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Knowledge Sharing in Collaborative Commerce: Its Characteristics, Research Framework and Process

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Abstract

C-Commerce (Collaborative Commerce) is the new generation of business pattern. In C-Commerce, Enterprises need to collaborate closely with each other, the basis of which is mutual understanding and knowledge sharing. The characteristics and requirements of knowledge sharing in C-Commerce are: complex, open and prolific. This article developed a knowledge-sharing framework based on semantic web and the associated process of knowledge sharing

Keywords: C-Commerce, Knowledge Sharing, Semantic Web, Ontology

1. Introduction

C-Commerce refers to the use of digital technologies that enable companies to collaboratively plan, design, develop, manage and research products, services, and innovative EC applications (Turban and King, 2003). In 1999, Gartner Group (Stamford, 1999) raised the concept of C-Commerce and felt that C-Commerce could be the new generation of business pattern as well as a trend of E-commerce development in the future. In 2000, several reports on C-Commerce were published by leading consulting companies, such as Morgan Stanly (Phillips and Meeker, 2000), IDC (Mahowald and Levitt, 2000) and PriceWaterHouse (PricewaterhouseCoopers, 2003), followed by various C-Commerce solutions from world's leading IT companies, like IBM, SAP, Oracle and HP.

Due to increasing global competition, shorter product life cycle, increasing product variety and higher customer expectations, business enterprises today are required to develop their inter-organizational collaboration network tightly and to shift their business focus from mass production to consumer-focused mass customization. C-Commerce is such a strategy that fully utilizes Web technology to enhance enterprises' ability of inter-organizational collaboration on product design, production, sales, marketing and customer relation management. As a result, enterprises can provide better customer service, improve flexibility and enhance competitive power. Gartner Group and IDC forecasted that most of B2B (business-to-business) E-Commerce would follow C-Commerce model in the future (Mahowald and Levitt, 2000; Bond, 2000) and believed C-Commerce was a breakthrough in E-Commerce development. For example, Group Dekko, a collection of 12 independently run companies, discovered the power of C-Commerce by installing an Internet-based application that allowed its customers and suppliers to work from the same set of product-related data to ensure product quality in a collaborative network (Hill and Voeller, 2001).

C-Commerce is an inter-organizational collaboration that requires a close understanding and knowledge sharing among enterprises. On this topic, Nayak et al. (2001) argued that a collaborative environment is essential for a successful dynamic e-Business and provided a Web-based infrastructure for it. Fairchild and Peterson (2003) examined e-business infrastructures of electronic markets and electronic networks for C-Commerce in Financial Services. Morris (2002) stated the importance of timing and collaboration standards. Thuraisingham et al. (2002) developed several models and architectures for C-Commerce and analyzed the role of knowledge management. By comparing the different notion between E-Commerce and C-Commerce, Holsapple and Singh (2000) synthesized an integrated definition of e-business, advanced a knowledge-management view and recognized e-business as being based on e-knowledge. Although previous research distinguished the advance of C-Commerce from E-Commerce and some of them further discovered the importance of knowledge management in C-Commerce, they did not provide any applied solutions to manage and share knowledge effectively in a dynamic and cross-organizational C-Commerce environment. In this paper, we analyzed the characteristics and requirements of knowledge sharing in C-Commerce. Then we develop a knowledge-sharing framework based on modern information technologies and describe the associated process of knowledge sharing.

2. Knowledge Sharing in C-Commerce

There is not an authoritative or unified definition of C-Commerce. Various researchers explained C-Commerce from different perspectives. For example, Gartner Group who firstly raised the concept of C-Commerce defined it as a new business model based on Internet technologies that allowed collaboration occurring intra- and inter- organizationally, or among participants in a trading community that could cover an industry, a branch of the industry or a specific supply chain. In August 2001, IBM pointed out in her Redbook that B2B C-Commerce was not only based on finance and goods exchange but rather providing electronic collaboration across the whole value chain: from product design, development and manufacturing to sales, marketing and post sales (IBM, 2001). As a result, it added value to the B2B E-Commerce by integrating the whole value chain. META Group Inc categorized four types of C-Commerce, i.e. Design C-Commerce, Marketing/Selling C-Commerce, Buying C-Commerce, Planning/Forecasting C-Commerce. AMT (Li, 2001) thought that the difference between C-Commerce and traditional E-Commerce was that C-Commerce emphasized the electronic means supported by Internet that could collaborate and synchronize the product R&D, manufacturing, delivery, finance transaction and performance measuring for all parts in the value chain. Consequently, C-Commerce provided additional business value to the participants in the trading community. Furthermore, Morris (2002) listed several successful factors of C-Commerce, including an open business relationship in which data can be shared, the ability to operate flexible, a commitment to total quality and long-term business relationship, and shared team-working culture. From above definitions and discussion on C-Commerce, we can summarize several C-Commerce characteristics, shown as follows:

- Cross-organization integrated: C-Commerce emphasizes the flow integration across organizations, i.e. sharing key information resources and knowledge to correspond participants' actions and relationships, and facilitating collaborations among

- enterprises to achieve optimal benefit for the whole virtual alliance. C-Commerce enables enterprises to utilize allied resources to compete in the market.
- Virtual: Compared with traditional supply chain management and E-Commerce, C-Commerce emphasizes the concept of virtual alliance, i.e. enterprises form temporary alliance and electronically collaborate by sharing knowledge, technologies and information to accomplish a specific task.
 - Dynamic: C-Commerce emphasizes the dynamic integration among enterprises by in-time information exchange and real-time management. Therefore, advanced information technology on Internet is essential to support dynamic information sharing in C-Commerce.
 - Open: Because the alliance in C-Commerce is usually temporary, the collaboration rules should be open enough to quickly absorb new participants, to make new alliance and to share competitive advantages.
 - Comprehensive: Compared with supply chain management and E-Commerce that focuses on material exchange and information sharing, C-Commerce emphasizes comprehensive information collaboration at all levels among participants. By sharing knowledge and technology, C-Commerce raises the total competitive power for the alliance and brings it more benefit.

It is obvious that the core point in C-Commerce is the total collaboration among participating enterprises to accomplish collective targets. To achieve a satisfying collaboration, well understandings among participants enabled by sharing knowledge, technology and information is the foundation. For example, there is a need to understand specific trading partner attribute that are more likely to ensure successful C-Commerce (Angeles and Nath, 2003). However, the relationships among participants in C-Commerce may be long-term and stable, as well as short-term and temporary (AMT, 2002), which may bring barriers to knowledge sharing in collaboration. Compared with traditional knowledge sharing in an organization, the cross-function or cross-enterprise sharing mechanism in the C-Commerce environment becomes more complex, which may have following characteristics:

- Complex: C-Commerce covers wide range of fields, from R&D, marketing to customer service, each of which contains its own “know-how”. Furthermore, the field knowledge may be stored and expressed in different forms across enterprises. Therefore the knowledge sharing mechanism in the C-Commerce environment is expected to be flexible enough to support the variety of knowledge expression, knowledge storage, knowledge sharing and knowledge increment.
- Open: Because of the uncertainty of participants, the knowledge sharing mechanism in C-Commerce environment should allow enterprises dynamically entering and withdrawing the collaboration. In this way, different enterprises can quickly express, spread and obtain knowledge from a unique supporting platform.
- Value-added: Compared with intra-organizational knowledge sharing, the most significant characteristic of knowledge sharing in C-Commerce is its increment ability. A comprehensive collaboration should discover new knowledge by integrating and ratiocinating obtained knowledge. The effectiveness of managing and discovering knowledge in C-Commerce will return more profit to allied enterprises.

3. Knowledge Sharing Framework in C-Commerce

With rapid development of Internet and other information technology, many technologies that can support increasing enterprises collaboration activities, such as EAI (Enterprise Application Integration), XML (eXtensible Markup Language)-based data interchange, and Web Service (W3C, 2003), come into being and are transforming the nature of C-Commerce (Morris, 2002). Although these technologies are useful to intra- and inter- organizational communication and information interchange, they cannot effectively solve the problems of knowledge sharing among enterprises. One major reason is that they cannot provide functions of knowledge expression, knowledge query and semantic transfer among enterprises.

In 2001, Tim Berners-Lee, the inventor of WWW (World Wide Web), raised the concept of semantic web as the new generation of WWW. By assigning a clear and well definition to information, the semantic web is a worldwide mediate platform effective for information interchanging, sharing and obtaining (Berners-Lee et al., 2001). Now W3C (The World Wide Web Consortium) is promoting the technologies development in semantic web that contains two key technologies: One is RDF (Resource Description Framework) that is a general framework to describe the properties of Web resources and their associated value. The other is Ontology, a formal explicit specification of a shared conceptualization (Gruber, 1993), designed for use by applications that need to process the content of information instead of just presenting information to humans. These two technologies add structural and semantic information into the traditional Web document, such as HTML document, and make it possible for computers to automatically understand and handle information on Web.

In knowledge sharing, Ontology is a set of terminologies used by a group of common understanding. In particular, it can be a description of concepts and relations used by enterprises in their collaborative works. Currently Ontology is supported by XML DTD, XML Schema and RDF while DAML (DARPA Agent Markup Language) with OIL (Ontology Inference Layer) is the recommended language for semantic web (W3C, 1999; DARPA, 2003; Brickley, 2002).

To meet the need of knowledge sharing in C-Commerce, we developed a knowledge-sharing framework based on semantic web technologies, shown as figure 1. Each enterprise may have its internal knowledge and terminology set that are expressed by RDF and Ontology, respectively. RDF can refer the terminologies in Ontology as well as express and transfer the knowledge to share with participating enterprises in the same alliance.

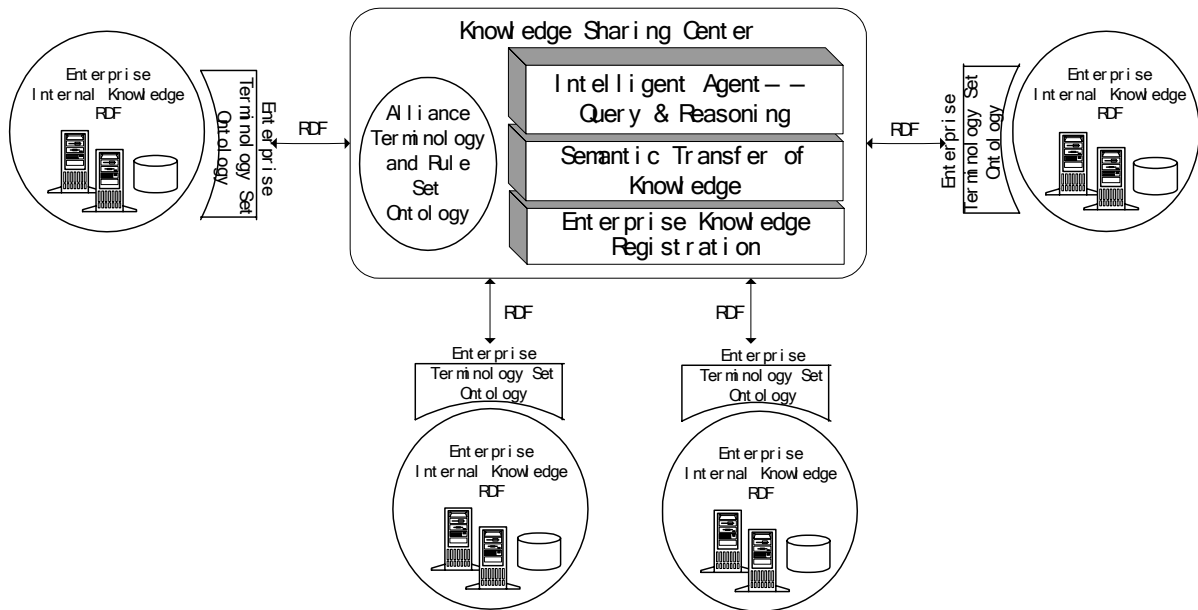


Figure1: Knowledge Sharing Framework in Collaborative Commerce

To share knowledge successfully and effectively, there are several considerations that may draw enterprises' attention. For security issue, sharable knowledge that is registered with the alliance should be stored inside the enterprise. Other enterprises and applications in C-Commerce can visit and use the registered knowledge through Internet by given access permissions. Enterprises can dynamically register new knowledge and allow new participants to registering their knowledge at any moment to meet the open requirement in C-Commerce.

Due to various backgrounds of participants in C-Commerce, the enterprise terminologies cannot be expected the same. Therefore we utilize Ontology technology to unify alliance' terminologies and to construct rules to associate terminologies used in the alliance with that used in particular enterprises. These rules indicate the one-to-many relations of terminologies between alliance and participating enterprises and form the important consortia-based standards (Morris, 2002) in C-Commerce. Based on enterprises' Ontology, alliance's Ontology and associated rules, semantic transfer model can automatically accomplish tasks like semantic transfer and content conformity to share knowledge among enterprises. Furthermore, participating enterprises can query and utilize shared knowledge in the alliance by using an intelligent agent model which is designed to understand queries from enterprises, collect RDF documents from all participants based on registration information, reason the knowledge from the associated rules in Ontology, pack up necessary knowledge in the form that the enterprise can understand and finally return it to the inquirer. It is clear that this framework fully utilizes the strong semantic support from Ontology and provides significant power of knowledge expressing, storing and communicating, which becomes a solid foundation for well knowledge sharing and value adding in C-Commerce.

4. Knowledge Sharing Process in C-Commerce

The knowledge sharing process among enterprises in the C-Commerce environment can be briefly described as follows: first, enterprises develop their internal knowledge expression system and maintain knowledge themselves. When collaborating with other participating

enterprises, they can release and accredit necessary knowledge to the alliance. Through query agent, knowledge reasoning and other applications, the knowledge can be fully shared and utilized in the alliance. Figure 2 exhibits the whole process of knowledge sharing among enterprises.

There are several steps in the knowledge sharing process in C-Commerce. First enterprises develop their internal knowledge expression mechanism and create a complete knowledge description system based on their Ontology. In a knowledge expression system, the terminologies used to describe the enterprise internal knowledge can be either a common set generally recognized in the whole industry or a specific set only available inside the enterprise. No matter how, this system defines a way to express knowledge inside a particular enterprise and forms the foundation for future knowledge sharing in C-Commerce.

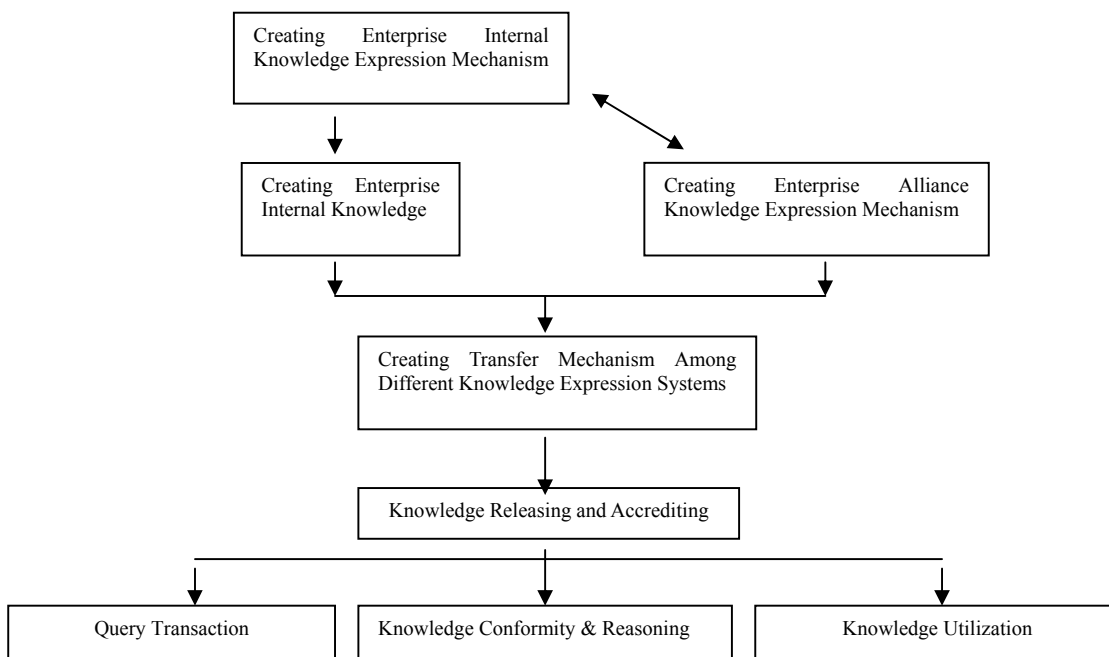


Figure2: Knowledge Sharing Process in Collaborative Commerce

The second step is to establish enterprise knowledge base. After defining Ontology, enterprises can use RDF to describe and record their information and knowledge. Together with Ontology, these RDF files comprise the enterprise knowledge base. This knowledge base contains enterprise’s comprehensive understanding and its unique value in the market that can be shared by functions inside the enterprise.

The third step is to develop knowledge expression mechanism for the alliance. To share knowledge among participants in the alliance, all enterprises should “speak the same language”, i.e. the alliance should apply a unified knowledge expression system. Otherwise, collaborative activities will be seriously hindered by the lack of a common language (Kumar and Zhao, 2002). This system can be developed and maintained by a third party, e.g. industrial association, other nonprofit organizations as well as industry leaders in the alliance. However, to be a wide

accepted Ontology in the alliance, this system should cover all general information and knowledge in the industry and be well consortia-based standardized (Morris, 2002). For example, HP released the open-source of its C-Commerce system, i.e. e-speaking, to the public in 2000 and passed its control over the system development to a nonprofit open-source governing council (Landry, 2000).

The fourth step is to develop a transfer mechanism among various knowledge expression systems. Due to different knowledge expression systems each enterprise may use, a dual-way transfer model that can translate between enterprise knowledge expression system and alliance system is essential in C-Commerce. By constructing relations between enterprise terminologies and alliance terminologies in the alliance's Ontology, the transfer model can utilize these relations to translate terminologies and forms the foundation of in-alliance knowledge sharing, semantic conformity, knowledge query and knowledge reasoning.

The fifth step is knowledge releasing and accrediting. When enterprises form an alliance to accomplish special tasks, they usually share knowledge with partners to improve their efficiency and competitive power. However, in knowledge sharing system, enterprises should always be able to control their knowledge, i.e. determining the content of shared knowledge and the objects to share. By registering with the knowledge-sharing center, enterprises inform the alliance of their sharable knowledge and access permissions that other enterprises are assigned to, while information and knowledge is still stored inside the enterprise.

The sixth step is query transaction. When alliance members seek domain knowledge in the field they are not familiar with, they can describe the query using the "language" in their own expression system and submit it to the knowledge-sharing center. When receiving the query, the center will translate the query into the unified expression in the alliance. Then the center searches for associated knowledge, determines knowledge locations, and extracts contents from enterprises based on the registered information.

The seventh step is knowledge reasoning and semantic conformity. The contents of knowledge extracted from various enterprises are usually described by different knowledge expression systems. Therefore, alliance' Ontology should be applied to convert terminologies into unified set and to conform the semantic meanings of knowledge. Furthermore, new knowledge can be reasoned out for the purpose of knowledge increment and knowledge innovation.

The final step is knowledge utilization. Because the knowledge from query and reasoning is described by the unified terminologies in the alliance, intelligent agent model should translate it into the "language" that particular enterprises can understand, i.e. using enterprise's expression system to describe the knowledge.

5. Conclusion

C-Commerce is an inter-organizational collaboration that requires a close understanding and knowledge sharing among enterprises. Although previous research distinguished the advance of C-Commerce from E-Commerce and discovered the importance of knowledge management in C-Commerce, they did not provide any applied solutions to manage and share knowledge effectively in a dynamic and cross-organizational C-Commerce environment. This paper studied

the characteristics of knowledge sharing in C-Commerce, developed a knowledge-sharing framework based on semantic web technologies, i.e. Ontology and RDF, and described the associated process of knowledge sharing in C-Commerce. The framework will facilitate knowledge sharing among enterprises in C-Commerce and can be widely applied in e-Marketplace, supply chain integration, virtual organizations and other business collaboration across organizations.

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