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Utilization of IoT and database system of central warehouse project in the pharmaceutical industry

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ABSTRACT

This study aims to develop an MRPII device that utilizes internet technology for inventory management control processes, using case studies from pharmaceutical companies in Indonesia. The research was conducted using field observation methods and system development, then comparing the manual system and MRPII. An internet-based inventory management system was created by integrating the warehouse's material database into each material code via a QR. code. The study found that implementing the MRP II system design increases work effectiveness and reduces the risk of errors that frequently occur in conventional systems. Moreover, using the MRPII can facilitate the audit process and establish transparency in the inventory management process. Data processed using IoT is generated faster and more accurately as company operations improve quality, reduce unnecessary activities, and make it easier to organize materials and run administrative and technical processes in inventory management; it is measured based on reach, workforce requirements, supply, and handling time. In the industrial world, the MRPII database system has the potential to evolve into several more complex and comprehensive systems. It has broad integration and can assist humans working across all lines, particularly in the data processing system.

Contribution/Originality: This study uses field auditing to provide an overview of a systematic research design using IoT, impacting traffic processes and condition monitoring of integrated supply chain, sharing data information with each interconnected department function to improve company performance through several features, making it easier data processing on projects related to inventory management.

1. INTRODUCTION

According to the most recent Intercontinental Marketing Services Health Inc. (IMS) Report, SanbeFarma Company (PTSF) is one of the largest pharmaceutical producers in Indonesia. As the company grows, the PTSF business processes become increasingly complex [1]. Many companies have strategically integrated several sub-business processes into one unit by implementing Manufacturing Resource Planning II (MRPII) and Internet of Things (IoT) systems. The MRPII can integrate several sub-business processes in the industry's IoT

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implementation, including sales, purchasing, inventory, accounting (general ledger, fixed assets), and finance (accounts payable, accounts receivable, and cash management). The MRPII can integrate several sub-business processes as part of an industry/company-level IoT implementation, including sales, purchasing, inventory, accounting (general ledger, fixed assets), and finance (accounts payable, accounts receivable, cash management). During its development, MRPII integrated with the Enterprise Requirement Planning (ERP) spread across several departments, including the sales department, purchasing, accounting, finance, and project. Several departments, including sales, accounting, finance, and project, utilize MRPII in conjunction with ERP. For example, in this study, researchers conducted field observations in the engineering division's warehouse of the project material section, which controls stock-taking and good circulation. The section holds monthly audits, and the audit results must show balanced records between incoming and outgoing goods, ensuring excellent warehouse management with no adverse findings.

The regulatory system determines the inspections that comprise the audit process. In general, the audit aims (a) to provide management with reasonable assurance that objectives have been met, (b) to support risks resulting from control weaknesses, and (c) to advise management on corrective actions in formulating and implementing corporate strategy in the short, medium, and long terms.

According to various definitions, auditing systematically examines a company's financial statements, internal control, and accounting records. The purpose is to evaluate and provide an opinion on the financial statements' fairness based on the evidence obtained and performed by an independent and competent person. The current study presents a comprehensive overview of a systematic research design that utilizes the IoT, focusing on its impact on traffic processes and the monitoring of supply chain project conditions through an integrated system. Such a system includes sharing data information with each department function that is related to one another and helps improve company performance [2]. The system also streamlines the material audit process by incorporating various existing features and simplifying data processing for inventory management projects within the project division of a pharmaceutical company. Moreover, the integrated system regularly conducts a material project audit at the warehouse, also known as stock-taking, once a month to determine the condition of the stock using the database and ensure a balance between the database and the actual in the warehouse.

2. LITERATURE REVIEW

2.1. IoT System

The IoT is a concept in which all real-world objects can communicate with one another as part of an integrated system via the internet network [3]. Several authors regard the IoT as the fourth industrial revolution, promising numerous changes in all aspects of human life enhancement [4]. Over the last few decades, the IoT paradigm has increased scientific interest in various applications, economic fields, and populations [5]. It has thus become a global technological trend to innovate. IoT is increasingly used in health, agriculture, and industrial research [6]. There are several IoT application scenarios. Physical or virtual devices or objects perform functions or recognize the physical world and its context, as exemplified, in smart home and industrial services, healthcare, self-care, environmental monitoring, logistics, defense, transportation, and safety [7]. These technologies can catalyze adaptability, resulting in the evolution of a next-generation of services and devices that will dominate social and technological ecosystems [8, 9]. Predictably, this next-generation technology's systems and services will permeate a variety of domains, including home and clinical healthcare, medical follow-up, online government services, transportation, supply chain, energy supply, other critical needs, and public services [10]. So far, the IoT has been most closely associated with machine-to-machine (M2M) communication in manufacturing electricity, oil and gas, and even communication techniques in cybercrime prediction [11]. For example, smarts or “smart” systems, such as smart labels [12], are products built with M2M communication capabilities. The label is the part of the product that carries verbal data about the product or seller.

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A smart meter, on the other hand, is a digital meter that continuously records electricity consumption in real-time. Consumers can access recorded data by sending it to Perusahaan Listrik Negara (PLN) (state electricity company) via an internet connection. smart grid (SG) is a power system network (from upstream to downstream) that monitors and manages the process of transferring electrical energy from all generating sources to meet load requirements [13].

Modern people are progressing towards a new era where they can connect not only smartphones or computers to the Internet, but also a wider range of real-world objects. Nevertheless, a wider range of real-world objects can connect to the Internet, including manufacturing machines, automobiles, electronic equipment, and equipment that humans can wear and use [14].

2.2. Database Systems

The inventory management system database will integrate data communication hardware and computer systems with the MRPII database software system. The system will improve and focus the supply chain processes in the warehouse, including stock checking, purchasing and receiving goods, storage, movement, and retrieval of goods. Using an inventory management system, such as a goods inventory management system or a warehouse management system (WMS), is necessary to manage inventory.

To carry out processes in a warehouse or supply chain project, WMS employs a database system, barcode scanner, cloud, and a set of procedures in an MRPII system. In the last decade, the data generated has reached previously unseen levels. According to the International Data Corporation [15], by 2025, the global amount of data will reach 175 zettabytes (ZB), with 30 percent of this data collected in real time. In particular, the number of IoT devices is expected to grow to 20 billion connected devices [16], which are used in various application scenarios, such as smart cities [17] and traffic monitoring [18]. Simultaneously, devices like embedded computers and mobile phones constantly improve their processing capabilities. Exploiting their capabilities will be critical for dealing with future IoT data volumes. Hence, IoT is one of the most rapidly emerging trends in the field of information and communication technology [19]. The proliferation of connected devices is causing the emergence of new data-driven applications. These applications require low latency, location awareness, geographic distribution, and real-time data processing across millions of data sources. To activate this application, data management systems must leverage the capabilities of IoT devices. For this purpose, data processing must extend beyond the cloud [20].

2.3. Central Warehouse Project

Inventory management is a company activity that stores or provides stock of raw materials or finished goods to ensure the smooth operation of a project. Inventory management is defined as a company's series of decisions or policies to ensure that the company can provide quality supplies in a specific amount and time [21].

MRPII is an effective planning method for a manufacturing company's resources. It consists of several interconnected functions, including business planning, operations, sales, production plans, basic schedule determination, material requirements, and implementation of support systems for materials [22]. Such goods (e.g., various materials or components) will be sent as a supplier's responsibility by ensuring proper integration with the management in other supply chain configurations [23]. Managing the incoming and outgoing materials to the warehouse will be difficult, as there is an increasing variety of materials and components in a project.

Implementing an IoT database system for inventory management provides several benefits, such as real-time tracking, predictive maintenance, and optimized resource allocation. These benefits result in a more efficient production process and reduce risks, such as late delivery of finished goods or suboptimal machine performance. By leveraging IoT technology, businesses can improve supply chain management and make better decisions. In the end, this guarantees the optimal fulfillment of work requirements.

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Layout is one of the most critical aspects of inventory management. An efficient layout, especially in a warehouse, can reduce the time it takes to produce and distribute goods when needed. A favourable layout makes the flow of goods and information smoother, increasing productivity and operational efficiency. Improving warehouse layout is about placing goods, optimizing work processes, and maximizing space utilization. Thus, improving warehouse layout is the key to achieving efficiency and effectiveness in industrial inventory management.

Using an IoT database system to support goods inventory simplifies material management. It reduces risks, such as delayed delivery of finished goods, sub-optimal machine performance, and inability to meet work needs optimally. Therefore, it is essential to improve warehouse layout to ensure an efficient flow of goods and information for the industry.

Following the implementation of good inventory management and warehouse layout, the process of evaluating or auditing the operation of the inventory management system follows. An independent party performs critical and systematic audits on the financial statements prepared by management, along with bookkeeping records and supporting evidence, to provide an opinion on the fairness of the financial statements and assess their equivalent suitability using standarized criteria. The results are then provided to interested users. The audit objective is also valuable for providing users of financial statements with an auditor's opinion on whether the financial statements are presented fairly in all material respects by the applicable financial accounting framework [24].

3. METHODS

This study employed the observational research method. Sugiyono [25] defines observation as a data collection method with distinct characteristics compared to other methods. Observations include not only people, but also other natural objects. Through observation activities, researchers can learn about behavior and its meaning. The descriptive and causal research design was used. Case studies can use various evidence sources, including documentation, archive recordings, interviews, direct observation, participant observation, and physical devices.

Meanwhile, the data collection methods used in this study were observation, interviews, and warehousing system simulation. Figure 1 shows the methodology flow and some of the research process flows. The first step is to identify the problem, which includes conducting a literature review, which can be defined as a series of activities related to library data collection methods, reading and recording, and processing research materials and determines the background problem, the formulation problem, and the feasibility of the research proposal. The second step involves identifying the research method, followed by observations of the project's warehousing system, inventory system, and the process of storing and retrieving products from the warehouse. Furthermore, an interview with the warehouse and production departments related to the warehousing system with simulation is an observation of the company's historical data, which includes the amount of material, the number of receipts, the release of goods in the warehouse, and the final audit or stock-taking process.

When receiving and sending materials, the raw material warehouse simulates the application of the WMS. The data gathered prior to the simulation and during its execution, which involves calculating the time needed for material movement during both material reception and dispensing, demonstrates the continuous operation of the field warehousing process, its positive influence, and its ability to expedite transaction times during stock-taking and auditing. It can demonstrate the continuity, impact, and speed of the warehousing process in the field during transactions, stock-taking, and auditing using the MRPII. The author conduct a literature study to inform his thinking and facilitate problem-solving.

Based on their observations, the authors plan to develop a WMS that integrates with an IoT database system, utilizing the MRPII platform as an existing interface. This system will integrate all system processes into warehouse management, aiming to minimize errors caused by human factors and data procedures. Database system topology describes the system's main functional elements, responsibilities, and interactions with other elements.

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Elements' responsibilities are defined to ensure the smooth operation of information systems. In information systems, various departments collaborate with several departments and in parallel with several other departments. Each department assigns tasks and performs them correspondingly with other departments.

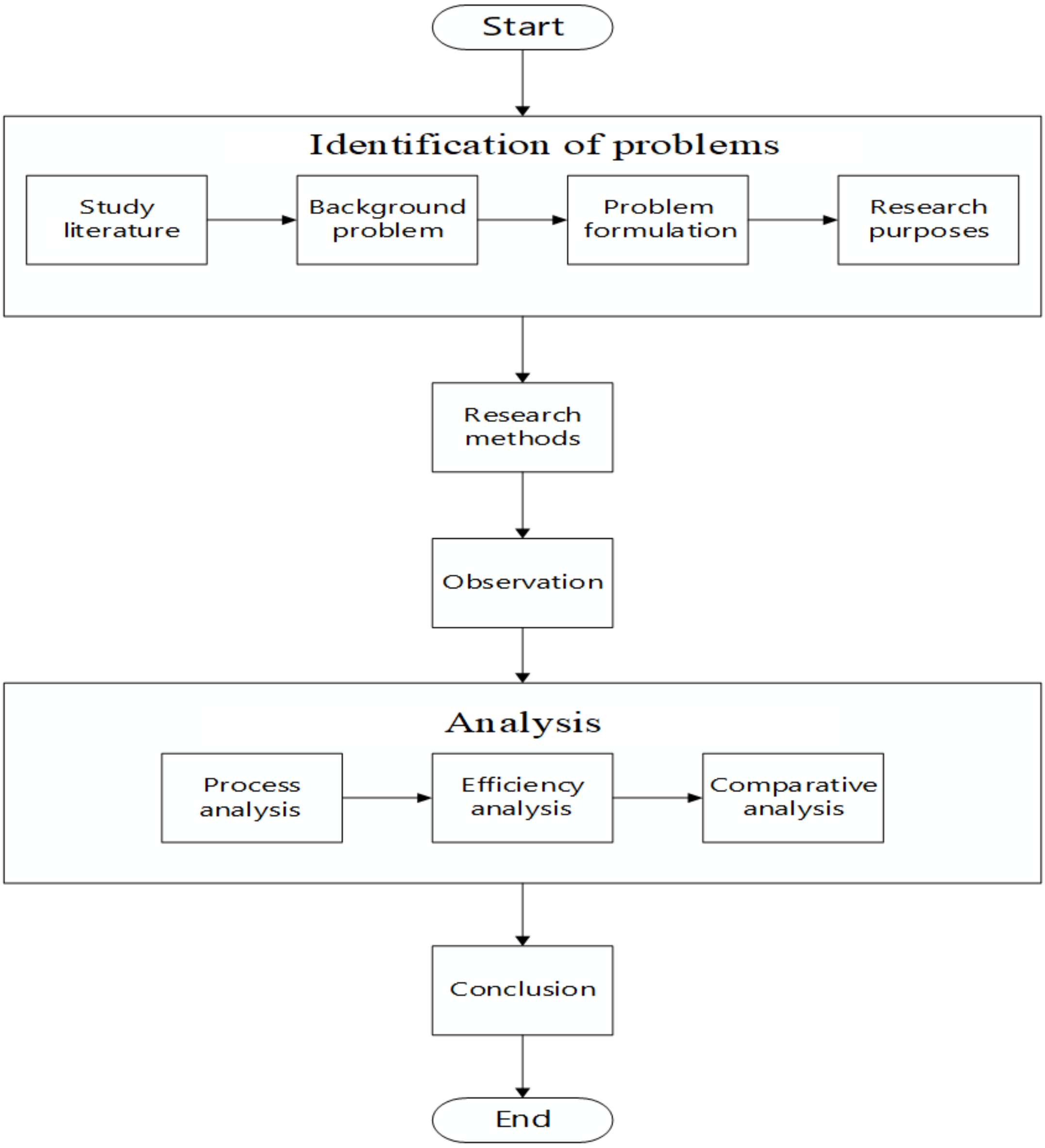

Figure 1. Flow of research methodology.

The functional view is the most fundamental and crucial model for any information system. It consists of functional elements, interfaces, connectors, and external and internal system entities. It not only describes the function of the element, but it also defines the scope of each entity. Examining the interface defined as hardware and software reveals the functional point of view, with each large block symbolizing a functional elements and arrows indicating interfaces with other functional element [26].

The fourth step is analysis, which includes process analysis, efficiency, and comparison. The fourth step involves a review of the existing literature, which provides a detailed background to define the problem and includes domain analysis. The main problems identified were the need for more efficient communication between departments, tracking material stock, periodic audits, and managing traffic across the warehouse as internal suppliers.

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Internal suppliers' needs in projects involving this domain are also identified to be prioritized and appropriately managed. To address this issue, the project section proposes an architecture based on project requirements. Viewpoint is a model-building template for information systems based on system requirements and stakeholder concerns. This viewpoint describes a system's functional elements and interactions with one another and resources outside the system. They also consider system requirements for software and hardware support, physical deployment, and communication between different components. They use ubiquitous language to create models that software developers and business people can understand. This businessperson is here to assist in modeling an architecture that suits the needs of stakeholders, particularly in terms of maximizing business benefits.

The WMS is modeled as an information system connected to several internal and external elements. In this paper, we propose architectures using diagrams of contextual, functional, and operational viewpoints. It is used in warehouse modeling to identify problems and solve them by proposing a model. In addition, we design and develop IoT-based hardware prototypes to implement this architecture in the project division.

4. RESULT

4.1. Material Warehouse Project

Zinkin, et al. [27] state that "topology can be interpreted as a layout or architecture/ computer network diagram." Topology MRPII system network is a rule that governs how computers are physically connected. The way network components (e.g., servers, workstations, routers, and switches) communicate with one another via data transmission media is referred to as topology. When we select a topology, we must adhere to its specifications. Several common topologies are bus topology, star topology, ring topology, tree topology, and mesh topology. We can see the database topology system at PTSF in the project division in Figure 2, where all data will be centralized on one database server and integrated via the internet network, which is directly connected to the company's cloud center as a dependency on the network system, such as sharing information [28] and mutual transfer of data from an interconnected network system [3].

Following the analysis of the findings and discussion, the final step is a conclusion that includes the conclusions of the discussion by the research objectives, recommendations, and suggestions for future research.

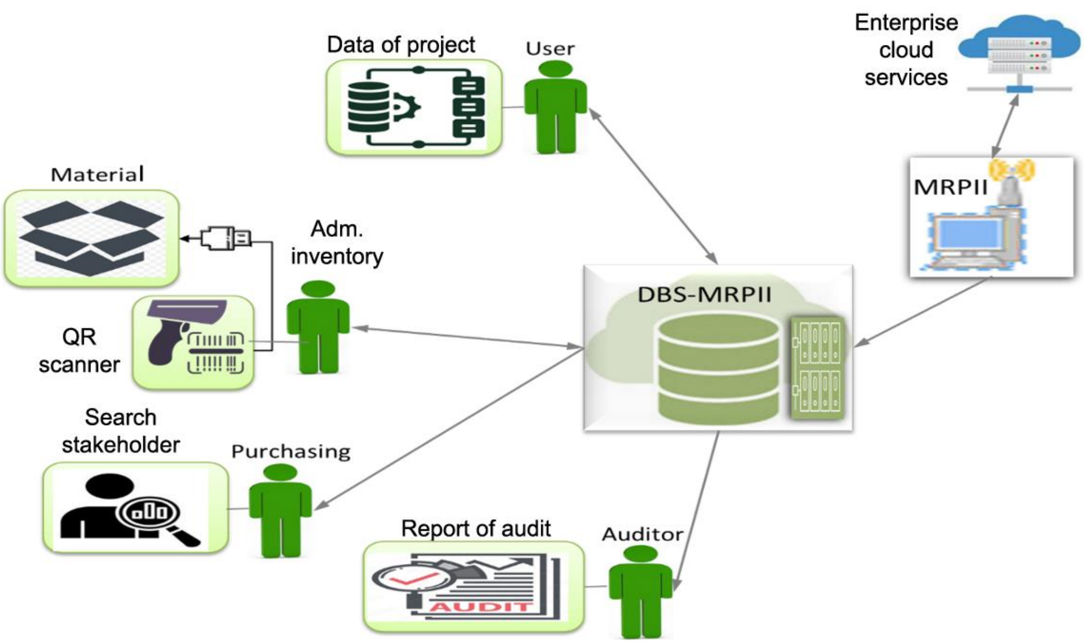

Figure 2. Database topology of the system.

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The control implementation with the IoT system for the warehouse project at PTSF uses first-in-first-out management. Project material control with this concept enables material flow management within the system. Moreover, every material or component with a barcode mark can be scanned, its position is known, the item is placed, and the status of the person in charge of this item is identified. It helps identify finished goods manufactured by providing data and information about these goods to be entered into the company's database. Furthermore, goods data and information will be automatically collected at the terminal, scanned, and transferred to the company's database in real time.

Because all processes are based on the IoT system and configured with a database, automatic data retrieval will reduce problems or employee errors in entering data into the MRPII system. It is also beneficial for monitoring and controlling incoming and outgoing goods. Generally, the project division of PTSF uses the IoT system to explain the stages of the inventory management process:

4.2. Procurements

During the procurement or purchase of goods in the PTSF project division, several steps must be followed. Human and system errors are highly likely because the purchasing process involves multiple parties from various divisions. Therefore, using IoT systems and databases is a solution for reducing errors caused by the human factor. The following are some of the parties involved in the procurement process:

4.2.1. Users

Users in the WMS are buyers or parties responsible for purchasing within a division equipped with the IoT system. This database will enable a user to monitor data processing and order necessary goods for distributions, thereby identifying the most efficient distribution channels based on route and time efficiency [29]. A system that can also control the buffer stock is used so that stakeholders can determine the project needs and the stocks needed according to the results provided by the IoT database system.

4.2.2. Inventory Control (IC)

Division IC is in charge of checking related expenses and income. The IoT system will send out warnings and notifications to suppliers, process purchase orders to match incoming spare parts with orders placed by the purchasing team, generate printouts for suppliers as proof of receipt of spare parts, identify spare parts that have run out and are missing from buffer stock, and provide information on spare part inventory available in the warehouse. The system's controller can check the entire system using the system database, thanks to the integration of all these processes with barcode scanning on each spare part.

4.2.3. Purchasing Division

The purchasing division's job is to buy goods or services from third parties for the company's operational needs. Every business requires raw materials or other supplies [30]. This division is responsible for purchasing goods or services that other divisions require.

This purchasing division can help supervise the warehouse of spare parts. The IoT database system's role is to provide information on spare parts inventory and display users with access to warehouse information systems. Moreover, information about suppliers is available to easily create purchase orders, with information on the orders' storage status. The IC division can approve and print purchase orders for execution. The system also helps locate information on spare parts that have been ordered and track their arrival at the warehouse. There is also a menu designed to identify the users who have placed orders for spare parts at the warehouse, as well as to monitor the inventory of spare parts, including stocks and finished parts. Figures 3–9 depict a flow process flowchart for warehouse management using the MRPII database, with details shown at PTSF-Division of the project:

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a) The user creates a Goods Request Sheet (GRS) following the bill of materials (BOM) and enters all project requirement data into the database;

b) IC creates procurement requirements (PR) in MRPII according to the database provided by the user, which can be seen in Figure 3;

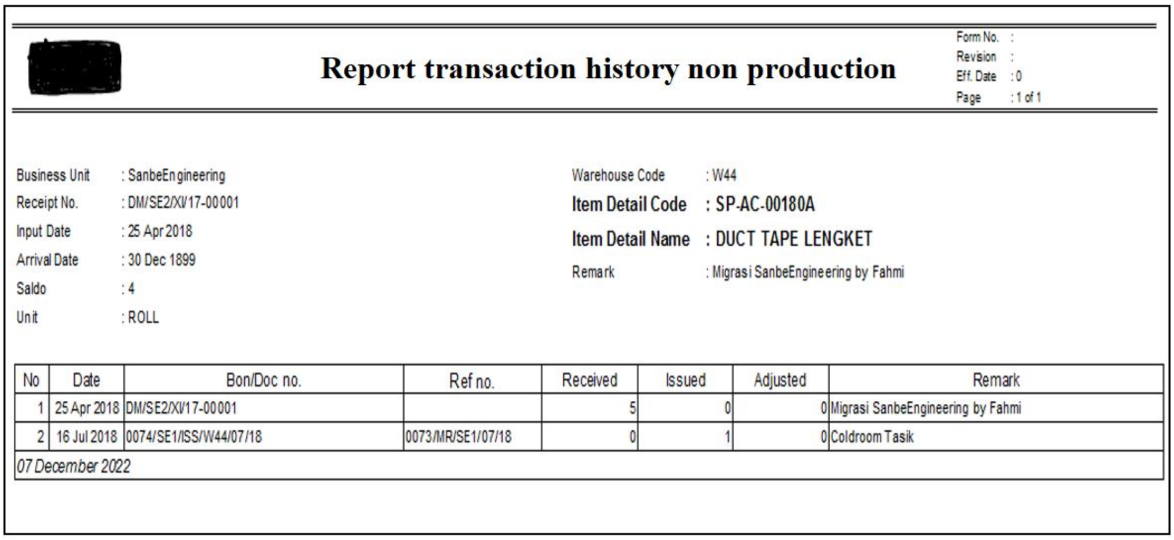
c) The database project will approve or sign the PR documents, check them simultaneously, and then send the PR to purchasing division for vendor processing.

d) Purchasing makes purchases according to the needs, and the user accepts specifications provided by the vendor. When the Accept Specification process is complete, it will enter the purchase order (PO) stage;

e) IC will receive goods and travel documents from vendors and simultaneously input goods arrival data into the MRPII database to make it easier for users to monitor materials, as can be seen in Figure 4;

f) IC installs QR codes on materials that already contain complete information about these materials to facilitate checking per unit, as shown in Figure 5;

g) IC places materials on rack or cabinet location, where already listed on the stock card database and QR code (Figure 6).



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Report transaction history non production

Form No. :
Revision :
Eff. Date : 0
Page : 1 of 1

Business Unit : SanbeEngineering
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Input Date : 25 Apr 2018
Arrival Date : 30 Dec 1899
Saldo : 4
Unit : ROLL

Warehouse Code : W44
Item Detail Code : SP-AC-00180A
Item Detail Name : DUCT TAPE LENGKET
Remark : Migrasi SanbeEngineering by Fahmi

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1	25 Apr 2018	DM/SE2/XI/17-00001		5	0	0	Migrasi SanbeEngineering by Fahmi
2	16 Jul 2018	0074/SE1/ISS/W44/07/18	0073/MR/SE1/07/18	0	1	0	Coldroom Tasik
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Figure 3. PR creation MRPII software.

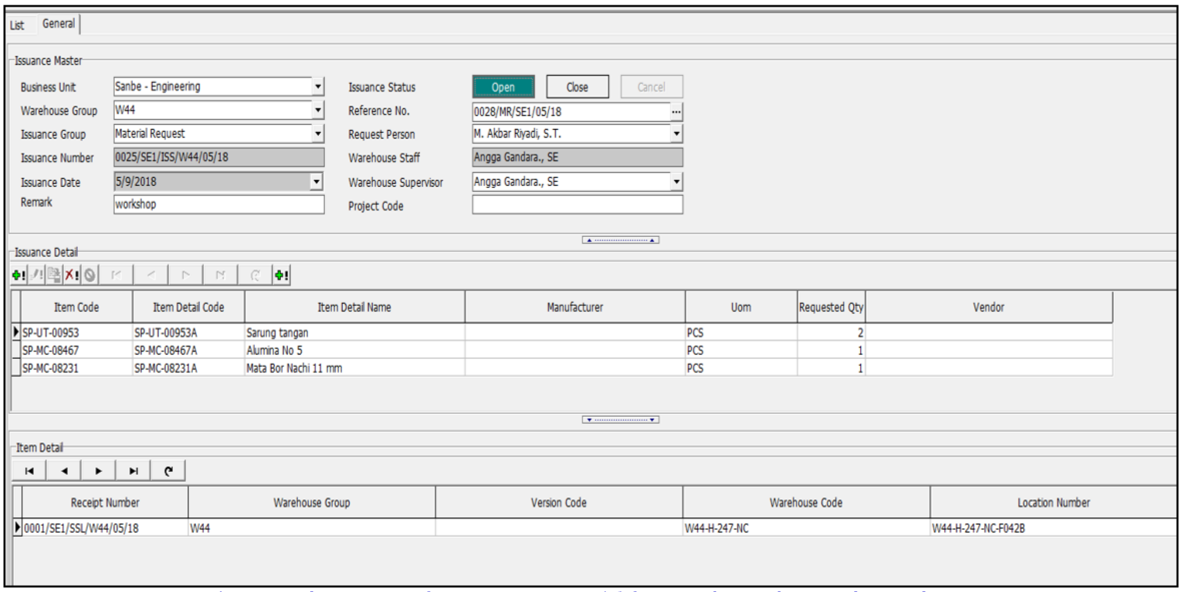

Figure 4. The MRPII software accepts material from vendors and enters the warehouse.

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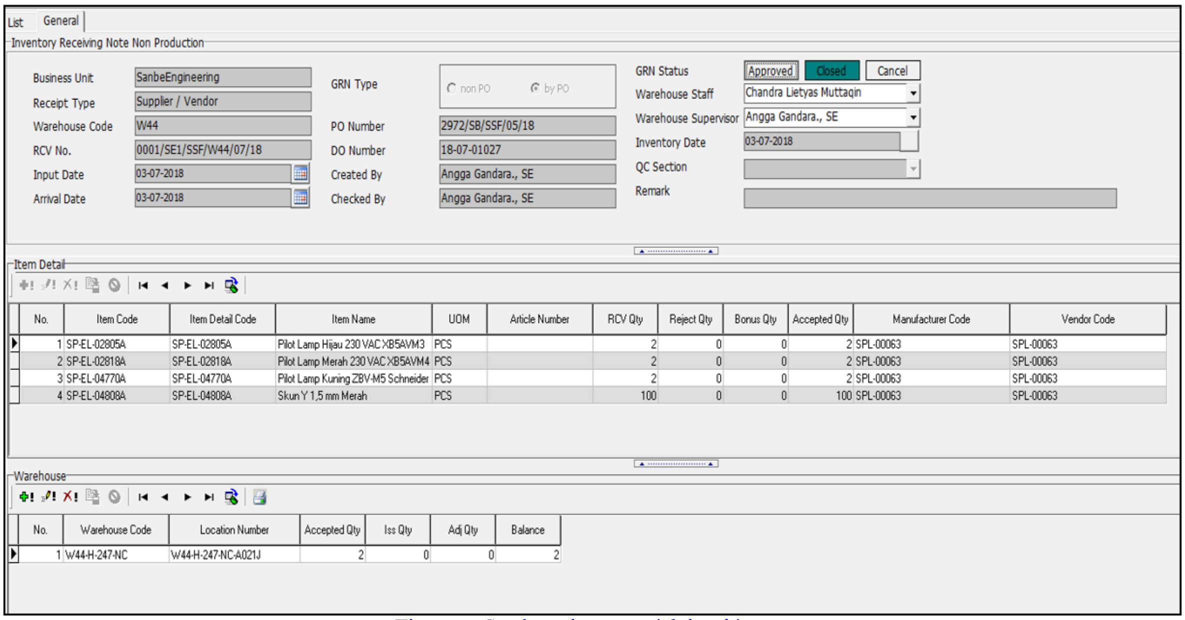

Figure 5. Stock card or material data history.

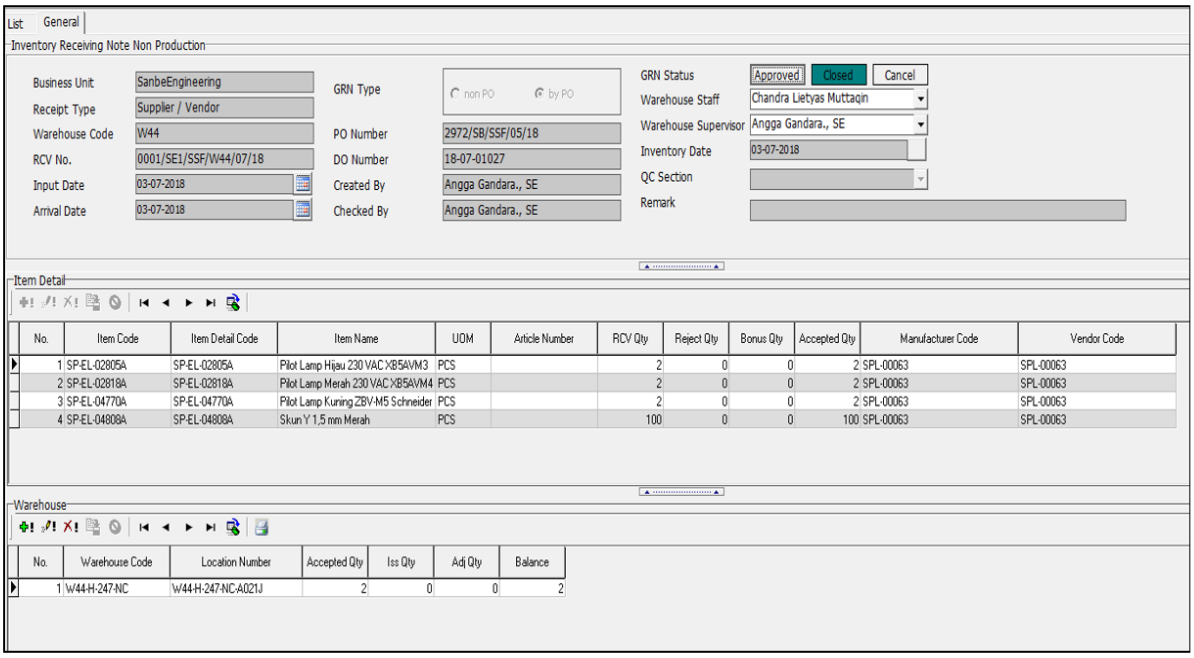

Figure 6. MRPII software for dispensing materials from the warehouse to the user.

The MRPII system simplifies and expedites all data processing and tracking, as the database exhibits all the necessary information for a real-time PTSF-Division project, which is as follow:

a) IC creates a material audit period schedule or stock-taking schedule every 1 or 3 months; when the audit period schedule is complete, it is given to the auditor or cost accounting division.

b) The audit division inspects all project materials in the warehouse. The IC Division, in collaboration with the audit team, combed the entire rack while scanning the quick response (QR) code for each material to determine whether the actual stock with the integrated database was present, as shown in Figure 7.

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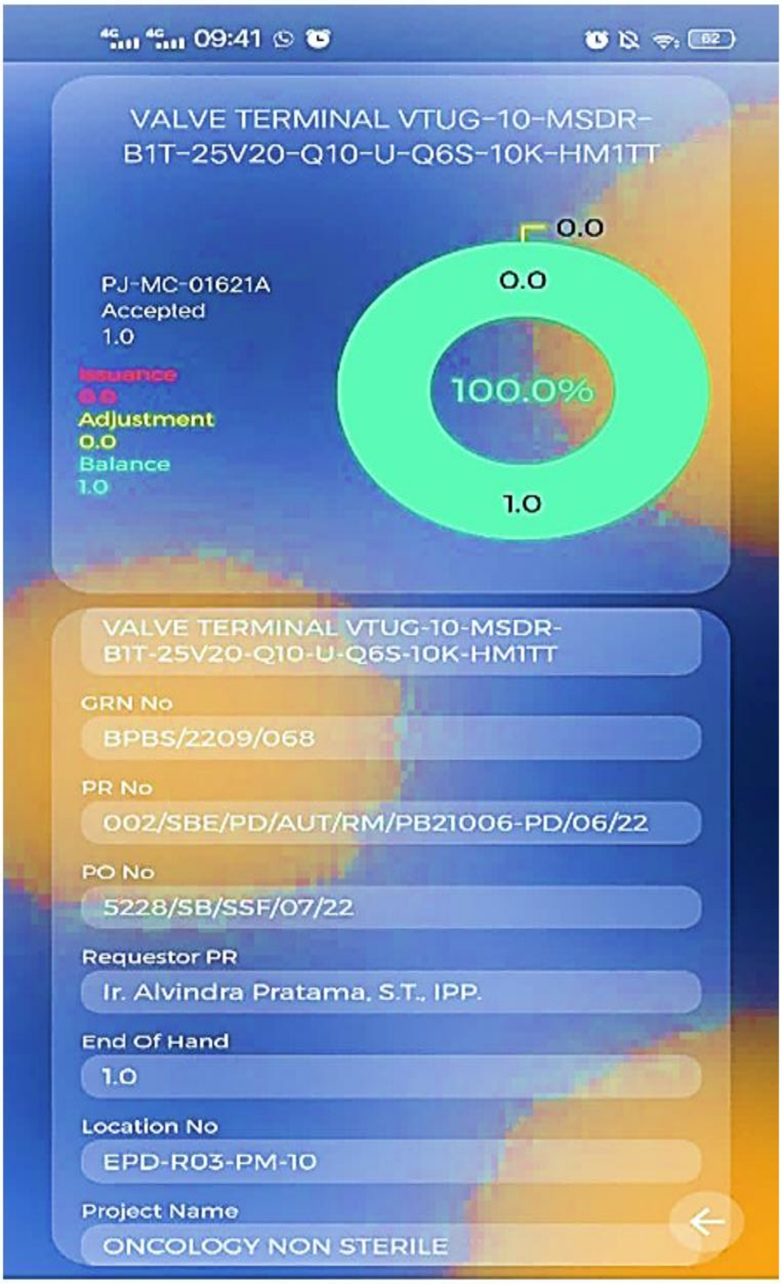

Figure 7. Example of scanning QR-code material.

c) The auditor team compares the scanning (actual) data with the database at MRPII; if the material stock with the database, it is considered balanced, and the report results indicate no issues. However, if material clarification, as shown in Figure 8, the data is out of balance, the user is contacted to request.

The MRPII database will report material audit results and declare them in once management can view all integrated material data in the MRPII cloud system. Before the MRPII database system was created, the error and confusion factor in all processes was very high, which could result in significant losses. The percentage of errors would be lower because the entire process did not use manual data processing but instead used the MRPII system, in which all data can be executed by the system and software, as well as the level of fraud in each audit, which will not occur because of the data audit.

With a database system, all data can be checked using MRPII, making the audit process more effective and efficient. Figure 9 (Appendix 1) depicts the flow process for procurement activities. The MRPII database system was used to design all these systems, simplifying each process and reducing errors or data errors compared to the manual method.

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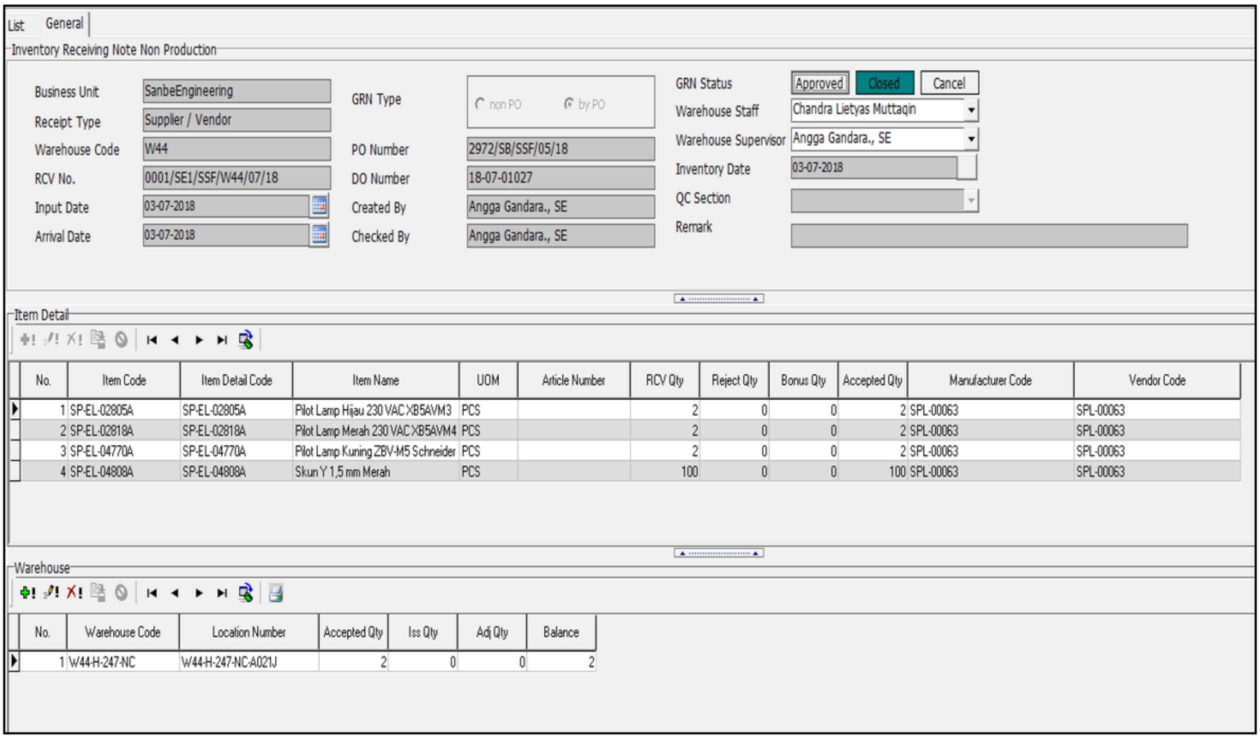

Figure 8. Software MRPII list of materials issued via QR code scanning.

5. DISCUSSION

5.1. Time Efficiency Analysis

The analysis and observation of the PTSF-Division warehouse yielded the following results. The material audits project has a total material database of 3,700 different types of material from various departments within the project division, with the following analysis:

5.1.1. Transactional Time Analysis of Material Expenditure Transactions

There were ten employees as the sample in this study, which was conducted by observing and calculating the time needed to take material from the warehouse, using both manual and MRPII processing methods, as in Table 1. The comparative analysis of the two methods in Table 1 shows some statistically significant results, one of which is the mean result from the service of the ten employees who are the same between the two data for the manual service process, which takes 576 seconds. In contrast, the MRPII method process only takes 172.8 seconds. In this case, the MRPII system outperforms the manual system with a time efficiency of 403.2 seconds (standard deviation from 219.66 to 72.991 seconds, or 66.8%). Other literature shows that in addition to being efficient, there is also a higher level of effectiveness [31] and an accurate time control function [32]. It could increase service time, which has been a problem in the material transactions section in the warehouse division, and it can be optimized, or the service process can be more efficient by 70% after using MRPII.

Table 1. System service time analysis- manuals and MRPII.

Services process		
Item	**Manual**	**MRPII**
Man power	10	10
Mean	576.00 seconds	172.80 seconds
Deviation std.	219.56 seconds	72.99 seconds

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5.1.2. Warehouse Audit Time Analysis

Four sections currently comprise the warehouse project: the consumable and spare parts warehouse, the cable warehouse, piping warehouse, and plate warehouse. The audit was carried out in (Figure 10: Appendix 2), from one warehouse to the next. Table 2 illustrates the author analysis of the audit process time over the last five months, using both the manual process method and MRPII. The analysis of the audit time of the two methods yielded significant results, one of which is the mean result of the duration of the audit process over five months. It takes 26.6 working days to perform an audit using the manual method. In contrast, the manual audit process takes longer because all material is calculated manually, and all comparative data must be processed using a manual system, causing the audit process to take longer and be more complicated. The MRPII audit process takes only 4.40 working days.

This is because the entire process already uses the PTSF cloud server database, which is integrated with the MRPII system. Because all materials can be identified using the MRPII system, the audit process is very effective and efficient in scanning the QR code attached to the material, as shown in Figure 11. (Appendix 3) All material data can be detected simply by scanning the material [33]. Therefore, the MRPII database and warehouse operator can already compile the audited materials, eliminating the need for manual or existing processes to compute them during the audit process using the MRPII method. Figure 12 (Appendix 4) depicts the audit process.

Table 2. Audit time analysis existing and MRPII system methods.

Audit process			
Item	**Existing method**	**MRPII method**	**Reduction/Efficiency**
Mean (Days)	26.60	4.40	83.5 %
N	5	5	-
Deviation std.	2.074	0.548	73.6%
Sum	133	22	83.5%
Grouped median	27.00	4.40	83.7%
Geometric mean	26.53	4.37	83.5%

Table 3 presents a comparative analysis of the conventional inventory management process and the IoT-based MRP system. Table 3 provides advantages over the manual system, including users do not need to make BOM manually because the MRP II system is equipped with a Project BOM database. The Inventory Control Division can directly retrieve existing data in the database and input arrival material into the MRPII database as monitoring data by attaching a QR Code to the material and setting the placement location fully in the MRPII system. Users can search for available stock data [34, 35] and check all stock data, placement locations, owner names, and projects [36]. Stock material checking is only done by scanning the material, and a material stock card appears so that the stock-taking results appear in the MRPII system database.

The results of the audit report can be viewed in real-time by all levels of the management directly [37]. Accuracy and ease of the audit process are needed to produce optimal performance; this will be easy and fast when the auditor takes the results of part samples or as a whole, making it easier to make decisions from the comparison results that have appeared in the MRPII database system because the transaction process is more efficacious [38] and has a positive impact on the company's financial factors from an integrated system [39, 40].

The results of audit reports are prepared manually and circulated to management by mail, which is felt to be less than up to date, with system improvements through the MRPII system database base, which can be seen in the MRPII system by all levels of the management directly when the entire audit process has been completed [41] The MRPII system no longer requires a lengthy process [42]. When the auditor has completed the entire audit process [43, 44] this study found that by reducing the audit process, the overall efficiency is up to 87%. It is in line with Barr-Pulliam, et al. [45] that the effects of person-specific, task, and environmental factors on digital transformation positively impact time, energy, and other resources. Apart from that, the audit implementation is

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much more transparent and can be accounted for by the system so that the level of accuracy is more guaranteed. In this instance, the design outcomes of the System of Central Warehouse Project database system with data processed with IoT utilization confirm that they are generated faster and more accurately as company operations are modernized to improve quality and reduce unnecessary activities.

Table 3. System comparison analysis.

No.	Manual system	Database MRPII system
1	Users usually manually make a bill of materials (BOM) and provide the data to the inventory control division. The inventory control division must rewrite the list of materials needed to make procurement requirements (PR).	Users do not need to manually make a bill of materials (BOM) because the manufacturing resource planning (MRP II) system is equipped with a database for the BOM project, and the inventory control division can directly retrieve data in the database.
2	Inventory control writes material arrivals in the log book as monitoring data.	Inventory control inputs material arrivals into the MRPII database as monitoring data.
3	Inventory control classifies materials only based on material class	Inventory control attaches a QR code to the material, and the MRP system comprehensively regulates the placement location.
4	Users need to support data specifications to check materials.	Users can check all stock data, placement locations, owner names, and projects by scanning the material's QR code.
5	The auditor team verifies all materials by manually calculating and writing data on paper.	The auditor team checks the stock material only by scanning it; the stock card appears, and it is easy to track products.
6	The auditor team processes data on all materials by conducting data comparisons by writing information manually on paper.	The stock-taking comparison results have appeared in the MRPII system database.
7	Results of audit reports are prepared manually and circulated to management by mail.	The audit report results can be seen in the MRPII system by all levels of management directly when the entire audit process has been completed.

It makes operating processes more straightforward and sophisticated to improve quality and reduce unnecessary activity [46].

This system can be continued to duplicate systems that have been built and used for other system databases required by the company, for example, in maintenance management system activities for production [47, 48] where digitalization with MRPII database integration is an efficiency strategy for all production planning activities in productivity improvement [49] and makes it easy to track products [50] so that with the support of IoT utilization and application software, it can be consolidated database by unusual operations to coordinate and integrate all the information, resources, and activities that are interrelated [34] as well as others that are necessary for the company so that all manufacturing databases are integrated both in the pharmacy or manufacturing industry and other implementation.

6. CONCLUSIONS

The MRPII database system at PTSF, specifically in the project division warehouse, has had a positive impact and has been remarkably effective and efficient in suppressing problems in the warehouse's inventory management process system so far. The entire audit process will be more transparent from all lines, effective in terms of audit time, reliable, and avoid suspicion of fraud using the MRPII database system. Furthermore, compared to manual data processing audits, MRPII database system can shorten the audit process time by 83.5 percent and reduce service time by 70 percent. Data processed with IoT is generated faster and more accurately as company operations are modernized to improve quality and reduce unnecessary activities. Additionally, this research can make it easier to organize materials and run administrative and technical processes in inventory management at PTSF,

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particularly in the project division warehouse, which is measured based on reach, workforce requirements, supply, and handling time.

The MRPII database system has the potential to evolve into several more complex and comprehensive systems in the industrial world through further research. It has broad integration and can assist humans working from all lines, particularly those engaged in the data processing system. The MRPII database system is mainly used in substantiated automation in the manufacturing industry in developing countries. The automation substance integrated with MRPII will be developed in the maintenance management system for production machines based on the main parameters seen in the overall equipment effectiveness system. This will serve as an information tool for monitoring the condition of the spare parts installed on the machine. It will provide information regarding the spare parts' strength and durability so that they are ready for purchase before the damage occurs.

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Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Writing - review & editing, methodology. supervision, E.S.; conceptualization, writing, software and investigation, A.P.; assisting review-final draft, D.N.; investigation, M.P.; data curation and analysis, M.M.B.; review and editing, R.A.H. All authors have read and agreed to the published version of the manuscript.

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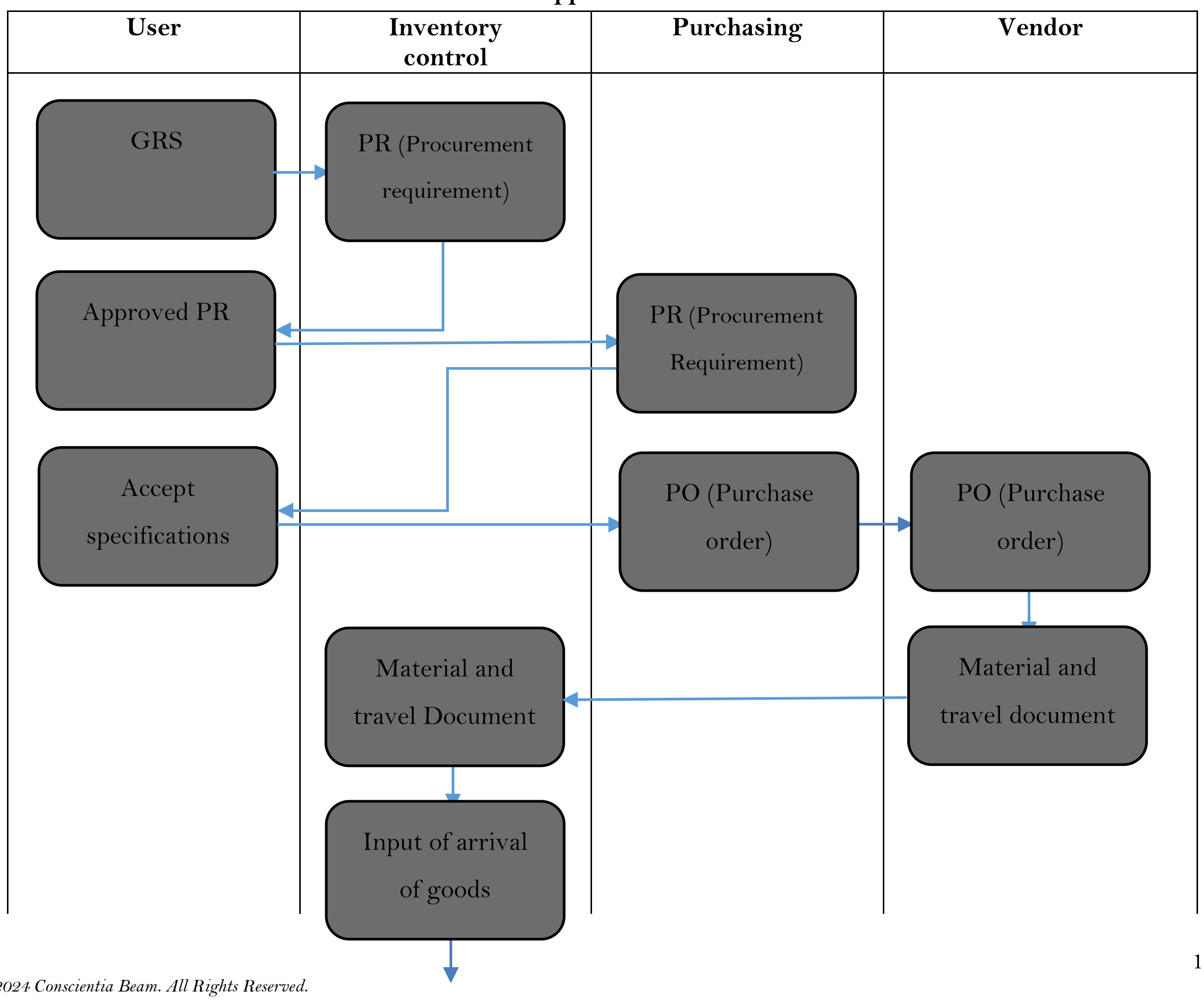
Appendix 1



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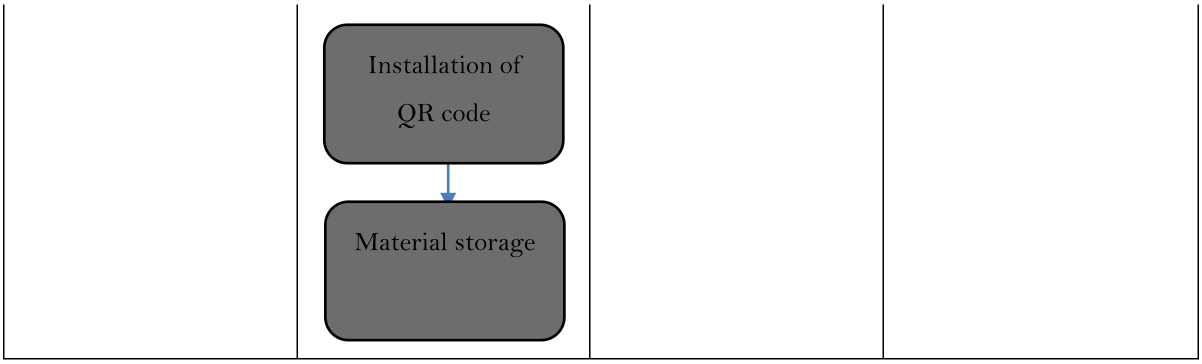

Figure 9. Process flow diagram.

Appendix 2

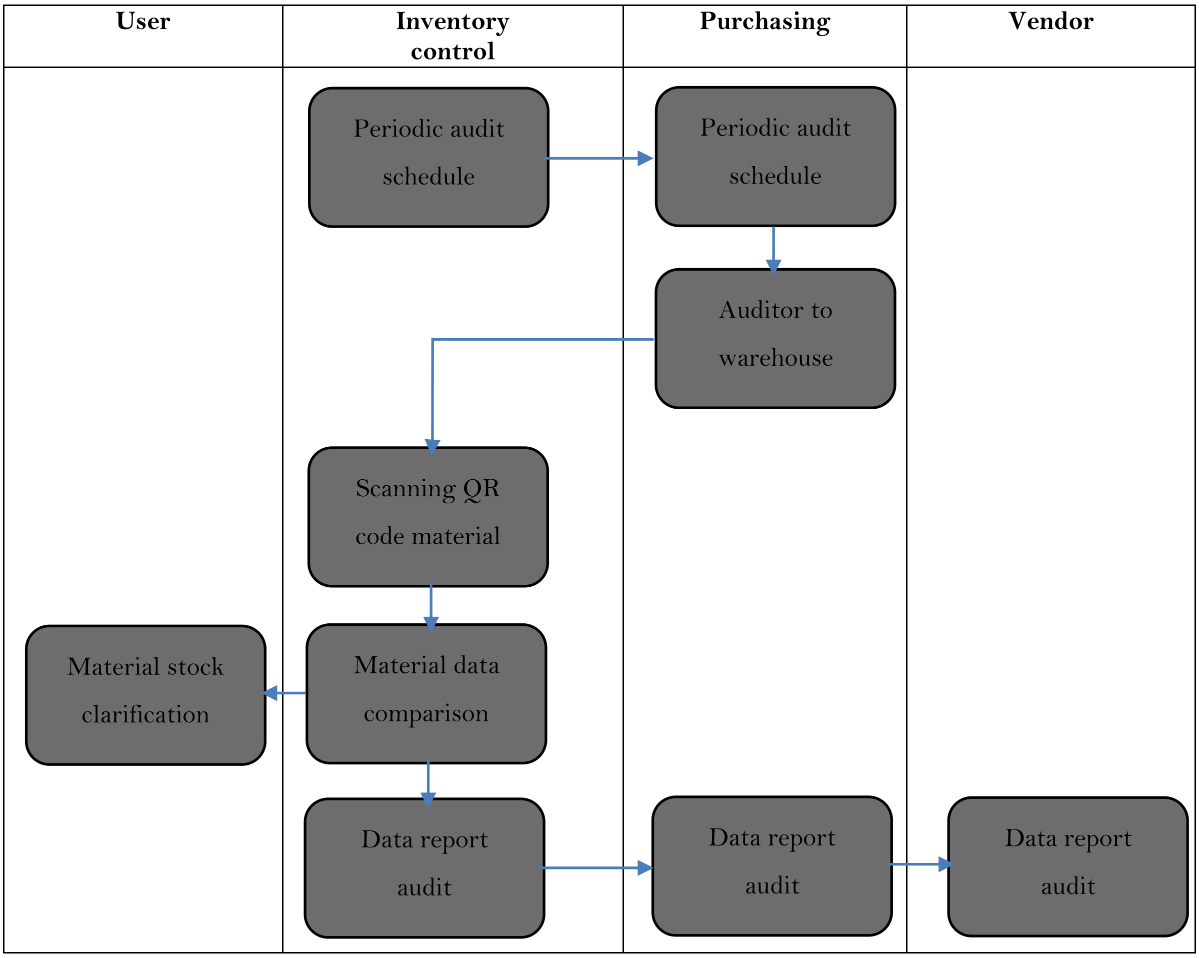

Figure 10. Stock take and process flow.

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Appendix 3

Figure 11. QR code on material.

Appendix 4

Figure 12. Material project audit process comparative analysis.

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