J-INTECH (Journal of Information and Technology)
Accredited Sinta 4 Ministry of Higher Education, Science and Technology Republic of Indonesia SK No. 10/C/C3/DT.05.00/2025
E-ISSN: 2580-720X || P-ISSN: 2303-1425

Development of an Android-Based Inventory Application to Improve Stock Management Efficiency

Herayati[1], Anus Wuryanto[2], Dewi Yuliandari[3], Hari Sugiarto[4], Widiarina[5]

[1]*Bina Sarana Informatika University, Faculty of Economics and Business, Management, 98 Kramat Raya, Central Jakarta, Indonesia*

[2,3,4,5] *Bina Sarana Informatika University, Faculty of Engineering and Computer Science, Information System, 98 Kramat Raya, Central Jakarta, Indoensia*

Keywords
Android; Inventory Management; Mobile App, Stock Management

Corresponding Author:
herayati.hya@bsi.ac.id

Abstract
Advances in information technology are driving companies to implement digital systems to improve operational efficiency, particularly in stock and inventory management. PT Interior Indonesia still uses manual stock recording methods, involving manual ledger entries and data input into Excel, which results in data inaccuracies, delays in information, and difficulties in monitoring stock availability. This research aims to design and develop an Android-based mobile application capable of supporting structured, accurate, and efficient stock and inventory management. By developing a mobile application that is directly integrated with on-site warehouse operations, it enables real-time stock updates by multiple stakeholders (Sales, Admin, Data Entry) simultaneously. The research method employed was a qualitative approach involving observation, interviews, and literature review, utilising the Rapid Application Development (RAD) software development model. The application was developed using the Flutter framework with Firebase Cloud Firestore as the backend database. The research results indicate that the developed application is capable of improving the accuracy of stock recording, accelerating the stock management process, and facilitating real-time monitoring of product availability. Consequently, this application is expected to support the smooth running of operations and decision-making at PT Interior Indonesia.

1. Introduction

The rapid advancement of information technology has had a significant impact on various business sectors, including companies operating in the interior design services sector. The use of technology in operational activities has become essential as it enhances the accuracy and efficiency of work. One crucial aspect requiring technological support is stock and inventory management [1] , as it is directly linked to the availability of materials needed to support project implementation [2]. Inventory management is the process of planning, controlling, and monitoring all aspects related to a company's inventory, ranging from the procurement of raw materials, through storage, to the distribution of finished products [3] . In this regard, inventory management aims to organise raw material stocks systematically and accurately so that they can be

utilised effectively and efficiently [4] . PT Interior Indonesia, as a company specialising in interior design services, handles a wide range of materials, equipment, and project-related items in significant quantities. However, inventory recording—which is still carried out manually using ledgers or simple applications—often leads to data inaccuracies, duplicate entries, and the loss of information regarding specific items. When multiple projects are running simultaneously, the need for fast and accurate stock data becomes increasingly crucial. Manual recording processes result in time-consuming stock checks and hinder decision-making, particularly when materials must be prepared immediately for on-site requirements.

Similar issues are also frequently encountered in warehouse and inventory management across various organisations. Previously, Warehouse Management Systems (WMS) were developed to manage warehouse operations using network and database technology [5],[6]. However, the implementation of WMS in previous studies has largely centred on stationary desktop or web-based platforms. This limitation creates a gap whereby warehouse and project staff with high mobility in the field struggle to update stock data in real time, leading to delays in information sharing between departments. To address this gap, this research makes a significant contribution by proposing to transform the WMS into an Android-based application platform integrated with a cloud database [7] . This approach not only overcomes the limitations of stationary access but also ensures real-time inventory data synchronisation for users with various roles (Sales, Admin, Data Entry) within the interior design project environment.

Furthermore, warehousing issues often arise because warehouse management is still manual or semi-manual and lacks integration, which ultimately results in sub-optimal warehouse performance and can disrupt production and distribution processes [8] . These conditions highlight the need for a system capable of unifying all stock management processes in a structured and integrated manner. Research [9] shows that the implementation of a web-based inventory system using the Rapid Application Development (RAD) method can improve the efficiency and accuracy of stock management. Another study by [10] developed an Android-based inventory application that has been shown to improve the efficiency and accuracy of stock recording. Furthermore, research [11] confirms that an integrated inventory system can improve recording accuracy and operational efficiency. Nevertheless, most of these studies still focus on web-based systems that restrict user mobility within warehouse areas, or have not yet fully utilised cloud synchronisation for real-time multi-stakeholder collaboration. To address this gap, this research offers a dual contribution [12]. In practical terms, the integration of mobile applications and cloud databases eliminates information delays between physical activities on-site and digital recording, enabling project and warehouse staff to update data instantly from any location, which is not possible with stationary web-based systems. Academically, this research contributes by providing empirical evidence and a framework for the implementation of mobile-cloud architecture within the context of multi-role inventory management (Role-Based Access Control), confirming that real-time data updates significantly reduce cross-departmental data discrepancies compared to the periodic synchronisation methods used in previous studies.

Based on the aforementioned issues and previous research, this study proposes the development of an Android-based mobile application to support stock and inventory management at PT Interior Indonesia. Although mobile inventory applications and cloud databases have been widely implemented in general, the novelty of this research lies not merely in the use of the technology, but in the formulation of a collaborative system architecture specifically designed to address information fragmentation in interior project operations. Unlike conventional inventory systems that operate in a stationary manner, the novelty of this system lies in the implementation of a Role-Based Access Control (RBAC) mechanism integrated with real-time cloud synchronisation, which enables asynchronous collaboration between field staff (Sales), administration (Data Entry), and warehouse (Admin) personnel without the risk of data conflicts. This approach specifically bridges the gap between dynamic material requirements at interior project sites and static record-keeping at the central warehouse—an issue that has not been optimally addressed by previous research [13] . Consequently, the proposed solution does not merely digitise record-keeping, but eliminates cross-departmental information latency to support far more accurate and responsive inventory decision-making.

2. Research Method

This study employs a qualitative method with an information systems development approach. The qualitative method was chosen as it provides an in-depth understanding of the actual conditions, workflows, and issues

arising in the management of stock and inventory at PT Interior Indonesia. Data collection was carried out through direct observation of warehouse activities, interviews with those involved in inventory management, and a literature review on inventory management systems [14] . Interviews were conducted with warehouse administrators, data entry staff, and the sales department to identify system requirements, operational constraints, and features required by users. Data from observations and interviews were analysed using data reduction techniques, system requirement categorisation, and user requirement validation to produce system specifications aligned with the company's operational conditions. Application development was carried out using the Rapid Application Development (RAD) method, which emphasises an iterative process and active user involvement throughout system development [15] . At each prototype iteration, users were allowed to evaluate the application's interface, workflow, and functions. User feedback was then used as the basis for improvements in subsequent development stages, ensuring the resulting application better meets operational needs in the field.

2.1 Data Collection Methods

Data collection in this study was carried out through observation, interviews, and a literature review. Observation involved directly observing the operational processes of stock and inventory management at PT Interior Indonesia, including the flow of materials in and out and the stock recording methods used. Interviews were conducted with parties involved in stock management, such as warehouse staff, project managers, and the administration department, to obtain more in-depth information on the constraints of the current system and the requirements for the desired application. In addition, a literature review was conducted by examining various relevant references, including books, scientific journals, and previous research, to strengthen the theoretical foundation and support the design of a system that meets user requirements.

2.2 Application Development Model

The application development in this study utilised the Rapid Application Development (RAD) model. The Rapid Application Development (RAD) model is an approach to application development that emphasises short, iterative development cycles [16] . In practice, users are actively involved at every stage of system development, from requirements identification and prototype evaluation to application feature testing. In the initial stage, prototypes of the interface and system workflow were developed based on the results of observations and interviews with warehouse administrators, data entry staff, and sales staff. These prototypes were then evaluated by users to obtain feedback regarding ease of use, feature requirements, and the suitability of the operational workflow. The feedback received was used as the basis for improvements in subsequent iterations, such as simplifying menu navigation, adding a stock search feature, and optimising the inventory report display. Through this iterative process, system development could be carried out in a manner that was more responsive to user needs, ensuring the resulting application was better suited to the operational conditions at PT Interior Indonesia. This model was chosen because it enables the development process to be carried out rapidly whilst actively involving users through repeated feedback.

Generally, the stages of application research and development follow the sequence below:

a. planning system requirements based on the results of observations and interviews,
b. designing and creating an application prototype,
c. building the application in stages, and
d. testing and implementing the system.

These stages are carried out iteratively so that any changes in requirements can be immediately accommodated in the next prototype version.

2.3 System Design and Mechanisms

The system design utilises the Unified Modelling Language (UML) to describe the functional requirements, system structure, and application workflow. The application was developed using the Flutter framework [17]

for the user interface and Firebase Cloud Firestore as the backend database, which supports real-time data synchronisation. The system mechanism is designed to support the secure and efficient management of stock and inventory. Technically, the authentication process is designed in several stages: when a user enters a password, the system does not store or transmit the original password but instead transforms it using the BCrypt hashing algorithm. The generated hash is then matched against the hash stored in the Firebase database. If there is a match, the system generates a session token to grant access. Following successful authentication, the system applies Role-Based Access Control (RBAC) to restrict navigation and data operations in accordance with the user's role (Sales, Data Entry Staff, Warehouse Admin). To validate the rigour of these access controls, specific Access Control Testing was carried out. These tests were carried out by simulating access rights violation scenarios (for example, a Sales account attempting to access an endpoint or stock-in management feature that is the sole right of a Warehouse Admin) [18] . The test results showed that the system successfully denied such unauthorised access, both through the hiding of UI elements on the frontend (Flutter) and the rejection of requests via backend security rules (Firebase Security Rules). Furthermore, the system also implements filtering and sorting algorithms to facilitate data retrieval. The implementation of this multi-layered mechanism aims to enhance data security, ease of use, and the efficiency of inventory information management.

2.4 System Testing

System testing was carried out using two complementary approaches. Firstly, functional testing utilised the Black Box Testing method to ensure that all application functions (such as authentication, stock management, and reporting) operated in accordance with the requirements specification, without regard to the programme's internal structure. Secondly, User Acceptance Testing (UAT) was conducted to evaluate usability and user acceptance [19] . To assess user acceptance of the developed application, User Acceptance Testing (UAT) was conducted with 10 respondents, comprising 2 warehouse administrators, 4 sales staff, and 4 data entry staff. The evaluation was carried out using a 1–5 Likert scale questionnaire covering the aspects of ease of use, ease of navigation, speed of information access, data accuracy, work efficiency, and user satisfaction.

3. Result and Discussions

The Unified Modelling Language (UML) is a language visualised in the form of diagrams, used to provide an overview and specifications for the construction and documentation of object-oriented system development [20]. In this study, UML is used to model the system through several key diagrams, including:

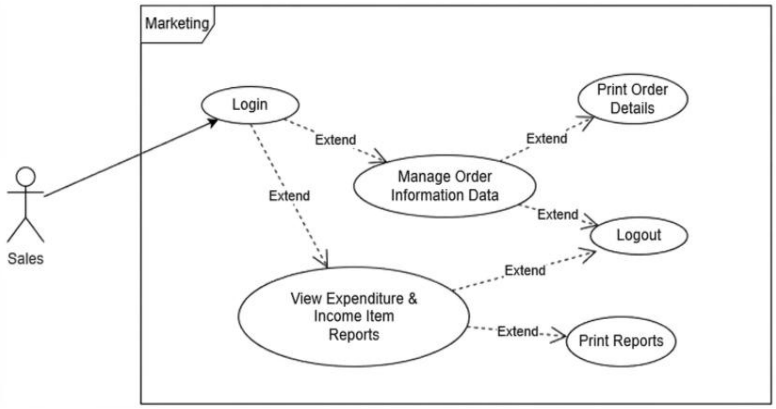

Figure 1. Sales Use Case

In Figure 1, the sales staff must first log in to the Marketing system. Once logged in, they can choose to manage order information or view financial reports for goods. From each of these menus, they can print documents (order details/reports) and end their session by logging out.

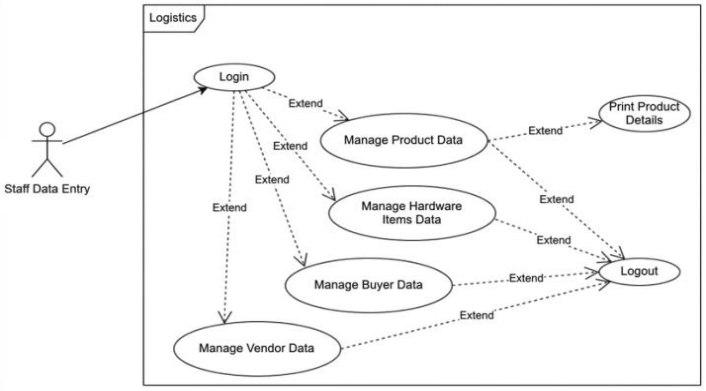

Figure 2. Staff Data Entry Use Case

Figure 2 shows Data Entry staff in the Logistics module logging in to manage four types of data: Products, Hardware Items, Buyers, and Suppliers. Specifically, in the product management menu, staff can print product details. Once they have completed all these management tasks, staff can log out of each menu.

The use of class diagrams in information system design is expected to produce a clear, structured, and easily understandable system model [21].The following class diagram illustrates the inventory system that has been developed:

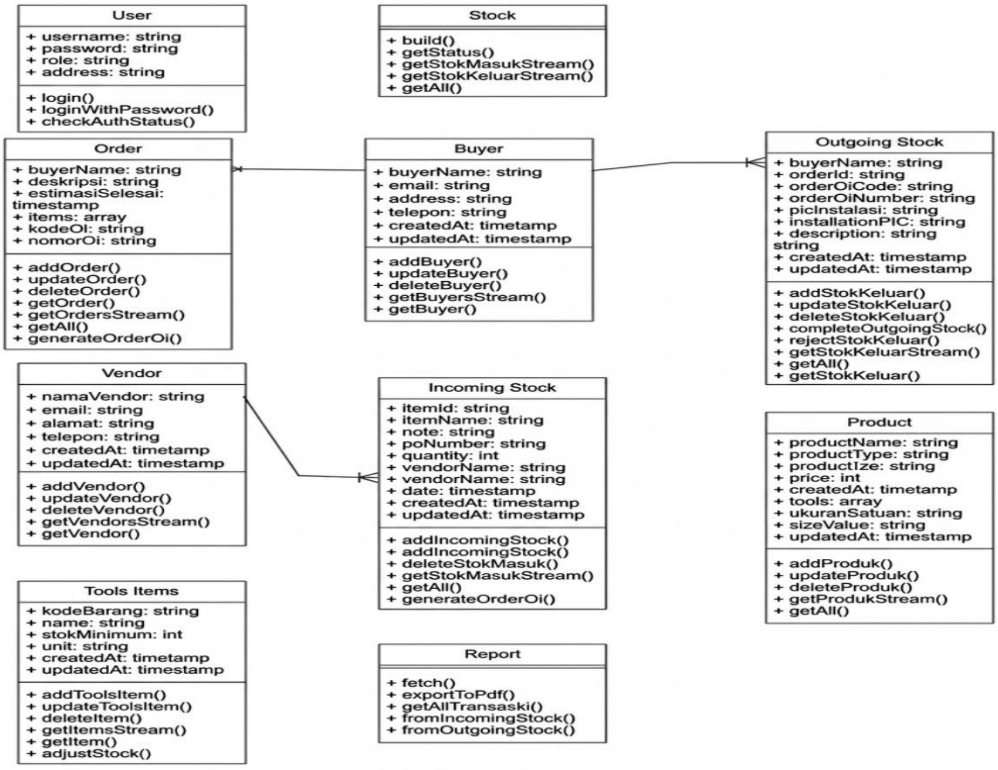

Figure 3. Class Diagram

Figure 3. A system architecture based on CRUD (Create, Read, Update, Delete) and data reporting. The system is capable of handling user management, sales cycle management (Buyers and Orders), supply management (Vendors and Stock Receipts), dispatch management (Stock Dispatches), stocktaking (Products and Tools), and the compilation of data into documents (Reports).

An activity diagram presents system activities as a series of actions, showing the start of each action, the possible decision flows, and the end of the action [22] . The following is an activity diagram illustrating the operational processes of the inventory system:

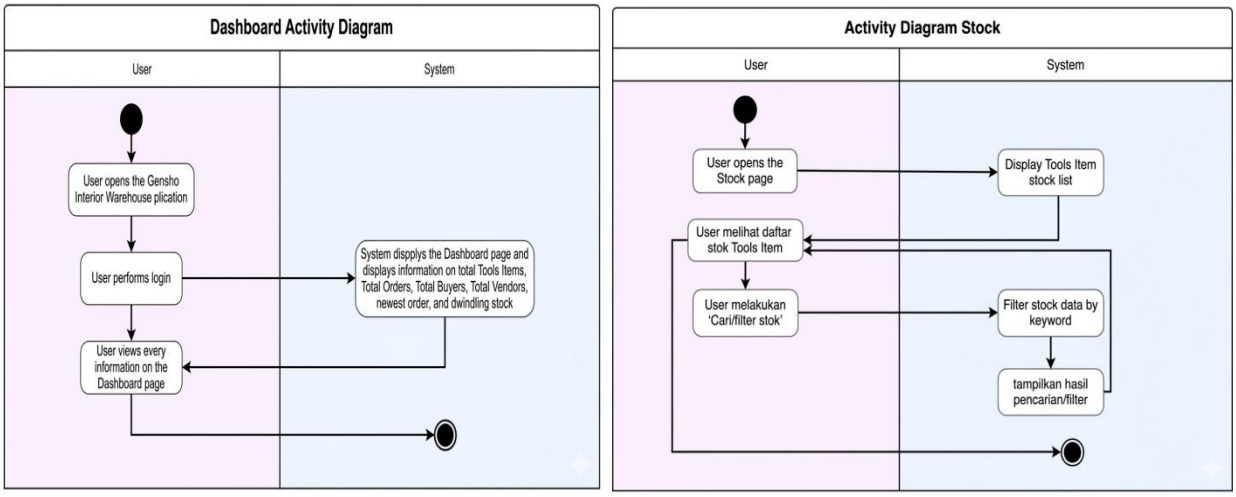

Figure 4. Dashboard and Stock Diagram

Figure 4 above illustrates the user flow from opening the app and logging in to viewing various information on the dashboard—such as total inventory, orders, customers, vendors, recent orders, and stock levels. The process begins with the user opening the stock page, viewing the stock list, and then searching or filtering stock data by keyword, after which the system displays the search results.

3.2 Application Implementation Results

The application interface is designed on a role-based basis to enhance the system's effectiveness and ease of use. The application is divided into three main roles: sales, data entry staff, and warehouse admin. This division of roles ensures that each user has access tailored to their operational needs, enabling inventory management processes to be carried out in a more structured and efficient manner. The application is divided into three main roles, namely:

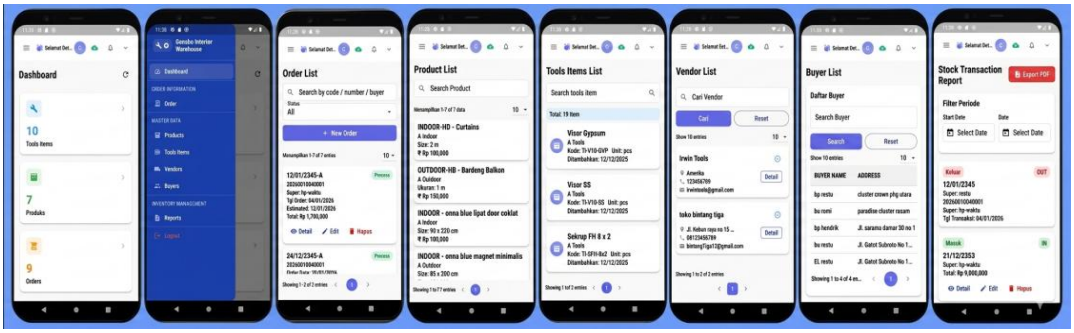

Figure 5. Sales Application Interface

Under the previous manual system, sales staff had to contact the warehouse administrator by telephone or text message and wait for confirmation of stock availability, which often took up to several tens of minutes. Through the implementation of the interface shown in Figure 5, the efficiency of inventory management has been improved by providing direct access to real-time stock availability information (for tools and products). With integrated search and filtering features, sales staff can now independently verify the availability of materials for project requirements in a matter of seconds, thereby significantly speeding up responses to clients and reducing communication bottlenecks between departments.

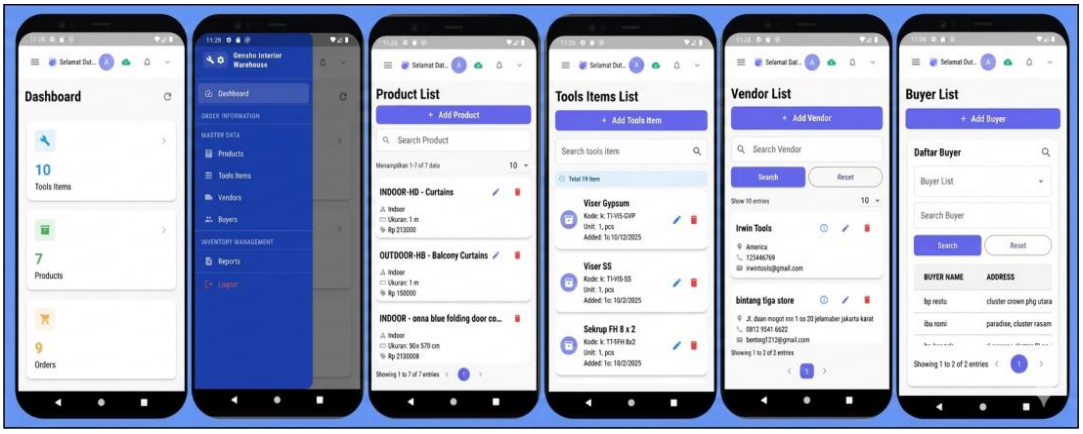

Figure 6. Staff Data Entry Application Interface

The previous manual process of updating master data was prone to data duplication and human error resulting from re-recording in ledger books. The implementation of the interface shown in Figure 6 improves efficiency and accuracy through the digitisation of master data management (products, vendors, buyers). The centralised Create, Read, Update, Delete (CRUD) features enable data entry staff to make data changes with a single input. The presence of a system validation mechanism also eliminates the risk of duplicate entries, thereby maintaining the integrity of inventory data without the need for time-consuming double-checking processes.

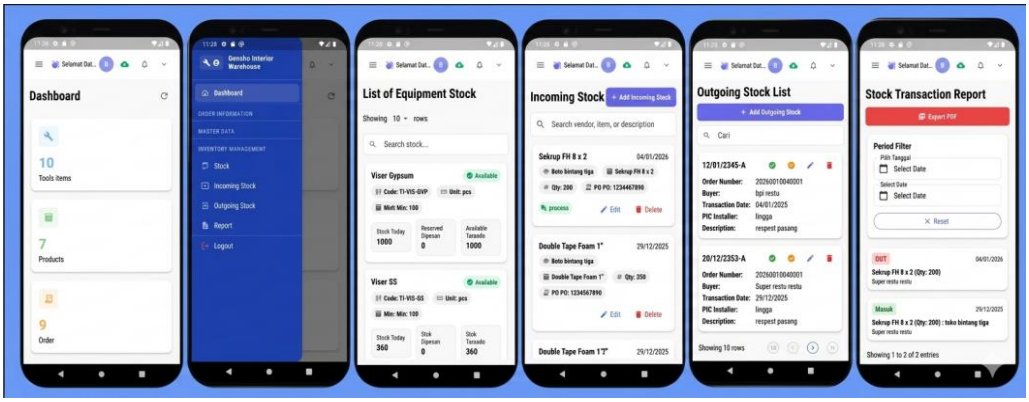

Figure 7. Staff Data Entry Application Interface

The main challenges previously faced by warehouse administrators were delays in information between the physical conditions in the warehouse and the data on the administrator's desk, as well as the process of generating end-of-month stock reports, which took hours. The implementation shown in Figure 7 has fundamentally transformed operational efficiency through stock-in/stock-out management features and auto-generated reports. Every time an incoming or outgoing goods transaction is recorded, the remaining stock calculation is automatically updated by the system (cloud). This not only enables real-time monitoring of stock levels without delay, but also transforms the process of generating summary reports—which

previously took hours—into an instant and accurate process, thereby supporting faster decision-making regarding goods procurement.

Table 1. Number of Respondents

Respondent Categories	Number
Warehouse Administrator	2
Sales Staff	4
Data Entry Staff	4
Total	**10**

User Acceptance Testing (UAT) involved 10 users, comprising 2 warehouse administrators, 4 sales staff, and 4 data entry staff who use the application directly in their day-to-day operational activities.

Table 2. Questionnaire Indicators

Code	Indicators
P1	Ease of use of the application
P2	Ease of understanding the menu
P3	Speed of accessing information
P4	Accuracy of inventory data
P5	Efficiency of work processes
P6	Overall user satisfaction

The UAT evaluation was conducted using six indicators measuring usability, operational efficiency, information accuracy, and user satisfaction with the system.

Table 3. Results User Acceptance Testing (UAT)

Indicators	Average Score	Percentage
Ease of use	4.5	90%
Ease of navigation	4.4	88%
Data access speed	4.3	86%
Accuracy of stock information	4.6	92%
Work efficiency	4.5	90%
User satisfaction	4.4	88%
Overall average	**4.45**	**89%**

Based on the UAT results, the application received an average score of 4.45 out of 5, representing an acceptance rate of 89%. These results show that users gave the application a positive rating, particularly in terms of the accuracy of stock information (92%) and ease of use (90%). These findings suggest that the application is capable of supporting the inventory management process more effectively than the manual recording methods previously used. In addition to enhancing user satisfaction, the implementation of the system also delivers significant operational benefits. Users stated that the process of recording incoming and outgoing goods has become faster compared to the manual methods previously used. Real-time access to stock information enables more effective coordination between the Warehouse Administrator, Data Entry Staff, and Sales in meeting project material requirements.The findings of this study align with those of [5] and [6], which demonstrate that the digitalisation of inventory management can improve stock management efficiency and reduce recording errors. However, this study makes an additional contribution through the application of real-time cloud-based data synchronisation and Role-Based Access Control (RBAC) mechanisms, which enable inventory management to be carried out in a more integrated and secure manner within the operational environment of interior design projects. Based on user feedback, the application developed not only meets the system's functional requirements but also delivers practical benefits in terms of

improving operational efficiency, speeding up access to stock information, and supporting more accurate data-driven decision-making.

Based on the results of the User Acceptance Testing (UAT), users gave a positive assessment of the implementation of the Android-based application for inventory management. The majority of respondents stated that the digitisation of recording processes, real-time data synchronisation, and role-based access control helped to speed up workflows and simplify inventory management compared to the manual methods previously used. Consequently, the application is considered to have the potential to improve operational efficiency based on users' perceptions and experiences during the system evaluation process.

Table 4. comparison

Activities	Before the system	After the System
Stock checks	12 minutes	2 minutes
Transaction entry	8 minutes	3 minutes
Report generation	30 minutes	5 minutes
Stock data updates	Not real-time	Not real-time

4. Conclusions and Future Works

Based on the results of the system's design, implementation, and testing, it can be concluded that the Android-based inventory application developed has successfully addressed the issue of manual record-keeping at PT Interior Indonesia. Specifically, the implementation of a mobile-cloud architecture with an RBAC mechanism has proven to eliminate information delays between field staff and the warehouse, with test results showing that all system functions operate correctly and have achieved a high level of user acceptance (UAT). The use of the RAD model has also proven effective in accommodating dynamic user needs through prototype validation at each iteration. Nevertheless, this study has several limitations. Firstly, real-time data synchronisation in this system is highly dependent on the availability and stability of the internet connection in the warehouse area; thus, if the connection is lost, the recording process cannot be carried out. Secondly, the security testing carried out is still limited to the validation of access control logic (RBAC) and does not yet include in-depth penetration testing at an enterprise scale. Thirdly, the scope of the research is still limited to a single company case study, so adaptation for other types of industries may require adjustments to the business workflow.

Based on these limitations, the recommended directions for further development are: (1) Implementation of a local database (e.g. SQLite) on mobile devices, integrated with a background synchronisation mechanism to support offline mode in warehouse areas with no signal coverage; (2) Addition of a module for forecasting project material requirements using predictive algorithms (such as Simple Moving Average or Machine Learning) to replace manual estimates; (3) Development of push notifications based on Firebase Cloud Messaging (FCM) directly integrated with critical stock thresholds to provide automatic alerts to the Warehouse Administrator; These features can be used to simplify the process of tracking goods in the warehouse, speed up the recording of stock in and out transactions, and help monitor order status more accurately and efficiently, as well as (4) More comprehensive stress testing and network security testing prior to integration with the company's wider ERP/financial systems.

5. References

[1] M. A. F. Sa'i, D. A. Prastiningtyas, and L. Isyriyah, "Inventory Information System Development of Non-Information Technology Facilities and Infrastructures in STIKI Malang," *J-Intech: Journal of Information and Technology*, vol. 10, no. 1, pp. 47–54, 2022, doi: 10.32664/j-intech.v10i1.686.

[2] M. W. Rhamadani, A. Ardi, and A. Apriyani, "Optimizing Medical Equipment Inventory Management through Web-Based System Implementation for Real-Time Monitoring and Alerts," *J-INTECH Journal of Information and Technology*, vol. 14, no. 1, 2026, doi: 10.32664/j-intech.v14i01.2221.

[3] T. Octaviany and A. Gunawan, “Mengoptimalkan Manajemen Persediaan Melalui Teknologi Rantai Pasokan,” *Journal of Informatics and Business*, vol. 1, no. 3, pp. 150–155, 2023.

[4] N. Nuraeni and B. Santoso, “Peranan Manajemen Persediaan Bahan Baku Terhadap Penjadwalan Produksi PT XYZ,” *Jurnal Bisnis dan Manajemen (JURBISMAN)*, vol. 2, no. 2, pp. 379–394, 2024, doi: 10.61930/jurbisman.v2i2.614.

[5] M. A. Razali, R. Masrom, S. R. Hamid, and N. H. Mohamed, “Market Review and Analysis for the Development of Highly Intuitive Mobile Apps for the Smart Warehouse Management System (SMART WMS) in Supporting Warehousing and Custom Legal Requirement,” *IJRISS*, 2025.

[6] S. Milwandhari, “Warehouse Management System Berbasis Android,” *Jurnal Sosial dan Sains*, vol. 2, no. 1, pp. 28–39, 2022, doi: 10.59188/jurnalsosains.v2i1.293.

[7] N. I. Fadlilah, P. Widodo, and T. Hidayatulloh, “Development of an Android-Based IT Helpdesk System at the Kospin Jasa Purbalingga Disaster Recovery Center,” *J-INTECH Journal of Information and Technology*, vol. 11, no. 2, p. 266, 2023.

[8] H. A. Hutahaean, “Implementasi Warehouse Management System (WMS) untuk Meningkatkan Kinerja Warehouse pada Perusahaan Otomotif,” *Jurnal Praktik Keinsinyuran*, vol. 2, no. 3, pp. 189–202, 2025.

[9] M. B. R. Magfuron, “Perancangan Sistem Informasi Inventory Gudang Berbasis Web dengan Menggunakan Framework CodeIgniter pada PT Mitra Majeng Rahayu Pulogadung,” *Skripsi*, Universitas Bina Sarana Informatika, 2024.

[10] A. F. Febrian, A. P. Ramadhan, and R. X. Savero, “Implementasi Sistem Informasi Inventory Berbasis Mobile pada Warung UMKM Diza dengan Metode Agile,” *Skripsi*, Universitas Bina Sarana Informatika, 2025.

[11] H. Ardianto, “Perancangan Sistem Inventory Barang Berbasis Website Menggunakan PHP (Studi Kasus: PT. Inoac Polytechno Indonesia),” *Skripsi*, Universitas Bina Sarana Informatika, 2025.

[12] P. M. Tapara, F. O. Vera, and M. C. Carbonell, “A Mobile System with Usage Pattern Analysis to Optimize Storage Management,” *IJASEIT*, vol. 15, no. 2, pp. 538–544, 2025.

[13] M. Firmansyah, Mustika, and Pujianto, “IMPLEMENTASI ROLE-BASED ACCESS CONTROL PADA SISTEM INFORMASI LAYANAN ADMINISTRASI PADA LEMBAGA BAHASA UM METRO,” *Jurnal Mahasiswa Ilmu Komputer*, vol. 6, no. 2, pp. 113–122, 2025, doi: 10.24127/ilmukomputer.v6i2.9875.

[14] N. A. S. Nazmi and N. A. N. Ahmad, “Testing Phases for RFID Inventory Management System,” *Journal of Computing Technologies and Creative Content (JTec)*, vol. 6, no. 2, pp. 52–56, 2021.

[15] Y. Yanuardi, L. Azhari, A. A. J. Sinlae, and A. D. Alexander, “Development of Public Service Complaint System Using Rapid Application Development (RAD) Methodology,” *J-INTECH Journal of Information and Technology*, vol. 12, no. 1, 2024.

[16] A. J. Masaid *et al.*, “Rancang Bangun Sistem Informasi Layanan Masyarakat Menggunakan Model Rapid Application Development (RAD),” *JURNAL DIGIT*, vol. 14, no. 2, pp. 179–187, 2024, doi: 10.51920/jd.v14i2.411.

[17] M. S. Usen and S. D. Sancoko, “VibeScreen: A Mood-Based Movie and Music Recommendation Mobile Application,” *J-INTECH Journal of Information and Technology*, vol. 13, no. 2, 2025.

[18] A. K. Nasich, S. A. Wicaksono, and M. C. Saputra, “Implementasi Role Based Access Control (RBAC) dalam Sistem Informasi Manajemen Pelanggan dan Pembayaran Air Berbasis Web (studi pada PT Tirta

Wangi Sejahtera)," *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer (J-PTIIK)*, vol. 9, no. 9, 2025.

[19] A. Aliyah, N. Hartono, and A. A. Muin, "Penggunaan User Acceptance Testing (UAT) Pada Pengujian Sistem Informasi Pengelolaan Keuangan Dan Inventaris Barang," *Jurnal Sains dan Teknologi Informasi*, vol. 3, no. 1, pp. 84–100, 2025, doi: 10.62951/switch.v3i1.330.

[20] S. Narulita, A. Nugroho, and M. Z. Abdillah, "Diagram Unified Modelling Language (UML) untuk Perancangan Sistem Informasi Manajemen Penelitian dan Pengabdian Masyarakat (SIMLITABMAS)," *Bridge: Jurnal Publikasi Sistem Informasi dan Telekomunikasi*, vol. 2, no. 3, pp. 244–256, 2024, doi: 10.62951/bridge.v2i3.174.

[21] S. W. Ramdany, S. A. Kaidar, B. Aguchino, C. Amelia, and A. Putri, "Penerapan UML Class Diagram dalam Perancangan Sistem Informasi Perpustakaan Berbasis Web," *Journal of Industrial and Engineering System*, vol. 5, no. 1, pp. 30–41, 2024, doi: 10.31599/2e9afp31.

[22] A. Ramadani, "Sistem Informasi Cuti Kepegawaian pada Rumah Sakit Umum Daerah Kabupaten Batu Bara," *Modem: Jurnal Informatika dan Sains Teknologi*, vol. 3, no. 1, pp. 67–75, 2025, doi: 10.62951/modem.v3i1.350.