Development of Warehouse Management System Using Extreme Programming

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Abstract— *The Bio-Fertilizer Company is a company that produces liquid biological fertilizer which is sold to farmer groups and communities throughout Indonesia. The company has problems in carrying out the data collection process in the warehouse at the time of production, this happens because the recording process is still done manually, so workers must take longer because the data entered is not systematically arranged. Warehouse Management System (WMS) is a picture that is used to assist a company in improving every aspect related to storage to be well organized. In the process of making a system, researchers use the SDLC Extreme Programming method where the method is suitable for small and medium scale teams. This is to overcome incompatible requirements and change requirements very quickly. The results of this research are in the form of an application that can help business processes, especially the inventory recording of goods in the warehouse. Before the use of the system, the recording was still done manually so that the data previously recorded using paper was not arranged neatly which caused the data was not in the right order, so from these problems it was hoped that the implementation of the new system using the warehouse management system could help overcome the problems is in the company.*

Keywords— Warehouse Management System; SDLC Extreme Programming

1. INTRODUCTION

Bio-fertilizer manufacturing is a company that produces liquid fertilizers that are sold in Indonesia. This fertilizer contains microorganisms that are complicated to apply to the surface of the soil will help growth and provide nutrients to plants [1], [2]. As a company that has a vision and mission, also has a business process that is run to support all operational activities in the company. As a company that has a vision and mission, of course, also has a business process that is run to support all operational activities that exist in the company.

The business process itself is a series of activities that work together in an organizational and technical environment that together to achieve business goals [3]. A business process is not only used for business organizations, but is used by other organizations that aim to achieve value results for customers and interested parties [4], [5]. However, in developments related to technology, the company has not yet implemented a system that has the function of recording all inventory of raw materials and finished products [6].

In this case the WMS or warehouse management system was chosen as a consideration in order to provide convenience to the parties in recording the inventory of raw materials that will be processed at the factory and the results of these materials, namely finished products, will be recorded in a system [7]. In the company, the problem that is happening right now is that as consumer demand increases, the production of goods also increases, causing more data about the stock of materials and products to be added, and causing the data to become improperly ordered [8]. It self is the right choice for use by companies in various sectors. WMS implementation can reach the inhibition of the storage process and reduce the operating time during the recording process [9], [10]
. In designing WMS, researcher uses the SDLC Extreme Programming method where the method is preferred because it is suitable for small and medium scale teams. This is to overcome incompatible requirements and change requirements very quickly [11]. Thus based on the above problems, researchers will create a WMS that has information and features that help support existing business processes in the company that were previously done manually.

2. LITERATURE REVIEW

2.1 Warehouse Management System

Well managed warehouse system help an organization keep proper track of inventory, maintain the levels of inventory as per requirement, increase in accuracy, reduce labor costs and ensure proper maintenance as well as storage of stock. This kind of

management will provide ease and convenience to the suppliers and distributors to keep the track of inventory and maintenance as well [12].

Impact of adopting WMS on the overall business performance through using Management Information Systems (MIS), thus meeting customer requirements faster, increasing customer satisfaction that improves competitiveness, and also helping in inventory investment reduction. presented a system based on web service that can help small enterprises to improve their warehouse management and business, the main idea of this system is to send information about the stock to the computer through desktop application, it helps in supporting faster and easier decision-making because it provides accurate data compared to the manual system that depends on recording all items the manually. Han and Zhu analyzed the logistics of warehousing system and analyzed the existing problems for the purpose of finding methods to improve logistics and storage system. The authors have presented an optimization design of logistics and warehousing by establishing a warehouse management information system that can improve the efficiency of the enterprise, strengthen the coordination between all departments, reduce labor size, solve the problem of material confusion and reduce costs [13].

2.2 Extreme Programming

Extreme Programming (XP) is a software development method that is simple and includes one of the agile methods pioneered by Kent Beck, Ron Jeffries, and Ward Cunningham. The main purpose of the Extreme Programming method is to reduce the cost of software changes, in traditional systems development methodologies, system requirements specified in the first phase of the project development and it is not changed. This means that the cost to the needs of the change that occurs in the later stages will be very expensive [14]. Extreme programming also has four stages that must be passed when starting and working on a project, namely: Coding, Testing, Listening, Designing, and starting again from the coding stage, until finally doing a small release [15].

3. RESEARCH METHODOLOGY

Extreme Programming tends to use an Object-Oriented approach. The stages that must be passed include: Planning, Design, Coding, and Testing. Extreme Programming is designed to complete the project in accordance with the Requirements but has a small to medium work team. Extreme Programming is the most widely used agile method and is a very well-known approach. Extreme Programming in its use, has several stages in developing a software, this stage is the main backbone that makes Extreme Programming, namely [16]:

- **Planning**
  Planning activities begin by forming user stories. The XP team member then assesses each story and determines the cost and is measured in the development week.

- **Design**
  At the design stage, modeling of a system is made based on the results of the needs analysis. Modeling the system used.

- **Coding**
  Extreme Programming recommends that two people work together on a workstation computer to create code from one story (pair programming), to provide real time problem solving and guarantee real time quality. After pair programming is complete, the code is integrated with other work (continuous integration).

- **Testing**
  Unit tests that have been made must be implemented using a framework and arranged into universal testing suites, system integration and validation can be done every day. Customer test (acceptance test) is performed by the customer and focuses on the overall features and functional systems. Acceptance tests are obtained from customer stories that have been implemented as part of software release.

  In object oriented development within Extreme Programming we can use CRC to design the framework on Extreme Programming. CRC is Class-Responsibility-Collaborator are not the part of the UML Specification, but they are useful tool for organizing class during analysis and design.

  Class responsibilities are the class attributed and methods. Clearly, they present the class state and behavior. Collaborations represent the associations the class has with other classes.

  CRC cards are useful when the development of classes need to be divided between software system, as the cards can be physically handed over to them. A useful time to di this is when classes are being reviewed, for say determining whether they are appropriate in the design.

Fig.1. Class Responsibilities Collaborator

The figure 1 class responsibilities collaborator shows that in the responsibilities section there are several items consisting of edit warehouse stock, view product report, register new employee, managed raw materials also delete or edit data, and for collaborators have interconnected classes consisting of master stock, product, and employees.

4. PROPOSED WAREHOUSE APPLICATION

Based on the problems that have been explained in the introduction, the researcher proposes a warehouse management system application that focuses on the inventory of goods in the warehouse both raw materials and finished products. The application made makes it easy for users, especially workers in the warehouse who have the task of recording and monitoring what stocks need to be added in order to avoid running out of materials. In addition, applications that are made using visual basic and have an easy-to-use display to their users so that workers who have access to the application can immediately understand how the application can run.
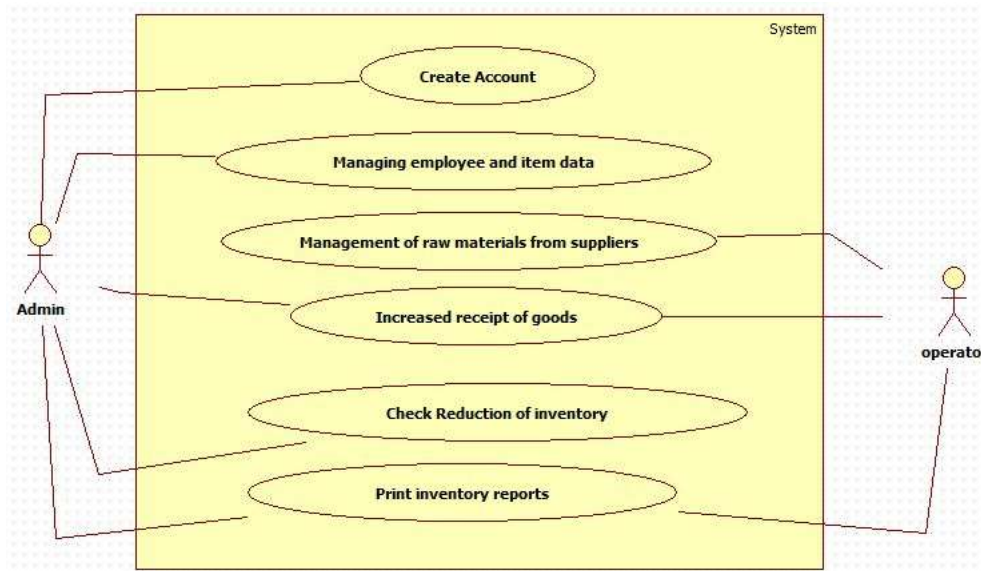

Fig.2. Use Case Warehouse Application

The figure 2 use case warehouse application, we can see that there are two actors who have different roles or tasks. The admin can create an account that will be used by employees to login so that employees can perform tasks related to the application. Employees can also input a number of raw material data obtained from suppliers and product data obtained from the production process at the factory.

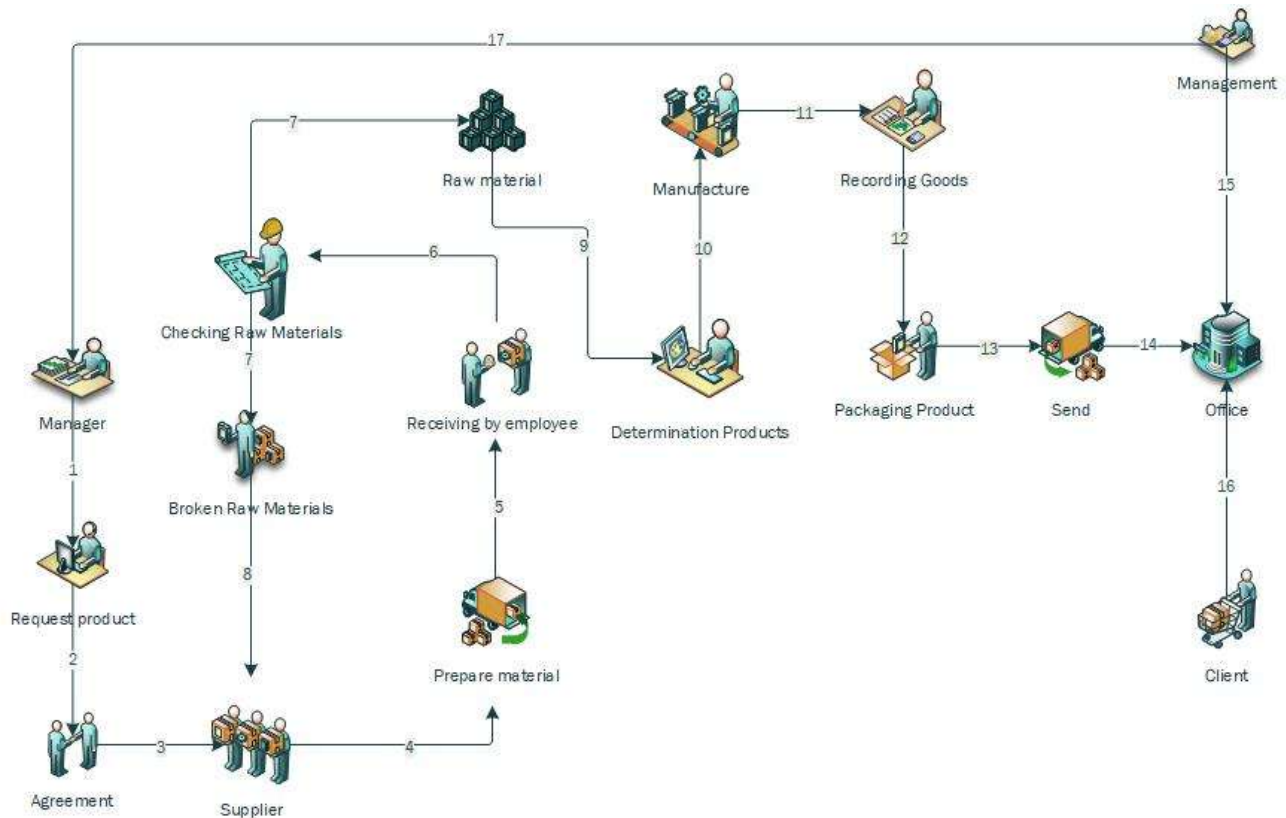## 5. DIFFERENCE BETWEEN OLD SYSTEM AND NEW PROPOSED WAREHOUSE APPLICATION

Fig.3. Current System of Recording Goods

The figure 3 current system of recording goods, in the initial stages, the manager checks the stock in the warehouse through paper which is used as a medium to record inventory, the inventory contains details about the amount of material remaining and what materials are needed during production, the amount of material is not many will be managed by the manager to place an order immediately before the available stock in the warehouse runs out.

The submission was recommended to the supplier by negotiating a number of things such as the price agreement and the shipping process. If ordering materials and the agreed price at each party agree, then the material will be sent to the production site. At the time of ordering materials, the manager will record orders for raw materials needed as proof of ordering materials from suppliers. Goods that have been sent will be received by workers who are responsible for checking the materials received whether in accordance with the order.

If the material received is damaged during the trip to the production site, then the material will be exchanged back to the supplier to be replaced with a new one. This is done in accordance with the accuracy made at the beginning before sending goods to the production site.

Then, the materials that have been received by the workers who recorded the materials will be recorded manually using a stock registrar to know what materials and how many materials have been received. Furthermore, the material that has been recorded will be sent to the production site where the material will be processed in the factory. After that, during the production process the materials will be used according to the needs of each product. If the goods that have been processed have been completed, then the product will be recorded in the goods availability report book. After going through the data collection process, the goods will be packaged to be sent to the marketing office to be sold to consumers.
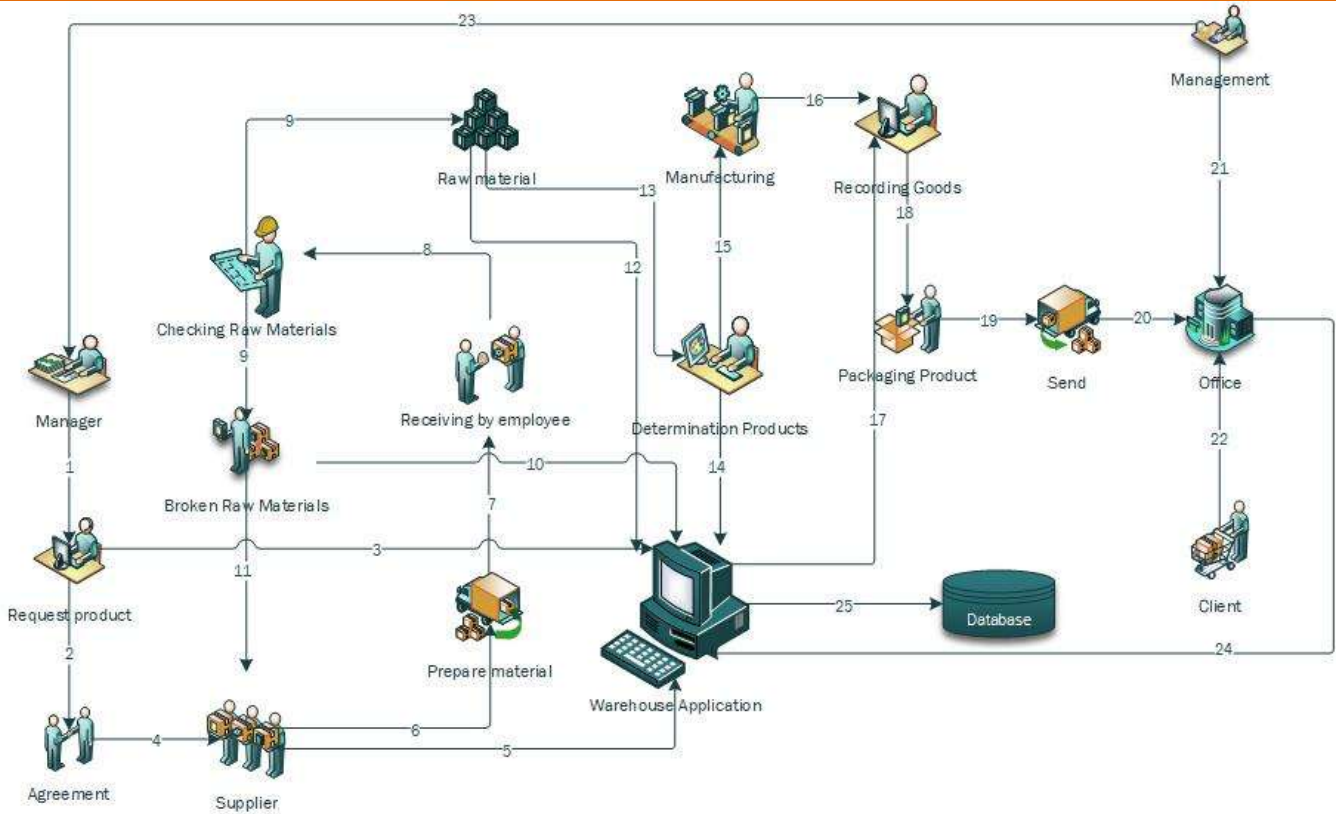
Fig.4. Proposed Warehouse Application

The figure 4 Proposed Warehouse Application, In the initial stages, the manager submits the supplier, if the ordering of materials and the price has been agreed on with each party then the material will be sent to the production site and will be recorded into the system regarding what materials are ordered to the supplier.

Subsequently the material will be sent to the production site, at this stage workers who have received the material will be recorded in advance to ensure that the goods ordered correspond to the amount of goods received. If the material is damaged, the material will be sent back to the supplier to be replaced with a new one. The process will then be recorded into the system regarding returning a number of raw materials to the supplier.

Furthermore, after the raw material has been completely received, the next step is to send the material to the factory where it is produced. Raw materials that have been recorded by workers will be entered into the warehouse system to find out how much raw material is needed to produce each finished product.

Then, after the material has been produced will be collected by workers who take care of the inventory of finished goods, where the goods will be recorded into the warehouse application to ensure that the amount of goods in the warehouse is still available. In the next stage, the goods which are ready for use will be packaged to be sent to the marketing office so that the goods are ready to be marketed to consumers.

6. HOW RECORDING GOODS WILL BETTER USING PROPOSED WAREHOUSE APPLICATION

The recording of an item is an important thing that must be available in various fields, especially in the industrial field, the recording of goods manually is not a problem in business processes, but if a business continues to grow, it is still done manually that can affect the performance of a company, especially in data collection goods.

The use of paper as a medium in recording an item can be a problem if mistakes made accidentally can occur such as the paper is torn, or damaged due to careless workers because of the activities carried out in the place where he worked other than that,

recording Manually, it can be time consuming because there is a lot of data that needs to be recorded, such as when goods enter from suppliers or goods to be produced.

Application that is made, has a feature of recording an item to be integrated with the system, thus this application can overcome data that might be lost because the recording is still done using paper, and can display the amount of stock of goods available systematically and structured according to the type of goods which is available. This application is also able to record all receipts of raw materials sent from suppliers, so that when inputting data by workers about ordered goods can be connected to the database so that workers cannot manipulate data or change data that has been processed by superiors.

7. STRATEGY OF DEVELOPING WAREHOUSE MANAGEMENT USING EXTREME PROGRAMMING

- **Planning Phase**
  In the planning stage, researchers create user stories and what are the needs of the company. From the results of user stories can be known by user acceptance testing, the use of UAT is a requirement to find out what problems are in the application. Then the results of the testing will be entered into the UAT report section.
  In the first user story, as workers we need a system that can accelerate our performance in recording data items.
  In the second user story, as workers we need to record reports on the return of raw materials to suppliers to ensure that the materials returned and received are as ordered.

- **Designing Phase**
  At the designing stage, researchers create a system design by making modeling based on the results of the needs analysis. The modeling system used is the Unified Modeling Language (UML) as shown in Figure 1. The use of UML makes it very easy to find out who has a role in running the application and determine each role or access right in the use of the application.

- **Coding Or Development Phase**
  At the coding stage is the part that takes longer than the designing phase, at this stage the researcher makes an application development or coding, where the use of extreme programming is expected to minimize errors or bugs in the application. To make this applications using visual basic 2013 and MySQL as database management system. The application that has been created can be seen in figure 5 and figure 6.

- **Testing Phase**
  In the testing phase is a way to find out if there are still errors or bugs in the application.

Fig.5. Interface to Fill Raw Materials

As can be seen in figure 5 interface to fill raw materials, Warehouse Management system Displays pages that have various functions created to facilitate users in accessing applications and entering data related to warehouse activities. The raw data addition page displays a number of transactions made by managers who have ordered materials with suppliers to find out the record of the purchase of goods and to know on what date the material was ordered.

Fig.6. Interface to Fill Data Product

The figure 6 interface to fill data product, display various features that have the function to record what products have been made during the production process at the factory. On this page workers can find out about the details of each product, it is useful to facilitate workers when the data collection process of any materials needed in the process of making products that will be sold to consumers.

8. CONCLUSION

Based on the results of the discussion based on the application of the warehouse management system has a function that can help the company in recording all the materials that are in the warehouse. On raw materials before going through the production process, this data will be useful in advance to avoid mistakes or mismatches of goods sent by suppliers and those received by workers. In addition, using the warehouse application can also help data collection of finished products that can prevent out of stock of goods related to supervision of goods or products that are in storage.

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