

Collaborative Commerce and Knowledge Management

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This paper describes collaborative commerce (c-commerce); it essentially combines e-commerce, knowledge management and collaboration to carry out transactions and other activities within and across organizations. We first discuss the building blocks for c-commerce. Then we describe models and federated architectures. Next we analyze the strategic role of knowledge management for c-commerce as well as discussing managerial and business implications. Finally, we provide directions for c-commerce. Copyright © 2002 John Wiley & Sons, Ltd.

INTRODUCTION

Three closely related information technology disciplines have emerged during the past decade. They are collaborative computing, knowledge management, and electronic commerce (e-commerce). Collaborative computing enables people, groups of individuals, and organizations to work together with one another in order to accomplish a task or a collection of tasks. These tasks could vary from participating in conferences, solving a specific problem, or working on the design of a system. With the advent of the web, it is now possible for organizations to effectively manage their knowledge and experiences. That is, knowledge management is about using knowledge as a resource for an organization and subsequently creating a knowledge organization with knowledge workers. Electronic commerce (e-commerce) is one of the fastest growing application area for the World Wide Web. Essentially, it is about carrying out transactions on the web such as buying and selling products, as well as carrying out various activities such as training, procurement, and supply chain management.

While the three disciplines have evolved somewhat independently over the past decade, they

have a lot to contribute to each other. Effective collaboration is key to knowledge management and good knowledge management practices are essential for a successful e-business organization. More recently, organizations are going beyond collaboration, knowledge management and e-commerce. These organizations are collaboratively carrying out transactions on the web and going beyond organizational boundaries. That is, the organizations are autonomous and yet cooperate with each other. This form of collaboration has come to be known as c-commerce (or collaborative commerce) (Chen, 2000). Essentially, organizations have to work across international boundaries, collaboratively carry out transactions, as well as share and collaborate on activities and projects. Such collaborations can span across not only organizations but also continents. The participants must be able to share information, but at the same time protect their privacy as well as sensitive information. Disparate heterogeneous information systems have to be integrated to form federations and subsequently work effectively within as well as across organizations for c-commerce.

This paper focuses on models and architectures for c-commerce, and then analyzes the role of knowledge management. In the next section we

first discuss the building blocks for c-commerce. Then in the third section we discuss business models for c-commerce and introduce an example, which we will use throughout the paper. In the fourth section we describe how c-commerce enables organizations to work across boundaries of various types. In particular, federated architectures for c-commerce will be discussed. The role of knowledge management will be stressed in the fifth section. We also briefly address business and managerial implications for knowledge management and c-commerce in this section. Finally we discuss the directions and challenges for c-commerce.

BUILDING BLOCKS FOR C-COMMERCE

The building blocks of c-commerce are essentially e-commerce, knowledge management and collaboration. This section discusses these building blocks.

E-business and e-commerce

By definition e-commerce involves carrying out commerce on the web, which includes buying and selling of products. The term e-business is about carrying out any business on the web and is broader than e-commerce. Various types of corporations are now in e-business, including corporations that provide consulting as well as solutions and products such as IBM, and smaller corporations such as the dot-com companies. Some of these smaller corporations can connect consumers with healthcare providers, lawyers, real estate agents and other professionals who provide services of various kinds. Consulting companies may come in and assess the state of a corporation's business practices and advise it on how to develop

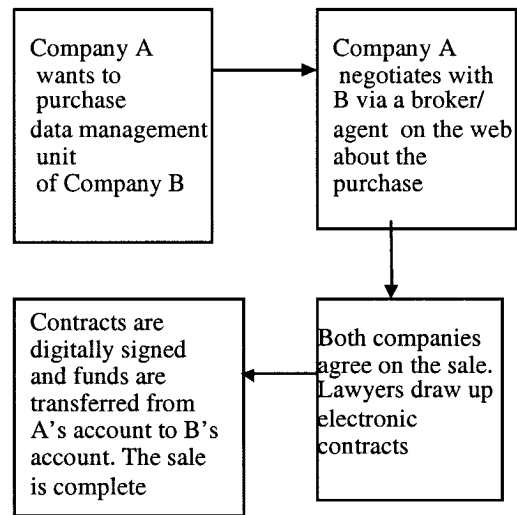


Figure 2 Business-to-business e-commerce

e-business solutions. One of the latest trends is to provide fully integrated enterprise resource management and business process reengineering capabilities on the web. A strong business component is essential for e-business. Technology will provide only the tools to make e-business more efficient. Various aspects of e-business are illustrated in Figure 1 (see also the discussion in Thuraisingham, 2000).

Two paradigms, which we can consider to be models for e-commerce, are emerging. They are business-to-business e-commerce and business-to-consumer e-commerce. As its name implies, business-to-business e-commerce is all about two businesses conducting transactions on the web (see Figure 2) (Tracy, 2000). We give some examples. Suppose Corporation A is an automobile manufacturer and needs microprocessors to be installed in its automobiles. It will then purchase the microprocessors from Corporation B who manufactures the microprocessors. Another example is

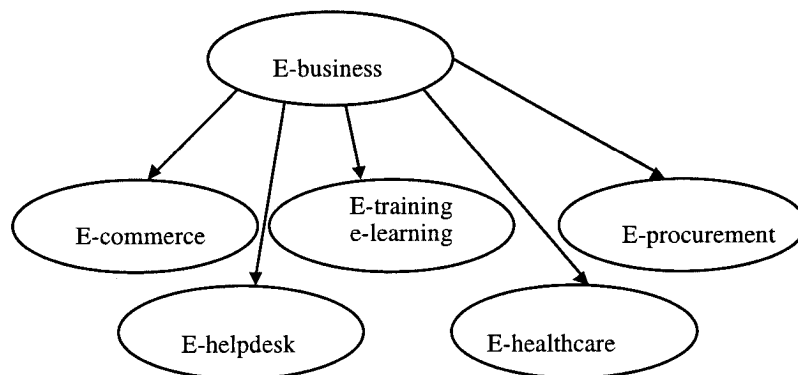


Figure 1 E-business and its components



when an individual purchases some goods, such as toys, from a toy manufacturer. This manufacturer then contacts a packaging company via the web to deliver the toys to the individual. The transaction between the manufacturer and the packaging company is a business-to-business transaction. Business-to-business e-commerce may also involve one business purchasing a unit of another business or the two businesses merging together. The main point is that such transactions have to be carried out on the web.

Business-to-consumer e-commerce is when a consumer such as a member of the mass population makes purchases on the web (see Figure 3). In the toy manufacturer example, the purchase between the individual and the toy manufacturer is a business-to-consumer transaction. Business-to-consumer e-commerce has grown tremendously during recent years. While computer hardware purchases still constitute the leading application for e-commerce transactions, purchasing toys, apparel, software, and even groceries via the web has also increased. But many experts believe that the real future will be in business-to-business transactions, as this will involve much greater amounts of transactions. Furthermore, for organizations to work across boundaries, we need effective business-to-business e-commerce. Accordingly, we focus on the latter segment in this paper.

Knowledge management

While e-business and e-commerce enable business transactions to be performed on the web, one needs effective knowledge management and collaboration techniques for organizations to work across organizational boundaries (Winch, 2000).

Knowledge management is the process of using knowledge as a resource to manage an organization. It could mean sharing expertise, developing a learning organization, teaching the staff, learning from experiences, as well as collaboration (Saunders, 2000). Knowledge management essentially changes the way an organization functions. Instead of competition, it promotes collaboration. This means managers have to motivate employees, to share ideas and collaborate, by giving awards and other incentives. Team spirit is essential for knowledge management. People are often threatened imparting knowledge to others as they feel their jobs may be on the line. They are reluctant to share their expertise. This type of behavior could vary from culture to culture. It is critical that managers eliminate this kind of behavior not by forcing the issue but by motivating and educating the staff in all the benefits that can occur with good knowledge management practices; this aspect becomes especially important when one is dealing with situations involving borders of different types.

In the collection of papers on knowledge management by Morey *et al.* (2001), knowledge management is divided into three areas as shown in Figure 4. These are strategies such as building a knowledge company and making the staff knowledge workers; processes such as techniques for knowledge management including developing a method to share documents and tools; and metrics that measure the effectiveness of knowledge management. Organizational behavior and team dynamics play major roles in knowledge management.

While knowledge management practices have existed for many years, the web has really promoted

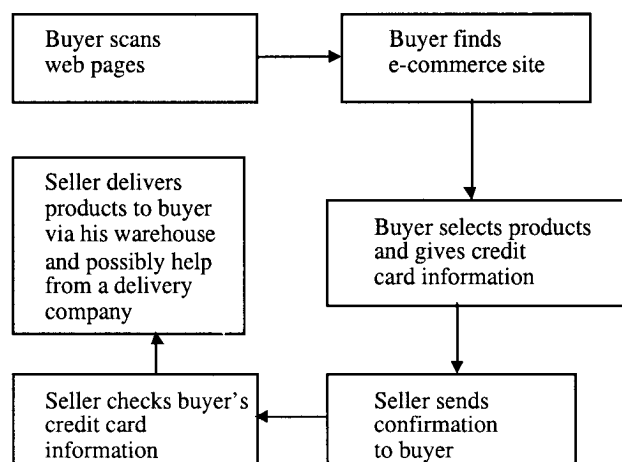


Figure 3 Business-to-consumer e-commerce



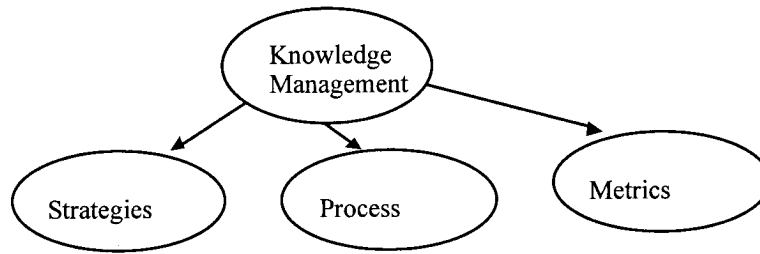


Figure 4 Knowledge management components

knowledge management. Many corporations now have an Intranet, which is a very powerful knowledge management tool. Thousands of employees are connected through the web in an organization. Large corporations have sites all over the world and employees are becoming well connected with one another. Email can be regarded to be one of the early knowledge management tools. Now there are many tools such as search engines and e-commerce tools. With the proliferation of web data management and e-commerce tools, knowledge management will become an essential part of the web and e-commerce. Figure 5 illustrates the knowledge management activities on the web such as creating web pages, building e-commerce sites, sending email, and collecting metrics on web usage.

Collaboration

While e-commerce enables organizations to carry out transactions, and knowledge management captures the knowledge of an organization, we still need a third component to enable organizations to work together and yet be autonomous. That third component is collaboration. As mentioned above, collaborative computing enables people, groups of individuals, and organizations to work together to accomplish a task or a collection of tasks. These tasks could vary from

participating in conferences, solving a specific problem, or working on the design of a system. Specific contributions to collaborative computing include the development of team workstations (where groupware creates a shared workspace supporting dynamic collaboration in a work group), multimedia communication systems supporting distributed workgroups, and collaborative computing systems supporting cooperation in the design of an entity (such as an electrical or mechanical system). Several technologies including multimedia, artificial intelligence, networking and distributed processing, and database systems as well as several diverse disciplines such as organizational behavior and human computer interaction have contributed significantly towards the growth of collaborative computing.

While early collaborative computing systems focussed on small teams working together, collaboration has taken on a different dimension with the advent of the web. Organizations can now collaborate across international boundaries, without making any a priori arrangements, and perform mutual and joint transactions in a near-real-time basis (Caldwell *et al.*, 2000).

Putting the building blocks together

One of the key aspects here is how does e-commerce differ from c-commerce and what is the role of

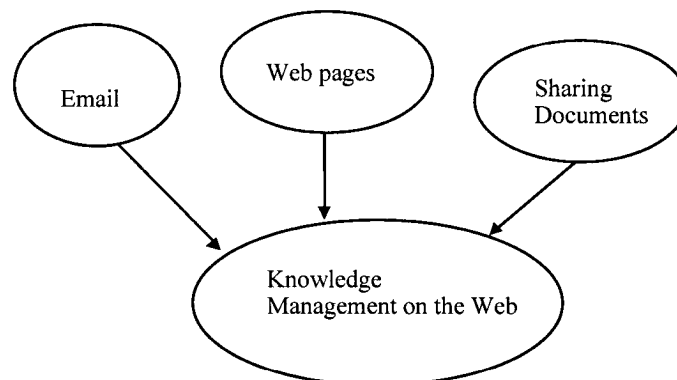


Figure 5 Knowledge management on the web



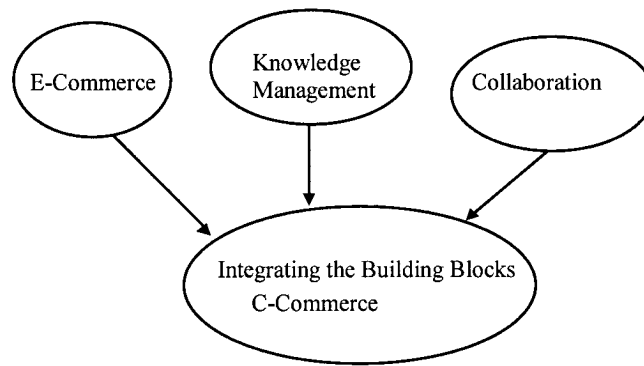


Figure 6 Putting the building blocks together

knowledge management in c-commerce? While e-commerce may assume an environment where sellers sell their products on the web while buyers purchase these products, c-commerce assumes an environment where organizations have to collaborate with each other to carry out transactions. Web collaboration is an essential part of c-commerce. For example, groups of designers and manufacturers have to collaborate with one another in order to come up with a new design or product. C-commerce assumes that organizations are autonomous but collaborating entities that carry out business with each other.

Knowledge management plays a key role in c-commerce. It captures the best practices and experiences from previous transactions and makes use of them effectively to carry out c-commerce. We will elaborate on the role of knowledge

management later. Figure 6 illustrates the integration of the building blocks for c-commerce. More details on the building blocks can be found in Flynn (2000), Ginsburg and Kambil (1999), Malhotra (2000), Rehfeldt and Turowski (2000) and Scott (2001).

MODELS FOR C-COMMERCE

In order for organizations to carry out c-commerce collaboratively, one needs suitable business models. Seller to buyer relationships in c-commerce can take one of many forms. Figure 7 attempts to illustrate this. In a tightly coupled model, one party dominates the business practices and the others conform to them. Because the dominating party is so large, it is either the dominant seller or the

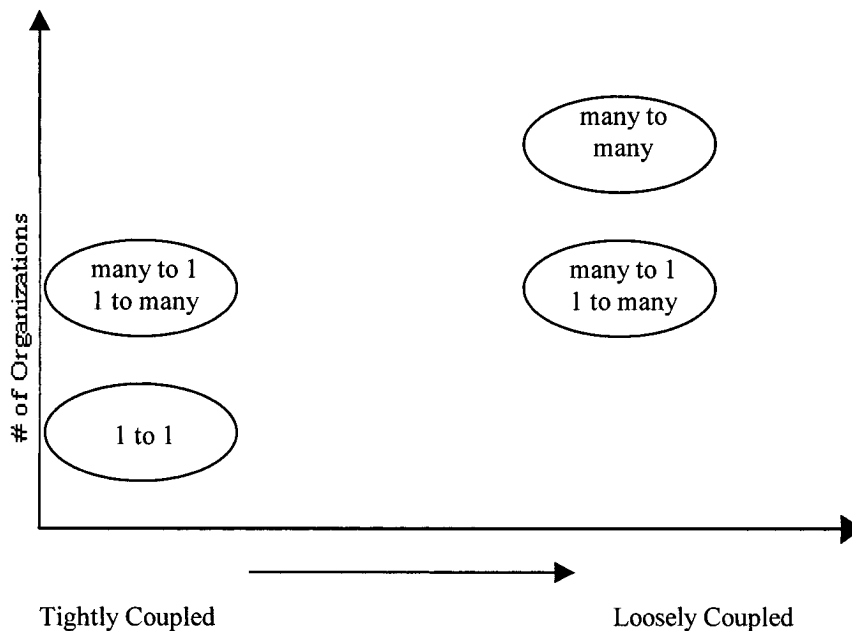


Figure 7 Models for c-commerce



dominant buyer in the market. Therefore, it has the power to dictate what system will be used to conduct the transaction. Tightly coupled relationships can take the form of a one-to-one, a many-to-one, or one-to-many relationship. In a one-to-one relationship between buyer and seller, both parties are the primary customer or supplier for each other. However, either the supplier or the customer will dominate the relationship and the other will conform to the dominant's standards. In a many-to-one or one-to-many relationships, one larger supplier or customer deals with many other smaller businesses or consumers, which all conform to the larger organization's business practices.

Conversely, in a loosely coupled model, no party has the power to dictate the system used to conduct transactions. In a loosely coupled environment a company does not have one main supplier or customer, instead it may deal with whichever company it pleases, taking into account such things as price, value, and reputation. In order to complete the transaction, the companies must either constantly be changing their business practices to adapt to new partners or there must be some sort of mitigation system which can resolve differences between partners. This would allow a business to form a relationship with another with minimal effort or changes to their e-commerce infrastructure. However, the forming of such a mitigation system is not trivial and may require serious investment.

In order to illustrate the concepts in the subsequent sections, let us consider the following example. Suppose an organization AUTO is an automobile manufacture and it essentially assembles the parts together to assemble an automobile. Some of the parts such as the engine may be manufactured in-house while other parts such as tires may be purchased from other organizations such as PART1 and PART2. Suppose the consumers are CON1 and CON2. CON1 and CON2 place orders to AUTO. AUTO then has to order its parts from PART1 and PART2. These parts have to arrive in a timely manner. Then AUTO puts together the parts and assembles the automobiles for CON1 and CON2. In this case CON1 and CON2 are the consumers of AUTO. AUTO is the consumer of PART1 and PART2. However, to carry out the orders by CON1 and CON2, the three organizations AUTO, PART1 and PART2 have to collaborate with one another.

In certain cases, CON1 and CON2 may also have to collaborate with AUTO to ensure that the parts are delivered according to the specifications. We illustrate this example in Figure 8. In this example, one could have both loose coupling and tighter coupling models. For example, PART1 may be tightly coupled with AUTO and this could mean that PART1's only customer is AUTO. PART2 may be loosely coupled with AUTO. In this case, AUTO cannot dictate to PART2 and PART2 can have the freedom to supply parts not only to AUTO but also to another manufacturer AUTO2.

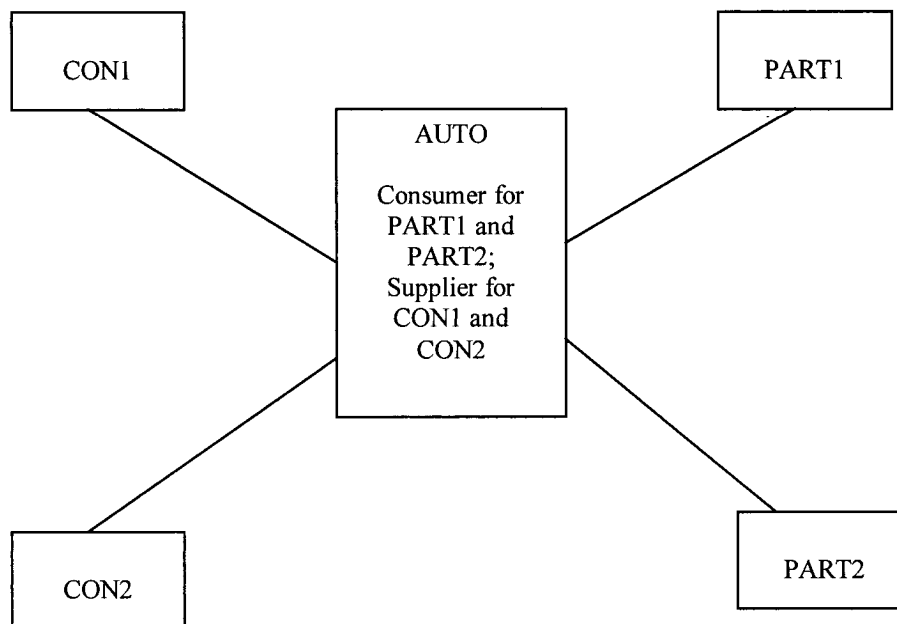


Figure 8 C-commerce example

FEDERATED ARCHITECTURES FOR C-COMMERCE

In a business-to-business c-commerce environment, many corporations may have to collaborate with each other (Shim *et al.*, 2000). The various c-commerce sites have to form federations so that the organizations can collaborate on transactions and projects and yet maintain their autonomy. That is, a collection of cooperating c-commerce servers, which are possibly autonomous, may form a federation. The intent is for an organization to continue its local operation and at the same time

participate in a federation if it wants to. Architecture for a federated environment to carry out c-commerce is illustrated in Figure 9. In this architecture, the e-commerce sites are connected through an EFDP (e-federated distributed processor). The various e-commerce servers form a federation and have to cooperate with one another. They also have to maintain some kind of autonomy. The administrator of an e-commerce site would want to have as much autonomy as possible to carry out intra-organizational operations. At the same time he would want to carry out as many inter-organizational transactions as

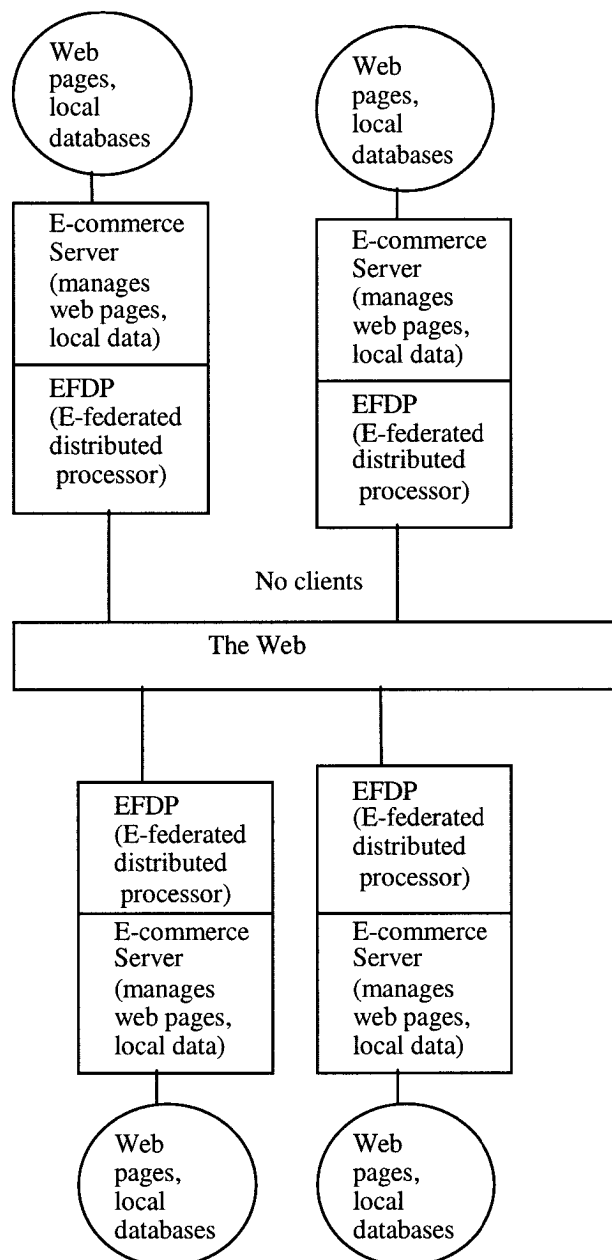


Figure 9 Federated architecture for c-commerce



possible. That is, the administrators of the different c-e-commerce sites would have to cooperate with one another to share each other's data as well as carry out transactions. Autonomy and cooperation are conflicting goals and therefore a balance between the two has to be achieved. Autonomy, which enables an organization to join or leave a federation whenever it wishes to, makes the task of developing a c-commerce environment quite complex. While there is much research to be done on federated architectures for e-commerce, many of the concepts and techniques for federated database management discussed in the paper by Sheth and Larson (1990) can be applied here. We discuss some of the issues.

In federated databases, various aspects of heterogeneity have been examined. These include policy heterogeneity, schema heterogeneity and data model heterogeneity. All these aspects have to be considered for federated e-commerce organizations. More importantly, each organization may enforce a different business model. For example, one organization could enforce a model where payments are received within a month while another organization may enforce a model where payments are received during purchase. This is just a simple example. There may be many other aspects to heterogeneity with respect to business models. Therefore, if organizations have to form federations and carry out business-to-business transactions they have to ensure that the differences are reconciled. Business model heterogeneity is illustrated in Figure 10. Essentially, each organization may have different business rules and the

differences have to be reconciled. We have mediators to handle representation schemas and brokers to make negotiations. It should, however, be noted that languages such as XML (eXtensible Markup Language) are providing common representation schemes for carrying out transactions on the web. In addition, various frameworks are being proposed for E-Commerce (see Rehfeldt and Turowski, 2000). These frameworks have to take federations into consideration.

Schema and policy heterogeneity are also important aspects for federated organizations. Here, the issues may be similar to those for federated databases. However, a more extensive investigation of the issues needs to be carried out. Figure 11 illustrates Sheth and Larson's view of handling schema heterogeneity for e-commerce organizations. With respect to policies, Figure 12 illustrates security policy integration for e-commerce organizations. We have essentially used Thuraisingham's view of integrating security policies for federated databases (Thuraisingham, 1994). Note that in the case of schemas, each organization may export schemas, which may be a subset of the schemas for the local organization. However, in the case of security policies, the export policies may be more restricted. That is additional access control mechanisms may be needed for foreign organizations to access data at another site. Policies are not restricted to security. They also include integrity policies and administrative policies. The differences between organizations have to be handled for all types of policies. The business rules discussed earlier may also be a type of policy. For

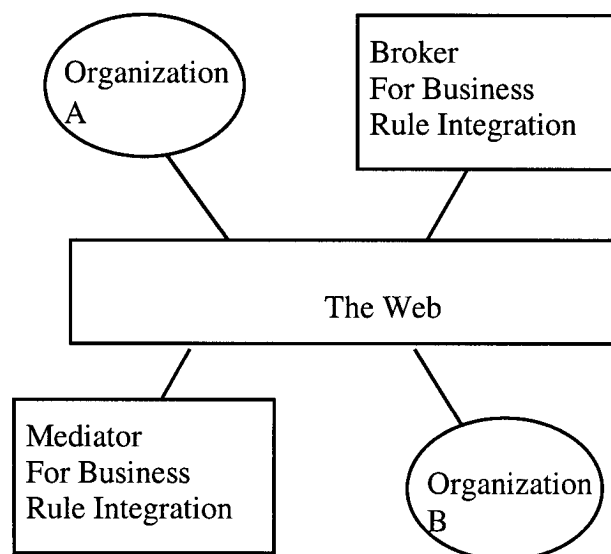


Figure 10 Business model heterogeneity



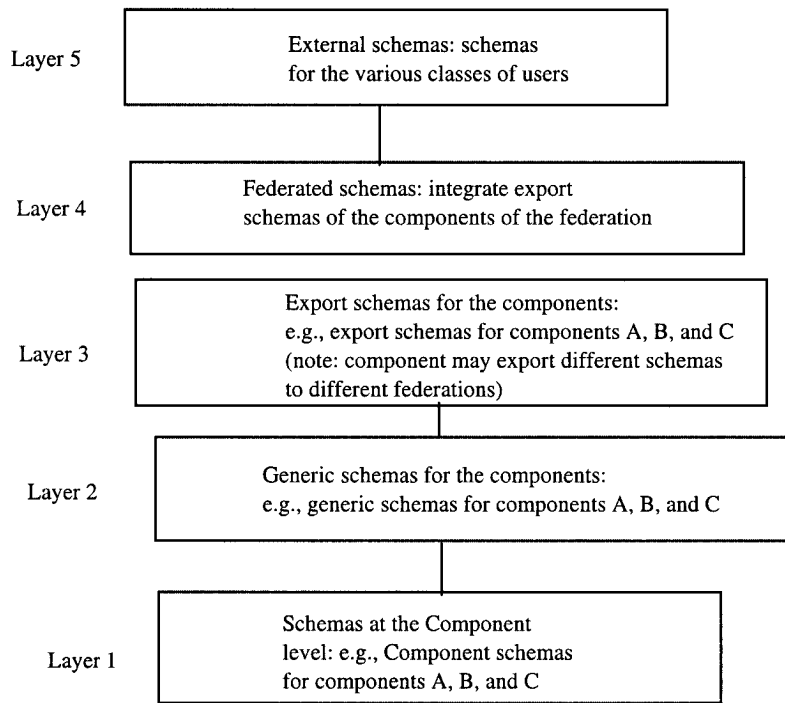


Figure 11 Schema integration and transformation in a federated environment

further discussions on security we refer to Bertino *et al.* (1999, in press).

Query processing and transaction management have also been studied for federated databases. When conducting business to business e-commerce

one party may need to query information from the other organization. This information is necessary for the parties to perform the transaction efficiently. Information-retrieval techniques have to be integrated with security policies as well as

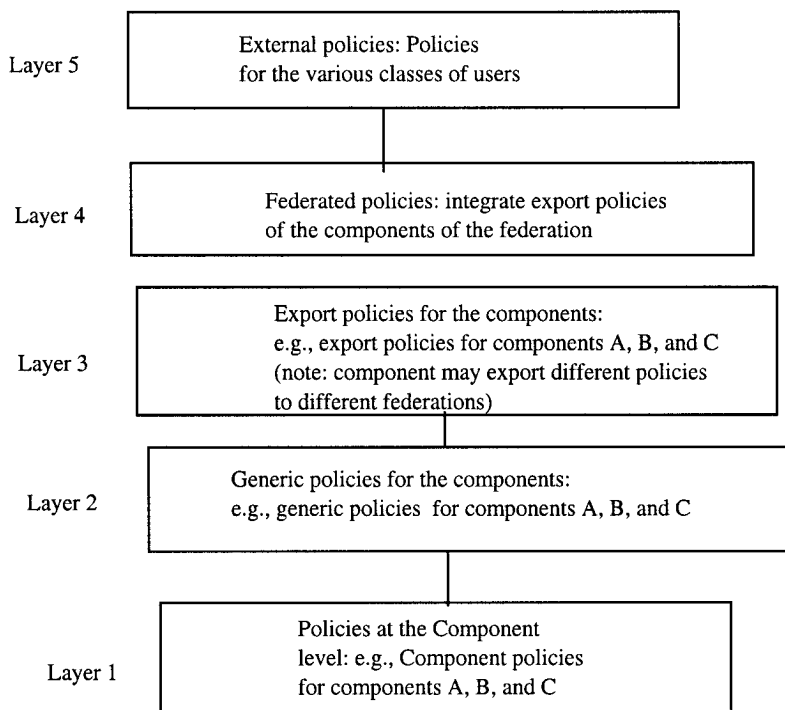


Figure 12 Policy integration and transformation



business rule processing. Transactions in business-to-business e-commerce are defined more broadly and are essentially activities that are carried out across organizations. They could be purchasing goods, merging, as well as acquisitions. While transactions for federated databases are involved with database transaction processing, the transactions for business-to-business transaction include data transactions as discussed in Ghosh (2000) as well as database transactions. We need social transaction models for federated c-commerce organizations. There is research on transaction processing for e-commerce, but a lot remains to be done. For example, how do you carry out concurrent transactions? What happens if the transactions fail? There are not only technological considerations but also business considerations.

In the case of federations, while organizations cooperate and collaborate with each other, they also have autonomy. Sheth and Larson (1990) have discussed various aspects of autonomy. One particular type of autonomy, very relevant to federated organizations, is communication autonomy. For example, Organizations A and B may want to collaborate with each other and carried out business-to-business transactions and the same with Organizations B and C. However, A and C may not want to carry out any transactions. The privacy of A and C have to be protected by B when carrying out transactions.

Let us now examine our AUTO example. Each of the organizations AUTO, PART1, PART2, CON1 and CON2 may have different schema, which they may export to federations. For example, PART1 may export only certain schema to

AUTO while it may export certain other schema to say another manufacture which we will call AUTO2. In addition, the different organizations may enforce different security policies. AUTO may give access to all its automobiles to CON1, while it may give access to only certain automobiles to CON2. Finally, the different organizations may have different business models. As mentioned earlier, AUTO may have a loosely coupled model with PART2 while it has a tightly coupled model with PART 1. Many of the techniques developed for federated data management may have to be adapted for c-commerce.

ROLE OF KNOWLEDGE MANAGEMENT

The previous sections discussed models and architectures for c-commerce. The question is, how does knowledge management support c-commerce? Since training is part of knowledge management, knowledge management helps e-learning and eventually would help e-commerce as well as c-commerce. One needs to learn from experiences experts when creating and managing c-commerce sites. One can also use previous experiences to carry out transactions with organizations. We illustrate this in Figure 13.

Finally what are the implications of knowledge management and c-commerce for business and management? Organizations want to be cost effective. While becoming leaner and meaner organizations want to avoid duplication of effort. They want to reduce staff and employ knowledge workers. Knowledge management plays a strategic

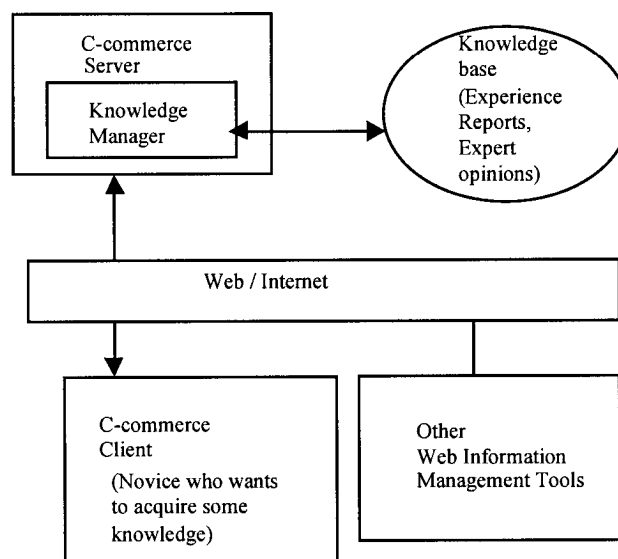


Figure 13 Knowledge management for c-commerce



role here. Based on previous experience, organizations can avoid serious mistakes as well as avoid carrying out business with undesirable partners. For example, AUTO may have had adverse experience with PART1. In this case AUTO may want to stop its business association with PART1 and join a federation with, say, another organization PART3. Knowledge management tools will also make managers more efficient so that they can focus on leading the organization instead of just managing it. We see knowledge management and c-commerce to be the central components of any effective and successful organization.

SUMMARY AND DIRECTIONS FOR C-COMMERCE

This paper has described c-commerce. It is essentially integration of e-commerce, knowledge management and collaboration technologies. We first discussed the building blocks for c-commerce and then described models and architectures. Then we addressed the strategic role of knowledge management for c-commerce.

As noted in this paper, there are several areas for further research. This paper has provided some directions from models and architectures based on the work carried out for federated databases. What are the suitable architectures for c-commerce? How can we handle differences with respect to business models, schemas and policies for different organizations? What are the security concerns (Ghosh, 1998)? What information management technologies are applicable? How do we develop standards for c-commerce? We believe that there are plenty of opportunities for research into suitable models, architectures, standards and technologies for c-commerce. In addition, one also has to consider the managerial and business implications of c-commerce. Our ultimate goal is to build organizations that show strong leadership and are cost effective.

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