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Integrating Case-based reasoning to enhance performance of E-supply chain management system

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Abstract- **The cost collaborative management of supply chain is a new topic which integrates three fields: cost management, intelligent application, supply chain management, and develops one of the most important tools on how to apply multi-agents and case-based reasoning to the improvement of cost collaborative management. This study has two objectives: one is to develop the multi-agents system for CCM; the other is to construct a novel framework model of cost collaborative management in supply chain based on the application of case-based reasoning. More specifically, this paper develops a new method–the four steps for CCM, in order to improve the competitive capacity and to solve some current problems in the cost management of supply chain.**

Keywords— **Case-based reasoning to enhance performance of E-supply chain management system.**

I. INTRODUCTION

Supply chain is a series of business processes in which products or services are produced and delivered to customers through value adding activities implemented by involved parties. In a manufacturing supply chain, the value. adding activities mainly include product development, product design, raw materials supply, manufacturing the product, product packaging, delivery to customers, and post sale services. Supply chain management for a manufacturing company refers to incorporating its manufacturing process to all value-adding activities implemented by parties who add values to its final products. The term, supply chain, is a simplified description for vertically related business processes. Nowadays, it is more frequently referred as supply networks or supply chain networks because a company is likely to be involved in more than one supply chain and the related companies form business networks.

Since information technology became an enabler of improving business processes, supply chain management has gained tremendous benefits from applying ICT to various aspects of its tasks. IT application moves from data management to control automation, and then moves to enterprise integration.

Supply chains have advanced the last two decades with improved efficiency, agility and accuracy. However, it was only at the time when the Internet technology became a practical means of information exchange in industries, that supply chain management started changing its way of allocating and controlling resources across organization boundaries. When business activities of a company are electronically incorporated in value-adding processes throughout the supply chain, e-supply chain management becomes a new term that distinguishes itself by Internet-supported, net-centric and real-time features from traditional supply chain management. In this chapter, principles, methodologies and examples of esupply chain management will be discussed in the following sections.

II. E-SUPPLY CHAIN MANAGEMENT

The fundamental challenge for supply chain management is how to efficiently integrate and optimize supply chain operations with dispersed marketplaces and characteristic demands using the latest advances in information technology. eBusiness using Internet technology to facilitate information exchange and communication in business networks has emerged as an innovative approach further exploring value-adding opportunities in supply chains. The e-business approach plans and executes front-end and back-end operations in a supply chain using Web-based applications [1]. Incorporating e-business approach in supply chain management has been proved as a competitive method for increasing values to be added and improving process visibility, agility, speed, efficiency, and customer satisfaction. e-Supply chain refers to the business activities that incorporate e-business approaches into supply chain processes. e-Supply chain management involves applying e-business technologies to assist and optimize value-adding activities in supply chains. A more detailed definition of e-supply chain management can be found in the description of Norris et al. [2]: “Electronic supply chain management (e-SCM) is the collaborative use of technology to enhance business-to-business processes and improve speed, agility, real-time control, and customer satisfaction. Not about technology change alone, e-SCM is about culture change and changes in management policy, performance metrics, business processes, and organizational structures across the supply chain.” A key feature of e-business equipped supply chain management is networkcentric. This focuses on connectivity, co-operation, co-ordination and information transparency. Networked supply chain partners share information, knowledge and other resources in real time. The networked relationships change the traditional supply chain information flows from linear transmission to end-toend connections, i.e. information can be transferred directly from any partner of the supply chain to another partner without distortion and delay. Figure 1 shows a simplified traditional

supply chain structure and a networked supply chain structure.:

a) TYPE 1 –These types of selfish nodes forward the routing packets, but, don't forward the data messages intentionally for other nodes in the network.

b) TYPE 2 –These selfish nodes neither forward data packets nor forward the routing packets, or modify the Route Request and Reply packets by changing the TTL value to smallest possible value.

c) TYPE 3 –These selfish nodes change their behaviour dynamically by dropping packets based on its residual energy.

d) TYPE 4 –These selfish nodes forward the routing messages with a delay near the upper limit of timeout change in order to avoid being the active route member for others.

If intermediate nodes act as non-cooperative nodes (selfish nodes) and refuse to forward packets, the communication beyond radio range is not possible. Over the course of time, the selfish activities of such nodes may leads to significantly decrease in the performance of the network.

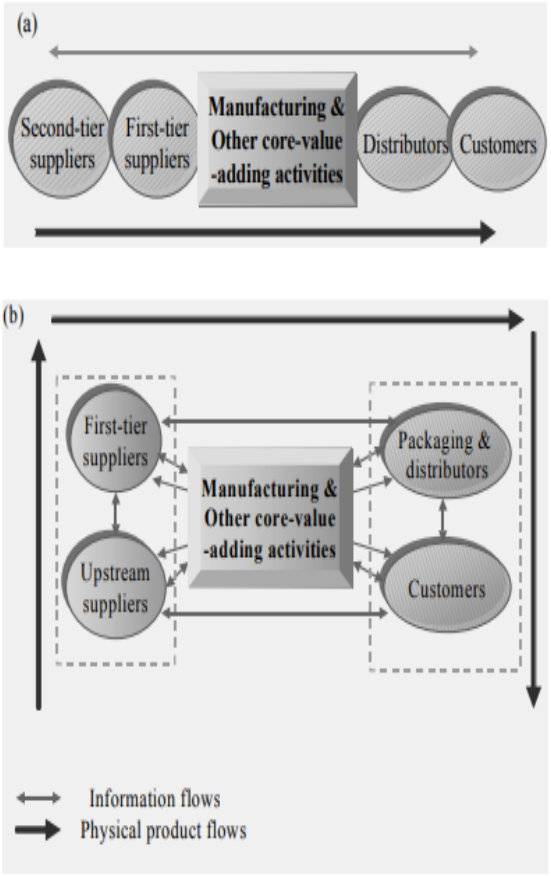

Figure 1: (a) Traditional supply chain structure. (b) Networked supply chain structure

Related Work

The supply chain strategy has great impact on the whole supply chain system performance. The supply chain is not just a process of conversion of raw materials to end users' products. Hence there is a lot of work done in this fi eld. Matthias Schnetzler (2004) discussed about the implementation of business strategy that was considered as the mandatory element for the success of the business. In the development of the supply chain strategy, the facts of fundamental decisions & objectives were emphasized. The whole strategy was implemented through repetitive development of strategies at the sublevels. Chan(2002) proposed fi ve models for supply chain system. These models were divided into 3 categories such as interorganizational, network and regional clustering supply chain. He has also introduced SIMPROCESS simulation tool that evaluated the performance of the supply chain system. Udin(2008) developed the knowledge-based collaborative supply chain Management. The concepts of Knowledge Based, GAP analysis and AHP approach were utilized to intend this system. He used the knowledgebased system to hold all information gathered from customers. To outline the dissimilarity among present & past standing of the fi rm the GAP analysis was being applied in this framework. Yuhua(2011) discussed the causes of instability of pear supply chain system. He emphasized on the information system as the week information system & inaccurate market demand caused the instability of pear. To strength the stability of pear supply chain system he suggested various factors such as common logistic distribution center. Wang (2007) developed the case-based conceptual model for assisting process of supply chain strategy expansion in small & medium-scaled enterprises. This model enhanced decision-making between strategic choices in process of supply chain management (SCM). Liya(2010) integrated the fuzzy reasoning with casebased reasoning to evaluate the risks in military supply chains. In the military supply chain, the main aim was to fulfi ll the military need. The cases were represented with the help of fuzzy logic concept. On receiving the new problem, the similarity was determined by using fuzzy similarity mechanism. Keramati(2011) proposed knowledge based framework for analysing and improving the capabilities of supply chain models. For simulation of business process, this framework used meta-interpreter and workflow engine to understand business scenarios. This framework used Fundamental Business Process Modeling Language(FBPML) which had capabilities of modeling the commerce procedure. All these major finding showed that the artificial intelligence approaches are extremely constructive in the analysis of the supply chain management performance. Hence in forthcoming section of this paper, the case-based reasoning is being applied to evaluate the strategy of the supply chain management system.

III. CASE-BASED REASONING

The case-based reasoning is one of the most shining fi elds in the artifi cial intelligence. It provides the way of automating the human thinking. According to Douglas Adams "Human beings, who are almost unique in having the ability to learn from the experience of others, are also remarkable for their apparent disinclination to do so". Hence the experience

is the valuable fact & can be used in various manners. There exists various real time example in which many problems are being solved with past experiences i.e. physician, fi nancial consultant & drilling engineer. If someone wants to modulate the human reasoning then it is necessary to emphasis on the utilization of past experiences. The case-based reasoning is more appropriate preference for these situations. The case-based reasoning is the problem-solving approach which solves the new problem by searching the similar solutions among stored past problems solutions. It also investigates the proposed solution according to the particular problem's constraints.

All information about the solution of past problems is stored in case form. The upcoming problem is considered as new case containing all information regarding upcoming problem. The case-based reasoning problem solving cycle is divided into 4 phases as given below:

- Retrieve phase: The similar cases are selected from case base regarding the new problem.
- Reuse phase: The knowledge of selected cases is utilized to build proposed case.
- Revise phase: The proposed case is verified if it fulfil the all constraints of new problem. If not, then it is modified to fulfil all constraints of the problem.
- Retain phase: The modified case is stored in the case base for future use (Aamodt and Plaza, 1994).

The figure II demonstrates the 4 REs phases of case-based reasoning cycle. In figure II, the cases are represented with help of rectangle shape with labelled its types. The figure II is given as below:

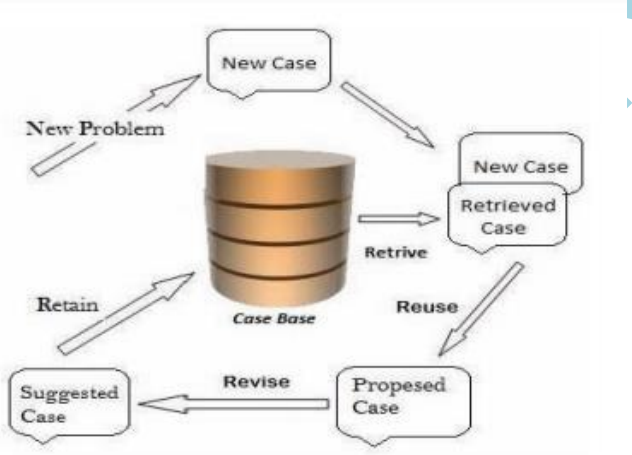

Figure II: Case-based reasoning cycle (Aamodt and Plaza, 1994).

IV. INTEGRATION

This research considers a supply chain consisting of retailers, manufacturers and suppliers. A customer visits a retailer and purchases the product if it is in stock. If the customer demand cannot be met by the retailer, it is ordered from a manufacturer and backlogged. The manufacturer produces products by assembling components from a supplier. The manufacturer receives product orders from the retailer and places component orders to the supplier. The supplier produces components and supplies them to the manufacturer. The supply chain incurs linear holding costs and linear backorder costs at each stage. The goal of the retailer is to maximize profits by minimizing stockouts and inventory costs. The manufacturer pursues profit maximization through the minimization of inventory costs and efficient management of manufacturing and procurement processes. The supplier is interested in maximizing profits by maintaining low turnaround times and low inventory. The present research examines two levels of collaboration situations among partners in the supply chain. In the first situation, the partners have a low level of collaboration because they maintain an arms-length relationship. They collaborate minimally by exchanging order information and pursuing their own goals individually. In the second situation, the partners have a strategic partnership and collaborate intensely. They pursue a global goal for the entire supply chain and share extensive information beyond the transactional level. We call the first situation, the Autonomy Level of collaboration, and the second, the Collaboration Level. The overall framework of the system is presented in Figure 2. There are three distinct components in the framework: agent-based web services, coordination and service ontologies, and the web service directory (UDDI). We assume that only retailers, manufacturers and suppliers exist in the supply chain. The retailer agent (RAgent), the manufacturer agent (M-Agent), and the supplier agent (S-Agent) model the retailer, the manufacturer and the supplier, respectively. We also introduce a coordinator agent for a supply chain (MACESCM). This coordinator agent manages more strategic collaboration among the agents. As discussed earlier, the introduction of the MACESCM is consistent with prior literature that describes the advantages of having a separate collaboration engine in addition to an optimization engine locally. Kwon and Lee [18] used a coordinator agent to collaborate with marketing and production departments in a manufacturing firm. We extend their idea to the coordination problem in a supply chain.

V. CONCLUSION

We reviewed the importance of supply chain models as a valuable, rare, inimitable, non-substitutable, and heterogeneous resource that leads to a competitive advantage to the firms in a supply chain. We also considered the advantages and disadvantages of supply chain models based on optimization methods and multiagent and CBR. While optimization models are good at providing solutions with precision, it takes time and effort to build quality models and a supporting database. Furthermore, it is getting harder to build the models as the problem domain expands. Although multi-agent and CBR based models provide near-optimal solutions, less effort is required to build the models which can be used with less expertise. This approach is more amenable to model complexities caused by the expansion of the problem domain. CBR can accommodate additional problem dimensions and multi-agent can address collaboration and

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