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Design Warehouse Information System to Increase Stock Accuracy

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Abstract:- In its development, the warehouse is currently not only used as a room for storage but has been integrated with the information system used in carrying out its warehousing activities. One of the objectives of the warehousing information system is to achieve stock accuracy according to the Company's target. PT Zoomlion Indonesia Heavy Industry (PT. ZIHI) is one of the heavy equipment industry companies engaged in the provision of heavy equipment, construction and plantations that have used the SAP system in managing their inventory but have not reached the stock accuracy target expected by the Company because in SAP there is no warehouse module. The purpose of this study is to find out what causative factors can affect stock inaccuracies in Jakarta warehouses, find out the dominant factors that cause stock inaccuracies and to find out the improvements made in increasing stock accuracy in PT Zoomlion Indonesia's Jakarta warehouse. The methods used are the DEMATEL (Decision Making Trial and Evaluation Laboratory) method, five why analysis, fishbone diagrams, for further design of the bin location system database.

The results showed that (1) the factors causing stock accuracy inaccuracies at PT Zoomlion Indonesia Heavy Industry were due to increased receiving, storage, and *shipping activities* and limited manpower, and were not supported by a system that facilitates the location of parts. Meanwhile, according to fishbone analysis, the factor diagram that causes stock accuracy is not optimal is done through the five whys approach, which consists of human factors, methods, materials and the environment, (2) the dominant factors that cause inaccuracies in stock accuracy occur at risk (E10) There is no SAP support system for registering Bin location, (3)The web database stock location design developed is a form of improvement effort from the manual monitoring system that is not running smoothly. This stock location database will provide information about materials while in the warehouse room. Therefore, the use of a mobile-based web server can make it easier for users to access the system from a smartphone device.

Keywords:- *Warehouse Location Information System Design, Stock Accuracy.*

I. INTRODUCTION

PT Zoomlion Indonesia Heavy Industry (PT. ZIHI) is an industrial corporation specializing in the distribution of heavy equipment, plantations, and construction. Established in 1992, Zoomlion has operated on a global scale for over two decades and has been at the forefront of pioneering advancements. Now, PT. Zoomlion Indonesia operates nine branches across the nation of Indonesia. Sorong, Surabaya, Jakarta, Balikpapan, Banjarmasin, Pelambang, Pekanbaru, Makassar, and Manado are the locations of these branches. It is intended to establish additional branches in Samarinda, Pontianak, and Medan in 2023. Presently, PT Zoomlion Indonesia maintains 6502 items across all its branches in Indonesia for a total inventory value of 14,849,390,265 in order to support its operations.

The purpose of a warehouse is to store and provide information on the status and condition of products stored within a company's logistics system. This information must be current, readily available, and easily accessible to any interested party [1]. The two depots at the PT Zoomlion Indonesia Heavy Industry facility in Jakarta are utilized to store nine extant product lines. However, the current quantity of warehouses remains insufficient to accommodate the 6502 items that require storage space. These items comprise various large components, including engines, torque converters, cabins, and boom cylinders. Warehouse performance is adversely affected by a number of issues stemming from suboptimal layout arrangements, including protracted collection and binning lead times [2]. The protracted parts collection process frequently leads to delayed distributions to branches. Furthermore, discrepancies frequently arise between the quantity of products recorded in the system and the actual quantity present at the location.

Several improvement efforts have been implemented, including the reorganization of warehouse goods and the early preparation of parts collection. However, the company has been unable to meet its warehouse performance targets due to the lack of manpower and the high volume of goods entering the warehouse (inbound) [3]. In addition to these limitations, the location system in the warehouse is not supported by the IT infrastructure of the organization. Enterprise Resource Planning (ERP), an abbreviation for data-driven solution, assists organizations in enhancing and optimizing the efficacy of their business operations through the utilization of computerized data. By integrating all pre-

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existing company systems, the system facilitates the fulfillment of business requirements by all parties involved [4]. Since PT ZIHI's ERP system is based on a Chinese SOM system that does not yet support WMS (Warehouse Management System), the container locator in the warehouse is unable to be integrated into the ERP system of the organization. Material locations are only recorded using Excel, resulting in a very high error rate for location containers. The substantial location bin error leads to a reduction in warehouse stock accuracy.

The organization upgraded its ERP system from SOM to SAP 4 HANA in January 2023. Nevertheless, the organization failed to incorporate a WM module interface into the SAP 4 HANA system, preventing the submission of the receptacle locator into the company's SAP. This circumstance complicates the process of registering locations and necessitates the use of Excel data for manual recording. This condition affects the number of phantom warehouses, the rate at which parts are collected (outbound), the sluggish process of placing parts into locations, and ultimately, the accuracy of stock. The researcher employed the Dematel method, five why analysis, and fishbone diagram to conduct an analytical approach in this study. Subsequently, a database for a bin location system was developed with the objectives of enhancing stock accuracy, facilitating location searches, and documenting transactions involving goods in the warehouse.

Determining the interdependent relationships among system factors and analyzing or examining the structure of a problem are both accomplished efficiently using the DEMATEL method [5]. In contrast, 5-why's analysis is a methodical procedure for identifying the source of a problem through the repeated posing of why questions to the resource person in order to gain an understanding of the issue [6]

The Ishikawa Diagram is also referred to as the Fishbone Diagram.[7]. This appellation is derived from the diagram's structure, which is comparable to the skeleton of a fish. This diagram was created by Professor Kaoru Ishikawa. He was an innovator in quality management at the Ishikawa Shipyard during the 1960s [8].

II. RESEARCH METHOD

A case study at the PT Zoomlion Indonesia Heavy Industry (ZIHI) warehouse in Jakarta constitutes the subject of this research. In the interim, the focus of the investigation is the veracity of stock at the PT ZIHI Warehouse. Aspects including the acquiring, placing, storing, order selecting, and dispatching procedures will be evaluated utilizing the dematel method. Data for this study were processed utilizing the Decision-Making Trial and Evaluation Laboratory (DEMATEL), five whys, and fishbone diagram techniques. By this approach, it is anticipated that the most optimal formula for enhancing stock accuracy at the Jakarta facility of PT Zoomlion Indonesia can be determined.

III. RESULTS AND DISCUSSION

A. Factors Contributing to PT Zoomlion Indonesia Heavy Industry's Inaccurate Stock Records

Using a cause-and-effect diagram, the analysis of the factors causing stock accuracy begins with ideation utilizing a 5 whys analysis approach, which is based on discussions and actual conditions that occur during PT ZIHI's warehousing process and involves multiple warehouse operations.

- *Recepitional Exercises*

Approximately two to four containers are delivered per month. Without a quality control procedure at reception, the components that are received from the container are merely deposited internally and externally of the warehouse during this material receiving activity. The QC procedure only verifies that the case number on the box or adjusted parts corresponds to the information on the packing list or travel letter. This quality control procedure relies solely on visual inspection of incoming parts due to the limited number of warehouse employees; disassembly, parts verification, and acceptance documentation are not performed.

The Incoming QC should affix the quality status "Release" to every pallet or crate received during this receiving procedure to signify that the material has undergone a sequence of incoming inspections and to provide details regarding the material's arrival. In contrast, the posting of quality status is frequently postponed or omitted when many materials arrive nearly simultaneously; therefore, the warehouse operator lacks precise knowledge regarding which materials will be delivered first.

- *Storage Operations*

Due to the absence of daily inventory counts and the creation of stock cards during storage operations, the process of locating components is protracted, as location searches are consistently performed. Following the offloading of the components from the container, the parts ought to be positioned in the predetermined location as documented on the stock card. Subsequently, the information should be updated in the Excel database. Periodically, the SO (stock taking) procedure is executed to ensure that the stock location recorded in the Excel database corresponds to the actual stock present at the designated location. Because of the restricted workforce of warehouse personnel, SO operations are exclusively executed per directive from HQ (Head Quarter). Therefore, the data in the Excel database does not correspond with the present whereabouts of the storage area, even though this surveillance operation is extremely useful for regulating rapidly moving materials. This is exacerbated by the fact that many shadow warehouses have portions stored in multiple locations due to storage space constraints.

- *Delivery Undertakings*

One challenge encountered in shipping operations is that gangway and storage areas are frequently occupied with additional materials, rendering the transit area insufficient to accommodate the incoming cargo.

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A fishbone diagram can illustrate the outcomes of the analysis of cause-and-effect relationships derived from the ideation session employing the five whys approach as described earlier (Picture 1).

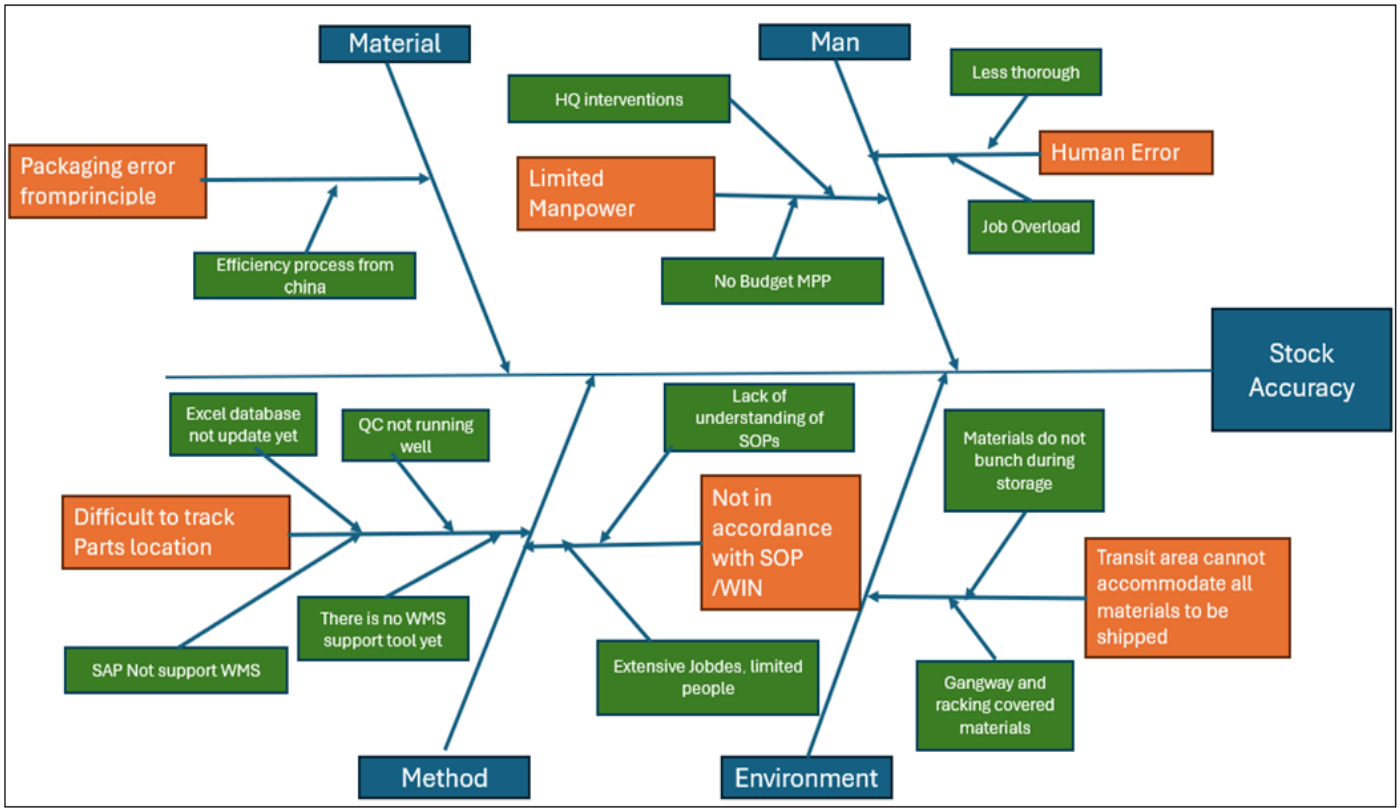

Fig 1 Fish Bone Stock Accuracy is not Optimal

A fishbone diagram analysis was conducted to ascertain the cause-and-effect relationship among the elements contributing to suboptimal stock accuracy. The analysis utilized a five-reason framework, which included human, method, material, and environmental factors.

➢ *Aspects of Man*

Inadequacies in the human element are evident in the quantity of warehouse operations that fail to correspond with the current workload due to workforce limitations. This imbalance negatively affects warehousing activities, specifically the adherence to work instructions (WI) and standard operating procedures (SOP). in addition to human error during Excel database input.

➢ *Method Variables*

The method factor that arises is the Incoming QC section delaying or failing to record the quality status, resulting in the absence of information concerning the material in storage at the time of receipt [9]. Inadequate completion of the stock card during daily inventory counts deprives the warehouseman of precise information regarding the location of the storage facilities. Materials are frequently discovered to be ungrouped during storage as a result of inadequate monitoring (shadowed warehouse).

➢ *Physical Aspects*

The inadequacy of the monitoring system for the motion of fast-moving materials and the warehouse employee's lack of awareness during Genba (arrangement of parts according to their location) contribute to the presence of dissimilar materials/parts in a single pallet or crate.

➢ *Environmental Determinants*

The environmental factors under consideration manifest in shipping operations, specifically in the form of gangways and storage areas that are frequently utilized because the transit area at the primary warehouse is insufficient to accommodate all shipments of packaging materials.

B. Principal Factors Contributing to Stock Accuracy Errors

Errors in stock calculations frequently result from inaccurate data, which frequently causes situations in which there are still a significant quantity of goods available or on the line, yet customers continue to place requests for them, or conversely, goods that have been depleted are no longer being requested. Creating reports on inbound and departing products continues to be a time-consuming process, thereby impeding the provision of crucial information to the leadership. Therefore, to address this issue, a computerized inventory information system is required to display data regarding the stock of products in a warehouse.

The results of the calculations (D-R) illustrate the magnitude of the correlation between risk events. A risk event is deemed a dispatcher if its D-R value is positive, which signifies that it has a greater impact than other risk events and can be considered a top priority. A negative value (D-R) indicates that the risk event is accorded a higher

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degree of influence and can be regarded as the receiver, which is the lowest priority. The results of the calculation (D+R) demonstrate the magnitude of the correlation between risk events. An increased (D+R) value indicates a stronger correlation.

The risk event category (E6) in the causal matrix is deemed the most significant and holds the highest priority due to its substantial influence and the presence of a strong and positive relationship level value that restores equilibrium. This risk event (E6) is referred to as a "dispatcher" and serves as a catalyst for the occurrence of other risks due to its high level of interaction influence. This occurs similarly in (E1). The risk events denoted as (E4), (E5), (E7), (E8), (E9), and (E10) are referred to as receivers despite their negative influence; the degree of correlation remains relatively robust, however, due to their positive values. The primary risk event in the receiver category is subject to the influence of additional conditions. Compared to other risk events, risk events (E10) have a significantly weaker relationship but a very large impact; therefore, it can be concluded that risk event (E10) is the primary cause of inaccuracies in stock accuracy.

C. Precautionary Measures to Enhance Stock Accuracy

➢ *Design of a Stock Location Database*

Table 1 Stock Accuracy Optimization Improvement Plan

No	Factor	Reason	Improvement Plan	Who	Place
1.	Human	Not careful. Wide job description, limited people.	Social reintegration of SOP The deployment of a web-based database-based computerized monitoring system that is accessible to all personnel within the warehouse.	Warehouse Parts Analyst	*Office Warehouse* *Office Warehouse*
2.	Methode	. Inadequate quantity of QC personnel to process incoming parts. . Daily stock taking does not involve the completion of stock cards . insufficiency of warehouse operational staff.	The deployment of a web-based database-based computerized monitoring system that is accessible to all personnel within the warehouse.	Warehouse/Parts analyst	*Office Warehouse*
3.	Material	a. Operator response during binning was inadequate. b. Insufficient operational personnel for monitoring system implementation.	The deployment of a web-based database-based computerized monitoring system that is accessible to all personnel within the warehouse.	Warehouse/Parts analyst	*Office Warehouse*
4.	Environment	Area for transit packaging Insufficient supplies are present in the primary warehouse.	Rent a new warehouse	*Team leader packaging* material	Area transit *packaging* material

The developed web design for the stock location database is an attempt to enhance the manual surveillance system, which is operating inefficiently. The information contained in this stock location database will pertain to materials while they are in the warehouse. When the material is received and has occupied the storage area in the warehouse, information flows; however, this information flow is confined to the material warehouse department.

➢ *Data Flow Diagram (DFD)*

- *Diagram of Context (Diagram of Context) Contextualization Diagram*

The illustrated system is depicted in Figure 8. The context diagram depicts four external entities: the warehouse chief, the operator, the administrator, and the warehouse team leader. The warehouse chief will receive reports on incoming and outgoing materials, while the warehouse operator will be provided with a report on the location of materials.

- *Flow Diagrams of Data*

The process reduction from the web database stock location context diagram will be accomplished in the form of a DFD, which serves as a practical and lucid means of describing the data flow within the system. DFD level 0 (Figure 9) delineates the data transmission and reception that occurs between the system and pre-existing stakeholders.

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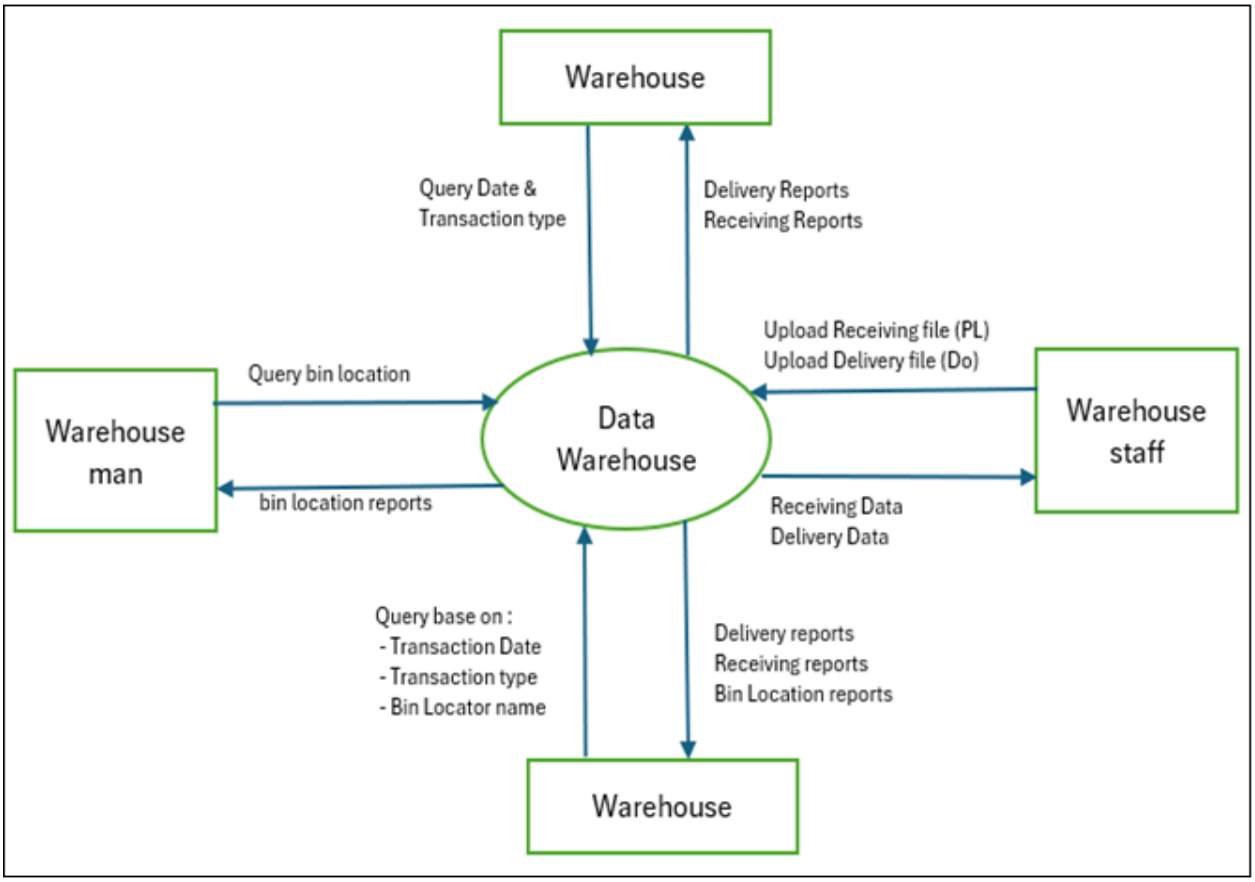

Fig 2 Level 0 Data Flow Diagram

The image below illustrates the detailed processes within the system, as shown in DFD level 1, derived from the context diagram above. Within DFD 2 processes comprise Level 1: material management and location management.

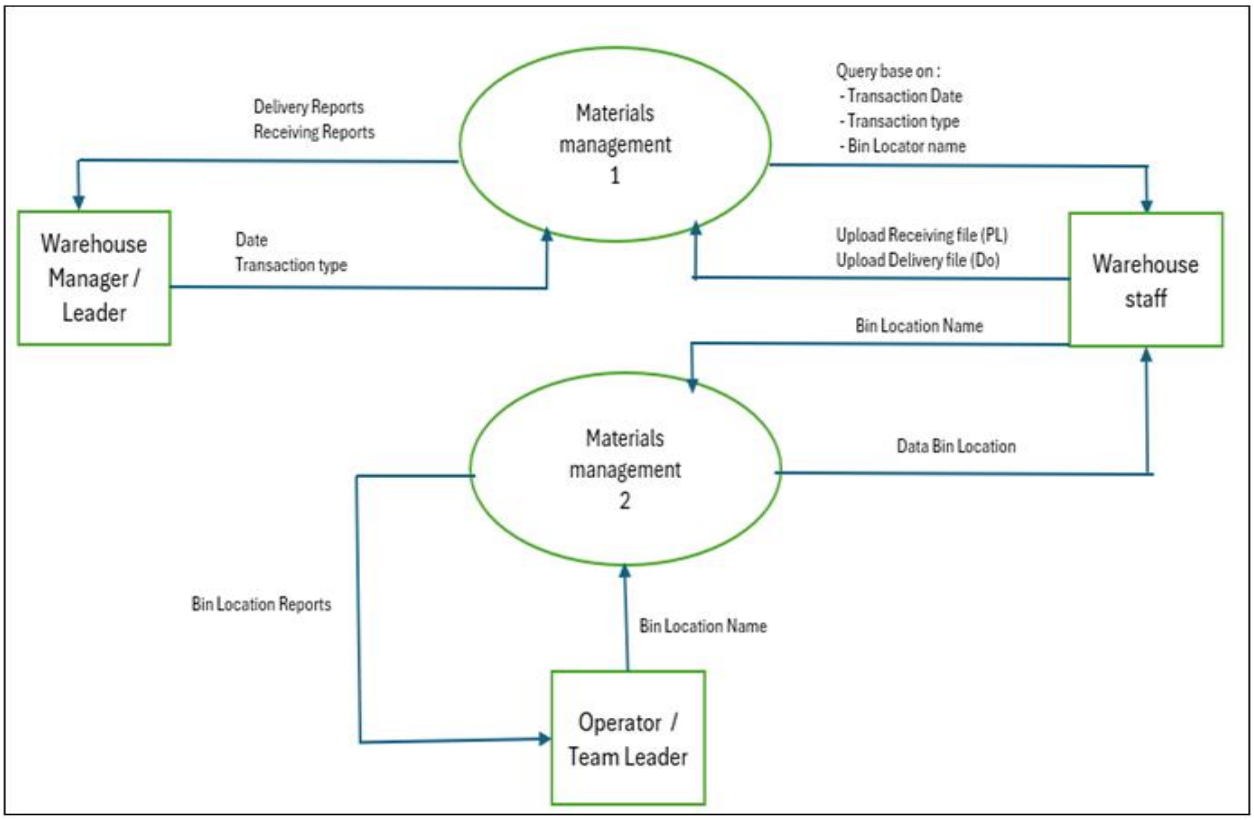

Fig 3 Level 1 Data Flow Diagram

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Material management consists of the following three procedures: material receipt, material distribution, and material report publishing. These three processes have been elevated from DFD Level 1 to DFD Level 2 in material management. For further information, please refer to the image provided below.

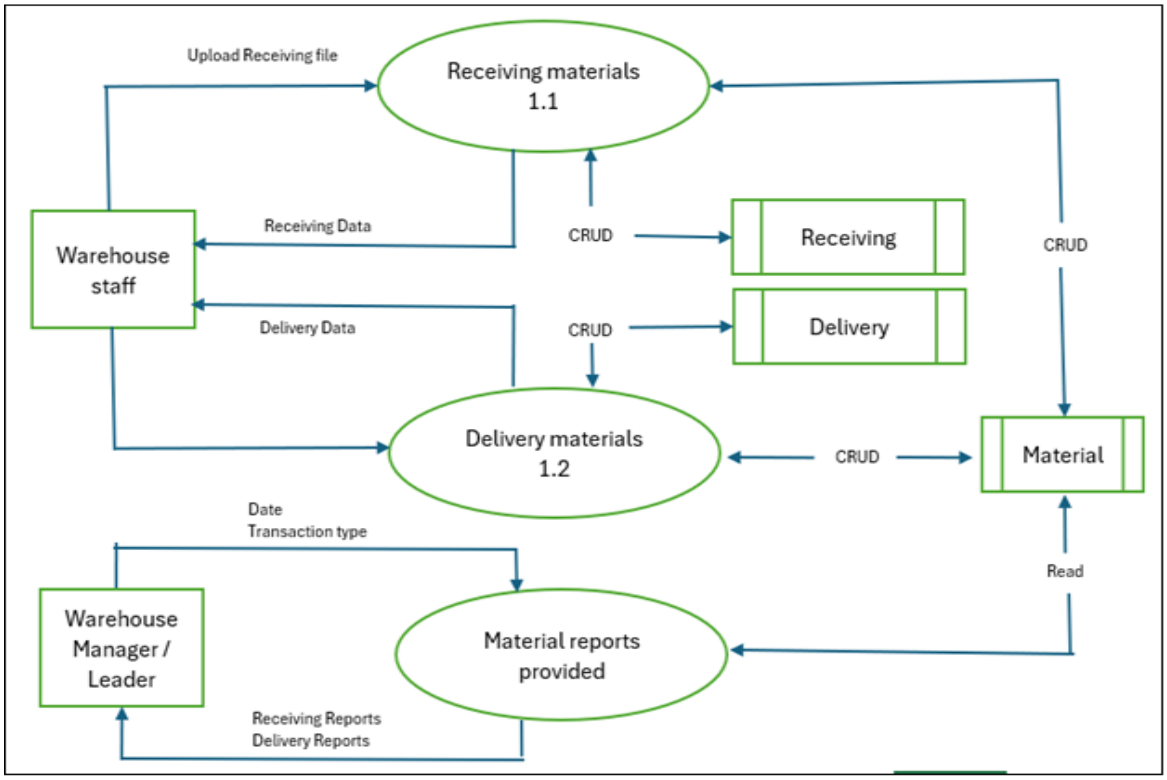

Fig 4 Data Flow Diagram Level 2 Pengelolaan Material

Location management comprises two distinct processes: location modification and location report printing. These two procedures constitute location management DFD Level 2. For further information, please refer to the image provided below.

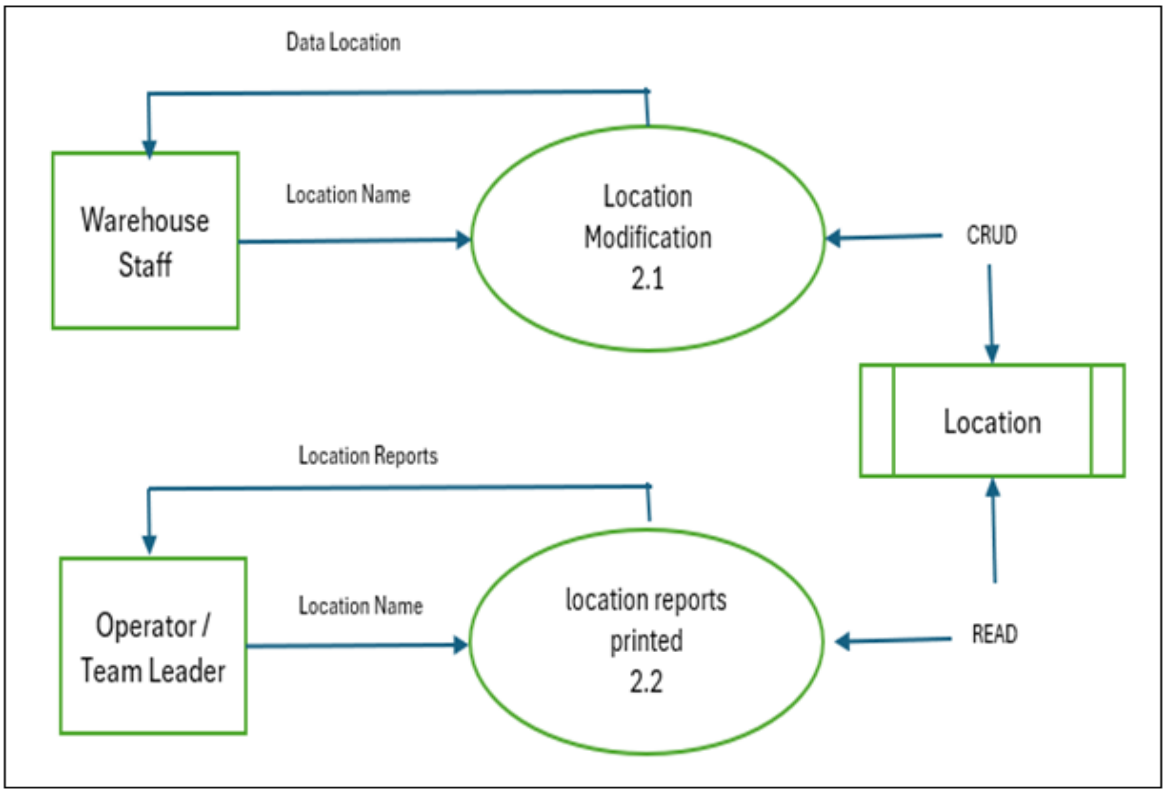

Fig 5 Level 2 Data Flow Diagram Location Administration

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➢ *BPMN (Business Process Modeling Notation)*

The business process is represented by BPMN, which is a graphical notation that illustrates the logic of every stage [10]. The BPMN of the processes entailed in the development of the warehouse location database web system is as follows:

- *Table at the Reception*

The receiving table (Figure 6) pertains to all material receipt-related activities, including the administrative process of inputting the packing list of incoming products and the system's registration of the packing list's component information.

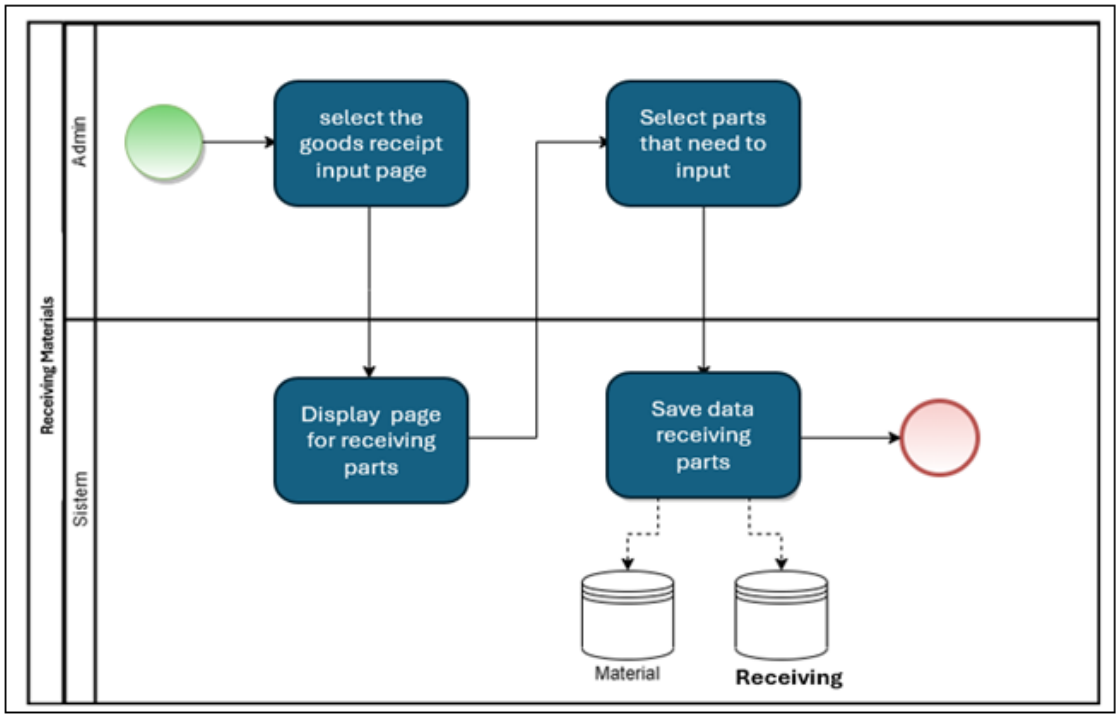

Fig 6 Receipt Table Structure

- *Place of Delivery Table*

The delivery table (Figure 7) is also applicable to all material delivery-related activities, in which the administrator enters delivery orders for shipments of outgoing products and the system records the component information in the DO

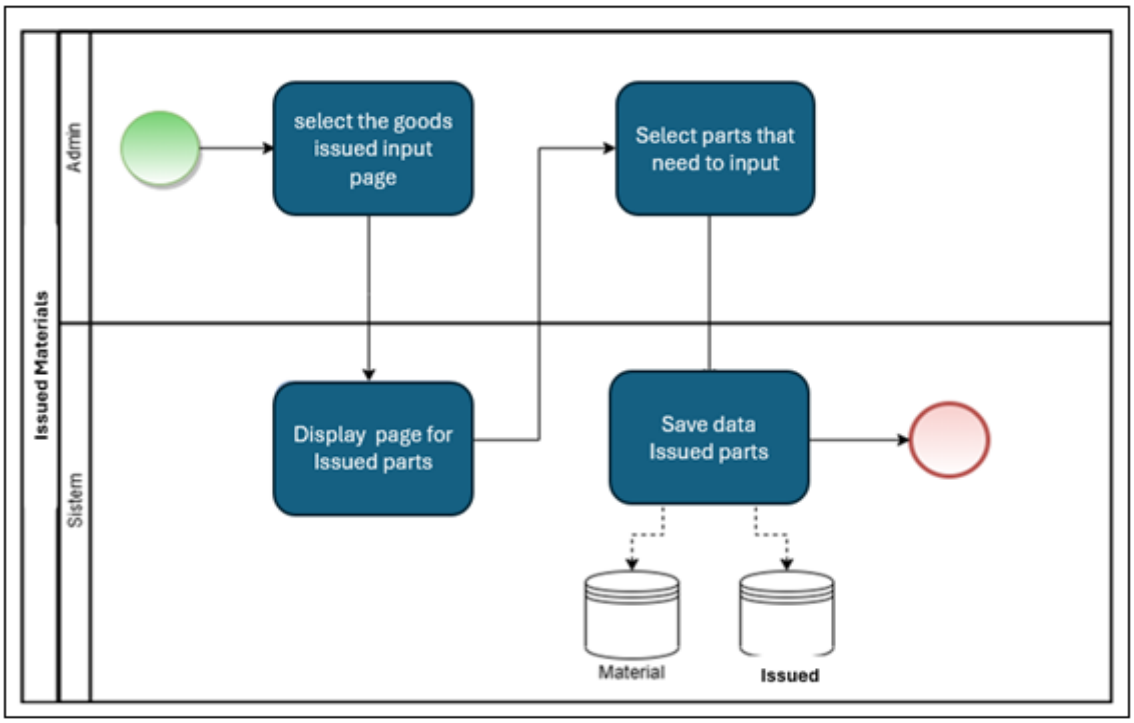

Fig 7 Expenditure Table Structure

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- *Table of Material Locations*

Daily operations rely on the stock location table (Figure 8) to determine the whereabouts of materials and components within the warehouse.

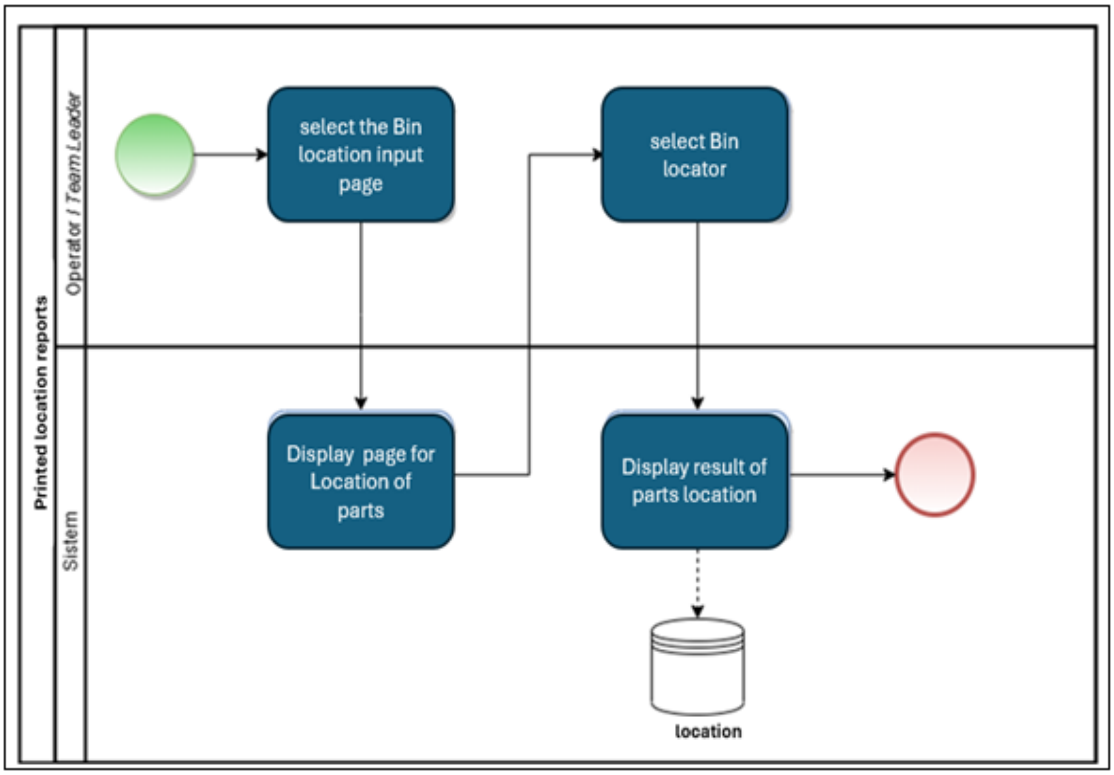

Fig 8 Organization of Material Location Tables

- *Table of Material Reports*

The material report table (Figure 9) is utilized to generate monthly or daily reports detailing the receiving and dispersing of components within the warehouse. Typically employed in monthly report generation.

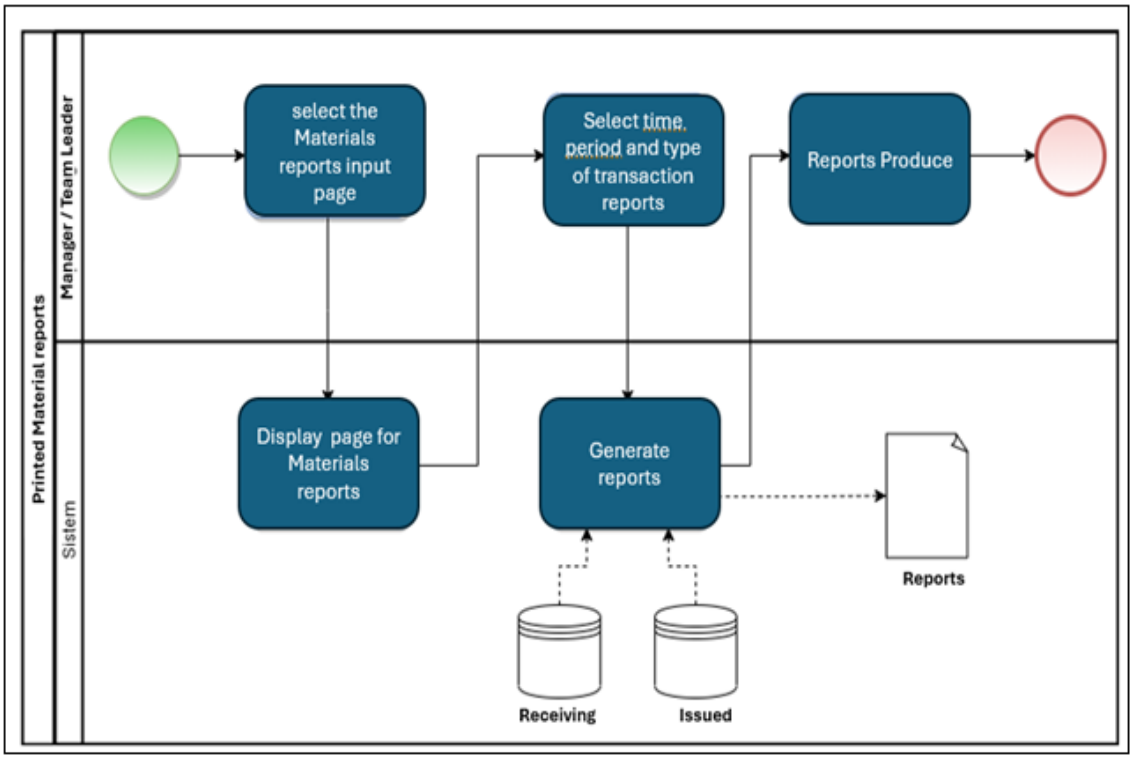

Fig 9 Material Report Table Structure

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- *Table of Material Location Additions*

Utilizing the material location addition table (Figure 10), new locations can be added to the web database system.

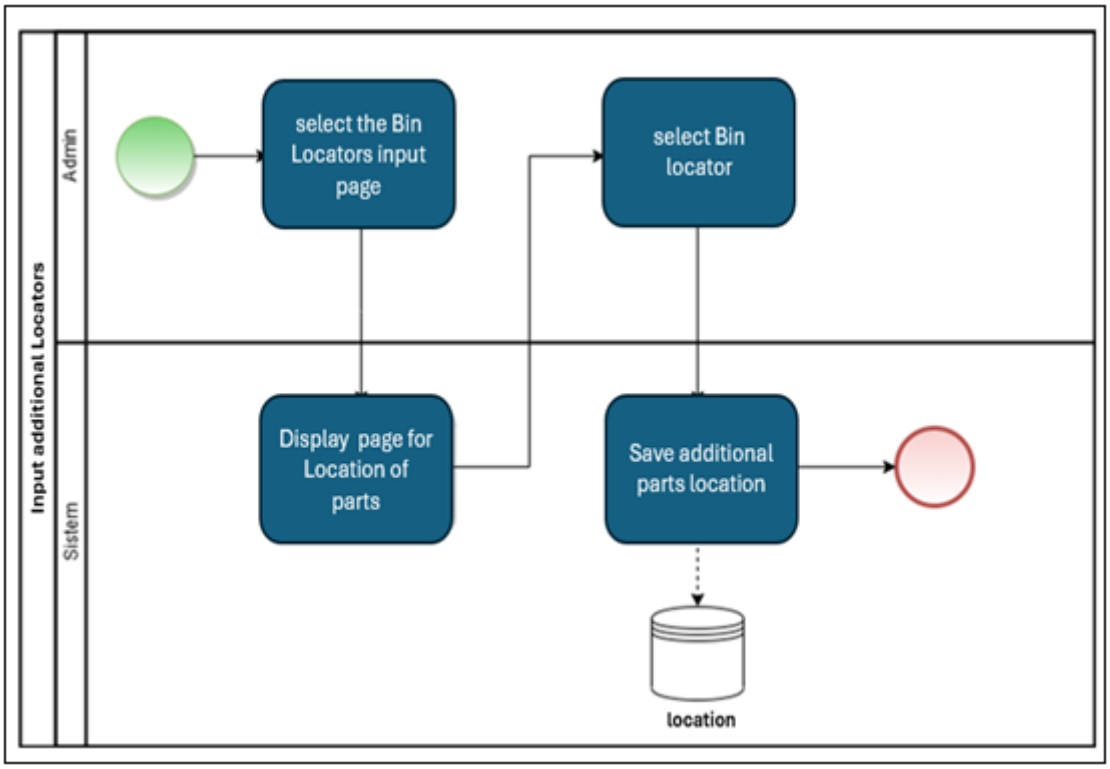

Fig 10 Table Structure for the Addition of Materia Locations

IV. CONCLUSION

➢ *Based on the Findings and Deliberations Outlined in the Preceding Chapter, the Investigator arrived at the Subsequent Conclusion:*

- The constructed warehouse information system can assist PT Zoomlion Indonesia Heavy Industry in streamlining the recording process, managing inventory, and facilitating storage operations.
- The warehouse information system is capable of delivering precise and timely reports as well as inventory location data in accordance with the organization's requirements.
- In the past, PT Zoomlion Indonesia Heavy Industry operated without a dedicated information system application for inventory management, which led to inaccuracies in stock counts, frequent delays in locating necessary components, inaccurate stock location data, and the lack of comprehensive reports and documentation. appropriately organized for presentation to the leadership. Design Proposed for an Information System:

✓ Master Data: Supplier Data, User Data, and Goods Data,
✓ Transaction Data: Transactions involving Incoming and Outgoing Goods.
✓ The Goods Data Report, the Incoming Goods Report, and the Outgoing Goods Report comprise the reports. Socialization and training are essential for novice users of the system in order to prevent operational errors. A new system should gradually supplant the outdated one. Capacity to operate this program: Proficiency in the Windows 10 operating system and fundamental computer knowledge and abilities are required. In the future, this application has the potential to facilitate additional tasks and can be enhanced further. This application is compatible with third-party applications, including administration and others
✓ In 2023, stock accuracy has increased substantially due to the implementation of the newly designed warehouse location information system
✓ Determining the prominent criteria that influence stock accuracy inaccuracy at risk using the DEMATEL method (E10)

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