Frameworks for a Human Centered Collaborative Commerce System

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Abstract

In the past few years, collaborative commerce (or e-Commerce) and human-centric systems have been research subjects of keen interest in Web-based technologies and have become a major focus for many organizations. C-Commerce creates and supports dynamic collaborative environments over the Internet or other public information networks (PINs). It offers many levels of collaborative interactions and enables the organizations and individuals to work simultaneously, cooperatively as well as independently. Recently, it has become increasingly important to integrate human-centered designs in collaborative systems to achieve user-oriented environments. This paper presents Human-centered C-Commerce System (HCCS), an architectural framework for collaborative commerce with integration of some human aspects. We discuss its architecture and describe each component of the proposed system. Using an intelligent c-Commerce system, such as HCCS, will enhance collaboration between users and organizations effectively.

Keywords: Collaborative Commerce, Human-centric Computing, Collaboration, Web-based Computing, Electronic Commerce

1. Introduction

Recently, the area of Web-based information technologies is changed dramatically. One such noticeable change is the requiring effective collaboration between actors (e.g., humans, systems, or both) with consideration of human factors. Currently, many Web-based systems, such as electronic commerce (e-Commerce), are toward to this trend to satisfy the requirements. The rise of globally distributed computer based workspaces and the advances made in communication technologies have enabled the incorporation of collaboration in e-Commerce systems [21]. These new strategies in the e-Commerce systems with collaborative environments are redefining the way organizations and individuals work simultaneously, independently and collaboratively. Collaborative environments should provide organizations and individuals to work together and share sensitive information efficiently and effectively. Working in these environments with e-Commerce technologies introduces the subject of collaborative commerce (or c-Commerce). C-commerce creates and supports dynamic collaboration over the Internet. Its primary objective is to harness all organizations’ information and applications into a computer-based framework in order to provide personalized access to all participants in a given community [13].
This paper presents a Human-centered C-Commerce System (HCCS), an architectural framework for collaborative commerce with integration of the human aspects. The HCCS consists of Web-based systems with collaboration, and the top of it human centric issues and components are considered, as shown in Figure 1. This means that HCCS can be used in any Web-based computing applications which require some degree of collaboration between two or more people or organizations. Possible applications may be e-learning systems, school admission processes, military training, transaction processing, and so on.

The paper is organized as follows. Section 2 introduces the background and main terminologies of collaboration and human centric issues in Web-based system. Section 3 discusses components of the human-centric collaborative system environments. Section 4 presents our architectural framework, called human-centered collaborative commerce system (HCCS), components, and a short case study to demonstrate the proposed architecture. Section 5 concludes the paper with some final remarks and future work.

2. Motivations and Background

For the rapid progress of WWW application technologies, effective collaboration with Web-based systems and human-centric computing has become an important factor for organizations to promote their performance and management. The key component in the Web-based systems is the Internet since the Internet has become the network and infrastructure in such a system. Using this universal scalable network, organizations can access information all the time, and share their information and knowledge. At the same time, they need to protect their privacy and sensitive information [16]. These requirements bring two issues: the enhancement of collaboration and the need for human centric issues. In this section, we review the main concepts and terminologies as well as some of the advances that have been achieved in these areas and technologies.

Advances in computing and communication technologies have allowed businesses and organizations to become more distributed and dynamic in nature. This spread and dynamism have divided important organizational entities, such as tasks, contexts, knowledge, specialization, and more important, humans, based on a variety of factors like time, geography, structure, roles, and so on. They have also changed the way organizations function, the way tasks are performed, and the way humans communicate, coordinate and cooperate. Because of its efficient ways and working environments, collaboration has emerged as an important field of IT. Within a collaborative environment, organizations can manage their knowledge and experiences efficiently and effectively. Kim and Smari [16] introduced the degree of collaboration between the 4Cs. Authors listed communication, coordination, cooperation, and collaboration as from the lowest to the highest degrees of collaboration, respectively. Kim et al. [17] argued that first three ‘Cs’ just mentioned form a continuum of progressively increasing interaction that culminates with the fourth and highest level: collaboration. Communication is the community linkages where the exchange of information takes place, coordination is operating autonomously while coordinating information, activities and resource sharing, and cooperation is the sharing of information, activities, and service integration, while working to achieve the same goal between two or more organizations. Collaboration is working together in a shared space to achieve planned results.

Based on the degree of collaboration work, needs analysis is developed and showed in Figure 2. If one needs to transfer data from one place to another, it requires only communication. But coordination requires communication and articulating work between people, between a person and tasks. Fuks et. al. [9] discussed three stages of coordination: pre-articulation of the tasks, their management, and post-articulation. In case of having shared goals among people, people need to cooperate to achieve their goals. Finally, collaboration requires aforementioned 3Cs and shared spaces to work together efficiently.

Figure 2. Needs Analysis for Collaboration
Effective collaboration with Web-based system is, also known as collaborative commerce (c-Commerce) system, more advanced form of commerce on the Web [3, 13, 21, 23, 28]. The concept of c-Commerce is fairly new. Therefore, not a lot of research has been done up to now. On the other hand, carrying out commerce on the Web, also called electronic commerce (e-Commerce), is one of the fastest growing and popular application areas for the World Wide Web (WWW), such as advertising, training, buying and selling of products and information [28, 30]. C-Commerce is a set of dynamic, Web-based collaborative interactions between organizations and individuals. It is one of the prominent business structures, such as business-to-business integration tool, for the future since it thrives in the environment of dynamic economies that require vivid inter-organizational cooperation and high level of flexibility [12, 21]. It also enables organizations to automate information flows within a multi-channel distribution network [13]. In c-Commerce environments, there is no geographical boundary, physical distance, or time constraints [3].

General collaborative systems enable globally distributed people to work together as well as offering collaboration capabilities for a small group of people located locally. In order to provide efficient and effective collaboration, there are some pieces of materials to be considered as shown in Figure 3: pervasiveness, autonomicity, affectiveness, and social, cultural, psychological and cognitive issues.

![Figure 3. Human Centric Issues](image)

Pervasiveness makes available a smart vision for the future computing since it guarantees rich and seamless interaction environments for new services and applications for both humans and computing systems. A pervasive computing infrastructure provides an intelligent environment for distributed applications, and should be transparent to users (understandability), work with users (integration), and be personalized to users (adaptivity) [28]. Usually, there will be a high level of complexity as these collaborative systems are widely distributed. These distributes tasks are usually handled by grids or multi-agents. Introducing autonomic capabilities in these grids and agents highly reduces the complexity in task distribution and handling. Affectiveness expands human computer interaction (HCI) by including emotional communication together with appropriate means of handling affective information. According to Picard [22], affective computing is a new multidisciplinary field that encompasses cognitive science, software engineering, computer engineering & sciences and information science. Finally, social, cultural, psychological and cognitive materials should be considered so that it can be adopted easily by people who have different backgrounds [20].

### 3. Web-Based Human-Centric Collaborative System Environments

The three main components in human-centric collaborative systems are Web-based systems, sociological and human related issues, and technological and collaboration processes issues [17]. These components constitute a comprehensive framework for human-centric collaborative system design. They also help realize the four C’s effectively. Web-based systems include the system components and applications on the Web that related to the intent of the collaborating people and/or machines. Sociological and human related issues encompass organizational, cultural, social and functional issues, while technological and collaboration processes issues look at the means by which one can implement collaborative applications, and includes methods, algorithms, tools and techniques that will support the required functions and activities of collaborative environments. The design of collaborative systems must also incorporate the fact that a group of people, with different characteristics, will use the system as they work together.

![Figure 4. Components of the Human-centric Collaborative System Environment](image)

In order to achieve human-centric collaborative environments, sociological and technological analyses are required. To understand the sociotechnical influences on these environments and achieve effective collaboration, two key areas and two essential components can be...
identified [11, 18]. Two key areas are cross-disciplinary users and distributed collaboration among geographically dispersed members, and these are to enhance members’ performance by making effective decision making throughout the collaborative processes. Two essential components are technical decisions and social interaction, and these are to achieve the goals from the view of sociotechnical issues. Web-based applications should be fully supported by other two components to get effective collaboration which includes enhancing members’ performance and achieving goals. Figure 4 illustrates these sociotechnical issues and basic components of such systems.

As an example of demonstrating these issues, Figure 5 shows four steps and possible requiring services of a Web-based application process [7, 10]. Users search information or a product by browsing on the Web (requiring user interface and data mining components). When they find the information or the product, they need to login (requiring trust) to the system to request the information or the product (requiring user profiling and access control). Then the system transfers the information to the users with various methods (data integration or workflow required), and finally all the actions are completed (event notification and user management required). The next section discusses a proposed architecture that considers aforementioned issues.

4. Architectural Framework for HCCS

More organizations have been configured as distributed sub-organizations which require cost effective reliable and secure global computer-communications systems. On the other hand, individual users seek better and faster services to access and share information, with user friendly system environments. A general collaborative system encompasses several components. These components should enable participants to develop complex projects in less time within a given secured shared place. However, when distributed multiple participants need to work on a single project, the problem becomes far more difficult. In order to provide seamless collaboration among these participants and systems, a good framework for collaborative system is required.

Figure 6 illustrates the big picture for the proposed human centric collaborative commerce system (HCCS) environment. The HCCS can also be implemented in information grid network environments since the information grid is essential for collaboration between organizations and users [8]. Smari et. al., [26] discussed the vision of an information grid with a distributed human-centric decision-making and knowledge management. The core component of this approach is a human-centered decision making system (HUDS) which is responsible for effective interaction between other components [17].

An organization’s users, such as departments and executives, as well as all others, such as customers, suppliers, collaborating institutions and partners can access to the system portal through the Website. On the Website, there are different types of general information of the organization, and anyone can browse the site anytime and anywhere. Existing or new authorized users in the organization can access to the virtual place after they are cleared for security and privileges.

Figure 7 shows the proposed architecture. The architecture has three managers: display manager, user manager, and information manager. Display manager takes care of controlling input and output devices of a virtual place and the Webpage. User manager controls login and access information of users (authentication and access control), and human issues (user analysis). Information manager manages information in the HCCS, such as accessing to the database, knowledge management, decision making, and human computer interaction.
4.1. Display Manager

Display manager consists of three blocks: I/O devices, a virtual place (VP), and a Webpage. The Webpage can be viewed to all users regardless of their privileges. If users want to access to the virtual place, then they need to provide their information. Different types of input/output devices reside in next to the virtual place, while different kinds of applications are in the information manager, to provide various supports to the participants. For examples, word processors and virtual conferencing tools can be placed. These applications and I/O devices in the virtual place should have interoperability functions to support 4Cs discussed in Figure 2, (i.e., basic communication, organizational process coordination, distributed organizations’ cooperation, and effective collaboration) [2].

The virtual place, which supports synchronous, asynchronous and distributed collaboration, is the core component of the block. It offers shared space environments for participants to access, exchange, discuss, and coordinate issues and problems [1, 5]. It also allows users simple access to one or more personal information pages (e.g., group portals, such as KnowledgeKinetics tools [30], or personalized portals, such as my.yahoo.com [19]). This portal-like virtual place provides integrated, personalizable, ubiquitous, secure and useful access to information, applications, data and people [24, 27].

Figure 8 illustrates different functions provided by the virtual place: open communication tools (e.g., conference center and white board), personal/group communication tools (e.g., chat and discussion threads), login members’ information and latest news (e.g., information board), shared file repository (e.g., filing cabinets), and other collaboration supporting tools (e.g., event calendar and search engines). The virtual place generates a human-oriented collaborative environment to provide smart shared spaces, collaborative tools and assistants, synchronous and asynchronous collaboration, and flexible coordination to geographically distributed users [2].

4.2. User Manager

User manager focuses on human related issues, such as analyzing relationships between users and machines, and identifying characteristics of users. It consists of three modules: authentication, access control, and user analysis. Authentication performs login/security check, which ensures permitted users in the VP. The access control is an essential component in secured collaborative systems, and it guarantees every access to the system and its resources is controlled and authorized [4,6]. In the proposed architecture, an access decision control method is used in the access control module. The access decision control method is based on the role-based access control (RBAC) and added groups and tasks controls to ensure better secure access to the system. Role-based access control (RBAC) [25] has rapidly emerged and enforced security in collaborative systems. Components of the RBAC are role-permission and user-role. Permissions are associated with roles, and users can be assigned and reassigned roles based on their privileges [14]. Due to space limitations, detailed methods for access control will be addressed in forthcoming papers [15].

New users must provide their information, and all analyzed users’ information is stored in the database. User analysis block enables the human-centric issues that we discussed in earlier section. In the collaborative environment, a user needs to interact between/within users and systems simultaneously. Based on characteristics of users, the
system processes users’ queries in different ways. Identifying characteristics of users, such as age, education, knowledge and skills, perceptual variations, and social, cultural, and cognitive capacities, is not an easy but an important task. Figure 9 illustrates four characteristic analyses of users and their examples. And it provides personal (e.g., users’ cultural and educational backgrounds), accessing (e.g., users’ account privileges), task (e.g., users’ specific tasks and procedures), and representational information (e.g., ways of representing results) to support users’ benefits and needs [31].

4.3. Information Manager

Human computer interaction, database, knowledge management, and decision making components are in the information manager block. Each component is comprised of several functions that work together to process the information and communicate with each other. The database (DB) component stores a variety of data: some that exist as information and some that are processed as Knowledge. The Knowledge management (KM) component implements the tasks of knowledge extraction, integration, and transferring. The decision making (DM) component processes the information inputted into the system to derive a decision for the particular situation. The Human Computer Interaction (HCI) component deals with interactions between the user and the system, for example, transferring inputs from the users to the system, presenting outputs from an application and other components to the user, and so on [17].

To demonstrate these interactions, let’s consider one scenario (i.e., processes of college admission to graduation). Processes of college admission to graduation are complicated processes and consisted of three parts: admission process, registrations process for academic years, and graduation process. Figure 10 illustrates the use of components in the information manager as well as other managers in this scenario.

Admission applications should be submitted through the Webpage at the beginning of the school year for entrance the following fall. A complete application is comprised of the application form, official transcript or an equivalent certificate, official scores from the SAT Reasoning or ACT, or official scores for Test of English as a Foreign Language (TOEFL), and the counselor’s recommendation. Based on this information, college admission officers decide who will be admitted to the school. Then, applicants who admitted to the school need to provide extra information to complete the admission process. The DB stores all information from applicants and current students, such as scores of SAT, mathematics placement test, and interested subjects for the electives. The KM interacts with the DB to provide the relevant information to the DM. Then DM creates all the possible class combinations for a student and acknowledges to the student. The student selects the best suitable schedule and then, the system registers these classes and sends the confirmation letter to the student and student’s advisor. In order to complete the degree of the college, a student needs to take care of many things, such as finishing all requirements classes, paid in full for all financial arrangement, and so on. The HCI collects all relevant information for the graduation. Then the KM checks all information and requirements and sends the results to the DM. The DM creates a list for graduation.
candidates and notifies to the students, their advisors, and the school.

5. Conclusions and Future Work

Recently, considering human centeredness is becoming a necessity and e-Commerce has received great attentions in distributed collaborative systems. Architectural frameworks for e-Commerce are quickly being developed by many organizations to reach the aim of seamless collaboration and emphasize collaboration in every aspect of the system.

In this paper, we studied the fundamentals of collaboration and human centric issues. Needs analysis of collaboration and human centric issues were discussed. Also, human centered collaborative environment was introduced and also discussed. We then proposed a human centered collaborative commerce system (HCCS) architecture and described its components. To ensure flexible functionality and satisfactory requirements, the architecture consists of three managers: display manager, user manager, and information manager. Display manager controls the virtual place and the Webpage for different types of users. User manager is in charge of authorizing accesses to the system and its resources as well as performing user analyses. Information manager deals with creating, accessing, and transferring correct information for users.

Currently, we continue to expand the architecture and its components. To verify models of it, from the admission to graduation processes are developing in details. As part of future work, we will test and refine the proposed architecture using various modeling tools.

References