TOWARDS AN AGENT-BASED CUSTOMER KNOWLEDGE MANAGEMENT SYSTEM (ABCKMS) IN E-COMMERCE ORGANIZATIONS

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***Abstract*—Till date, e-commerce organizations still have competency challenges in Customer Knowledge Management (CKM). Organizations need to develop competencies in all aspects of CKM, from understanding who their customers really are and what they want, to designing platforms specifically for customers. It is particularly important for customer processes involving information for, collected from and about customers to be turned into knowledge, disseminated and really used. Also, most companies do not always take full advantage of the knowledge sources that exist through customers' interaction with their websites. All these processes appear complex and fuzzy, which the introduction of agent technology in this paper poses a potential solution to this problem, in order to achieve an effective CKM in a dynamic business environment as e-commerce organizations.**

Keyworks: ***Customer Knowledge Management, Mobile Agents, Knowledge Management, E-commerce, Agent technology***

I. INTRODUCTION

To date, most e-commerce organizations have focused on collecting massive amounts of data about their customers. Typically, they have a Customer Relationship Management (CRM) system that captures the functional behaviour of their customers, e.g., where they shop, transaction information. However, CRM really only gives them a hard, nuts-and-bolts look at customers and their surface value to the company. Few companies have looked beyond these basics to better understand the true drivers of customer loyalty and satisfaction. As a result, they are not using what they know to understand customers at a deeper level and develop true customer relationships, which is found in Customer Knowledge Management (CKM).

Although current competitive challenges induced by today's digital economy place their main emphasis on organizational knowledge while customer knowledge has been overlooked. On the other hand, the business community has finally begun to realize the important role customer knowledge can play in the organizational boundaries of the corporate arena. As a result, there is an emerging market for the tools and utilities whose objective is to provide the intelligence for knowledge sharing between the businesses and their customers.

The scope, environment, and implementation of traditional CKM projects have changed because of various factors such as globalization, advances in computing technologies and, last but not least, the development and deployment of knowledge management projects in distributed, collaborative and virtual environments. As a result, traditional CKM methods fail to address the added complexities found in this ever- changing environment.

A software agent is an autonomous system that forms part of an environment, can sense the environment and act on it over a period of time, in pursuit of its own agenda. The software agent can also perceive, reason and act by selecting and executing an appropriate action. A thorough investigation into software agent computing resulted in the realization that software agent technology can be regarded as a new paradigm that may be used to support the CKM processes. The unique requirements of CKM and the ways in which agent technology may address these were subsequently identified. Research has shown that agent technology is specifically suited to geographically distributed systems, large network systems and mobile devices. Agents provide a natural metaphor for support in a team environment where cooperation and the coordination of actions toward a common goal, as well as the monitoring and controlling of actions are strongly supported. A through search of current literature revealed that little or no work has been done in the incorporation of the power of agent technology in facilitating and enhancing CKM.

Therefore, in this research work, a novel model approach to customer knowledge management (CKM) model is proposed, which will be titled ABCKMS (Agent-Based Customer Knowledge Management), that aims to take the unique nature and changing environment of knowledge management projects into account. The ABCKMS model is unique in that it will support the entire spectrum of CKM functionality, thereby supporting and enhancing each key function with a team of software agents. The business manager and the individual customers will be supported during CKM processes to simplify their tasks, eliminate the complexities, automate actions and enhance coordination and communication. At the same time, e-commerce websites, methods, systems, processes, mechanisms, technologies and infrastructure will be fully supported.

Finally, this research work will as well examine the wide variety of ways e-commerce websites are using KM in their customer relationships. The key organizational challenges of implementing CKM will be described. The research work will conclude with some best practices and advice about how to successfully implement an agent based CKM program in an e-commerce environment.

II. LITERATURE REVIEW

2.1 Customer Knowledge Management

Today, companies recognize knowledge as a crucial resource in the competition and the importance of utilizing knowledge to gain a competitive advantage, but many of them still ignore Customer Knowledge (CK), which is at the origin of most improvements in customer value [12]. In order to have a good relationship with their customers, customer-focused companies specifically dotcoms have to communicate and interact with them in a satisfactory manner and continuously meet customers' changing needs. This requires the management of customer knowledge [3], [6].

By definition, Customer Knowledge Management (CKM) is the application of Knowledge Management (KM) instruments and techniques to support the exchange of knowledge between an enterprise and its customers, enabling the company to make appropriate business decisions [12]. CKM constitutes a continuous strategic process by which companies enable their customers to move from passive information sources and recipients of products and services to empowered knowledge partners [8].

Other relevant literature such as [8], proposed five style of CKM, shows that by managing the knowledge of their customers, corporations are more likely to sense emerging market opportunities before their competitors, to constructively challenge the established wisdom of doing things around here and to more rapidly create economic value for the corporation, its shareholders and last, but not least, its customers. In their approach CKM refers to the management of knowledge from the customer i.e., knowledge residing in the customer, in contrast to knowledge about customers. Moreover, they discuss that theft approach is different from traditional Knowledge management in the objective followed: Where as traditional knowledge management is about efficiently gains (avoiding of re-inventing the wheel), CKM is about innovation and growth [8].

[15] defined customer knowledge as a kind of knowledge (also data or information which can be analyzed, interpreted and eventually converted to knowledge) in the area of customer relationship, which has direct or indirect effect on our organizational performance. They proposed two conceptual models: one for describing customer knowledge formation and another for customer knowledge classification. One of the most important messages of this study is that customer knowledge can be formed by informational interaction between customers and diverse entities such as: our company, our other customers, our competitors and information and consulting institutes. They highlighted that we cannot manage all of these informational interactions; therefore, we have to focus on managing interaction between ourselves and our customer and between our customers.

Knowledge for customer is a kind of knowledge (also data or information which can be analyzed, interpreted and eventually converted to knowledge) that our targeted customer attains in order to know us better. [15] also provided interesting definitions for three major types of customer knowledge. Often in the literatures, sources that provide knowledge for customer are overlooked. Data, information or knowledge for customers can be gained from our other customers, information consulting institutes, our competitors and the company itself to provide information needs of customer. Knowledge from customer is a kind of knowledge (also data or Information which can be analyzed, interpreted and eventually converted to knowledge) that the company attains in order to enhance its products and services. Knowledge about customer is a kind of knowledge (also data or information which can be analyzed, interpreted and eventually converted to knowledge) that the company attains in order to know its targeted customer better. Companies not only capture knowledge about customers but also purchase data, information and knowledge about customers [15].

With the development of the internet and budding of dotcoms, knowledge management in e-commerce is becoming important. In other words, the success of e-commerce increasingly depends on knowledge management [9], [13]. The rhetoric of e-commerce emphasizes the opportunities for knowing customers in the new economy. E-commerce is a rich channel in which the service experience and customer data gathering are closely coupled [12]. The advancement of the Internet and e-commerce technology provides companies not only with new ways to create knowledge, but also with opportunities to improve their ability to manage and utilize knowledge [10]. In this area, [10] identified 21 km mechanisms through studying online successful retailing and auction sites. In the light of process oriented point of view, they supposed knowledge sharing, knowledge dissemination and knowledge acquisition as three tenets of their Internet-based knowledge management model and classified mechanisms according to them.

However, there is still a need to further elaborate on the concepts of customer knowledge and CKM [11], especially within the e-commerce context [5] which is far from fully understood [9]. Although CKM has been discussed in various circles, fewer studies tried to concentrate on CKM in the area of e-commerce. Also, the literature has neglected so far to discover a comprehensive set of CKM mechanisms in which agent technologies can be incorporated. This paper therefore has important implications for e-commerce organizations seeking to improve their business and customer value through effective selection and deployment of Agent-Based CKM.

A customer knowledge management mechanisms model (CKM3) which is based on the theoretical aspects stemming from the information retrieval and analysis of the latest results in related literature and the research multiple case study results was presented by [15]. This model encompasses an extensive look at the three different dimensions of customer knowledge in more details than prior CKM researches and introduces the

comprehensive set of electronic mechanisms in accordance with each identified types of customer knowledge. The study has important implications for e-commerce web sites seeking to improve theft Business and customer value through effective selection and deployment of CKM mechanisms but also noted that there is a great need for the model to be refined through other mechanisms on which software agents poses great potentials.

2.2 Challenges in CKM

Customer knowledge can be formed by informational interaction between customers and diverse entities such as: our company, our other customers, our competitors and information consulting institutes. It is important to know that we cannot manage all of these informational interactions. In CKM, it seems that we have to focus on managing interaction between our customer and ourselves or between our customers. The case study highlights that CKM tools prevail among the leading British dotcoms. The research result in the selected cases also reveal that among three main kinds of customer knowledge (knowledge for, from and about customer), "knowledge for customer" has the highest utilization percentage. It will remain for future research to refine and expand the proposed model [15]. This project therefore employs the power of agent technology to manage these dynamic informational interactions.

Although CKM has been discussed in various circles, fewer studies tried to concentrate on CKM in the area of e-commerce. Also, the literature has neglected so far to discover a comprehensive set of CKM mechanisms in e-commerce websites [15].

"For all the technology and tools in use today, all the data capture and all the talk about understanding customers, most companies have yet one more mile to go to truly achieve insight into the behaviour, motivations and loyalty of their customers. What we need to know is soft, fuzzy and complex. Customers will tell us, if we ask the right questions, engage them in purposeful dialogue and listen." [14].

Further research is required to determine how all knowledge aspects together affect the performance of enterprises and what challenges come up with the integration of all four knowledge aspects [2]. Many companies find CKM a difficult concept to grasp [4] and few are doing it well [8], [3]. This is partly because we lack a simple framework for understanding it [1]. However, it is also because CKM is defined and implemented in a wide variety of ways and, depending on how it is defined, it overlaps a number of existing functional areas of a company [12], [4], [7].

3.0 The Proposed Model - ABCKMS

The sea star model by [15] was restructured in order to obtain an improved model, which now incorporates the agent technology, called ABCKMS (An Agent-Based Customer Knowledge Management System). This was done using an intelligent agent-based technology platform where each of the three dimensions of CKM (knowledge for customers, knowledge about customers, knowledge from customers) will be taken over by the customer knowledge supervising Agent (CKSA) as shown in the ABCKMS model presented in figure 1.

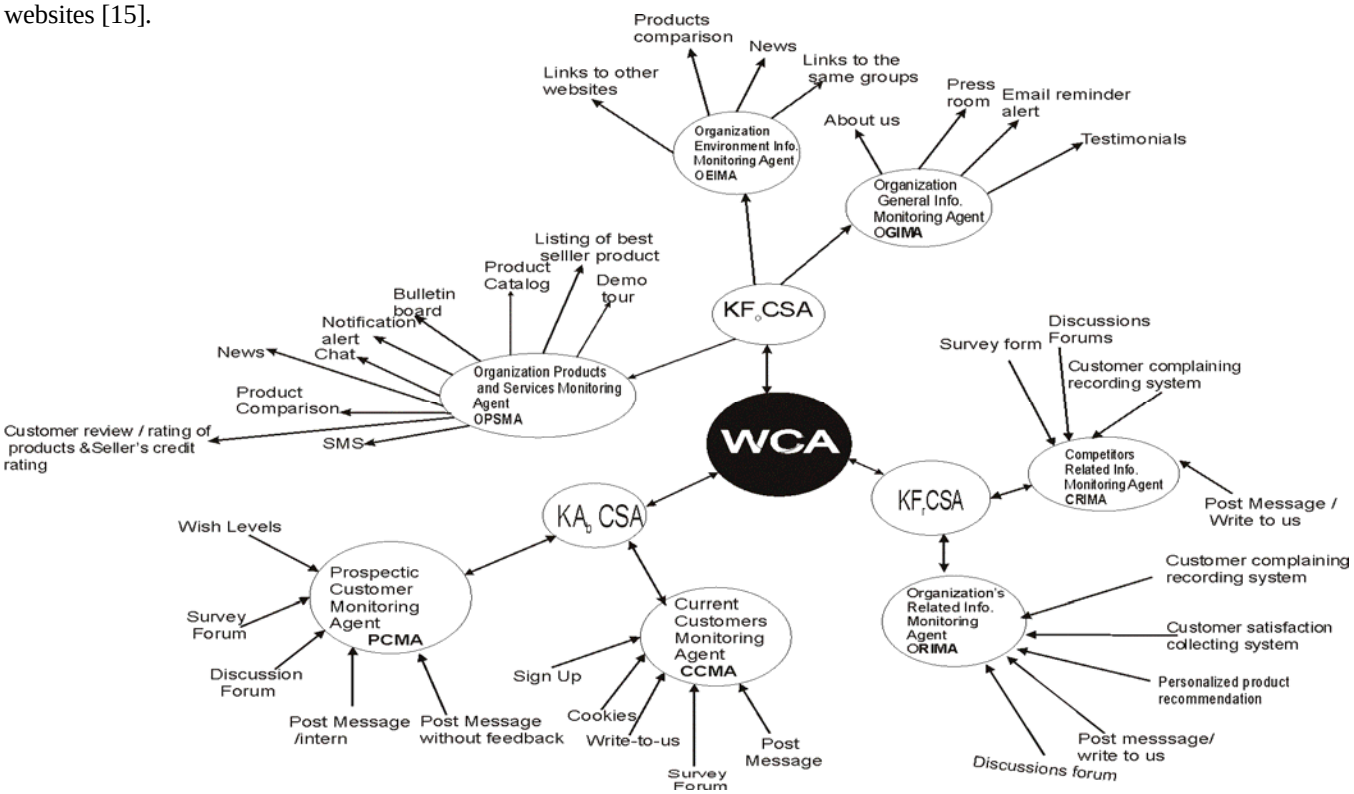

Figure 1: Architecture of the Proposed System - ABCKMS

All the agents are intelligent and mobile. The Website Coordination Agent (WCA) is at the center of control of the entire system. It has the responsibility of creating other supervising agents and killing then after they have completed the tasks assigned to them by the WCA. The only reports and feedbacks from the entire system goes to the human agent, who is the Chief Knowledge Officer (CKO) for organization through the WCA. There are three agents responsible for the three major knowledge relationships between the customers and the organization. They are the Knowledge For Customers Supervising Agent (KFoCSA) responsible for supervising all information and interactions coming from the organization to the customers. The Knowledge About Customers Supervising Agent (KAbCSA) is responsible for supervising all information and interactions coming from prospective and current customers of the organization to the WCA through the Prospective Customer Monitoring Agent (PCMA) and the Current Customer Monitoring Agent (CCMA). Thirdly, the Knowledge From Customer Supervising Agent (KFrCSA) responsible for the management of all information and interactions coming from the customers to the organization.

The Knowledge From Customers Supervising Agent (KFrCSA) is responsible for supervising all information and interactions concerning the organization's sales, marketing, products and services, coming from current customers of the organization to the WCA through the Competitors Related Info. Monitoring Agent (CRIMA) and Organization's Related Info. Monitoring Agent (ORIMA).

The KFoCSA is responsible for creating the Organization's Product and Services Monitoring Agent (OPSMA), the Organization Environment Info. Monitoring Agent (OEIMA) and the Organization General Info. Monitoring Agent (OGIMA). Any information going from the organization to current and prospective customers passes through the KFoCSA to one of these three agents depending on the type of knowledge. The monitoring agents OPSMA, OEIMA and OGIMA are responsible for sending the specific information/knowledge (e.g. sms, news, product catalog, product comparison, notification alert, e-mail reminder etc.) to each category of customers.

The use-case diagram of figure 2 explains a typical scenario of the functionality of this model. After a prospective customer fills a survey form from the organization's website, KAbCSA creates the PCMA who collects the information and passes is to the WCA through the KAbCSA. The KAbCSA must have refined the customer information before passing it to the WCA, who creates new information for customer through the KfoCSA. The KfoCSA creates two agents – P/S Agent and General Info. Agent, both responsible for supplying the prospective customer with company's product and services info. and also company's general info. on a regular basis. The WCA, who coordinates the entire system is the link between the agent-based system and the CKO. The CKO of the organization reserves the right to create, redefine the roles or kill the WCA at any system for update, repairs or maintenance purposes. The cycle continues in this manner as indicated in figure 2.

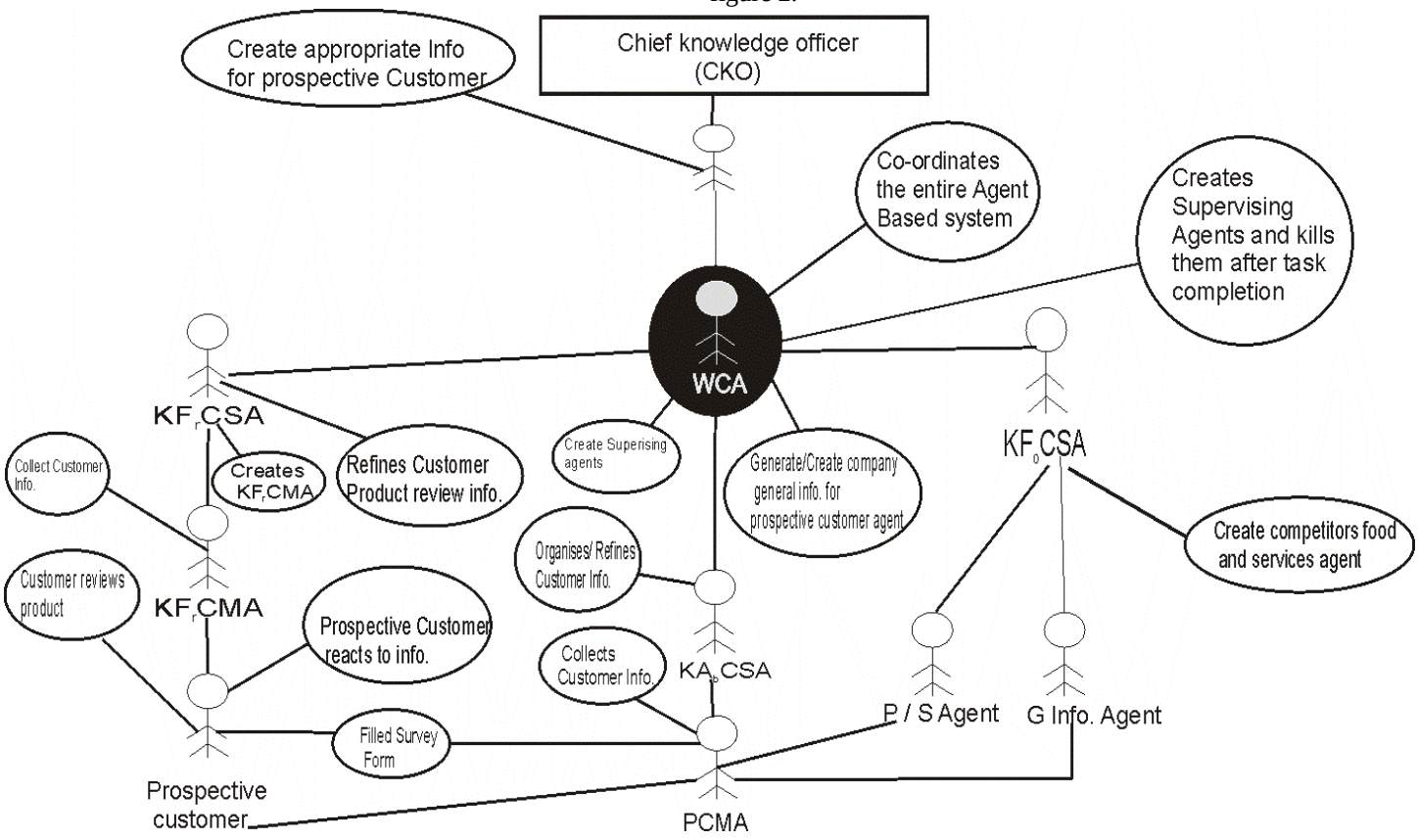

Figure 2: Use-case diagram for ABCKMS

4.0 Agent-Based Customer Knowledge Management System (ABCKMS)

Currently, implementation of the proposed ABCKMS environment is ongoing in ten e-commerce organizations' websites, which was randomly selected in Nigeria. The welcome interface for the system is displayed in figure 3 and the system's login page in figure 4.

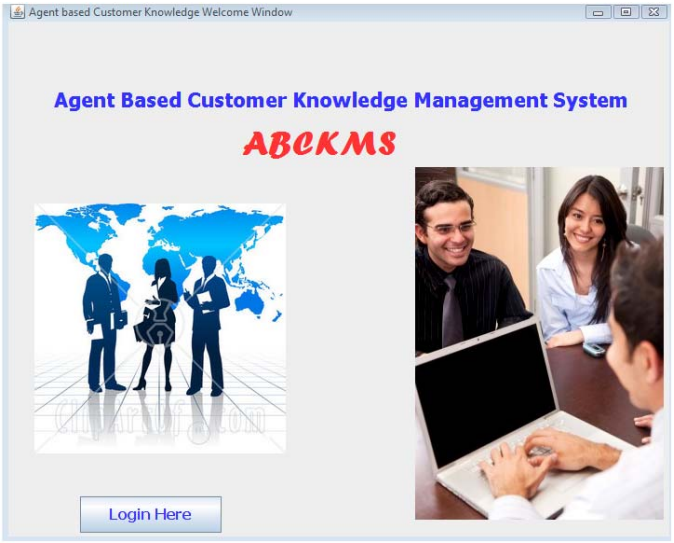

Figure 3: Interface Window for ABCKMS

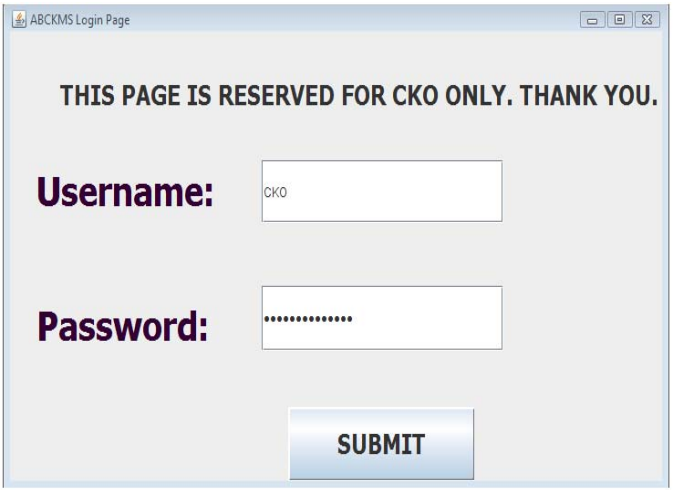

Figure 4: ABCKMS Login Page

The creation of agents was done within the JADE 3.7 agent platform, which is a Java based software development framework that conforms to FIPA standards for intelligent agents. The efficiency of JADE platform for agent development has been tested in scenarios where the number of agents and messages are increased, to test the efficiency of agent creation and scalability. The fact that JADE conforms to all the appropriate FIPA standards and enables portable and easily maintainable agent development using the Java language, makes it a perfect framework in which to develop a multi agent-based system for customer knowledge management.

JADE architecture matches well with our requirements. Interactions between organizations' agents and customers' agents take place in JADE containers (Figure 5). There is one Main container that hosts the WCA agent. The WCA, which is the website coordinating agent hosts the three supervising agents KAbCSA, KFoCSA, KFrCSA, which are the Knowledge About Customers Supervising Agent, Knowledge For Customers Supervising Agent and Knowledge From Customers Supervising Agent respectively. The three supervising agents in turn creates all their respective monitoring agents, all as explained in the design of section 3.

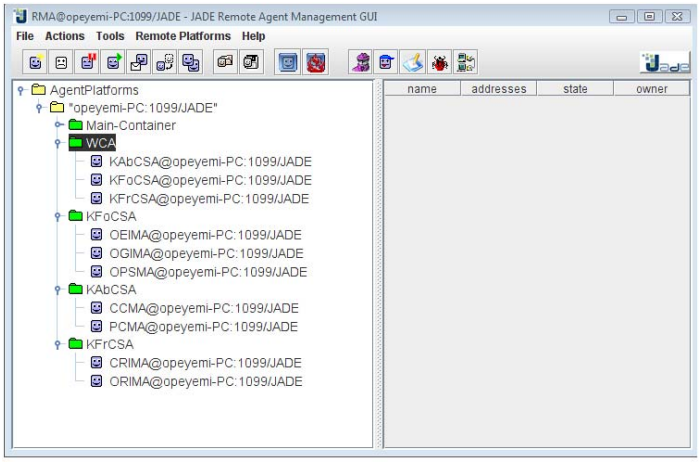

Figure 5: Multi-Agents in ABCKMS

5.0 Concluding Remarks and Future Works

We proposed a new concept to the implementation of customer knowledge and customer knowledge management. Then we established a conceptual model for CKM called ABCKMS – a refined and well expanded model for CKM using the software agent technology approach. The model helps businesses successfully identify and utilize all kinds of customer knowledge in order to enable their customers to move from passive information sources and recipients of products and services to empowered knowledge partners. ABCKMS removes the fuzziness and complexity of existing models and will definitely manage all the informational interactions apart from the usual interactions between the organization and customers or between our customers. With the autonomous agent interaction in a dynamic software environment, useful knowledge from organization is delivered to customers effectively through software agents and also vital knowledge from customers are also promptly delivered to the organization without the day-to-day interaction of the human experts and other knowledge workers. Benefits that would be derived form the implementation of the ABCKMS model is very promising and the researchers foresee great results from this new concept.

Building a fully developed ABCKMS and also incorporating some level of reliable security features into these intelligent agents and their interactions in this environment is an anticipated area for future research.

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