E-Supply Chain Management Model for Garment & Textile Industry with Limitation of Technological Capabilities

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Abstract. Electronic Supply Chain Management (E-SCM) can be implemented by collaborating several electronic concepts for business process such as E-Transportation, E-Distribution, E-Fulfilment, Enterprise Resource Planning (ERP) and Warehouse Management System (WMS). These concepts require high technology, expensive implementation, high skill and cost in development. Garment and textile are the most numerous industries in Indonesia, especially in West Java, E-SCM can increased efficiency and effectively for textile or garment companies, but E-SCM development requires high costs and high technology. These are problems when many garment and textile companies in Indonesia have limited capabilities of technology. In this research we design new E-SCM model with Value Chain Analysis approach and used Software Architectural Design to make the model. We divided E-SCM system for garment and textile industry in multiple layers and then we collaborate with two existing E-SCM frameworks, namely E-Supply Chain Management Process and Technology Integration Framework and E-SCM Multi-Agent System Framework. We combine layers components with the relevant layers of the existing E-SCM frameworks. The result is a new E-SCM model for garment and textile industry that can accommodate limitations of technological capabilities.

1. Introduction

Information technology has been widely used to increase global competitive in various industries including textile and garment industry. Electronic Supply Chain Management (E-SCM) concept appears due to the emergence of the Internet and electronic communication that enabled companies to be more responsive to their business partners. Success of supply chain management requires changes in governance systems, business processes, business models and individual management to integrate the activities into one main supply chain process. The textile and garment industry as one of the most numerous industries in Indonesia that driven by collaboration of many stakeholders. Each plays an important role in the supply chain network.

Many Garment and textile industries in West Java have a lack of technological infrastructure. Processes data and information management still using office application package. Some system application already implemented desktop and web application, but most applications have not yet integrated with others departments and business partners. The E-SCM business process in the textile industry is a series from upstream activities (supply) to downstream activities (related to customers) with several approaches. The most common members of SCM are Suppliers, Manufacturers, Distribution and Customers. Some manufacturer associated with external parties such as expeditions and outsourcing. In the management of raw materials some mistakes occur in recording raw materials, the procurement of raw materials frequently late because of barrier in the order process [1]. Deviation in production planning occurs because of the delay in procurement of raw materials because there is no information regarding the stock of raw materials available at the Supplier [2]. Problems that occur in the supply chain in the garment and textile industry in several companies are:
a. Lack of information of availability raw materials in suppliers causing difficulties in material purchasing planning.
b. Information related to the production process and progress is also not integrated.
c. Late arrival of materials due to the slow response of the orders.
d. Information of availability of raw materials is difficult to access
e. Inadequate information of raw materials
f. Scheduling and monitoring

Problems that arise in the supply chain in [3] are:

a. Communication: difficulty of information received between SCM members.
b. Raw Materials: Procurement of raw materials is slow, due to the calculation of raw materials that are not suitable for production needs
c. Production Machinery: The slow process of requesting spare parts, because it takes a long time to get approval from the parties concerned.

These requirements of data include: Employee data, user data, woven data, thread data, material data, machine data, spare parts data, production plan data, delivery order data, percentage data, thread request note data, thread return data, stock data threads, maintenance data, spare parts data, order item repair data, goods purchase order data, production graph reports, thread stock reports, thread return reports, machine condition reports, spare part stock reports. Implementation of Web-Based Supply Chain Management (SCM) in the Weaving I Department to Overcome Delay in Production Results Case Study at PT Argo Pantes Tbk

2. Method
In this section discusses previous research about e-SCM frameworks for the textile and garment industry. In [4] the fashion industry's supply chain is full of uncertainty, so a system is needed to effectively captures of customer needs and helps manage the supply chain. Management of Quick Response (QR) has been widely used in the textile and garment industry as a way to maintain efficient supply, one of which is supply chain management (SCM). Previous research has integrated procedures for developing management information systems (MIS) with e-fashions systems through a multi-agent SCM system. Several related studies and reports from various countries have been thoroughly surveyed to find possible IT and non-IT methods to be used in SCM retail. This study provides an electronic mode SCM system by adopting Semantic Web techniques and multiple agents. Systems that can integrate different information technologies to make their behaviour smarter and capture more useful information from customers. The implementation also considers several practical issues in SCM fashion retailing.

The relationship of the supply chain fashion industry complex with the global market and economy shown in Figure 1. The chain can pass suppliers, manufacturers, distributors, retailers or stores, and then to customers from different countries.

In recent years, there have been many uses for the proposed method to solve supply chain problems in the fashion industry. The taxonomy shown in Figure 2 can be used here to explain it. Solutions can be divided into two types, namely by and methods without IT and with IT. The SCM e-fashion multi-agent system is shown in Figure 3. Identifying the performance measures for textile supply chain network, tried to overcome it by recognizing three areas; cyclic processes of supply chain network consist of procurement, production and distribution, measures under three decisions making levels & considering balanced scorecard (BSC) perspectives [5]. Four major goals of SCM are Waste reduction, Time compression, Flexible response and, Unit cost reduction [6] (see Figure 1).
Rapid development of E-commerce, there has been a rapid growth of garment sales through the internet. In this context, evaluating the fit-up of virtual garments is very important in the clothing industry. In the paper propose a Naive Bayes based model for evaluating garments. Input from the proposed model is digital clothing from different body parts, which are produced from 3D clothing CAD software; While the output is the result of garment prediction fit (fit or not feasible). By learning from this data, the model we propose can predict the garment quickly and automatically. Therefore, it can be applied to the evaluation of long-distance garment in the context of electronic shopping [7].

In Sri Lanka it was found that a successful SCM strategy and constraints in improving SCM performance were identified based on each lead time factor, added value and related direct contact. While macro and micro-environmental factors affect the performance of SMEs, the micro environment (especially lack of strategic business thinking, weak resource base, resilience to business risks and marginal profit with low profits) is the most prominent cause. Furthermore, the lack of fabric manufacturing bases in Sri Lanka is a common barrier for 'better' and less successful companies. The absence of direct contact with foreign buyers is very important for companies that are not successful because it has caused these companies to work with intermediaries. Critical supply chain decisions must be integrated through the purchasing office, which makes these companies risky [8].

Other research proposes a web-service-based architecture for SCM that enables companies to develop context awareness and to achieve interoperability in data, services, processes and business levels using notification of web based event services [9]. Other conceptual model attempts to create the layout and design of the procurement of raw materials, work-in-process, inventory and finished goods from various sources to the ultimate consumer in garment business [10].

The SCM concepts are implemented for overcoming the problems. Activities of value chain analysis consist of three stages: first stage is identifying value chain activities, the second one is identifying the cost driver for each value activity. The last one is developing competitive advantages by reducing costs or adding value. The functional requirements of SCM appear through value chain analysis that integrated SCM members.

A. Identify value chain activities

Value chain activities implements in Procurement and Purchasing activities, Warehouse activities, Manufacture activities, Distributors activities, Customer Service activities. The others activities are analysis upstream component, midstream component and downstream component of supply chain. Analysis the integration process between subsystems that still use limited technology.

B. Identify the cost driver for each value activity
Analysis of activities that have value based on procedures and supply chain activities that have been running in several textile and garment companies in West Java. Analysis is also carried out based on technology that has been used for hardware, software, networks, databases and tools that had been owned.

1) Value chain activities of procurement/purchasing, value chain analysis of suppliers in procurement and purchasing activities produces valuable activities:
   a. Supplier Management
   b. Supplier Information
   c. Management of Purchase Orders
   d. Order Status Information
   e. Information on Availability Materials
   f. Material Receipts Management

2) Analysis value chain for activities warehousing of production process produces valuable activities:
   a. Material Usage Management
   b. Production Plans Management
   c. Production Progress Management
   d. Manage Material Stocks

3) Value chain analysis of distribution activities produces valuable activities:
   a. Manage inbound and outbound logistic
   b. Tracking of goods

4) Value chain analysis related to customer produces valuable activities:
   a. Customer Management
   b. Order Management
   c. Order Compliance Status

Analysis of process run in subsystem upstream, midstream and downstream. The valuable activities classified in 3 approach:

1) Upstream activities
   1. Procurement
      a. Submission of purchases
      b. Purchase Order(PO)
   2. Supplier Management
      a. Supplier registration
      b. Supplier data collection
      c. Stock information
      d. Order fulfilment information
   3. Inbound and Outbound Logistics Management
      i. Recording of movement goods
      ii. Raw material inventory management
      iii. Inventory management

2) Midstream activities
   a. Recording of each stage of production
   b. Production progress information
   c. Information about progress in third party production

3) Downstream approach
   a. Data of finished goods
   b. Packaging
   c. Delivery plan
   d. Listing of produced items
   e. Delivery status information

Analysis of the integration process between subsystems with limitation of information technology. We carry out analysis based on the availability of technology infrastructure in the industry.

1) Value Chain Supplier Analysis for Procurement / Purchasing
a. Application for supplier information  
b. Using an agent to transform product data files such as Excel into database format  
c. Service to receive availability data of raw materials from many resources

2) Analysis of value chain in warehouse  
a. The application to display production info  
b. Production progress in dashboard  
c. Manage raw material stock

3) Value chain analysis for distribution activities  
a. Service to get goods tracking data  
b. The agent converts the data into some information gateway format

4) Value chain analysis for customer  
a. Catalogue Online  
b. Online Order  
c. Customer Account

C. Develop competitive advantages by reducing costs or adding value.  
Modelling activities of supply chain management for limitations of technological. The model consists of four main SCM processes. Drawed with the red box in SCM framework in Figure 2, becoming a simple functions to reduce the burden of system development, simplifying the functional results as follows:

1) Procurement:  
a. Procurement  
   i. Submission of purchases  
   ii. Purchase order  
b. Supplier Management  
   iii. Supplier Registration  
   iv. Supplier Data Collection  
   v. Supplier Stock Information  
   vi. Order Progress Information  
c. Incoming Logistics Management  
   vii. Recording of Entry Goods  
   viii. Update Raw Material Inventory  
   ix. Update Additional Material Inventory

2) Production:  
a. Usage of raw materials  
b. Management of production status and progress  
c. Reporting of production activities  
d. Information of outsourcing production progress

3) Physical distribution:  
a. Manage stock of finished foods  
b. Distribution management  
c. Goods tracking management

4) Customer services:  
a. Product catalogue  
b. Ordering Products  
c. Order Fulfilment Progress Information

3. Results and Discussion  
Based on the results of value chain analysis we build a model with Software Architectural Design by analyzed and divided E-SCM system in four layers. Layer 1 consists of hardware technology likes various of personal computers, smart phone and network of communication. Layer 2 consists of members of SCM system likes supplier, distributor, manufacture/company and customer. Layer 3 consists of sub-system of E-SCM system likes upstream, midstream and downstream component/activities. In this layer explain main activities that usually run in company. We determined main
activities based on value chain analysis. Layer 4 consists of database that needed like procurement, order production or fulfilment, logistic and customer database (see Figures 2 & 3).

Figure 2. A Framework for the e-SCM multi-agent system [4].

Figure 3. Framework of e-Supply chain the management-Process And Technology Integration [3].
We modify layer 2, layer 3 and layer 5 from E-SCM multi-agent system framework, beside that we analyzed and modify activities in framework of E-SCM Process and Technology Integration. In layer 3 describes the business integration process which consists of System SCM, ERP and CRM. All of three systems require long and expensive development process. Some features system are taken which are very significant valuable in the supply chain that are already running. The Model gives an overview of SCM systems with limitation of technology. The design and implementation stages of the system where system requirements and system integration are more clearly displayed in the model. At layer 5 the database is stream lined into 3 databases containing data of procurement, production and customer service processes.

Figure 2 shows layer that represents information of technology for hardware, software, and networks that are available to textile and garment companies. Layer 2 describes members of supply chain and how they are integrated with each other through services, agents, data sharing. Layer 3 describes core activities consisting of upstream with procurement and purchasing, midstream for production which can also collaborate with existing ERP systems. The last part is downstream that consists of sales, interacting with customers and can also integrated with CRM. Fourth layer include of how processes and data can be integrated through platform (semantic web) ontology. Requirement for databases represented with three main databases, namely procurement database, order fulfilment and production database and customer and logistics database (see Figure 4).
Evaluation of business processes is carried out by analyzing whether supply chain management is in accordance with the object of research taken. The indicators used are whether all existing business processes are all defined. Are there business processes that conflict with others business processes. Are there parts of a business process that do not accept input but produce output? Is there a part of the business process that receives input but does not produce the output. Are there parts of a business process that are not connected. Whether the existing business process sequence can represent the supply chain management process.

Results Evaluation of process content is that existing business processes have defined most business processes, analysis shows that there are no conflicting business processes. But in the business process section that does not accept inputs but produces output and parts of business processes that receive input but do not produce output are not explained in detail in this model. All business processes can be connected in layers and between layers. The existing series of business processes can represent the supply chain management process.
4. Conclusion
The result is a new model of e-SCM that can accommodate the limited capability of technology in the garment or textile industry. This model represented in 5 layers consisting of the technology layer, layer of main objects in SCM and its integration, layer for the functional activities from collaboration between objects, the connecting layer between business process activities and the database, and the database layer that divided into 3 main databases. The model has not been evaluated by involving an expert domain in the field of supply chain management in accordance with the object of research taken. Evaluation of the technology integration model in the proposed model is done by making a process simulation that is to do a simple implementation that is in accordance with the real word and has not yet been tested. Suggestions for further research are model evaluation to ensure that the model produced is in accordance with the need for effective implementation of the SCM model in companies with limited technology.

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