Inventory Information Systems in Water Companies: A Case of Data Synchronization Issue

Ermar Anjas Nugraha¹, Faiza Renaldi², Herdi Ashaury³

Department of Informatics, Universitas Jenderal Achmad Yani, Cimahi – Indonesia

Email: Ermarn9@gmail.com¹, faiza.renaldi@unjani.ac.id², herdi.ashaury@lecture.unjani.ac.id³

Abstract. Inventory is an activity that records every process in the flow of an item starting from importing goods, checking goods, requesting goods, to releasing goods from the warehouse. PT. Perdana Multiguna Sarana Barat Bandung (PMgS) is engaged in services for clean water distribution which include new connection installation services and line repair that have problems in their inventory activities. Starting from recording old customer items that do not exist, late recording of return of goods and when the goods needed following the installation or repair sometimes lacking this has an impact on the working time of repairing lines and installation of new connections is slightly hampered due to lack of rapid control of information about inventory data. For that reason, in supporting and improving company performance, inventory information system information is needed that can provide information easily, quickly, and integrated to all parts related to inventory. In building this inventory information system the system development method used is a waterfall and the output of this system is a system that can record the return of goods, control of the stock of goods taken directly can be known and data in and out of goods more controlled so that reporting of goods is easier and quicker. Our acceptance test showed that all the functions are working very well and have an overall high acceptance rate of 80.33%.

Keywords: Information Systems; Inventory Systems, Data Synchronization

1. Introduction

Inventory can be interpreted as an activity that provides a stock of raw goods, semi-finished goods, or finished goods for the smooth process of fulfilling the demand for goods. Inventory activities also record every process in the flow of an item from the entry of goods, checking of goods, demand for goods, to the release of goods from the warehouse [1]. Along with the development of increasingly advanced technology inventory systems based on information technology are needed to be able to help solve problems in the company, especially in processing goods inventory more efficiently to improve all access to information in every aspect of the company [2]. Information systems have also been used to solve problems in other fields such as sales [3], health [4], education [5], and so on. Utilization of information systems has also been used in managing inventory in an organization with the introduction of a web-based information system that can be accessed by all staff [6] in terms of delivering information ranging from recording entry of goods, exiting goods, managing stock of goods and demand for goods [7].

Problems that are often faced in an organization one of which is the problem of storing goods in warehouses, either production warehouses or goods storage warehouse [8]. Storage of goods in warehouses will be important when there is a lot of demand while the place that is used as storage of goods is lacking, as a result, the goods will pile up and not be controlled for that organization engaged
in production or service requires warehouses for storage of goods for business activities [9]. A study in China found that the problem of warehouse layout is one of the main problems in warehouse management, which involves all stages of the supply chain with an effective warehouse layout system that can reduce operating costs and in determining the location for different items in the warehouse [10]. Another study conducted in Malaysia concurred that with the implementation of a warehouse system that can control warehouse personnel and equipment as well as the use of inventory space has the potential to increase warehousing productivity [11]. Other studies that examine inventory information systems are based on the prediction of sales data using the Single Moving Average (SMA) method. This method was used for the calculation of 3 periods, which resulted in an accuracy of 85.66%, while for the calculation of 5 periods the accuracy was 83.75% [12]. Although there has been much research on web-based inventory information systems such as the fuel storage industry [13], health [14], manufacturing [15], sales [16] and those mentioned before, but not much can we found discussing about the detailed process of returning goods where the storage for returned goods is stored and when going to use the goods again can be easily identified. As well as an effective warehouse layout [17] will facilitate the search for goods.

This research was conducted aiming to resolve the issue, using PT PMgS as the case study. They have many problems in terms of storing storage of inventory data that have not been controlled and the absence of detailed information about the stock of goods often causes out of stock when demand for goods needed by others. Other problems at PT PMgS occurred during the return of goods from old customers who are no longer subscribed. These items/inventories were not recorded in the storage warehouse. As a result, when the old customer wants to re-subscribe and want to use these items, it was unavailable in the system. Making the inventory information system of goods now will make it easier for organizations especially the warehouse in terms of managing the warehouse more controlled. Furthermore, by making an inventory information system of this item in the warehouse can facilitate the organization's business activities more integrated and smoothen the processes in the delivery of information and data reporting internally.

2. Research Methods
This research was conducted using data collection techniques, namely by interview and observation because data collection is an important part of conducting a study [18]. The interview process was carried out with the company in the procurement, warehouse, field supervisor, and technician sections. The interview process first asked permission from the management, after being allowed to directly arrange the time to the parties concerned, especially to Mr. Rizki Jordy who was in charge of the procurement and warehouse section as well as to Mr. Hasan as a supervisor as well as the field supervisor interview conducted on 16 February 2020. Besides the interview Observation was also carried out on February 19, 2020, with a duration of 2 hours, February 20, 2020, with a duration of 4 hours, February 21 with a duration of 2 hours, February 24 with a duration of 2 hours and on the 27 February 2020 with a duration of time 2 hours by jumping in and seeing what activities are related to business processes in the company to find out the documents used in the inventory process at PT PMgS, West Bandung. Below this is a that defines the needs of actors from observations and interviews.

2.1. Business Process Identification and System Objective
Identifying business processes is to assess how well the process is running [19]. Because in making a new system existing business processes must be improved for this reason in this research business processes that occur now begin from customers registering as new customers or old customers who are complaining about the improvement of the path. The new customer process starts from the list of new connections to the sub-section, after the list and the data is recapitulated, a memo is then submitted to the warehouse section to remove the goods from the warehouse. For old customers complaining due to damage or leakage of the water connection line, not to the direct distribution section but handled by the engineering department and surveyed directly, after the survey was carried out the engineering section made a PO to remove goods from the warehouse if the stock in the warehouse is lacking in the warehouse section submitting the goods proposal to the procurement department after the goods there is a procurement section submit the goods to the warehouse. After observations are made for the release of
goods only one process only new customers and old customers are handled by the subdivision who later made a memo after the memo is made and submitted to the technical section of this section directly for PO to remove goods from the warehouse. After all the finished process, the sub-section has made an official report that the business process activity has finished, which will be applied to this research.

| Table 1. Problems Found during Business Process Identification |
|-------------------------------------------------------------|
| No. | Problems Found | Description | |
| 1   | Goods stock    | Lack of information about when to add data on the amount of goods stock when the goods have been reduced after the goods are taken as a result has an impact on other work that is hampered. |
| 2   | Returns of goods | Recording data on the return of goods is not recorded in the warehouse as a result when there are customers who want to subscribe again and use the item data that does not exist because the goods are only stored in the warehouse. |

The problems found during the identification of business processes are determined to help focus efforts to create a good system and increase opportunities to achieve that goal can be seen in Table 2 below.

| Table 2. Objectives of the Integrated inventory information system |
|---------------------------------------------------------------|
| No | Objective Description | Solving Problem No- |
| 1  | Web-based system that can be accessed by all sections in the delivery of information and reporting data in an integrated manner | 1, 2, |
| 2  | The purpose of this system is to overcome the problems related to the warehouse by providing clear information when the stock in the warehouse increases if there is a shortage of stock | 1, |
| 3  | Can Be Reached To manage all warehouse activities | 1, 2 |

2.2. System Design

There are several factors that influence the success of the system design process, one of which is the identification of relationships between parts of a system to finally optimize overall and the main needs for actors involved in the overall design of the system [20]. System design to determine the needs of users in the company of the system to be built which is useful for the interaction of interrelated elements working together to achieve goals. By using the system design process of the translation of data requirements that have been analyzed in a form that is easily understood by the user. Design an important database table design that is used

| Table 3. Database design of incoming goods table |
|------------------------------------------------|
| No | Nama Field | Type | Length | Index | Desc |
| 1  | Transaction_code | Text | 12 | PK | Not Null |
| 2  | Transaction_date_in | Date |  |  |  |

The incoming goods table is used to store data on incoming goods sent by the procurement divisions, which will later display the transaction code and date in Manage the goods entered by the warehouse division.

| Table 4. Database design of detailed incoming goods table |
|---------------------------------------------------------|
| No | Nama Field | Type | Length | Index | Desc |
| 1  | Detailed_code | Text | 12 | PK | Not Null |
Detailed incoming goods table is used to store item entry details starting from the date of entry of goods, item code, number of items entered. For the item code that is labeled the entry detail of this item is taken from the item table used as a foreign key.

| No | Field               | Type   | Length | Index | Desc          |
|----|---------------------|--------|--------|-------|---------------|
| 1  | Item_id             | Text   | 5      | PK    | Not Null      |
| 2  | Item_code           | Text   | 12     | FK    | Not Null      |
| 3  | Item_name           | Text   | 25     |       | Not Null      |
| 4  | Number of items     | Int    | 11     |       | Not Null      |
| 5  | Descriptions        | Text   | 25     |       | Not Null      |

The goods table is used to store all goods starting from the stock of goods, the item code, the name of the item used in the whole process starting from the exit of goods entering the goods and returning goods.

### 2.2.1. Actor’s Identification.

Actor identification greatly contributes to the achievement of organizational goals [21]. Based on user analysis it can be concluded that the actors involved in this system are the customer relationship division, engineering division, warehouse division, procurement division, and the HR & general manager for each actor having their respective jobs. Of the 5 actors involved in the running system, all actors can use the system. There are additional IT staff actors to manage user data by creating access rights so that users can access the system.

| No | Actors                        | Descriptions                                                                 | Mentioned in            |
|----|-------------------------------|-----------------------------------------------------------------------------|-------------------------|
| 1  | customer relationship division| can make memos and make news events, send data returns                         | W1abdulq1, OB 6         |
| 2  | engineering division          | making POs, receiving goods and receiving memos                              | W1rizkiq4, w1rizkiq5,   |
|    |                               | who confirms the PO issues the goods and submits the goods if the stock of the warehouse is exhausted and confirms the return of the goods | w1rizkiq8               |
| 3  | warehouse division            |                                                                             | W1rizkiq1, w1rizkiq2    |
| 4  | procurement division          | Confirms the proposed goods and add goods to the warehouse                   | W1rizkiq1, w1rizkiq8    |
| 5  | IT staff                      | Access rights to the system for actors.                                     | W1rizkiq2, w1rizkiq3    |
| 6  | HR & general manager          | Manage view reports and print reports                                       |                         |

Note: W[x][name][q[y]] means that the actor was mentioned in the interview number [x] by interviewee [name] which explicitly mentioned in question number [y]. While OB[z] means that it was acquired during observation number [z]. The main actor of the system created is a warehouse division. This actor is very important in the management of the warehouse because the warehouse section manages all goods
in the warehouse starting from entering goods, out of goods when there is demand and the rest of the goods returns after the company's business activities are finished.

2.2.2. Functional Analysis

This functionality analysis helps in the initial analysis of the available applications [22]. Based on functional analysis, it can be concluded that the functions used in the current system are the Module Users, Module goods, Module goods proposal’s, Module product exit, Module PO, Module Memo, Module BA, Module item returns, and Report.

| No  | Functional Analysis                  | Proses                              | Solving Objective No |
|-----|--------------------------------------|-------------------------------------|----------------------|
| 1.  | User’s Module                        | Manage existing user data on the system such as Add user, edit user, view user | 1,2,3                 |
| 2.  | Goods Module                         | Manage data goods that exist on the system such as: Add goods, view goods, view item details | 2,3                   |
| 3.  | Goods Proposals Module               | Manage the proposed goods data in the system such as: Add item proposals, edit the proposed goods, View item proposed data, View item proposal details, Confirmation of product proposal, Add incoming goods, View data on incoming goods, View detailed data on incoming goods, View proposal request data, View details of proposal application data | 2,3                   |
| 4.  | Module out goods                     | Manage data out of goods that exist in the system such as Send item, view the data details of goods out, view data out of goods | 2,3                   |
| 5.  | PO Module                            | Manage demand for goods that exist in the system such as Add PO, view PO data, view PO details, Confirm PO, Confirm receipt of goods, view PO application data, view detailed PO application data | 1,3                   |
| 6.  | Memo Module                          | Manage existing data memos on the system such as Add, Memo, View memo data, View memo data details, Confirm Memo | 1,3                   |
| 7.  | BA Module                            | Manage the news events on the system such as: Add BA, See BA, See detailed BA, BA Confirmation | 1,3                   |
| 8.  | Return Items Module                  | Manage data returns on goods in the system such as: Add goods returns, Check returns, view item returns, view item data return details | 1,2,3                 |
| 9.  | Report                               | Displays news report data, goods inventory reports, goods in and out reports |                       |

2.3. System Development

The software that has been built will be implemented and tested. Before running the software some things must be considered first, namely the software requirements. Software requirements are needed to support and facilitate the testing of software built. The software is built based on the web using the PHP programming language and uses the MySQL database contained in the XAMPP application. Google Chrome and Firefox function as a Web browser media. CodeIgniter as a Framework for PHP and the
CSS, Bootstrap, and javascript Framework.

3. Results and Discussions

The design and manufacture of systems in this study were completed within 3 months wherein the testing phase it uses 2 techniques of system testing and user acceptance testing. These tests are to determine the success categories in testing, design quality testing, implementation of tests, and conclusions from the results of quality testing.

3.1. Inventory Information System

On the warehouse page, there is a process for proposing incoming goods which starts when the goods in stock are already reduced. The warehouse section immediately proposes managing the proposed goods to the procurement department. After the goods are proposed, the procurement department approves the goods proposal and puts the goods following the goods proposal (see Figure 1).

![Inventory information system](image)

Fig. 1. Inventory information system

There is also managing the return of goods where all the remaining goods after the company's activities have been carried out and the subdivision makes the minutes of the remaining goods recorded and put back into the warehouse in the return data on the manage returns. For the product exit stage, it starts from the subdivision of making a memo sent to the engineering department, this memo can be many customers entered. After the technical department has agreed to make PO, for this PO only one PO for one customer after PO plus the PO directly sent to the warehouse to check the goods submitted for existing business activities or not. Below are test cases for filling PO from the Engineering section to the warehouse section and confirming Goods as shown in Tables 8 and 9.

| Use Case ID | Use Case Name | Test Scenario | Test Case | Pre-Condition | Test Steps | Test Data | Expected Result |
|-------------|---------------|---------------|-----------|---------------|------------|-----------|----------------|
| KP01        | Add PO        | Test the use case of managing POs on the PO added function | Enter data in the correct and complete format | Po data is empty | 1. Press the add PO button | 1. Fill in the item code:"ELE001", "ETE001"" | Notification "Data Successfully Added" |
|             |               |               |           |               | 2. Fill in PO data | 2. Fill in the number of items:"5", 5 "" | |
|             |               |               |           |               | 3. Click "submit" | 3. Fill in the Po code:<PO2506200001> | |
|             |               |               |           |               | 4. Fill in the date Po:<2020-06-25> | 4. Fill in customer code:<PEL-0001> | |
|             |               |               |           |               | 5. Fill in customer name:<ermar> | 5. Fill in customer name:<ermar> | |
|             |               |               |           |               | 6. Fill in the address:<bandung> | 6. Fill in the type of activity:<new connection> | |
|             |               |               |           |               | 7. Fill in the address:<bandung> | | |
|             |               |               |           |               | 8. Fill in the type of activity:<new connection> | | |
**Table 9. Test case scenario function confirm Goods Proposal**

| Use Case ID | KU04 |
|-------------|------|
| Use Case Name | Confirmation of Goods Proposal |
| Test Scenario | Perform the confirmation process on the proposed item by clicking the agree function |
| Test Case | Conduct testing of usecase confirmation of proposals on agreed functions |
| Pre-Condition | Proposed Goods with "Unapproved" Status |
| Test Steps | Click View details Request for goods proposal Displays detailed data on requests for goods proposals Click "Agree" |
| Expected Result | Notification "Item Proposal Has Been Approved" |
| Post Condition | "Proposed Item Has Been Approved" |
| Status (Pass/Fail) | PASS |
| Actual Result | ![Image](image1.png) ![Image](image2.png) ![Image](image3.png) |

Furthermore, for all users of this system are handled by the IT Staff. Each user is given a username and password to be able to access this system on the IT Staff page managed by the user. IT staff can add users, delete users, and view users.

### 3.2. The Acceptance Test

For user testing this test is carried out with 42 test scenarios for 6 types of users: (1) Warehouse Division; (2) Engineering Division; (3) Customer Relationship Division; (4) Procurement Division; (5)
IT Staff and (6) HR & general manager. UAT results can be seen in Table 10.

Table 10. UAT

| No | User/Tester                        | Acceptance Rate | Notable comments                                           |
|----|------------------------------------|-----------------|------------------------------------------------------------|
| 1  | Warehouse Division                 | (36 out of 42)  | 85.71% "A pretty good system makes it easy to manage stock items reduced in warehouse out automatically" |
| 2  | Engineering Division               | (35 out of 42)  | 83.33% "Pretty good but if you can see the incoming memo notification so know if there is a memo that entered" |
| 3  | Customer Relationship Division     | (30 out of 42)  | 71.42% "Still needs to be improved in Manage news events"  |
| 4  | Procurement Division               | (33 out of 42)  | 78.57% "Good enough"                                       |
| 5  | IT Staff                           | (34 out of 42)  | 80.95% "Good enough"                                       |
| 6  | HR & GENERAL Manager               | (36 out of 42)  | 85.71% "It's good in providing data information"           |

Based on Table 10 the acceptance test results obtained produced some of the highest percentage acceptance rates, namely in the warehouse divisions and HR & general manager of 85.71%, from these results indicate that the two divisions are greatly helped by the existence of an inventory information system. Although some users still have difficulties in adjusting to the new systems especially on the function of warehouse transactions. Some suggestions were also made during the acceptance test. The engineering department suggested that the notification/alert system should be placed and the HR and GM user groups were suggesting to have a convert to PDF feature in the report section.

4. Conclusions

The system was made and tested by the black box method and user testing of 6 users stated that the system was running well based on the results of respondents with an average of 80% the highest percentage of acceptance level, namely in the warehouse division and HR & general manager of 85.71%. These results indicate that the two divisions are greatly helped by the existence of an inventory information system. With this, it can be concluded that the system helps in all processes related to warehouse management of goods, managing returns and managing goods out to record all data items in and out and recording detailed data returns of goods so that when checking goods for old customers can be known quickly because there is already data. And also, provide information on inventory data so that the stock of goods in the warehouse is controlled in number so that when there is a shortage of goods, the stock returns which will not interfere with other work by managing the proposed goods. Finally, the construction of this system can be integrated with other parts so that it is easier for all information and data to be conveyed easier and faster with all the features in the system ranging from module goods, module proposed goods module out goods, module returns, and reports.

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