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Designing Enterprise Resources Planning Application for Integrating Main Activities in a Simulator Model of SCM Network Distribution

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Abstract. *Collaborative supply chain is a specific topic in supply chain management and studied by industrial engineering students in supply chain management course. Unfortunately, conventional learning media cannot explain the phenomenon of collaborative supply chain to the students. This study aimed to design a dynamic learning media so that inter-company collaboration and information sharing on the activities of Supply Chain entities can be explained effectively to the students. The problem was solved using 3 (three) steps. First, the distribution network was described using mock up. It consists of miniature trucks, miniature network and miniature of the manufacturer-distributor-retailer embedded with tag and reader of RFID. Second, the Enterprise Resources Planning application was developed for supporting business activities. Third, we developed the integrator consists of monitor's user interface and practice modules. The result of the research - an SCM-Simulator – will be able to improve learning skills of industrial engineering graduates, especially abilities to identify, formulate, and solve the activities of tactical plan & operational routines of Supply Chain entities. However, distribution module designed is for limited scale laboratory study of simple objects.*

Keywords: *Distribution Network, Enterprise Resource Planning, Industrial Engineering Education, SCM Simulator,and Learning Media.*

1. INTRODUCTION

Recent development of Information Technology (IT) makes information sharing activities between Supply Chain(SC) entities become easier, rapid, accurate, and real time (Gunasekaran & Ngai, 2004; and Hwang, 2005). Recent advances in IT, such as radio frequency identification (RFID) and Enterprise Resource Planning (ERP) software, have resolved the problem of information sharing between Supply Chain (SC) entities. The technology of RFID is used to identify product delivery units. The transaction based integrated ERP software provides different media that can support supply chain integration (Kellea and Akbulut, 2005). The development of IT encourages SC entities changes to improve the competitiveness of the company; from efforts of internal efficiency towards intercompany collaboration for leveraging benefits to achieve (Bowersox & Closs, 1996 and Matopoulos *et al*., 2007).

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The collaborative SC is one specific topic in Supply Chain Management (SCM) and this topic is studied by Industrial Engineering (IE) Students in SCM course. However, learning is need a complex craft, but the skills required to do it effectively can be taught. Unfortunately, conventional learning media (static learning media with a multimedia slide show) cannot explain the phenomenon of information sharing and collaboration between the entities of SC to students. So, for the learning process of SC course needs innovative teaching and learning methods to improve the ability of our students to solve complex problems in collaborative SC. Trend of IT, especially ERP and RFID, can be utilized for the development of learning media in Industrial Engineering Education especially in study of SCM. This study aimed to design a simulator model as a dynamic learning media so that inter-company collaboration and information sharing on the activities of SCM's entities can be explained effectively to the students.

2. 2. TERMINOLOGY AND LITERATURE REVIEW

2.1. Supply chain management

Supply Chain Management (SCM) is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders (The Global Supply Chain Forum, Lambert & Cooper, 2000). The evolution of the development of SCM science begun in 1960's when most of manufacturers focused in the primary operation strategy to minimize unit production cost (Ming & Zhou, 2002). Ross (2003) exposed that the development of SCM concept was based on the fact in 1960's when manufacturers were demanded to decrease production cost and the development of information technology – especially internet- supports manufacturer to be more efficient. The efficiency is not only in the scope of manufacturer itself but also with its partners involved in the supply chain network by collaborating to increase capability level in operation and market.

Christopher (1998) divided the evolution of SC to 4 (four) stages to reach integrated SC. Stage one is base line, the stage to accomplish the firm's business function independently, such as purchasing, material control, production sales and distribution. Stage two is functional integration, the stage to integrate related functions, such as materials management, manufacturing management and distribution. Stage three is internal integration, the stage to integrate the whole function in the firm (internal supply chain). Stage four is external integration, the stage to integrate internal supply chain with suppliers and customers.

Chopra and Meindl (2004) devides SC Problems Area in the three levels of decision hierarchy. First, Competitive strategy analysis: i.e. location-allocation decisions, demand planning, distribution channel planning, strategic alliance, new product development, outsourcing, supplier selection, it selection, pricing and network restructuring. Second, Tactical plan analysis: i.e. inventory control, production/distribution coordination, order/freight consolidation, material handling, equipment selection and layout design. Third, Operational routines: i.e. vehicle routing / scheduling, workforce scheduling, record keeping, and packaging. One of areas of supply chain require further research is conceptual, analytical and simulation models for the design and implementation of supply chain management concepts and for solving the operational problems of the supply chain (Gunasekaran, *et al.* 2000).

2.2. Industrial Engineering Learning Tools

Curriculum of Industrial Engineering Department must accomplish the requirement that graduates have the ability to design, develop, implement, and improve integrated system that include people, meterials, equipment and energy. The program must include in-dept instruction to accomplish the integration of system using approriate analytical, computational, and experimental practices (ABET, 2002 and Augusti, 2007). To support that, it is necessary to provide the learning tools related. Learning tool is a tool to deliver the message of learning (Bovee, 1997). In this case, between lecturer and college students. Learning itself is a communication process between learner, teacher and teaching material.

A good learning tool can activate learner in analytical, computational, and experimental practices of a course. In pedagogy, there are three studying theories are essentially discussed, that are Behaviorism, Cognitivism and Constructivism. In behaviorism, learning is based on models of stimulation and reaction. In behaviorism, the thinking processes are a "black box". In Cognitivism, thinking processes are brought to the foreground. One question at the cognitivism is how will declarative and procedural knowledge structures be formed? The Constructivism starts out from the theory that the recognizing subject does not show the reality passively, but the subject can only construct actively in the knowledge process. New knowledge must be realized, learned, experienced and integrated into the already available knowledge structure.

2.3. An Alternative Learning Media for study of SCM

In SCM study -especially collaborative SC- college students are supposed to be able to recognize, understand, and experience the problems related to inter-company collaboration and information sharing between SC Entities. So we propose learning media based on constructivism teaching by using multimedia. Interactive multimedia is a powerful tool for study SCM that can be used in many different ways, such as support to class presentations, tutorial for off-class consultancies or complementary activities, virtual laboratories, and simulators. Multimedia learning media are helpful in conveying subject matter to students. Media-based instruction methods have the ability to dramatically increase efficiency in the classroom and capture students' attention (Jimenez, 2006). The SCM-Simulator focuses in aiding students learning one specific topic in SCM. It is collaborative SC. This topic is covered in a senior-level course taught, Supply Chain Management, in the Department of Industrial Engineering at the University of Sebelas Maret. This course thus provides an ideal the integration of key business processes from manufacturer to retailer. The third-level of heading follows the style of the second-level heading. Avoid using more than third level for heading.

3. RESEARCH METHODOLOGY

We proposed a SCM-Simulator so that inter-company collaboration and information sharing on the activities of SCM's entities can be conveyed, realized, learned, and experienced by students. The phenomenon problem was solved using 3 (three) steps as shown in Figure 1. First, the development of SC network was made from mock up and consists of miniature trucks, miniature track network and the manufacturer-distributors-retailers embedded with tag and reader of RFID as an instrument for information sharing activities. Second, the ERP application was developed with Microsoft Access 2003 and Borland Delphi 7.0 for describing major business activities that occurred in the manufacturer-distributors-retailers. Third, the integrator was developed consists of user interface design and practice modules of dynamic learning media that can bee used as learning media in study of SCM.

4. THE MODEL OF SCM NETWORK DISTRIBUTION

Concept that bases the scenario of SC distribution Network is a need to develop an optimal supply chain network configuration model to be able to provide products in the right quantity, the right specification, and the right time to consumers but the total cost incurred is minimal. SC Network Model is used to describe the activity of distribution based on SC Collaboration scenarios on Business Process Model Proposed. On the development of the SCM Simulator, the SC Network that was developed consists of 1 manufacturer, 2 distributors, and 3 retailers as shown in Figure 2.

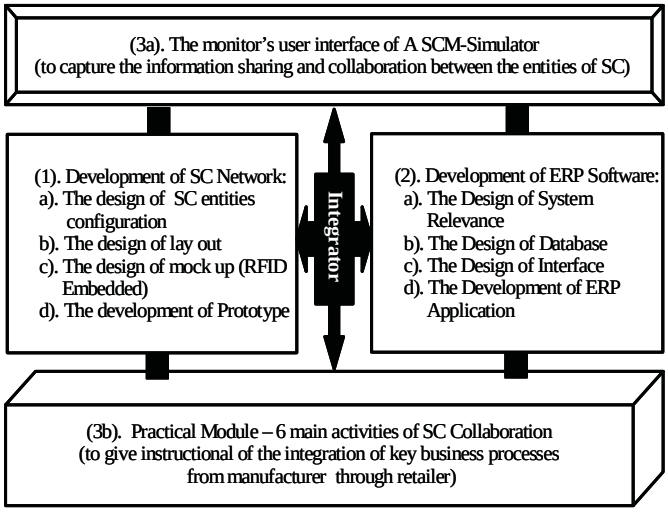


Figure 1: The development of a SCM-simulator

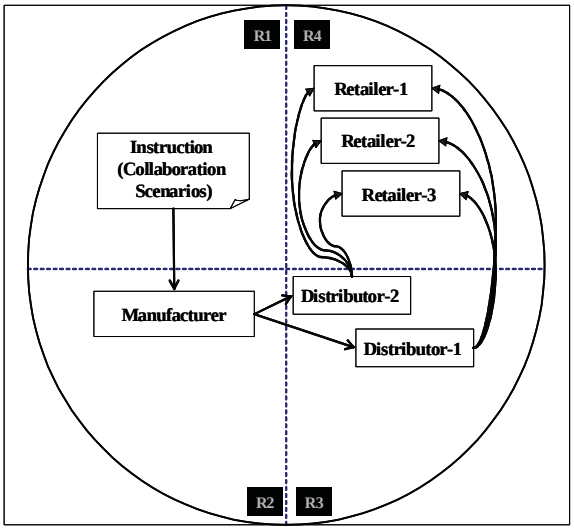


Figure 2: The Design of SC Network Distribution

The next is the facility lay out planning to design the mock-up of Network Distribution. It consists of miniature of object study, miniature of SC entities, miniature of truck as transportation mode, and miniature of truck tracks. Data of products structure is stored in RFID tag. RFID Reader is installed in the miniature of SC entities to read data in RFID tag based on the scenarios of the SC Collaboration in the

Business Process Model Proposed. The mock-up of distribution network is made of truck toys, ivory paper, plywood, and wood. Figure 3 shows example of tag and reader. Figure 4 shows the mock-up design of distribution network.

Figure 3: Example of tag and reader

Figure 4: The mock-up design

4.2. The Design of Business Process Collaboration

Considering that the scope of business activities in a collaborative SC is very broad, so the focus of this SCM-Simulator is the activities of tactical plan and operational routines mentioned in Chopra and Meindl (2004). The business activities simulated consist of 6 main business activities as follow:

i). order consolidation, order planning activity to minimize order cost and transportation cost from supplier to manufacturer,
ii). receiving/record keeping, product receiving activity from manufacturer to supplier,
iii). inventory control, inventory management to achieve the service level determined with minimum cost,
iv). coordination distribution, distribution planning activity to minimize transportation cost from distributor to retailers,
v). freight consolidation, delivery planning activity to minimize transportation cost from supplier to retailers, and
vi). Vehicle routing /scheduling, product handling activity to minimize transportation cost from supplier to retailers, so it needs route and schedule arrangement.

Interaction between manufacturer-retailers in the six business activities based on the distribution of the product family of Air Minum Dalam Kemasan - AMDK - (Bottled Drinking Water) as mentioned in Hisjam *et al.* (2008). AMDK business model is used as a reference of entities in manufacturer. Then, business model developed by creating collaboration in doing business processes between distributors and retailers entities. Figure 5. shows proposed business process to ease in designing the system.

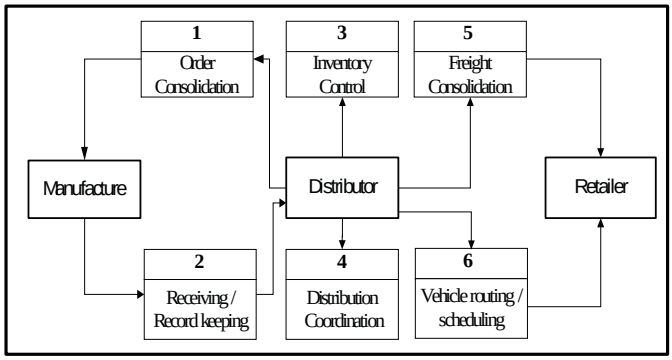


Figure 5: Proposed Business Process Model

4.3. The Framework of an SCM-Simulator

Dynamic-physical model and application program are integrated a miniature simulator. The integration considers facility layout of miniature object study, software and integrator. Laboratory of Logistics System and Business, Department of Industrial Engineering, Sebelas Maret University, has built a prototype of an SCM-Simulator (mock-up dimensions: 120 cms x 90 cms) and the Framework of an SCM-Simulator shows in Figure 6.

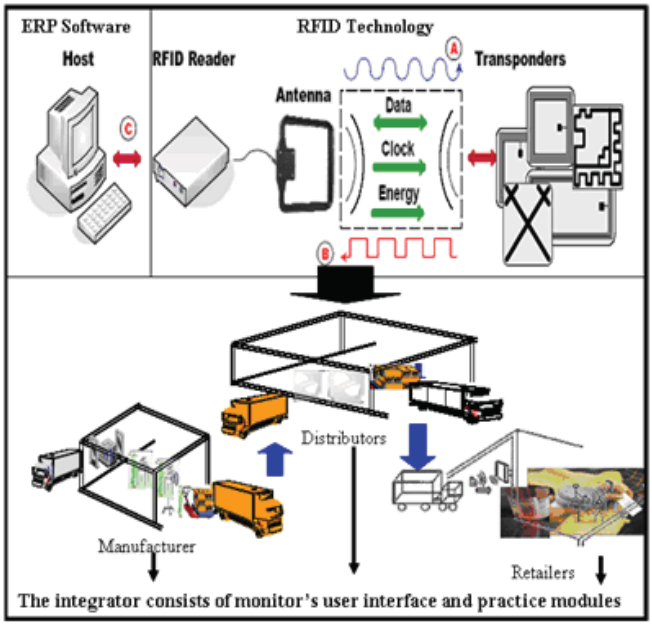


Figure 6: The Framework of A SCM-Simulator

5. THE DESIGNING OF ERP APPLICATION

In this step, we modeled the business processes using DFD because DFD is one of the most popular methods for functional modeling approach. The approach was chosen because the nature of the organization which is developed based on functionalities that performed by each entities. We used DFD to model them in level 0 and in level 1 using 4 diagrams. Based on the DFD, we designed the information system. Figure 7 and 8 shows the example of DFD level 0 and level 1 respectively.

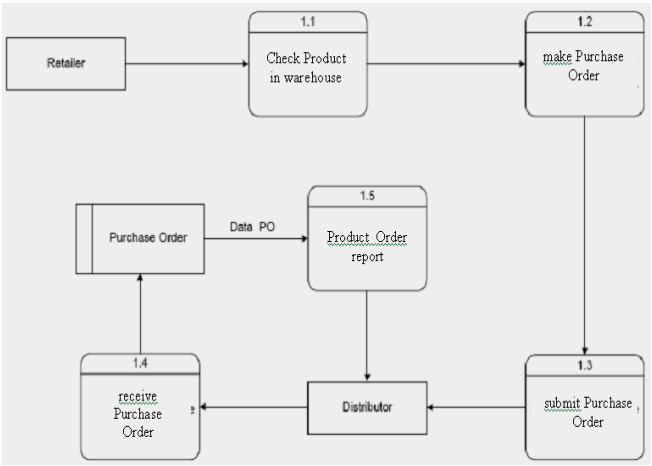
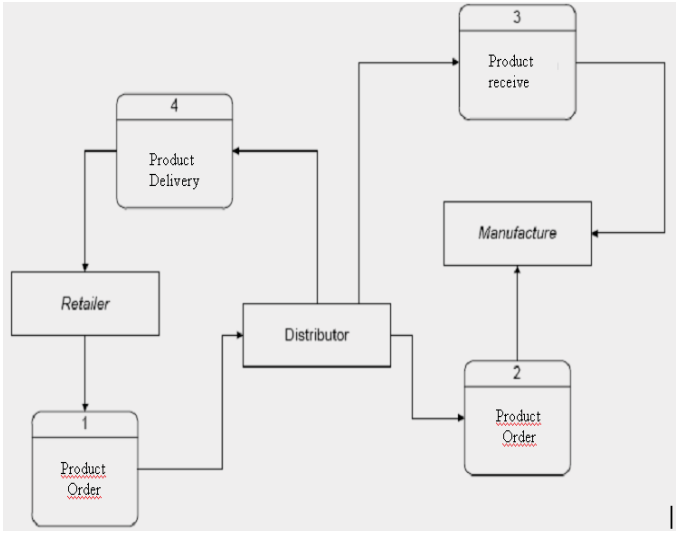


Figure 7: level O DFD, Distribution system



5.1. Database

We use RDBMS (Relational Database Management System) concept to support the business processes. This concept chosen because it is familiar to software developers and there are many application exist, include open source applications. Based on the DFD developed of each module, we design tables needed in database and after normalization process we need 9 tables and the table relation showed in Figure 9.

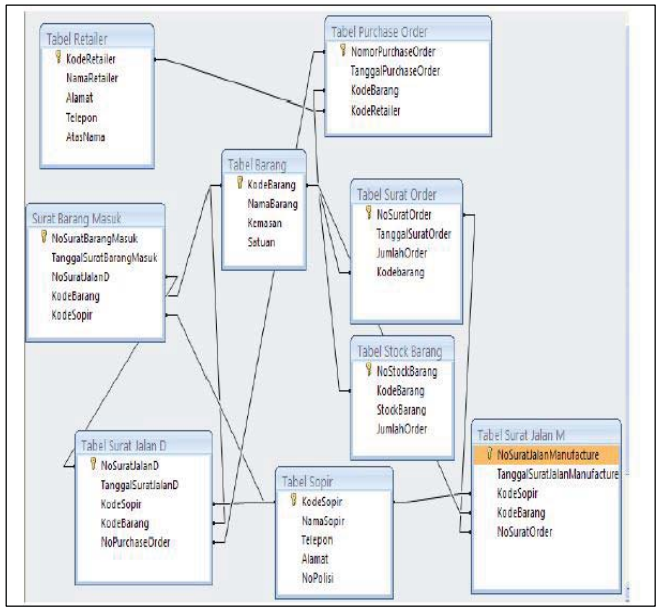


Figure 9: Table Relation

5.1 User Interface

User interface is designed to ease user to interact with the information system. The user interface is written in Bahasa Indonesia, because the users are Indonesian. The user interfaces designed are 4 forms for master data and 6 forms for transaction data; 4 documents and 5 reports. The outputs of user interface are in monitor screen and in printer. Figure 10 to 12 are examples of user interface.

5.2 Validation

The aim of validation is to ensure that the information system can perform as it should be. The validation was conducted using dummy data. The information system designed should be able to: (i) ease data management, (ii). ease document making and control, and (iii). support the communication between SC entities. This validation was performed to know whether the information system designed is useful to support the communication between SC entities. The results of validation was that the information system can achieve the aim of designing the information system.

6. CONCLUSION

The simulator model of SC network distribution presented reveals a new dimension of industrial engineering learning media. The simulator model of SC can be used as a dynamic-learning tool to explain college students about phenomena of information sharing and collaboration between the entities of SC through learning process in class and in laboratory practice. The interaction is the tool key feature of SCM-Simulator and consists of three components, that are ERP Software, Mock-up with RFID and Practice-Modules.

This dynamic-learning tool can be used to improve learning abilities of IE graduates, especially abilities to identify, formulate, and solve the activities of tactical plan and operational routines of SCM's entities. The simulator model designed gives beneficial for both students and tutors although it was designed for limited scale laboratory study of simple objects. Furthermore, The simulator model of SCM designed has to be improved to increase the capability to handle more complicated objects and more business activities.

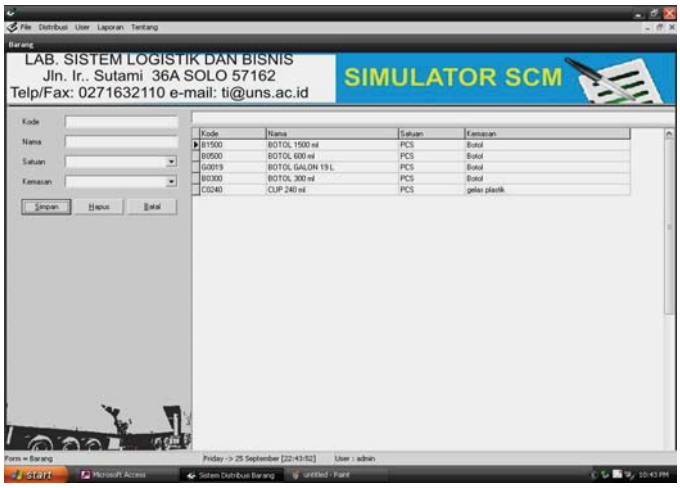


Figure 10: User Interface sample of a form, a product form

Figure 11: User Interface sample of a document transaction, a deliver letter document

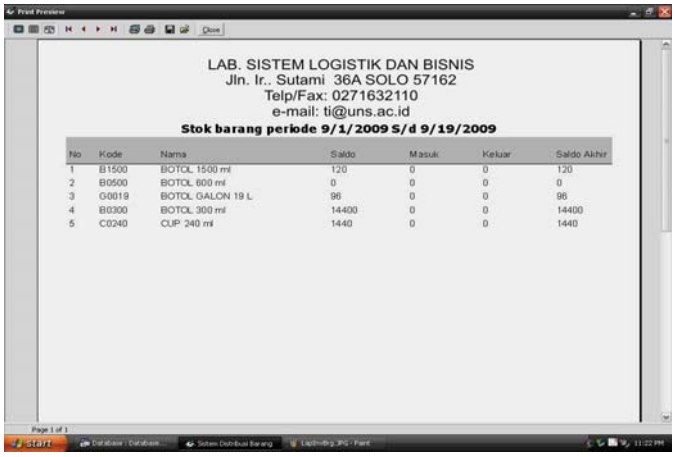


Figure 12: User Interface sample of a report, an inventory report

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