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Model of Web-based Supply Chain Management System for Salt Industry

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***Abstract*— The salt industry finds it difficult to meet the high demand because of the difficulty to predict and meet the needs of raw materials, and also to allocate products. Supply Chain Management (SCM) system can overcome these problems, but the existing SCM is not yet in accordance with business processes for the salt industry. This research intended to create a model of web-based supply chain management (e-SCM) for Salt Industry. The data were gathered through interviews, questionnaires, and literature review. The analysis and design of the system used the Object Oriented Analysis & Design (OOAD) method which refers to Unified Process and using Unified Modeling Language (UML) notation. The analysis method is applied while the business is being operated and is based on the needs of the industry. The result of this research was an e-SCM system model that is intended to support operational activities for salt industry.**

Keywords—model, web-based, supply chain management system, salt industry

I. INTRODUCTION

The increasing market demand for salt requires industry to be able to produce in large capacity. The national salt demand for 2012 reached 3 million tons, consisting of 1.2 million tons of salt consumption and 1.8 million tons of industrial salt [1]. From 2011, the average growth of salt industries demand reached 5.82 percent per year while the average growth of consumption of salt reached 1.40 percent per year. The needs of salt consumption consist of household need as much as 511 thousand tons. However, the fulfillment of these needs is constrained by the production, such as the lack of supply of raw materials for production. Other constraints occurred in the sales department, where there is difficulty recording the allocation of products until the delivery of orders to the distributor because of lacking necessary tools [2].

Researchers are still debating and have not made a consensus on the definition of Supply Chain Management (SCM) [3]. Chopra and Meindl [4] has defined SCM as a series of activities consisting of all parties directly or indirectly involved in meeting customer demand. SCM is also defined as the process of optimizing the company's internal practices in interacting with suppliers and customers to more efficiently bring products to market [5]. With the implementation of electronic supply chain management (e-SCM) all activities ranging from raw material inventory, goods production, distribution of goods and information flow can be done in computerized and integrated [6].

The identification of needs of service-based SCM systems is divided into two, which are functional and nonfunctional needs. In general, the functional requirements of this system are as follows [7]:

- The function of customer data management (distributors and retailers) by sales managers as service providers.
- The function of goods data management by customers (distributors and retailers).
- The function of automated financial transaction process either in the form of bill payments and cash flow cash activities.
- The function of automated capturing and data input using third party device
- The function of transaction process monitoring performed by the manager
- The function of summarizing function in the form of sales report
- The function of statistical analysis in the form of diagrams and graphs.

The non-functional needs of SCM system include performance, data management, economic, control, efficiency, and services.

The e-SCM system model built in this study can assist the salt industry in performing real-time production calculations as well as classifying the list of company's raw material needs. The system order can be accessed by distributors through the e-SCM system, so the company can take into account the calculation of monthly production needs and can retrieve products purchased by all distributors that integrated and can be accessed online. Also, the benefits of the system model built in the study include:

1. Help companies to get demand forecasting

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2. Accelerate the information flow from the products and raw materials inventory, and processing distributor orders from production to delivery process.
3. Make it easier for distributors to order products via e-SCM.
4. Facilitate the distributor to monitor the status of ordering and ongoing payment transactions through e-SCM.
5. The company can estimate and know the need of raw materials for future production and simplify the process to order raw materials.
6. Facilitate the company to record all sales data and inflow-outflow data of raw materials and products in the warehouse.
7. Facilitate the production of the company in requesting raw materials to the warehouse.
8. Facilitate the warehouse in monitoring demand for raw materials or products.

II. METHODOLOGY

Data collection methods for identifying information needs were literature study, field research, and system analysis-design:

- Literature Study

  The study activities conducted by reviewing books, articles, journals, and other resources related to e-SCM.

- Field Research

  In this method, data collection is done by visiting companies directly, and the activities include:

  a) Interviews. In this case, directly asked the salt industry management and distributors to know and get the information to build the system.

  b) Questionnaire. Data collections in the study are primary data. Primary data were collected by distributing a close ended questionnaire distributed directly to salt industry employee through Google docs. The study used the Likert scale to identify the most important features.

- System Analysis Design

  This study used Object Oriented Analysis & Design (OOAD) method with Unified Modeling Language (UML) notation. OOAD improves communication, conform to different execution environments, and helps to develop a very flexible, easily changed, and more maintainable system to reduce the risks [8]. The design process according to the OOAD method according to Satzinger which refers to UP (Unified Process) consisting of Inception Phase, Elaboration Phase, Construction Phase [9].

III. RESULTS

A. Requirement Gathering

The study was based on literature review, interviews, formal observations, and questionnaires. There were 90 participants from the sales, production, and warehouse department. The responses to the questionnaires were on the Likert scale. It can be concluded that all respondents agree that e-SCM system can help companies in operational activities, increase productivity, and save resources of the company.

Regarding some features of the e-SCM system, based on the results of the questionnaire, it can be concluded that the feature that has the highest percentage value in sequence are order management 73%, which can help the sales department to monitor and manage orders, invoice management 56%, and tracking order 54%, where sales department and distributors can track orders accurately. And from the results of the questionnaire obtained, 85.8% of respondents agree on the features applied to the e-SCM system will ease supply chain activities.

The interview was conducted to five distributors because e-SCM was designed using a pull-based supply chain model in which the production process was initiated from distributor orders. From the interview result, it can be concluded that the problems experienced by distributors including the number of products ordered were not matched with the expectation, and the estimated time of product delivery can not be determined. Also, based on the response of the interview result, all distributors agree that the key features of the e-SCM are creating order and tracking order.

B. Information Needs Analysis

The e-SCM system to be built is an application with a web-based platform that can assist companies in managing product and raw material data, transparently recording, information flows management, and products estimation to be delivered to distributors. So, it can save time and resources in the operational process from ordering to delivery. From the analysis results of business process, the study found several problems:

- The flow of information from the ordering process to delivery between internal and external parties was not integrated. This problem resulted in the possibility of errors in order recording as well as the slow retrieval of information.
- The difficulty of checking raw materials and products stocks availability because the checking process is manual, which the consequence is the delay of production process.
- The difficulty in obtaining clear reports of sales, invoices, and inventories of products and raw materials for a certain period. So, the flow of internal company information is not well-systematized and will lead to the possibility of fraud

In the inception phase, the study produces an e-SCM workflow based on the information needs analysis:

- In the early stages, to ensure the adequate supply of raw materials, if any raw material inventory reaches the minimum stock, the system will display the table containing the raw materials that low in stock. Then, the administrator will create a purchase order of raw materials to suppliers via email.
- After the warehouse receives raw materials from the supplier, it will be cross-checked with the purchase order, then the warehouse will process the raw material inflow, and raw material inventory will increase.
- The purchase order by distributor has two ways. If the distributor has access to the system, it can directly order product through the system, but if the distributor does not have access to the system, he can contact sales by phone or email to make reservations through sales.
- After the order is made, the sales department will check the orders that have been made to be processed through the system, and then sales department will update the status of the order to "On Process".
- Once the order is processed, the production department can check orders that need to be produced over the next month through the system. Then, they record the required raw materials.
- After the production department knew the required raw material, the production department will make a request material form to the warehouse to request the raw material needed to the system.
- The warehouse will check the request material form for processing, and prepare the requested raw materials for delivering to the production department. Then after processing the material request form, the raw material inventory will be reduced on request after submitted.
- Once the production of a product has finished, the production department will add the amount of product to the system, and send the finished product to the warehouse.
- The warehouse will receive the product delivered from the production department, then check the product physically and the data that has been input by the production department through the system. If the verification procedure has passed, it will directly process the stock to inventory and the stock inventory will increase after the product is being processed. If it is not passed, the warehouse will update its own inventory through the system with the menu update stock.
- Next, the sales department create a delivery order form through the system to deliver products that have been ordered by the distributor.
- The warehouse then hands over the product to the expedition to be delivered to the distributor.
- After the product has been prepared and submitted to the expedition, the warehouse will process the mailing form by inputting the expedition data (name and receipt) to the system then after processing the order status will be "In Courier" and the product inventory is reduced.
- For product orders that already received by the distributor, the sales department will update the order status to "Delivered", which is indicating an order has been completed (closed).
- The management can monitor the completed sales and directly download a report from the system.

C. *Supply Chain Management Model*

From the observation, the supply chain process in the salt industry is the pull-based supply chain model, where the information flow process is based on the demand of the distributor. Then, the company orders the raw material to the supplier, so it is more focused on the real demand than the demand forecast. This model is proposed for several factors:

- Order Factor

  The ordering process that occurs in the salt industry starts from the sales department which is the liaison between the distributor and the company. The sales department records the product order from the distributor, and then place the order to the head of sales department to approve and process it based on the distributor's request.

- Inventory Factor

  The salt industries have warehouse to store raw materials and finished salt products. If the ordered product is not available, then the warehouse will notify the production department to produce and estimate the need of raw material to make the raw material demand. If the raw material meets the demand, then the warehouse will directly process the request letter of raw materials and will send to the production. When the raw materials are insufficient, the warehouse will inform the purchasing department that the required raw materials are insufficient, and then will place orders to the supplier.

- Distribution Factor

  The distribution of the products will be made one month from the date of the distributor's order. The product will be distributed by the logistics department to be sent to the distributor's destination address.

- Production Factor

  If an ordered product is unavailable or insufficient, the production department will estimate the amount of raw materials to the warehouse. If raw materials are available, the production department will produce salt products that will be directly distributed to the warehouse.

D. *Activity Diagram*

The design of e-SCM system model aims to help improve the ordering process to the procurement process. The e-SCM

system is divided into six sections, the first section is for the distributor, the second is for the sales department, the third is for warehouse department, the fourth is for the administrator, the fifth is for management, and the last one is for the production department. The activity diagram of each process, including sales order process, raw material procurement, production, and management account is depicted in Figure 1.

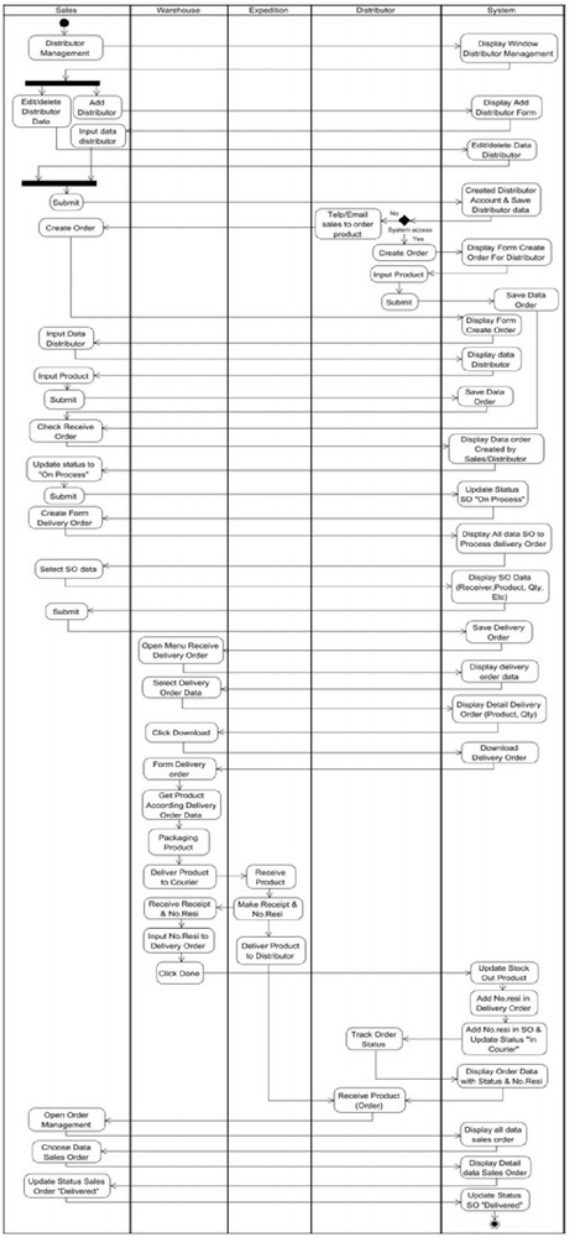

Fig. 1. Activity Diagram Sales Order

The sales department has access to manage distributor data on the e-SCM system, including adding or removing distributor data on the system. Distributors who have access to the e-SCM system can purchase orders. However, if the distributor does not have access, they can place an order by contacting the sales by email or phone. Then, the sales department will create a purchase order and input the distributor data that make the order. The sales department will check the booking that has been received and will change the status of the order to "on process" indicating the order received. Then the sales department will create a delivery order form that will be accepted by the warehouse. The warehouse department will select the delivery order form to process the shipment, and prepare the product according to the order data.

The warehouse department will do packaging process of the products and hand it over to the expedition. The expedition creates a receipt number for the ordered product to be received by the warehouse department. Then, the warehouse department adds the receipt number to the system to track the ordering status that becomes "in courier." After the distributor receives the order, the sales will update the sales order status to "delivered" that indicates the order transaction has been completed. Figure 2 shows the business process in the procurement of materials in e-SCM.

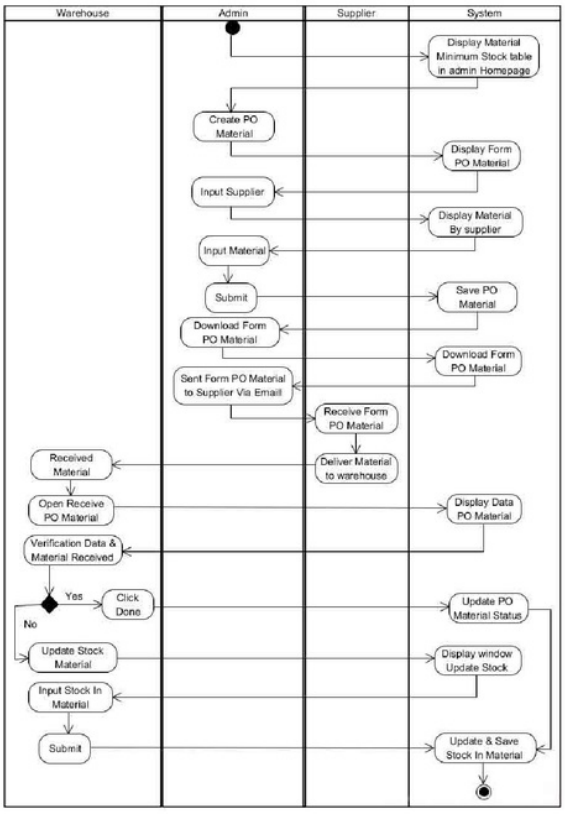

Fig. 2. Activity Diagram Purchase and Update Stock Material

If the system displays the table of raw materials that reached minimum level in inventory, then the administrator will create a purchase order on the e-SCM system. The purchase order will be sent to the supplier by e-mail. After that, the supplier prepares the required raw materials and sends them to the warehouse. The warehouse department then verifies raw materials to the purchase order data. If the raw material matches with the purchase order data, then the warehouse department will complete the purchase order status.

E. Use Case Diagram

Use case diagram describes features for each actor in an e-SCM system, such as administrator, distributor, sales department, owner, warehouse department, and production department.

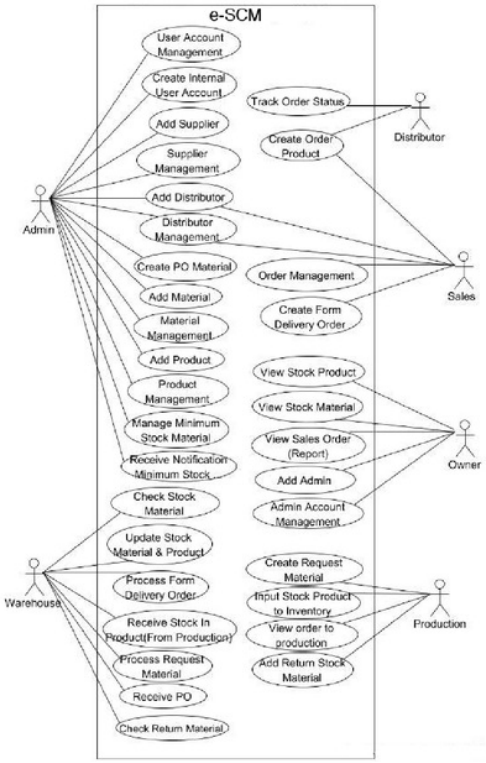

Fig. 3. Use Case Diagram

The system administrator is responsible for all operational activities, such as managing internal accounts in the e-SCM system and making purchase order of material. The distributor can access the e-SCM system to place product orders and can monitor the order status.

The sales department is responsible for processing distributor's orders, managing sales order data, and creating a delivery order. The production department may request raw materials and be responsible for monitoring the production process so that the quality, quantity, and timing are following the plan. The warehouse is responsible for receiving raw materials and products, preparing, and packaging the products following the delivery order.

Owners can create and manage accounts for administrators, and can monitor distributor orders and sales reports.

F. Navigation Diagram

Navigation diagrams are one of the results of the elaboration phase. For each actor, there are menu such as:

- Profile, to view personal data and change data
- Change Password, to change the account password
- Logout, to exit the system

Figure 4 shows the navigation diagram.

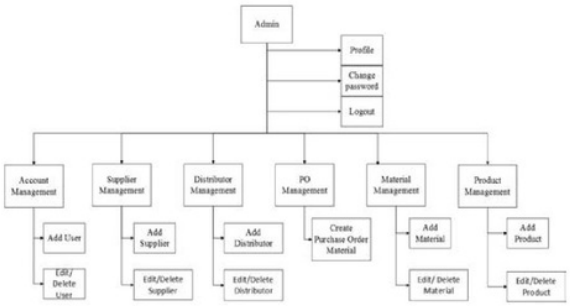

Fig. 4. Navigation Diagram

The administrator uses the following features:

- Account Management, to add data along with internal user accounts and change or delete data
- Supplier Management, to add supplier data and change or delete data
- Distributor Management, to add data along with distributor account and change or delete data
- Purchase Order (PO) Management, to make purchase order material
- Material Management, to add material data and change or delete data
- Product Management, to add product data and change or delete data

G. Domain Model Class Diagram

Domain Model Class diagram describes the class attributes and relation of each class in the e-SCM system model is shown in figure 5.

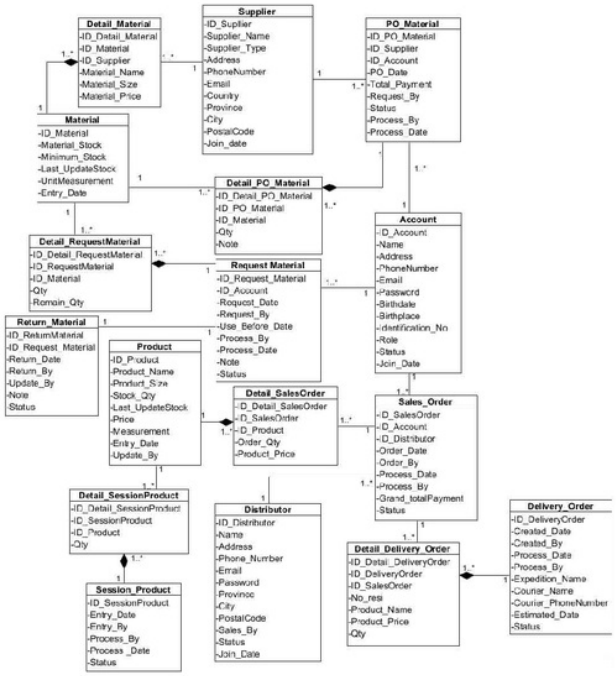

Fig. 5. Domain Model Class Diagram

IV. CONCLUSION

Based on the results of supply chain process analysis, the applied model is pull-based supply chain model. The information flow process is based on the demand of the sales or the distributor. Then the company placed an order to the supplier, so it is more focus on the real demand rather than the demand forecast. This model is proposed for several factors in supply chain process including order factor, inventory factor, distribution factor, and production factor.

This study found several problems in the supply chain process, such as the flow of information between internal and external parties are not integrated with each other, difficulty in checking the demand and the level inventory of raw materials and products in the warehouse that will cause delays in the production process, and the difficulty in retrieving reports of sales, invoices, and inventory of products and raw materials.

The design strategy used to build e-SCM based on the Object Oriented Analysis & Design (OOAD) method that referred to Unified Process (UP) can ensure the need that matches the company strategic business. In supporting the supply chain process, the e-SCM system can integrate all parts of the company in order to access and get a clear flow of information, facilitate the monitoring of raw materials and products inventory, and facilitate distributors and sales in creating an order. The internal parts involved in the e-SCM system include the administrator, owner, warehouse department, production department, sales department, and distributors.

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