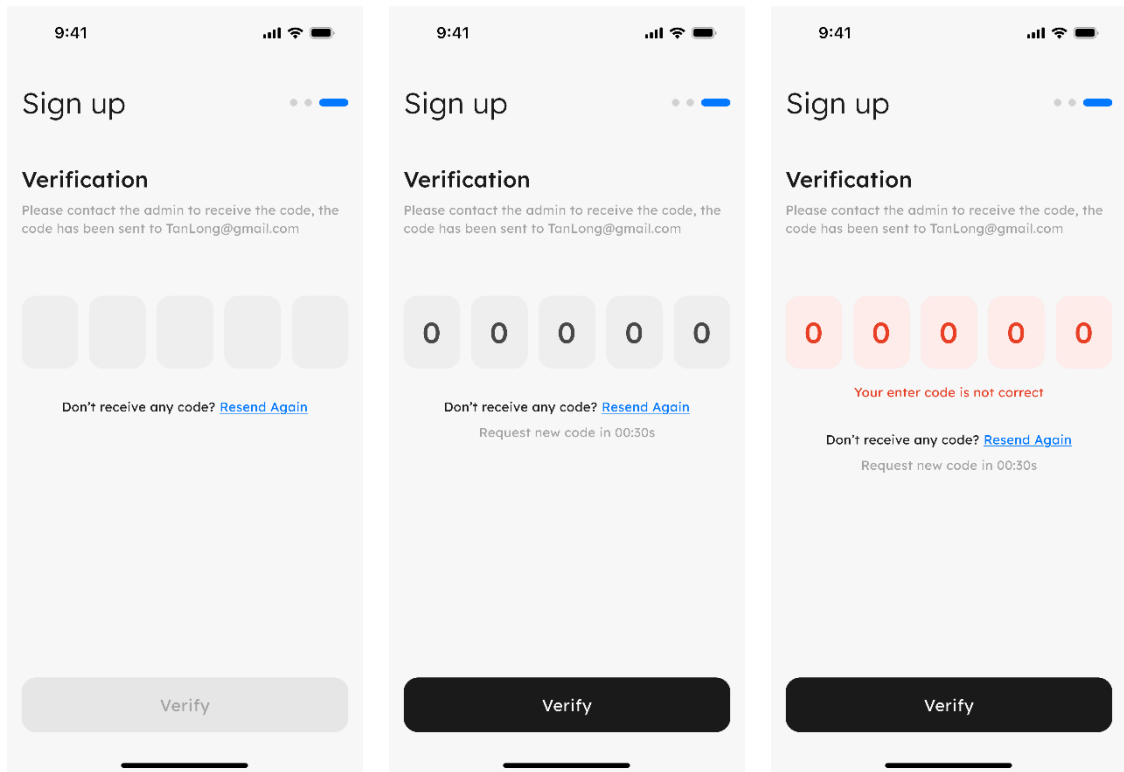


Figure 4.30: Step 3 in Sign up

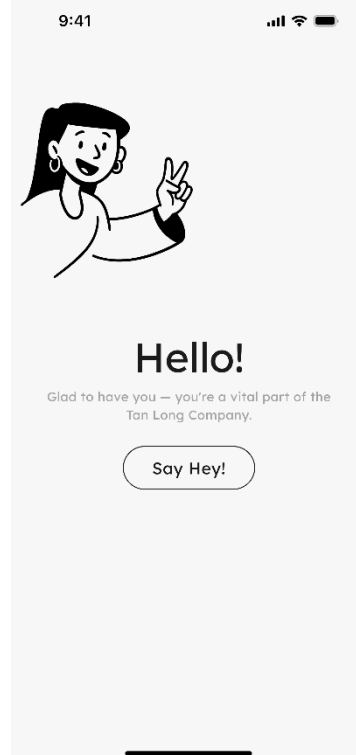


Figure 4.31: Welcome screen

#### 4.2.2.2.2 Main Screen

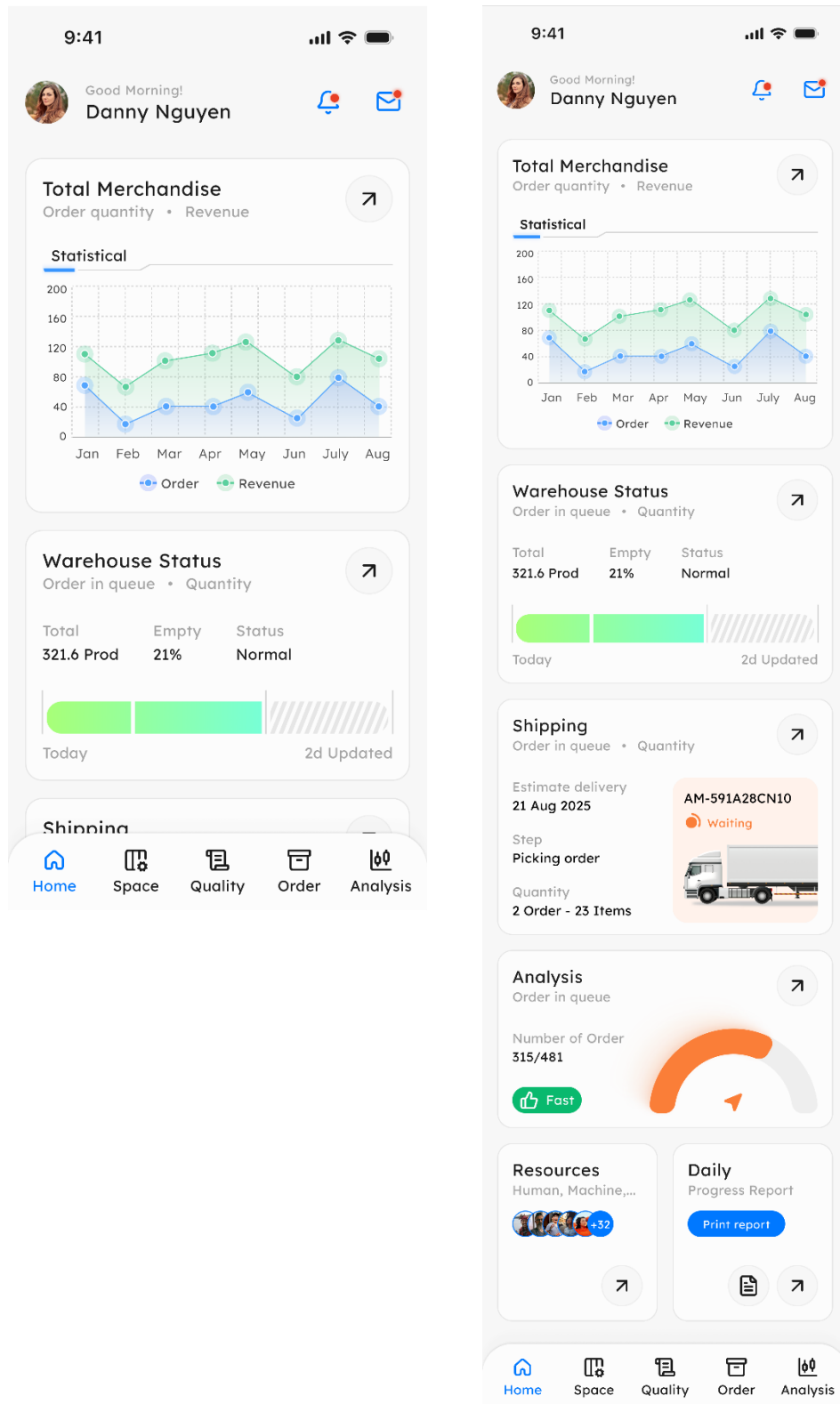


Figure 4.32: Home screen and Home screen expand

#### 4.2.2.2.3 Space

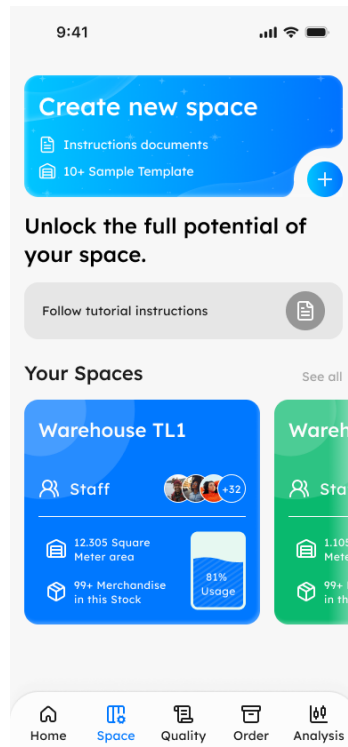


Figure 4.33: Space Screen

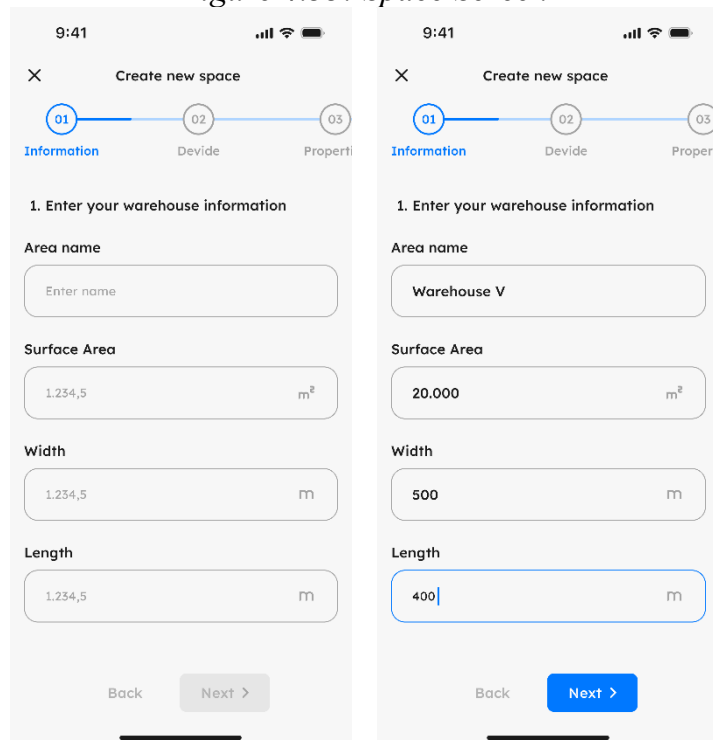


Figure 4.34: Create new space – Step 1: Information

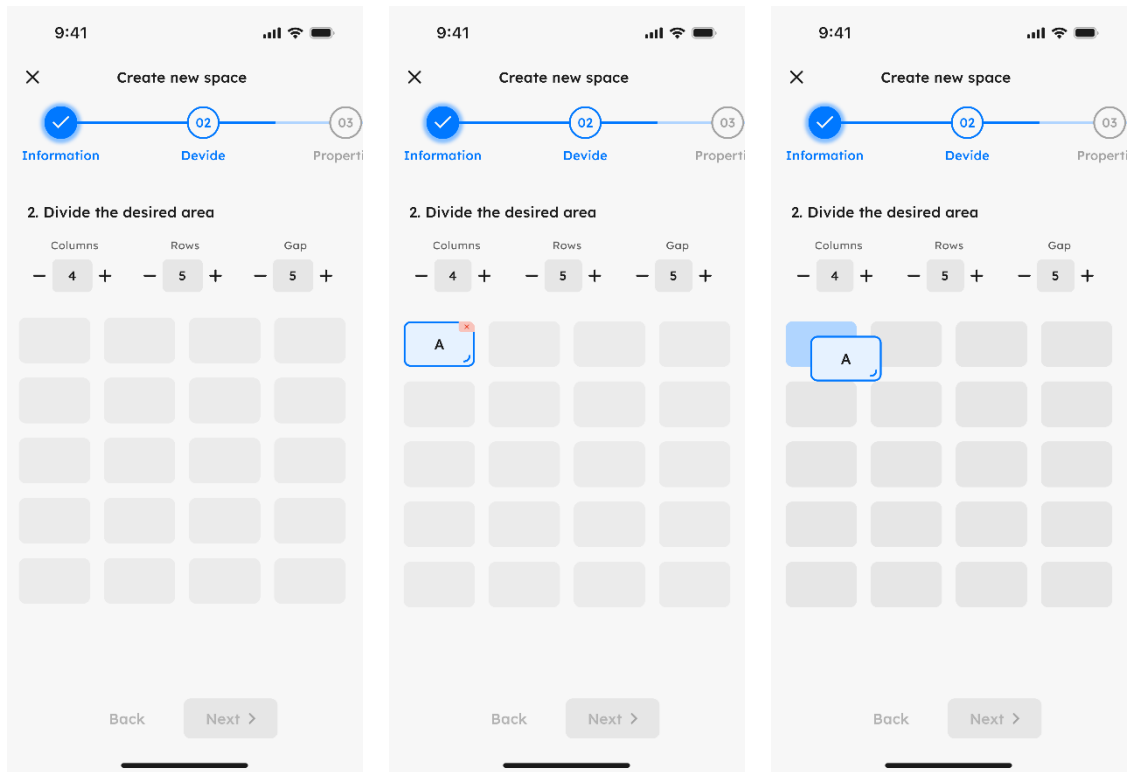


Figure 4.35: Step 2: Divide – Select – Drag & Drop screen

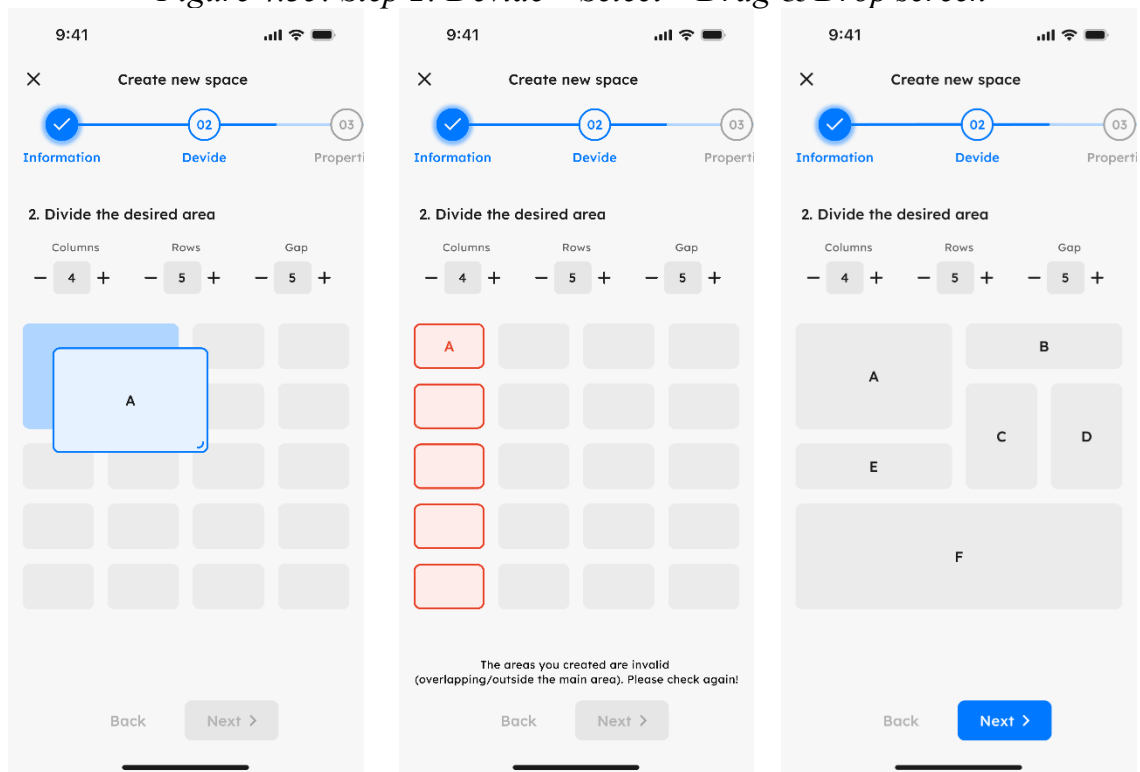


Figure 4.36: Step 2: Expand – Error – Completed screen

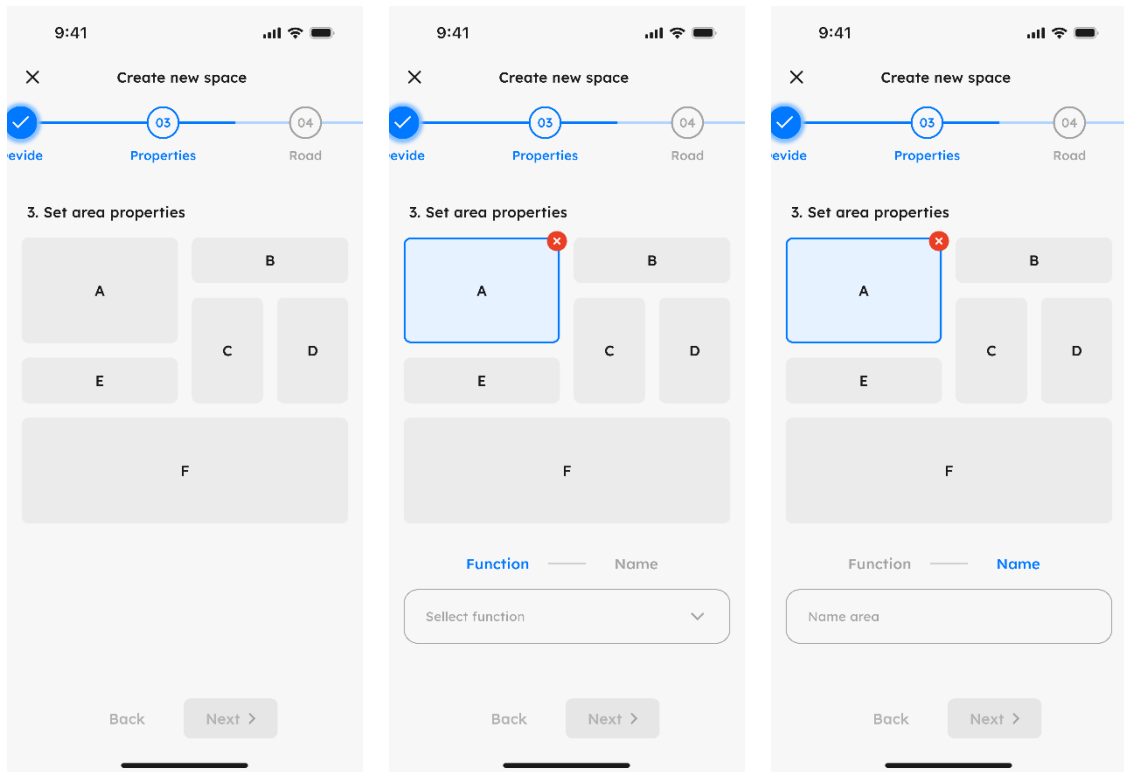


Figure 4.37: Step 3: Properties – Function – Name screen

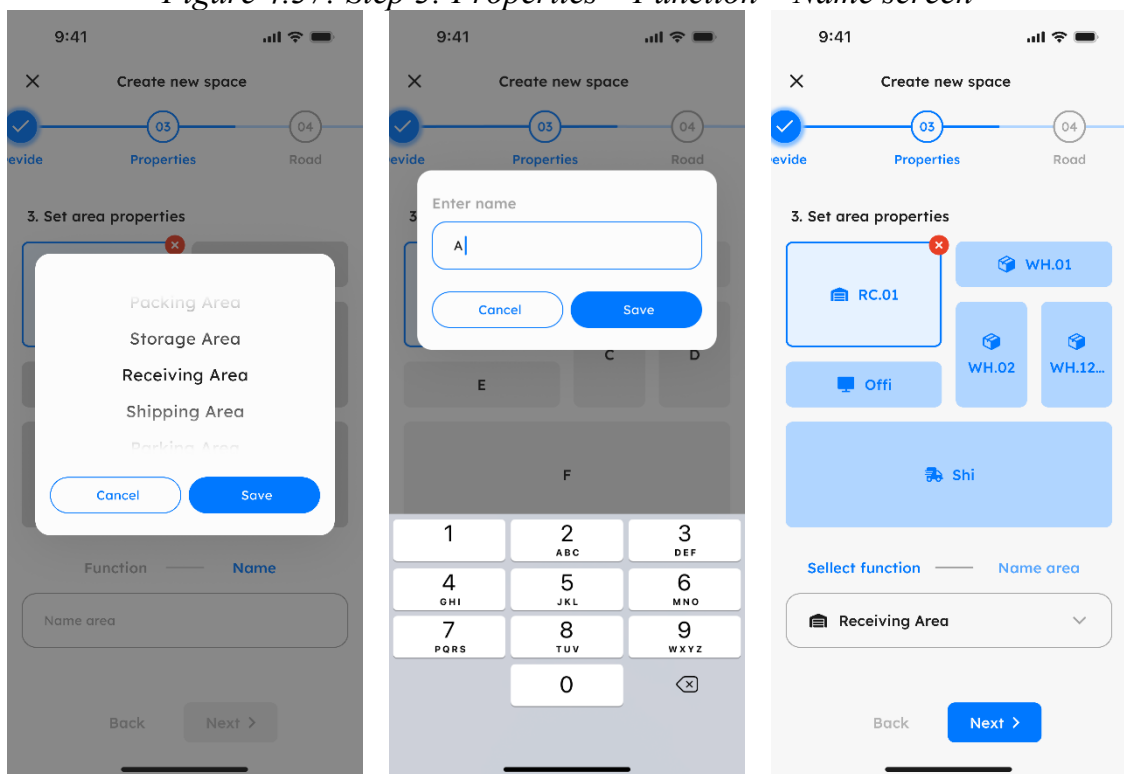


Figure 4.38: Step 3: Select function – Select name – Completed screen

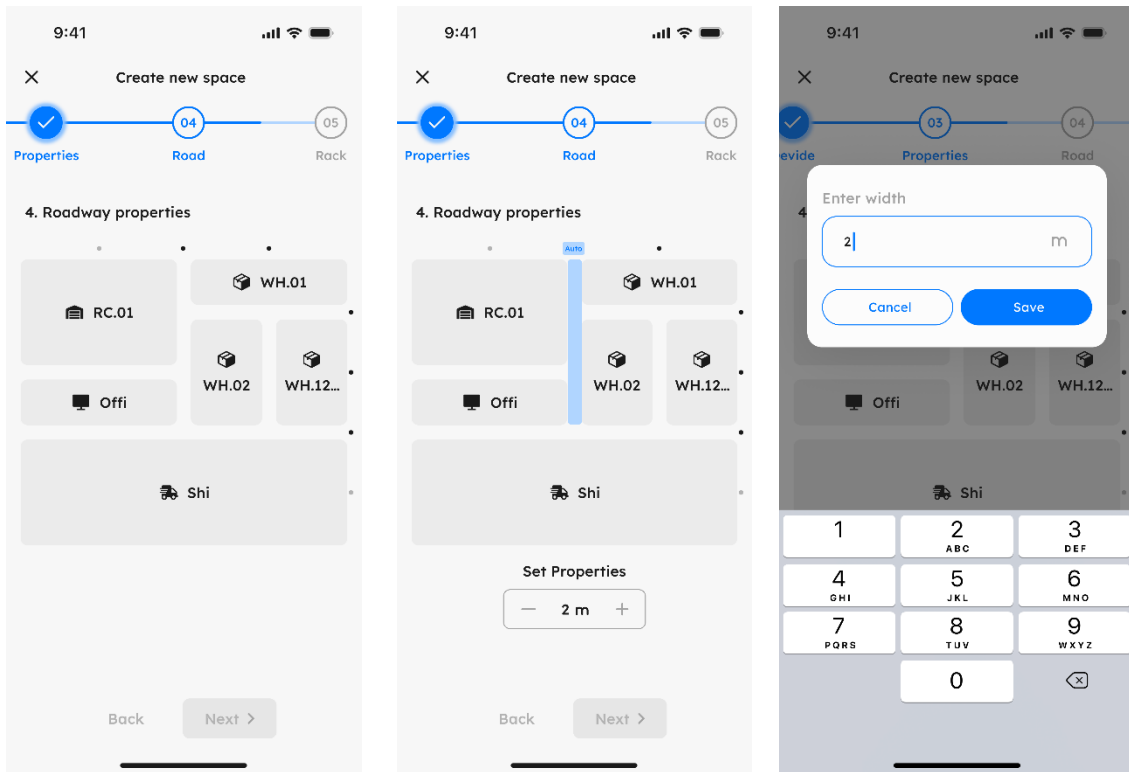


Figure 4.39: Step 4: Step 4: Road – Set Roadway properties – fill screen

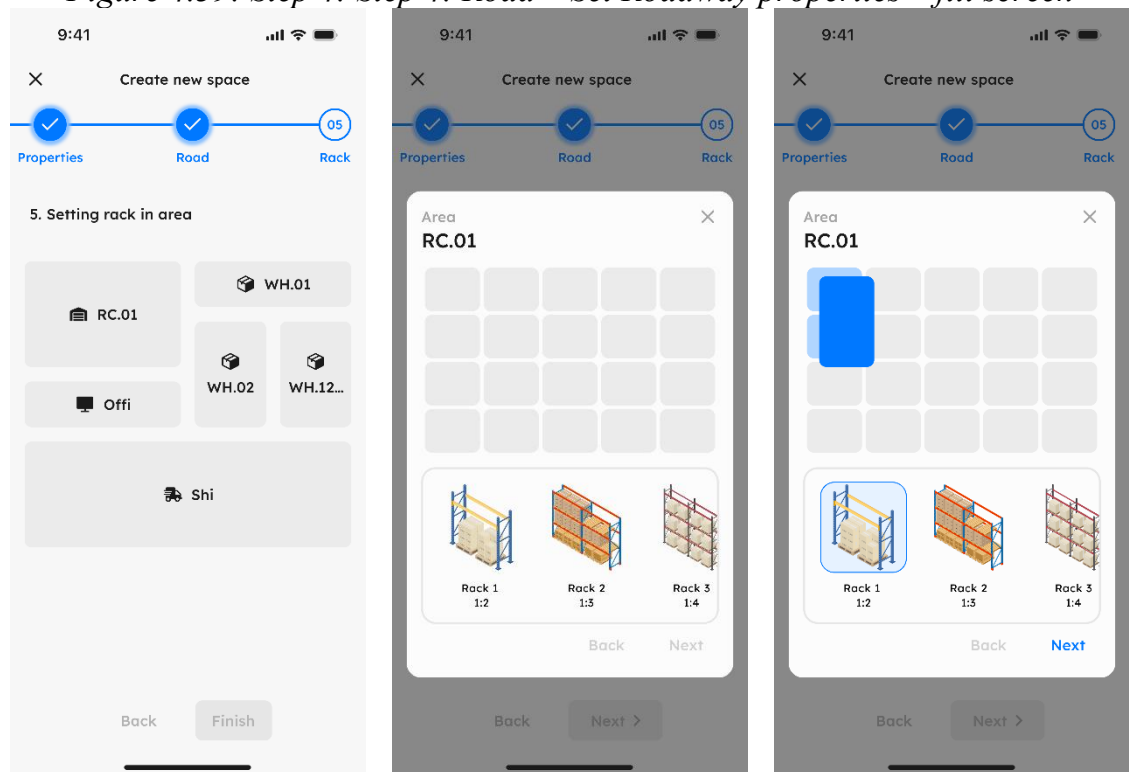


Figure 4.40: Step 5: Rack – Dialog rack – Drag & Drop rack screen

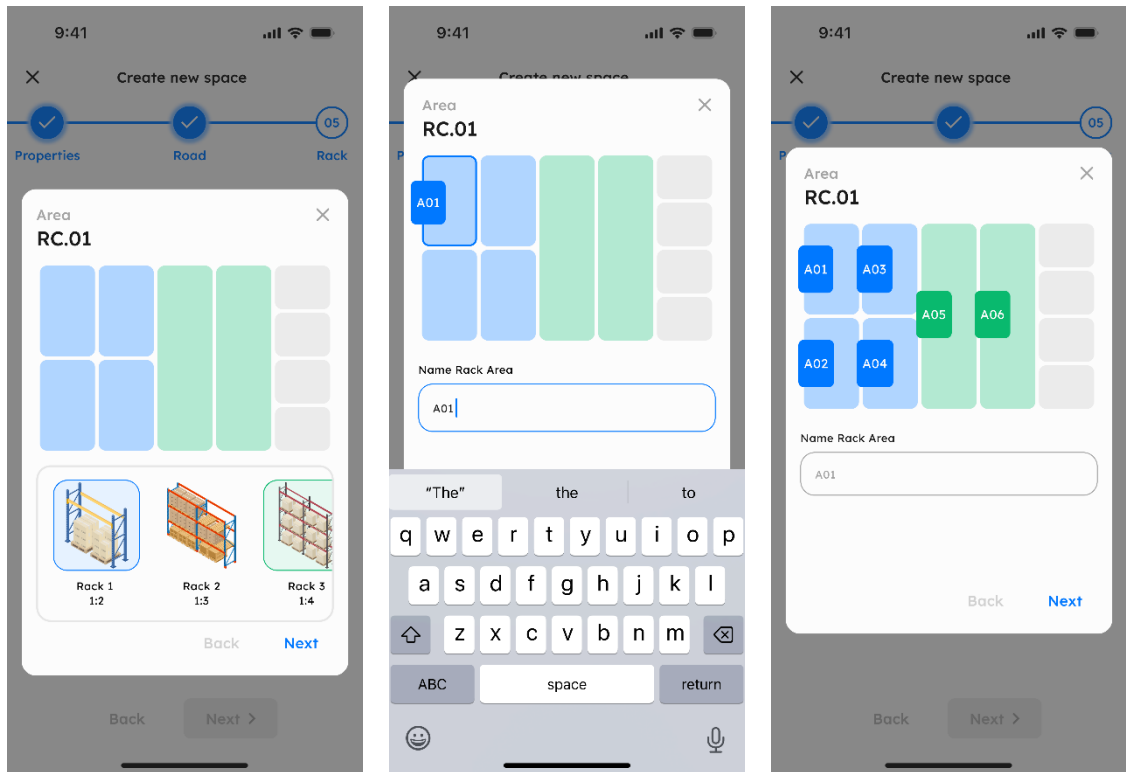


Figure 4.41: Step 5: Filled – Name – Name completed screen

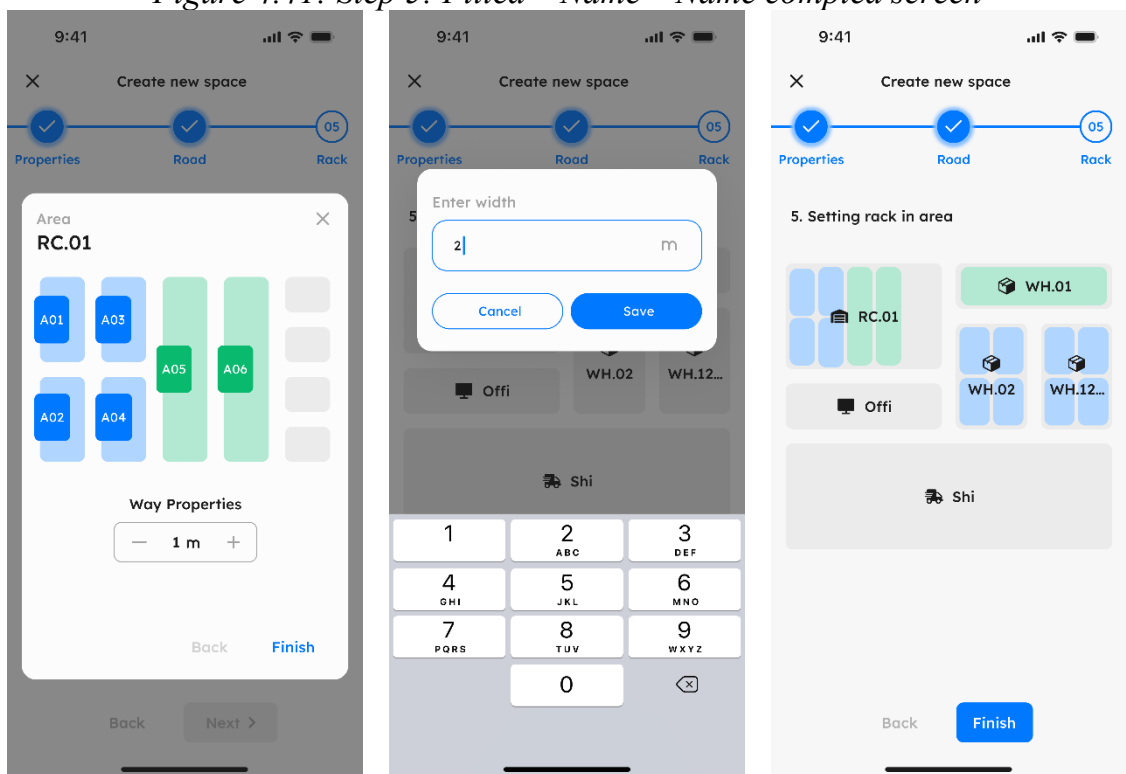


Figure 4.42: Step 5: Way properties – Dialog way – Completed screen

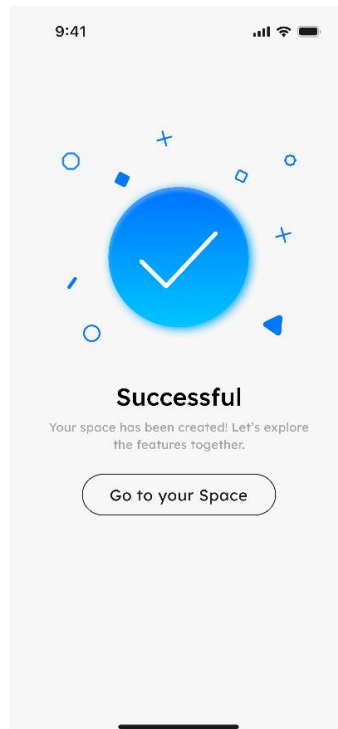


Figure 4.43: Create successful screen

#### 4.2.2.2.4 New Space

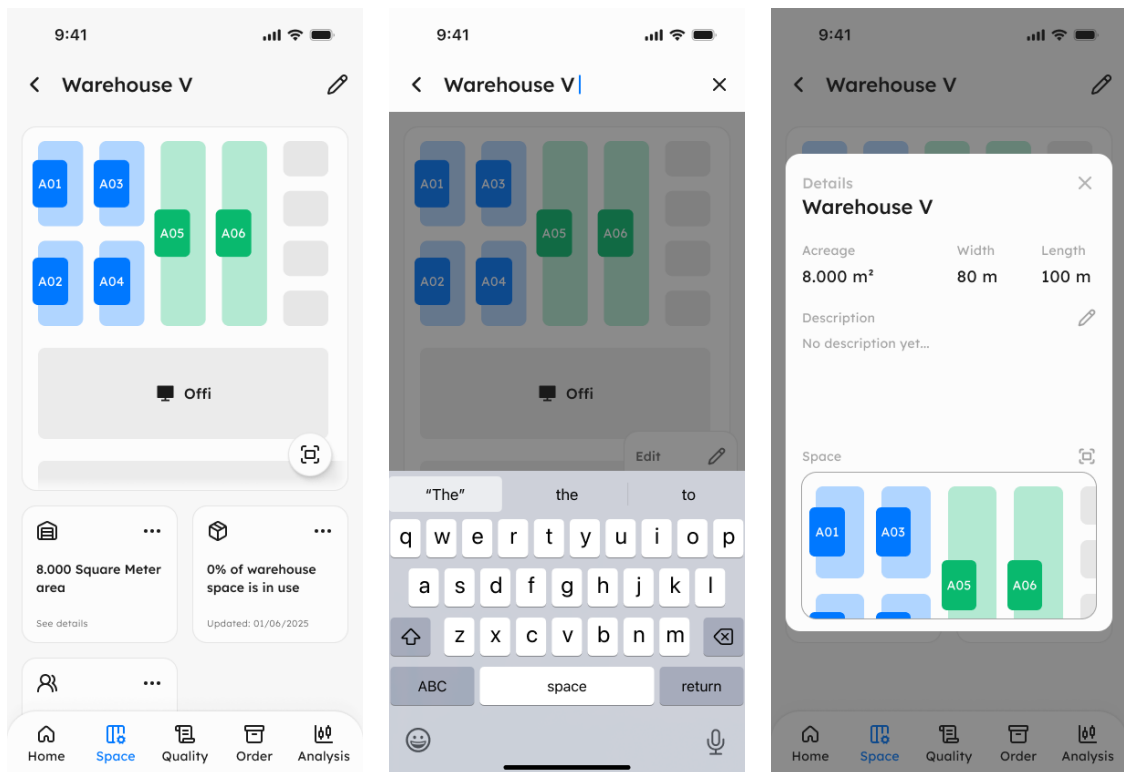


Figure 4.44: Detail Warehouse – Edit name – Dialog details screen

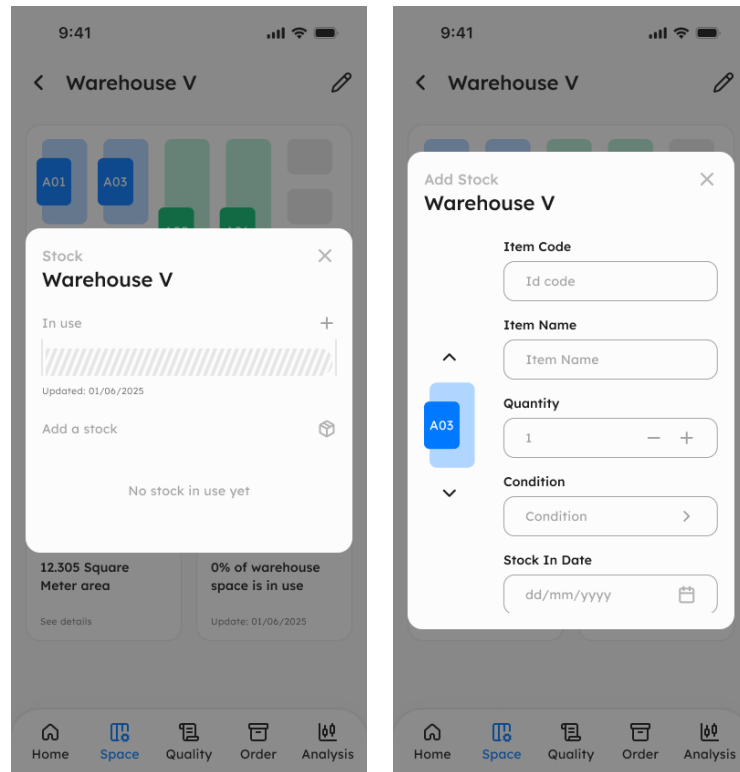


Figure 4.45: Dialog stock – Dialog add stock screen

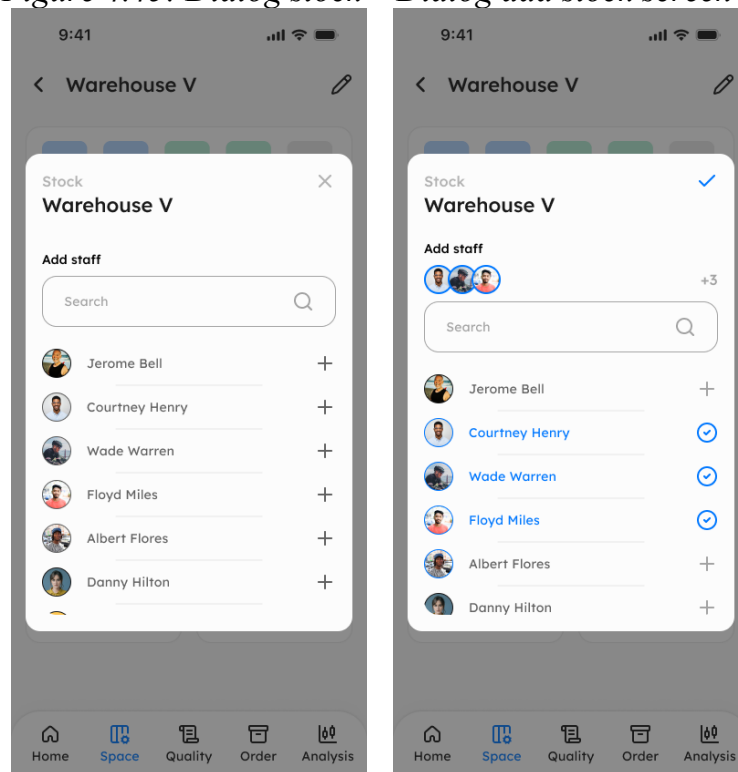


Figure 4.46: Dialog staff – Dialog staff selected screen

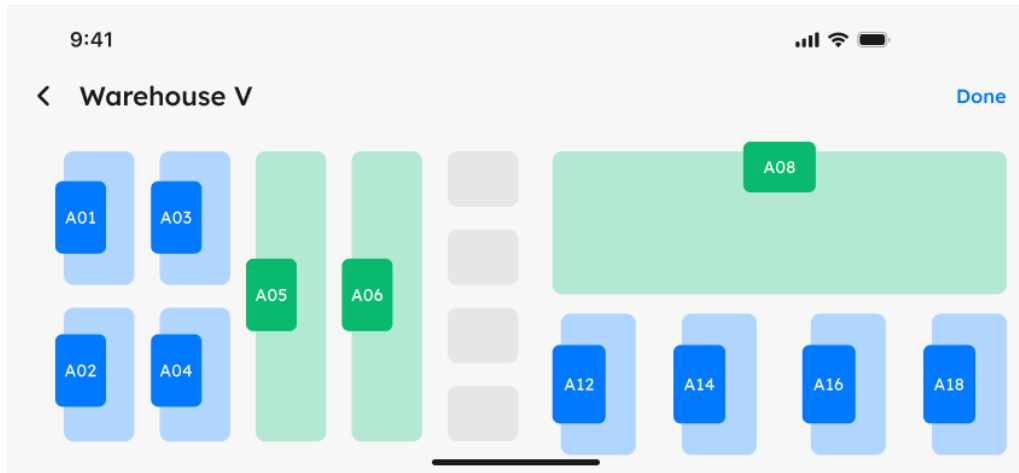


Figure 4.47: Full screen details warehouse

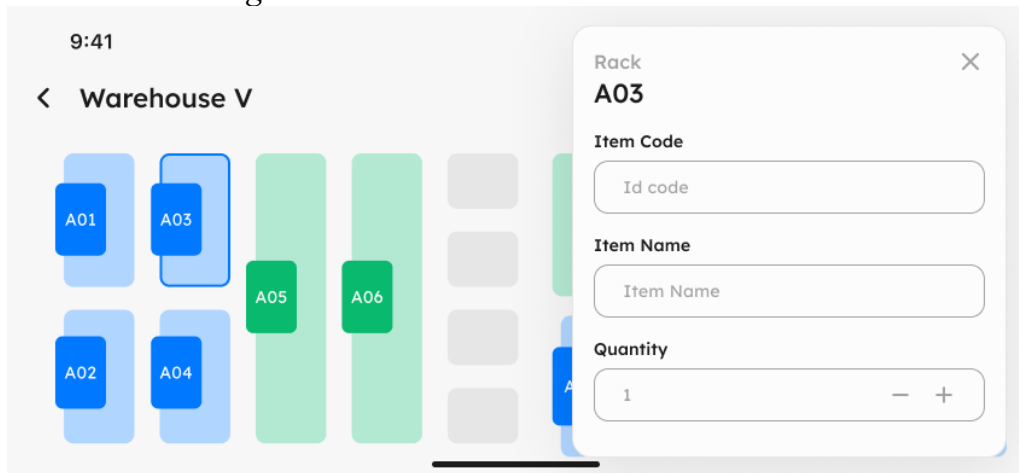


Figure 4.48: Full screen details warehouse selected

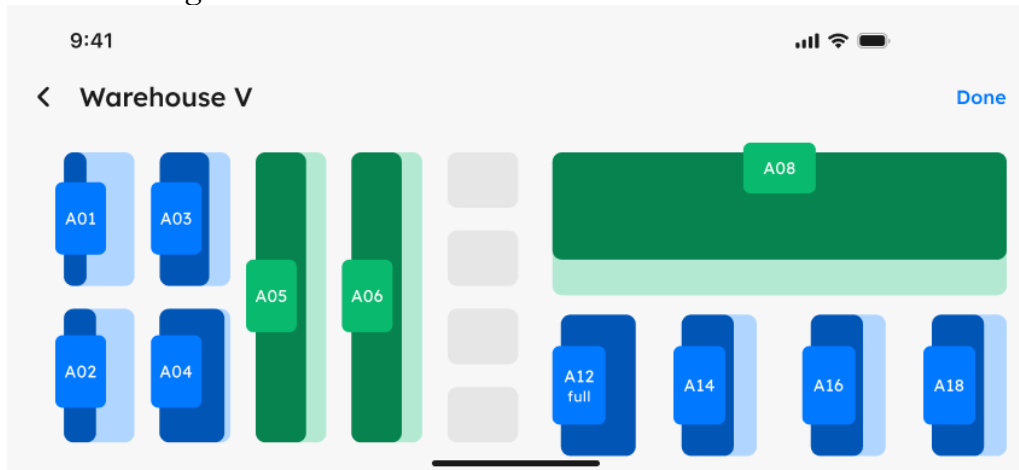


Figure 4.49: Full screen details warehouse filled

#### 4.2.2.2.5 Tutorial

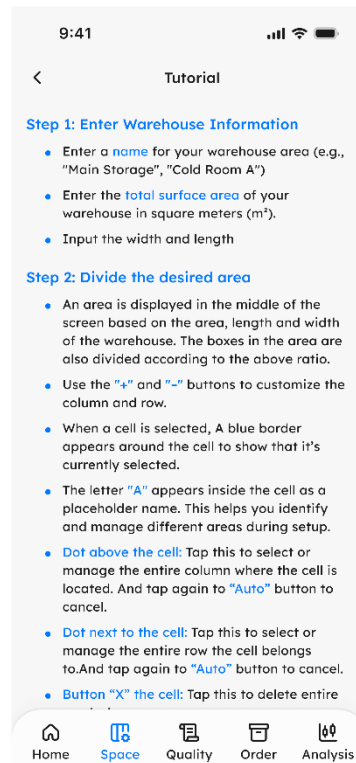


Figure 4.50: Tutorial screen

### 4.2.2.3 Implementation, guidance and training for use

#### 4.2.2.3.1 Deploy the app

- Warehouse management software deployments can take many models: On-Premise, Cloud, or Hybrid. The On-Premise model means that software and data are operated on the internal infrastructure of the enterprise, and the enterprise is responsible for hardware maintenance, security, and software licensing. Meanwhile, the cloud model allows software to be stored and run on the service provider's servers; businesses only pay for the resources they use without worrying about infrastructure maintenance. The Hybrid model combines both, taking advantage of the public cloud and private cloud, allowing businesses to keep sensitive data on-premises in the private cloud and use the scalability of the public cloud when needed.
- The software deployment process is usually divided into stages: release package, pilot deployment and official deployment (rollout).
- Supporting tools: For effective deployment, it is necessary to use DevOps and CI/CD tools such as Jenkins, GitLab CI, Docker to package and automate application deployment. With the mobile app, it is possible to use an MDM (Mobile Device Management) tool such as Microsoft Intune or Jamf to distribute and update software remotely
- Implementation steps:

- Planning: Identify the software to be deployed, user groups, devices/systems that will run the software, and prepare the infrastructure (servers, databases, network connections, licenses)
- Choose a deployment method: Decide whether to go on-premise or cloud based on your security and scalability needs.
- Pilot: Install the software on a limited group of devices/tests. Perform testing with real or fake data for errors, ensuring compatibility before scaling
- Evaluate the results: After piloting, collect feedback and fix errors. Confirm that the software meets the business requirements.
- Formal rollout: When the software is ready, conduct enterprise-wide rollout at the least impactful time (e.g., outside of peak hours).
- Post-deployment support: Ensure there are technical support channels (helpdesk, hotline) and monitor operational efficiency to promptly handle arising problems.

#### 4.2.2.3.2 General User Guide

After implementation, it is necessary to prepare documents and instructional means for users to familiarize themselves with the system. User onboarding can include an email onboarding, a manual, or an interactive guide right in the app. Common types of documents include:

- Detailed User Manual: A complete document explaining the software's functions, related business processes, and basic troubleshooting.
- Quick Start Guide: Summarizes essential operations in a brief step-by-step format, with illustrations of functional locations and clear instructions for users from the beginning.
- Video tutorials: Short videos introduce the interface and important operations, helping users learn in a visual way. Studies show that video tutorials can increase users' ability to remember by 65% compared to using text alone.
- In-App Guidance: Widgets such as guide pop-ups or tooltips in the interface that help users access features for the first time.

#### 4.2.2.3.3 How to create a new space

##### a. Step 1: Enter Warehouse Information

- Enter a name for your warehouse area (e.g., "Main Storage", "Cold Room A")
- Enter the total surface area of your warehouse in square meters (m<sup>2</sup>).
- Input the width and length.

→ Result: A white warehouse grid appears in the dimensions you just entered, ready to be divided into areas.

##### b. Step 2: Divide the Desired Area

- An area is displayed in the middle of the screen based on the area, length and width of the warehouse. The boxes in the area are also divided according to the above ratio.

- Use the "+" and "-" buttons to customize the column and row.
- When a cell is selected, A blue border appears around the cell to show that it's currently selected.
- When a cell is selected, A blue border appears around the cell to show that it's currently selected.
- Dot above the cell: Tap this to select or manage the entire column where the cell is located. And tap again to "Auto" button to cancel.
- Dot next to the cell: Tap this to select or manage the entire row the cell belongs to. And tap again to "Auto" button to cancel.
- Button "X" the cell: Tap this to delete entire row/column.
- Press and hold the selected cell to move it to a different spot on the grid.
- Use the small hook icon in the bottom-right corner of the cell to resize it.

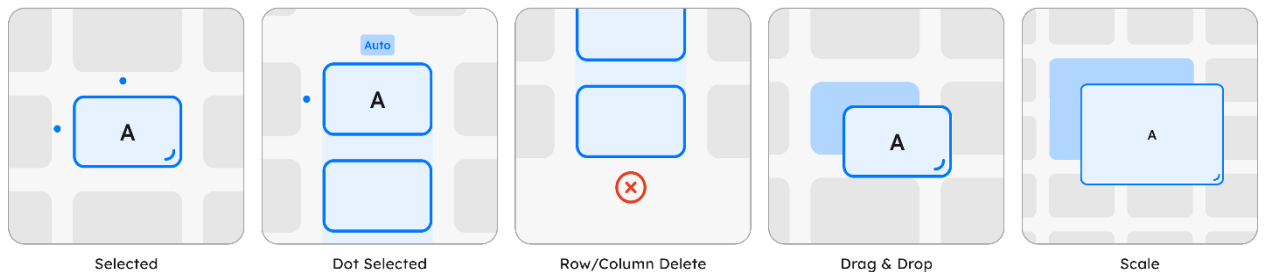


Figure 4.51: Image for instructions in step 2

c. Step 3: Set Area Properties

- In this step, when you select an area, 2 properties will appear about the warehouse's function and name. Select the "x" button to cancel the selection.
- Each area you create can be assigned a specific function in your inventory system, represented by an icon.
- These function are: Storage Area, Receiving Area, Shipping Area, Parking Area, Toilet, Tool Warehouse, Monitoring Room, Maintenance Room.
- Name the areas according to each function of that area.

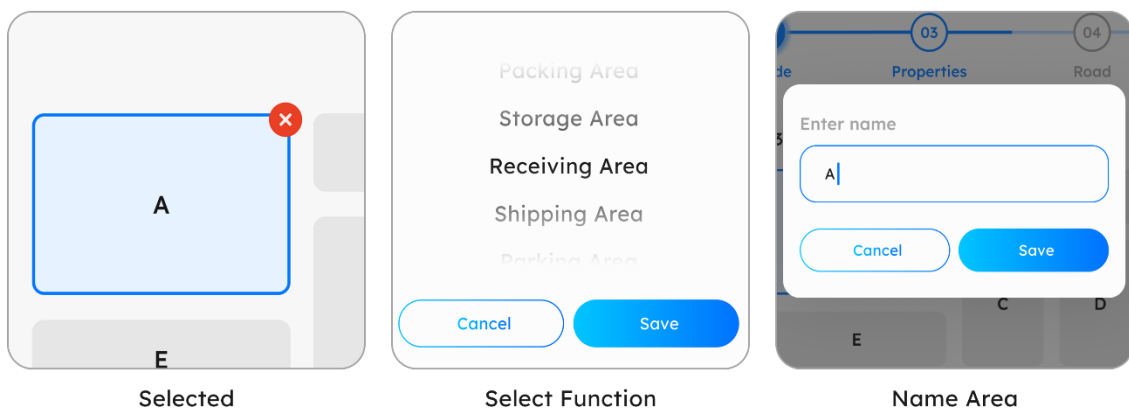


Figure 4.52: Image for instructions in step 3

d. Step 4: Roadway Properties

- In this step, the system automatically detects road sections that can be adjusted in width.
- To customize a road section, simply click the “•” button next to it to select and adjust its width.
- To cancel selection, select the "Auto" button
- Adjust the road section to your desired actual width. This helps ensure that each area fits accurately within your warehouse layout and reflects real-world spacing.

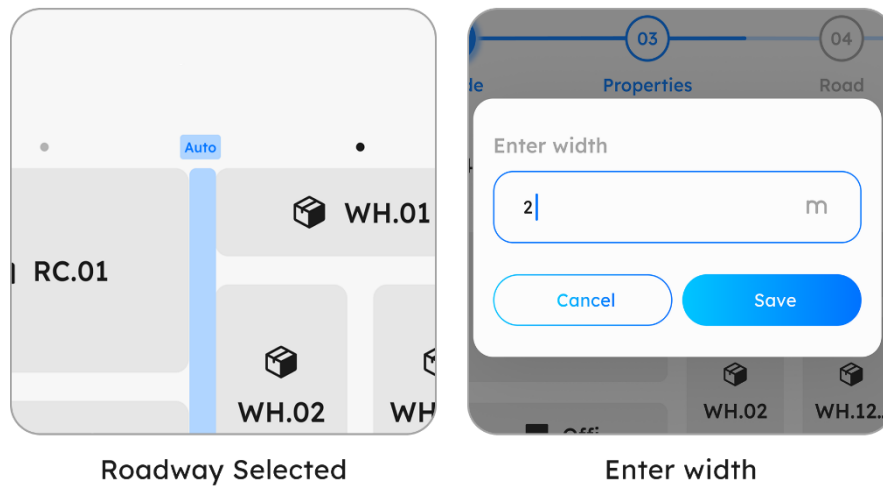


Figure 4.53: Image for instructions step 4

e. Step 5: Setting Rack in Area

- In this step, you'll assign shelves to each area and give them a name. To get started, select an area on the layout — a settings dialog will appear
- Select the rack that suits your needs, drag and drop it into the area. Each rack will have a corresponding color. Then select the "Next" button.
- Name your shelves appropriately. Then select the "Next" button.
- Adjust the road section to your desired actual width. This helps ensure that each area fits accurately within your warehouse layout and reflects real-world spacing.
- Then select the "Next" button.

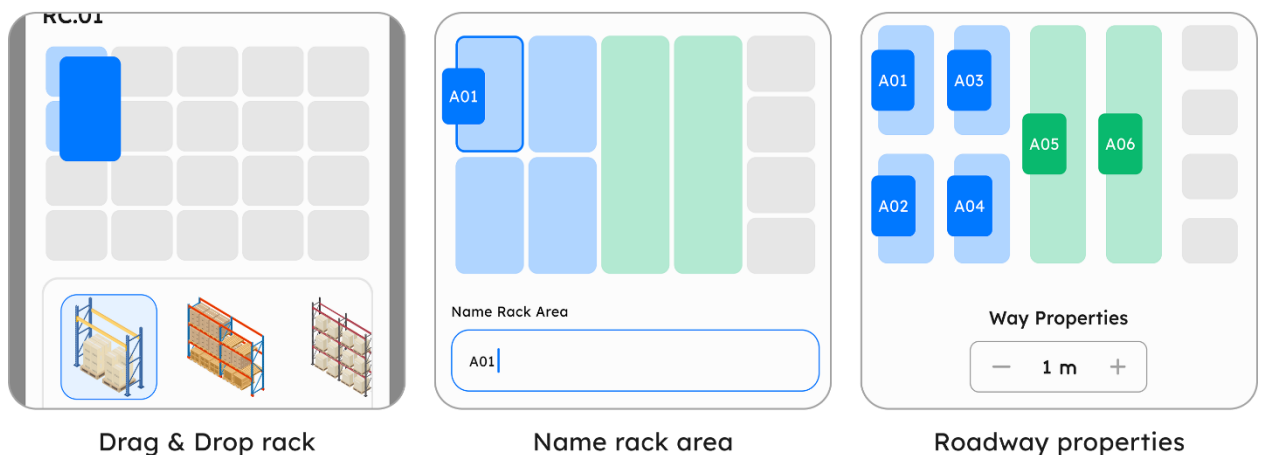


Figure 4.54: Image for instructions in step 5

## **CHAPTER 5: EVALUATING AND COMPARING SOFTWARE PERFORMANCE**

### **5.1 Software Performance Evaluation**

#### **5.1.1 API Response Time**

- **Definition:** API response time is the period of time between when an application sends a request to the server (e.g., fetching a picklist, checking inventory, or sending an order) to when the server processes the request and returns the data back to the client. This is a direct indicator of the speed and efficiency of the system.
- **Processing Speed:**
  - **Less than 300ms:** Applied to key business APIs such as picking lists, checking inventory, or sending orders. These are operations that require near-instant feedback to ensure uninterrupted work.
  - **Less than 1 second:** Applies to more complex reports, such as aggregating inventory data, creating new inventory data.

#### **5.1.2 Device Resource Usage**

##### *a. CPU & RAM Usage*

- **CPU:** This is how much the device's processor is used when the app is active. If the app takes up too much CPU, the device will slow down, causing work interruptions.
- **RAM:** This is the amount of memory that the app uses. If the RAM is taken up too much, the device may lag or the application may crash, especially on low-cost devices with limited RAM capacity (usually only 1-2GB).
- **In logistics, employees often use cheap or old equipment with low configuration.** If the app takes up 50% of the CPU or 300MB of RAM on a device with only 1GB of RAM, the device will be very slow, affecting tasks such as scanning barcodes, updating inventory. Moreover, employees may need to run multiple applications simultaneously, so keeping the CPU and RAM low is necessary to ensure performance. In fact, a warehouse management application that takes up 300MB of RAM on a 1GB device will cause the system to have almost no free memory, resulting in lag or crashes when employees try to scan barcodes constantly. In contrast, if the app only uses < 200MB of RAM, the device still has enough resources to run smoothly.
- **Processing Speed:**
  - **Average CPU: < 20%:** Keep CPU usage low to avoid overloading equipment, especially with weak configuration devices common in logistics.

- RAM used: < 200MB: Make sure the app doesn't take up too much memory, help the device work stably, and support multitasking when needed.
- b. *Battery Consumption*
  - Battery Consumption: This is the amount of battery that the app uses when it is in continuous operation. In logistics, employees often use the device during shifts for 1-2 hours or more, so the application must not drain the battery too quickly to avoid work interruptions.
  - Standard: ~10–15% battery reduction per hour of continuous use to ensure that the device can operate for a long time without frequent charging, suitable for extended shifts.
  - In fact, with an 8-hour shift, if the app consumes 15% of the battery per hour, the device will lose about 120% of the battery → run out of battery before the end of the shift. But if optimized at 10% per hour, the device only loses 80% of the battery, which is enough to operate most of the shift without charging. In addition, the software also does not require employees to use it continuously for 8 hours in each shift, so consuming 80% is only the maximum that employees' phones will have to be consumed if used continuously.
- c. *Network Usage*
  - Network bandwidth: This is the amount of data that an app sends and receives over a Wi-Fi network or mobile data. In a warehouse, multiple devices can access the internal network at the same time, so the application needs to use bandwidth efficiently to avoid network slowdown or congestion.
  - In logistics, if 50 devices synchronize large data continuously, the intranet will be overloaded, slowing down the connection for all devices. This affects the speed of order processing or inventory updates. If you use mobile data, sending and receiving data is not optimal, which can increase network costs. Even with internal Wi-Fi, bandwidth abuse also reduces overall performance.
  - Optimization Ways:
    - Event-Sync: Send data only when there is a real change, such as after warehousing or shipping.
    - Data compression: Use GZIP compression techniques for JSON and WebP format for images to reduce space.
    - Lazy loading: Loads data only when the user requests it, specifically loading a product image when an employee scrolls to that item instead of loading the entire item in the first place.

### **5.1.3 Stability Assessment**

#### *a. App Crash Rate*

- A crash occurs when an application closes suddenly, forcing the user to reopen it or unable to use it again. This is an important indicator to evaluate the stability of the application.
- Ideal Indicator:
  - Crash-free sessions > 99.5%: Out of 1000 sessions, at least 995 sessions are error-free.
  - Crash rate < 0.5%: The crash rate is less than 0.5% of the total number of times the app is opened.

*b. Stress Test Stability*

- This is the ability of the application to maintain stable operation when performing repetitive tasks continuously, such as scanning barcodes hundreds of times or processing multiple orders at the same time.
- How to evaluate:
  - Continuous operation: Update inventory repeatedly, log in again continuously
  - Server Response: Check if the server is overloaded, whether the API returns fast results.
  - App performance: Monitor if your app lags, slows, or crashes after multiple operations.
- Result:
  - The server is not overloaded, the API responds within an acceptable time, less than 2-3 seconds.
  - The app still runs smoothly after more than 100 consecutive operations.

#### **5.1.4 UX Evaluation**

*a. Learnability*

- Ease of learning measures the app's ability to help new users quickly get used to it and perform tasks without difficulty. In a warehouse environment where employees change frequently or need to start work quickly, this factor is important.
- How to evaluate:
  - Average time to complete the first time a new inventory is created: Record the time from when a staff member starts to when they complete an order for the first time.
  - Number of times a user needs assistance: Count the number of times an employee has to ask a colleague or trainer during the learning process. Fewer assists show that the app is easy to understand.
- Goal: After 1-2 training sessions (about 2-4 hours), new employees can confidently process information and operate in the warehouse area without additional support. After 4-6 training sessions (about 8-10 hours), specialists can

confidently process information and operate in the warehouse area, create a new warehouse and handle all the functions of the software without additional support.

*b. Usability in Operations*

- Ease of operation evaluates how simple and effective the user is when performing tasks. A good app will have a concise process, easy-to-use function buttons, especially on mobile devices – a popular tool in warehouses.
- How to evaluate:
  - The number of steps to complete a feature. Specifically, to create a new warehouse; If more than 10 steps are needed, the operation will be complicated and easy to cause errors. Users only need a maximum of 5 steps. Include:
    - Select the Space feature
    - Choose to create a new space
    - Enter information about the new space
    - Complete information entry
    - Tracking and control
  - Clarity of function buttons: Buttons should be easily recognizable, easy to touch on small screens, and have instructions when errors occur.

*c. Clarity of UI Design*

- Clarity ensures that users can easily recognize information and functions, even in difficult conditions such as low light or dust, which is characteristic of warehouses.
- How to evaluate:
  - Font: Must be large and clear enough to be legible in dark or bright storage.
  - Color: High contrast (according to WCAG standard) for easy identification, e.g. black text on a white background.
  - Icon: The icon must be simple and easy to understand even for employees with little technology experience.

*d. Consistency*

- Consistency ensures an app-wide interface and functionality, making it easy for users to switch between screens. Avoid confusion when users navigate between screens.
- How to evaluate:
  - Check whether the layout, color, and button position between modules such as Home, Space, Order, and Quality are the same.
  - Make sure the same action always has the same location and style.

*e. Rapid Responsiveness (System Feedback)*

- Fast responsiveness ensures that users always know the status of the system (processing, success, error) after each operation, avoiding a feeling of uncertainty. The goal is to make users always aware of the system status.
- How to evaluate:
  - Displays "Loading" when processing data.
  - A "Success" or "Error: [cause]" message after each action.
  - Avoid hanging without feedback.

f. Overall User Satisfaction

- Overall satisfaction is a user's comprehensive assessment of the app, reflecting how they feel after using it in their daily work. This factor is not only feature-based, but also includes the comfort, efficiency, and stability of the app. In a warehouse environment where employees need to operate quickly and accurately, an app that provides a good experience will help them work more efficiently and with less stress.
- How to evaluate: Give surveys to evaluate the criteria in a more quantitative way

## 5.1.5 Software Performance Assessment Survey

### 5.1.5.1 Survey Form

This form is designed to be easy to fill out and provide useful information from warehouse staff. Quantitative questions help measure satisfaction on a scale, while open-ended questions collect detailed opinions to improve the app.

The image shows a digital survey form titled "CUSTOMER SURVEY" for a "Warehouse Management Application". It is divided into three main sections:

- PART 1: PERSONAL INFORMATION**
  - 1. Name: .....
  - 2. Job Role:
    - Head (radio button)
    - Sale Department (radio button)
    - Supervisor (radio button)
    - Warehouse Manager (radio button)
    - Warehouse employee (radio button)
    - Driver (radio button)
    - Another: .....
  - 3. Time of application use:
    - Less than 1 week (radio button)
    - More than 4 weeks (radio button)
    - 1-4 weeks (radio button)
- PART 2: LEARNABILITY**
  - Evaluate the ease of learning of the application for new users.
  - 1. How easy do you find the app to learn how to use?
    - Scale: 1 (radio), 2 (radio), 3 (radio), 4 (radio), 5 (radio)
  - 2. How long did it take you to master the app?
    - Less than 1 training session (radio)
    - 1-2 training sessions (radio)
    - 3-5 training sessions (radio)
    - More than 5 training sessions (radio)
  - 3. Do you need support from a colleague or trainer when starting to use the app?
    - No support needed (radio)
    - Need support 1-2 times (radio)
    - Cần hỗ trợ nhiều lần (radio)
  - 4. What difficulties did you encounter when you first used the app? (if any)
    - .....
- PART 3: USABILITY IN OPERATIONS**
  - Rate how easy it is to perform operations in the application.
  - 1. How simple and logical do you find the operations in the application?
    - Scale: 1 (radio), 2 (radio), 3 (radio), 4 (radio), 5 (radio)

Figure 5.1: Customer survey part 1-2-3

**PART 3: USABILITY IN OPERATIONS**  
Rate how easy it is to perform operations in the application.

2. Is the number of steps to complete a transaction reasonable?  
 1    2    3    4    5

3. Are the function buttons on the app recognizable and easy to tap?  
 1    2    3    4    5

4. Do you have any difficulty performing daily activities? (if any)  
 .....

---

**PART 4: CLARITY OF UI DESIGN**  
Rate the clarity and ease of understanding of the application interface.

1. Are the fonts and colors on the application legible in a warehouse environment?  
 1    2    3    4    5

2. Are the icons in the app easy to understand?  
 1    2    3    4    5

3. Is the error message specific and easy to understand?  
 1    2    3    4    5

**PART 4: USABILITY IN OPERATIONS**  
Rate how easy it is to perform operations in the application.

4. Do you have any suggestions to improve the app interface?  
 .....

---

**PART 5: CONSISTENCY**  
Evaluate the level of consistency in design and layout of functions.

1. Are the design and layout of the modules consistent?  
 1    2    3    4    5

2. Are the same function buttons located in the same positions on the screens?  
 1    2    3    4    5

3. Do you feel confused when switching between screens? (if yes)  
 .....

---

**PART 6: SYSTEM FEEDBACK**  
Evaluate the responsiveness of the application after each operation.

1. Does the application respond promptly to your every action?  
 1    2    3    4    5

Figure 5.2: Customer survey part 3-4-5-6

**PART 6: SYSTEM FEEDBACK**  
Evaluate the responsiveness of the application after each operation.

2. Have you ever experienced an app crashing without any notification?  
 Never    Frequent  
 Sometimes

3. Do you have any suggestions to improve the responsiveness of the app?  
 .....

---

**PART 7: USER SATISFACTION**  
Rate your overall satisfaction with the app.

1. How satisfied are you with the app?  
 1    2    3    4    5

2. Does the application meet your business expectations?  
 1    2    3    4    5

3. What do you like most about the app?  
 .....

**PART 8: ADDITIONAL COMMENTS**  
Do you have any other comments or suggestions to improve the app?

.....  
 .....  
 .....  
 .....  
 .....  
 .....

---

**THANK YOU**

Thank you for taking the time to fill out this review form!  
 Your feedback is important to help us improve the app and provide a better experience for all employees.



Figure 5.3: Customer survey part 6-7-8 and thank you

### 5.1.5.2 Survey results and conclusions

- Number of survey participants: 12 warehouse employees
- Summarize the average score according to each criterion. The quantitative questions are rated on a scale of 1 (very dissatisfied) to 5 (very satisfied). Below is the average score for each criterion:

- Learnability: 4.2/5
- Usability in Operations: 4.5/5
- Clarity of UI Design: 4.3/5
- Consistency: 4.6/5
- System Feedback: 4.4/5
- Overall User Satisfaction: 4.5/5

→ The survey results show that the warehouse management application received positive feedback from 12 employees, with a high average score in most UX criteria (from 4.2 to 4.6/5). Users are particularly satisfied with the app's ease of operation, consistency, and quick responsiveness. However, the development team may consider improving some aspects such as clarifying icons, optimizing performance in weak network conditions, and adding data auto-saving to enhance the user experience in the future.

## 5.2 Compare performance after improvement

### 5.2.1 Performance Comparison

#### 5.2.1.1 Manual work performance

Step	Activity	Average Time
1. Receive and prepare an exit order	- Receive a paper slip (or email) from the sales/accounting department - Find and print export slips	2 – 5 minutes
2. Pick the goods (Pick up the goods)	- Find goods - Staff follow the exit slip to get each item code - Compare quantities, record a notebook or enter into Excel	15-17 minutes (depending on the item)
3. Quality Inspection & Temporary Packing	- Bonded inspection, pallet or carton closure - Insert the lining, wrap the shrink film, apply the tape	5 – 8 minutes
4. Close the ticket and move to the queue area	- Sign the confirmation of completion of the exit order on the paper slip - Move the package to the waiting area	2 – 4 minutes
<b>Total Time</b>		<b>24 – 34 minutes</b>

Table 5.1: Time for manual shipment

#### 5.2.1.2 Software performance

Step	Activity	Average Time
1. Receive and prepare an exit order	- Receive a paper slip (or email) from the sales/accounting department	1 – 2 minutes

	- Find and print export slips	
2. Pick the goods (Pick up the goods)	- Find goods - Staff follow the exit slip to get each item code - Compare quantities, record a notebook or enter into Excel	11-15 minutes (depending on item type)
3. Quality Inspection & Temporary Packing	- Bonded inspection, pallet or carton closure - Insert the lining, wrap the shrink film, apply the tape	2 – 4 minutes
4. Close the ticket and move to the queue area	- Sign the confirmation of completion of the exit order on the paper slip - Move the package to the waiting area	2 – 4 minutes
<b>Total Time</b>		<b>16 – 25 minutes</b>

Table 5.2: Time to export goods via the application

### 5.2.2 Conclude

Step	Manual time (minutes)	Time via software (minutes)	Decrease $\Delta$ (min)	% Off
1. Receive & prepare orders	2 – 5 (=3.5 average)	1 – 2 (=1.5 average)	2.0	57 %
2. Pick the goods (Pick up the goods)	15 – 17 (=16)	11 – 15 (=13)	3.0	19 %
3. Inspection & Temporary Packing	5 – 8 (=6.5)	2 – 4 (=3)	3.5	54 %
4. Close the vote & move up the queue	2 – 4 (=3)	2 – 4 (=3)	0	0 %
<b>Total Time</b>	<b>24 – 34 (=29)</b>	<b>16 – 25 (=20.5)</b>	<b>8.5</b>	<b>29 %</b>

Note:  $\Delta = (\text{Average Manual Time}) - (\text{Average Software Time})$ .

Table 5.3: Comparison and evaluation of the performance of 2 processes

Judgment and analysis:

- Order preparation step (Step 1): Reduced from an average of 3.5 minutes to 1.5 minutes, which is a reduction of up to 57%, thanks to automatic ticket generation and fast printing.
- Picking up the goods (Step 2): The time is reduced by about 3 minutes (19%), thanks to the navigation application, clearly displaying the location on the software so that workers can easily find the goods and pick up the goods.
- Inspection & packaging step (Step 3): Reduced from 6.5 minutes to 3 minutes (54%), thanks to the available inspection form, take a photo, and record it right on the app.

- Closing & Moving Steps (Step 4): There is no significant change as the physical manipulation (signing, moving) depends on the warehouse environment.
- Summary:
  - Total time reduced from ~29 minutes to ~20.5 minutes, which is a saving of 8.5 minutes (~29 %).
  - Thus, the software helps cut nearly 1/3 of the shipping time, especially optimizing the steps of document processing, reconciliation and inspection.

## **CONCLUDE**

The Mobile Application for Warehouse Management solution not only achieves the goal of increasing productivity and reducing errors, but also builds a synchronous technical-process-human foundation, contributing to improving competitiveness and operational efficiency for businesses. Continuing to improve and expand the application according to the above recommendations will help businesses maintain long-term advantages in the context of increasingly complex supply chains and the industrial era 4.0, besides increasing technological competitiveness also in this industrial era. Those benefits include:

- The mobile solution has significantly improved warehousing efficiency: the app shortens the total time to execute orders by 29% compared to manual operations, from an average of 29 minutes to 20.5 minutes.
- Provide real-time data, support decision-making: Dashboard displays "Total Merchandise", "Warehouse Status", "Shipping" to help leaders instantly grasp the warehouse situation.
- Bringing a personalization, a flexibility required in an environment that is always fluctuating in terms of customer needs. Increase benefits for the whole business, increase good relationships with customers.

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