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Information Systems for Enhancing Customer Relationships

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Abstract: For the advances of Internet technologies in recent years, Electronic Commerce (EC) has gained many attentions as a major theme for enterprises to keep their competitiveness. Among all possible endeavors for the EC, research has shown that effective management of customer relationships is a major source for keeping competitive differentiation. Therefore, it is common for an enterprise to promote its customer relationships by prospective information systems to achieve the so-called Customer-Oriented EC. In this study, many systems have already been presented in recent years: (1) Customer Decision Support (CDS), (2) Customer Relationship Management (CRM), (3) Customer Knowledge Management (CKM), (4) Recommendation System and (5) Intelligent Agent. In general, these systems emphasize on benefiting enterprises by means of customer information; customers in contrast receive less benefit through sufficient information from enterprises. To address this issue, Consumer Support Systems (CSS) is then proposed that supports effective information provision from enterprises to customers where sophisticated management mechanisms are employed to help on their decision making. For their usefulness on enhancing customer relationships, we review in this study, these existing systems by presenting their characteristics and discussing how these characteristics are useful for enhancing customer relationships. Amongst them, in particular, for CKM and CSS that are most recently concerned, we review also their architectures that address on their characteristics to provide guidance on their constructions.

Key words: Customer relationship, information system, architecture, CKM, CSS

INTRODUCTION

For the rapid advances of Internet technologies in recent years, Electronic Commerce (EC) has gained many attentions from enterprises to keep their competitiveness. Among all possible endeavors for the EC, research has shown that effective management of customer relationships is a major source for keeping their competitive differentiation. Therefore, it is common for enterprises to promote their customer relationships by prospective information systems. In this context, many systems have been presented: (1) Customer Decision Support (CDS) (Ba *et al*., 1997; Baker, 2000), (2) Customer Relationship Management (CRM) (Galbreath and Rogers, 1999; Lin and Lee, 2004; O'Keefe and Mceachern, 1998; Woodruff, 1997), (3) Customer Knowledge Management (CKM) (Bueren *et al*., 2004; Davenport and Klahr, 1998; Garcia-Murillo and Annabi, 2002; Lin, 2007; Mobasher *et al*., 2002; Thomke and Hippel, 2002; Wilkestrom, 1996), (4) Recommendation System (O'Mahoney *et al*., 2004) and (5) Intelligent Agent (Wagner and Turban, 2002). In general, these systems focus on the use of knowledge about/from customers for enterprises to deliver services satisfying customers; customers in contrast receive less benefit through sufficient information from enterprises (i.e., less information from enterprises to benefit customers). This presents a notable problem of information asymmetry that hurdles customer relationships since customers have no sufficient information to help on their decision making. To address this issue, Consumer Support Systems (CSS) is then introduced (Orman, 2007) that specifically supports effective information provision from enterprises to customers. Under its 4-layer framework, various technical/strategic solutions about customer decision support can be employed (Abdelhakim and Shirmohammadi, 2007; Divakar *et al*., 2005; Matsuo *et al*., 2004; Natividade-Jesus *et al*., 2007; Song *et al*., 2007; Westerman *et al*., 2007; Yu, 2004) and a guidance on its development by discussing its architecture and characteristics can also be found by Lin (2009a, b).

For their usefulness on enhancing customer relationships, we review in this article these existing systems by presenting their characteristics and discussing how these characteristics are useful for enhancing customer relationships. Amongst them, in particular, for CKM and CSS that are most recently concerned, we review also their architectures that address on their characteristics to provide guidance on their constructions.

CHARACTERISTICS OF EXISTING SYSTEMS

In recent years, customer relationships have been commonly recognized by enterprises as a critical factor to succeed their business. Effective customer relationships can help enterprises to satisfy customers by increased services speed, more contact channels, or reduced services cost. In general, these tasks are achieved by referencing customer profiles to capture their needs, preferences, or past transactions. Many relevant systems can be found as follows.

Customer Decision Support (CDS): Ba *et al.* (1997) and Baker (2000) that extracts data from an enterprise and filters them by means of decision support technologies to provide (existing or potential) customers with specific information useful for helping on (part of) their decision making process.

Customer Relationship Management (CRM): Galbreath and Rogers (1999), Lin and Lee (2004), O'Keefe and Mceachern (1998) and Woodruff (1997) that provides customized or personalized services for individual or groups of customers; it in particular uses knowledge about customers (e.g., characteristics or preferences based on their previous transactions) for an enterprise to conclude what these customers need for providing services that satisfy their requirements.

Customer Knowledge Management (CKM): Bueren *et al.* (2004), Davenport and Klahr (1998) Garcia-Murillo and Annabi (2002), Lin (2007), Mobasher *et al.* (2002), Thomke and Hippel (2002) and Wilkestrom (1996) that supports more effective management of customer relationships than CRM does by means of knowledge from customers (i.e., unlike CRM that uses customer knowledge derived indirectly from previous transactions, CKM emphasizes on the use of knowledge directly residing in customers); CKM thus could capture more valuable customer information to determine what these customers really need for providing services that more satisfy their requirements.

Recommendation system: O'Mahoney *et al.* (2004) that alleviates the problems in previous systems where information is collected from an individual enterprise; it instead focuses on the collection and analysis of services information from various enterprises to deliver comparative information about multiple enterprises; however, its recommendations for customers are made as in CRM by means of knowledge about these customers (i.e., derived indirectly from their previous transactions).

Intelligent agent: Wagner and Turban (2002) that is in general a personal software product for serving individual customers based on their characteristics, preferences, or previous transactions; as in Recommendation System, it supports the collection of services information from various enterprises for helping on (part of) the decision making process of each individual customer.

In general, these five systems focus on the use of knowledge about customers (e.g., preferences derived from past transactions) or knowledge from customers (i.e., knowledge residing in themselves) to catch what these customers need; their usefulness on enhancing customer relationships has been discussed by Bueren *et al.* (2004). Nonetheless, they still have the following limitations or shortcomings:

The CDS extracts data from an enterprise such that comparative information among multiple enterprises is not available for customers; in addition, it supports the decision making of customers based on knowledge about them; such an indirect collection of customer knowledge makes it difficult to capture what these customers really need and hence difficult to provide information useful for their decision making.

The CRM provides personalized or customized services for individual or groups of customers; its services however are based on the use of knowledge about customers that makes it difficult to capture what these customers really need and hence provide them truly useful information. Also, as in CDS, it addresses on individual enterprises and hence is not effective on collecting services information from multiple enterprises.

The CKM supports more effective management of customer relationships than CRM does by means of truly valuable customer information from a direct collection of knowledge from customers (i.e., residing in themselves). However, as in CRM, it belongs to individual enterprises and hence is not effective on delivering services information from various enterprises to customers.

Recommendation system alleviates the problems in above three systems that result from a collection of information from an individual enterprise; it instead collects information from various enterprises to deliver comparative recommendations. However, these recommendations for customers are made as in CRM by means of knowledge about these customers such that it is not easy to capture what these customers really need and hence provide them truly useful recommendations.

Intelligent Agent is a personal software product that collects information from various enterprises for delivering comparative information to individual customers where the preferences of each individual

customer are determined by his/her detailed information. However, since it does not specifically address the compiling (e.g., extracting or filtering) of services information from various enterprises, customers often receive massive and unstructured distributions and hence are difficult to get effective aids on their decision making process.

From the viewpoint of information flow, the above five systems emphasize on collecting customer information for enterprises (i.e., capturing knowledge about/from customers for enterprises) where the reverse delivery of information (i.e., receiving information from enterprises to benefit customers) is somehow insufficient; this results in a problem of information asymmetry that hurdles customer relationships since customers have no sufficient information to assist on their decision making about what they really need.

Due to these problems, Consumer Support Systems (CSS) is then introduced (Orman, 2007) to specifically support effective information provision from multiple enterprises to customers. CSS has a 4-layer structure with the following characteristics:

- It emphasizes on effective services information from various enterprises to support customer decision making; the information about desired services is structured, comparative and comprehended to aid on the decision making of customers
- To make information useful for customers, it references knowledge from customers (i.e., residing in themselves) to capture what they really need. Since capturing truly useful customer knowledge is trust-sensitive, it employs an independent agent (i.e., customer knowledge agent) for capturing desired customer knowledge for enterprises
- Since, customer requests are usually based on desired services, their satisfaction through searching and comparisons of available services is most critical for customers; therefore it employs a service agent to act as an intermediary between enterprises and customers. For enterprises, this agent helps to capture customer knowledge for their providing useful services information; for customers, it helps to collect and evaluate information from various enterprises for their recognition and comparisons
- Since, communities (Armstrong and Hagel, 1996; Hoadley and Kilner, 2005; Krieger and Muller, 2003) are commonly used among customers to share/co-learn information, it therefore associates with specific customer communities to support such work as sharing/co-learning information among customers, negotiation and cooperation with the service agent to process customer requests (i.e., searching and comparisons of available services that satisfy these requests)

THE ARCHITECTURES FOR CKM AND CSS

Among existing systems, CKM and CSS are most recently concerned for alleviating those limitations or shortcomings in other earlier ones. It is therefore worthy presenting more specialties about them where we focus herein on their architectures since these architectures address on their characteristics to provide guidance on their constructions.

The architecture for CKM: As presented by Lin (2007), CKM has its architecture support the realization of system functions desired by prospective customers. Its architecture is constructed by first identifying desired functions such that customers can use these functions (under their preferred execution environments) to satisfy their needs. As shown in Fig. 1 (Lin, 2007)) that describes these desired functions by respective use cases, this identification process includes five endeavors: classifying users, categorizing execution environments, building client units, formalizing customization and formalizing personalization.

After identifying desired use cases, the architecture for CKM is then described that imposes physical components to collaboratively support the realization of these use cases. For realizing these use cases, in particular, since from the perspective of service-oriented computing (Champion, 2002; Baresi *et al*., 2003), each use case is achieved by a set of desired services (e.g., web services (Stal, 2002; Curbera *et al*., 2002)) to be provided by local or remote service providers, a service-oriented architecture as shown in Fig. 2 (Lin, 2007) is thus presented that provides a technology infrastructure to support the use case realization through invoking local or remote services. Three agents are imposed in the architecture as those described by Lin (2007).

Interface agent: The interface agent is responsible for presenting customized/personalized service results to a user; these service results stem from the executions of those use cases retrieved from the use case bank and determined as suitable for the user based on the customization and personalization profiles. As shown in Fig. 3, this agent contains three managers: interface, customization and personalization managers. Specifically, the customization manager maintains a customization profile and analyzes it to decide which use cases are

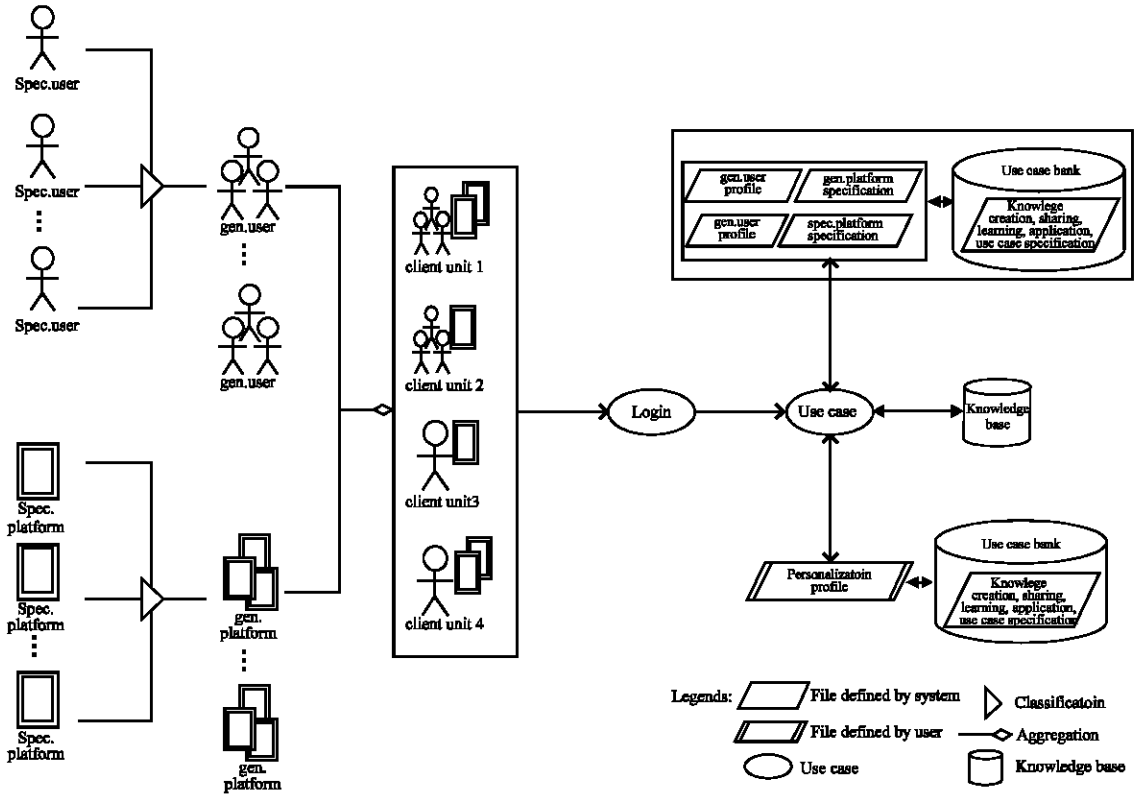

Fig. 1: The use case diagram

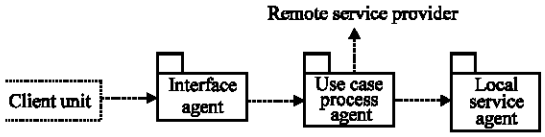

Fig. 2: The CKM system architecture

preferable to the client unit where the user and his/her execution environment are categorized. The decisions are based on examining the customization profile with those use case specifications retrieved from the use case bank. Therefore, at the beginning of the user session, decisions on customized use cases are made by examining which use cases retrieved from the use case bank match with those preferable ones declared in the customization profile. The customization manager transmits then the specifications of these customized use cases to the interface manager where (1) it instantiates first these use cases to make them accessible through an interface to the user; (2) once a use case is selected by the user, it transmits the selection to the use case process agent that identifies and invokes a corresponding process of required services to fulfill the execution of the use case; and (3) after receiving the execution results of invoked services from the use case process agent, it displays these execution results through the interface to the user.

Similar to the above customization process, the personalization manager maintains a personalization profile that is searched to decide which use cases have ever been designated by the user as his/her individual preferences. Thus, at the user session, after customized use cases are recognized and presented to the user, personalized use cases are then determined, if available and presented to the user for his/her selection. Once the user selects either of these personal use cases, the interface manager receives and forwards the request to the use case process agent for identifying and invoking required services to fulfill its execution. Finally, the interface manager receives service results from the use case process agent and then presents them to the user.

Use case process agent: The use case process agent receives use case requests from the interface agent and determines what processes of services are required for satisfying these requests. As shown in Fig. 4, the agent contains a process manager and four categorized process profiles. After receiving a use case request, the process manager identifies a process of required services by

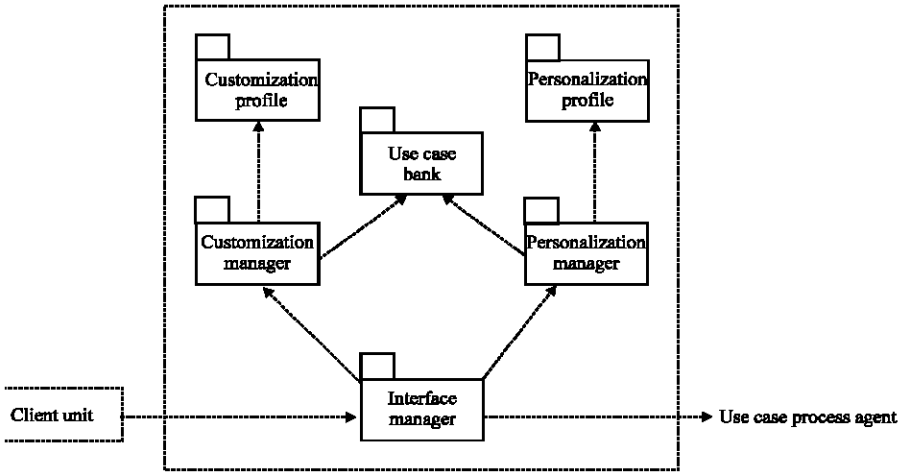

Fig. 3: The interface agent

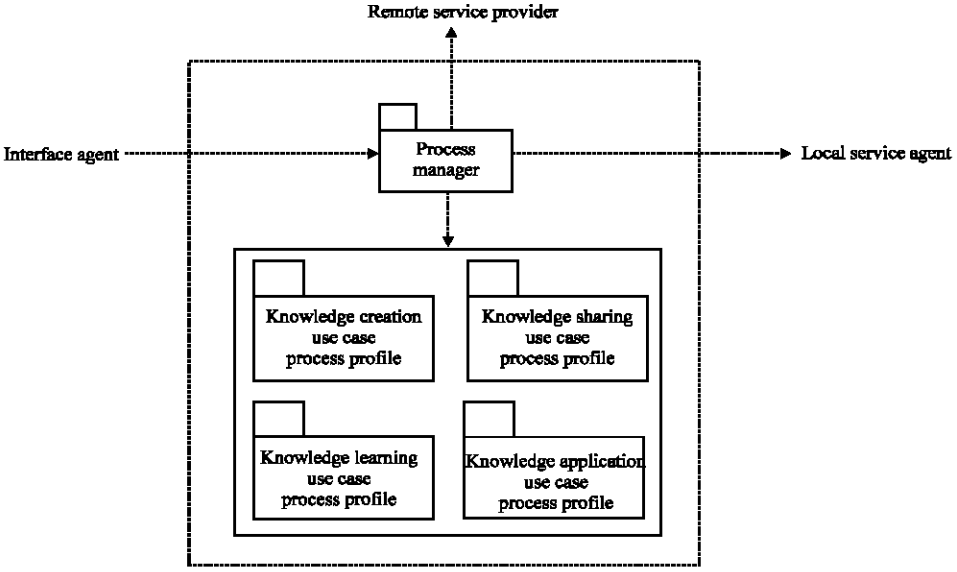

Fig. 4: The use case process agent

searching a process profile that designates the process of required services. Once identifying required services, the process manager determines first whether these services are provided by local or remote service providers and then forwards these service requests either to the local service agent at the local server or to some other service providers at remote servers. Finally, after receiving service results from the local or remote service providers, the process manager is responsible for composing these results as a whole and then returning it back to the interface agent.

Local service agent: The local service agent responds to any service requests from the use case process agent by providing these services through its local service directories. As shown in Fig. 5, the agent contains a service manager and four categorized knowledge-stored service directories. After receiving a service request, the service manager accomplishes it through accessing a designated directory that contains knowledge for achieving the desired (knowledge creation or sharing or learning or application) service.

The architecture for CSS: As presented by Lin (2009b), CSS has its architecture support the realization of system functions for effective information provision from multiple enterprises to customers. Based on its characteristics, CSS is structured into a 4-layer architecture where five components are imposed as shown in Fig. 6 (Lin, 2009b).

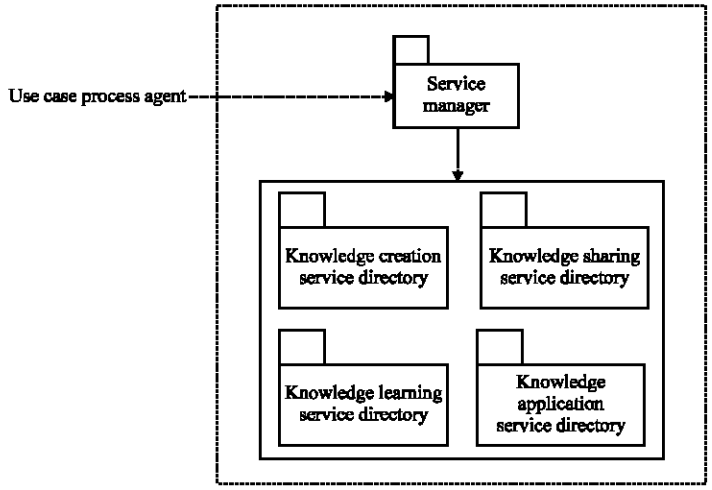

Fig. 5: The local service agent

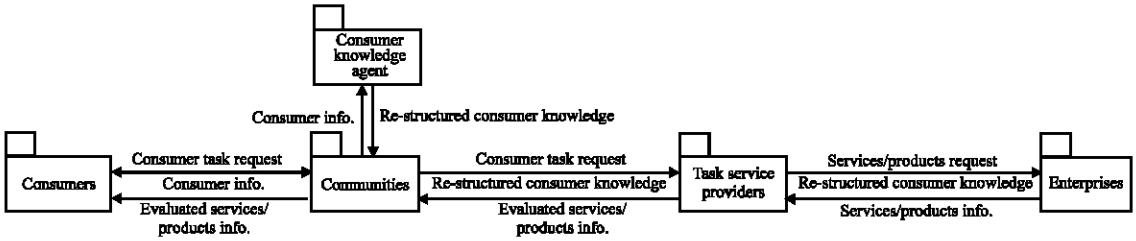

Fig. 6: The architecture for consumer support system

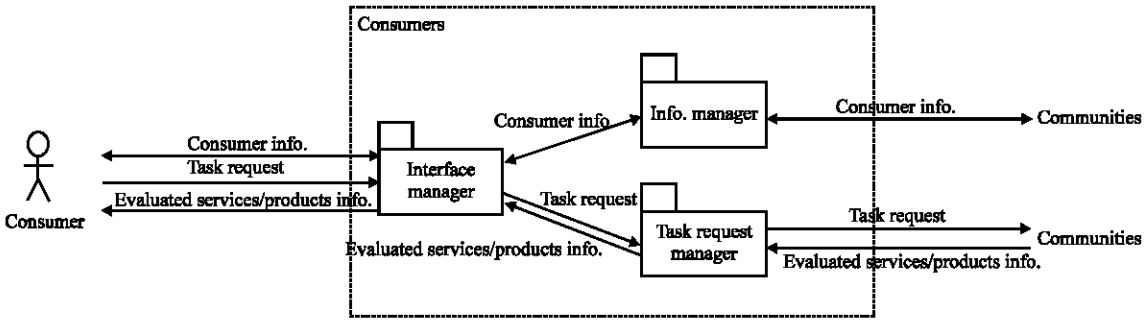

Fig. 7: The consumers component for consumers support system

Consumers: In CSS, consumers may make requests for their needs by issuing desired tasks in accordance with their knowledge or characteristics. To enhance their knowledge about these tasks, they may enroll into various communities for sharing/co-learning information among each other. After issuing task requests (via communities), consumers expect to receive information about available services/products. In particular, before presenting to consumers, any information about services/products should be collected (by task service providers) from various enterprises and then structured and evaluated to aid consumers on their analysis and decision making. Therefore, the Consumers component has the following two use cases: (1) share/co-learn consumer info. – help to interact with consumers to access information that is shared or co-learned (through communities) among each other and (2) issue task request-help to interact with consumers to issue task requests (through communities) and then present desired task-relevant services/products information (from communities).

To realize these use cases, the Consumers component has its components as shown in Fig. 7 where

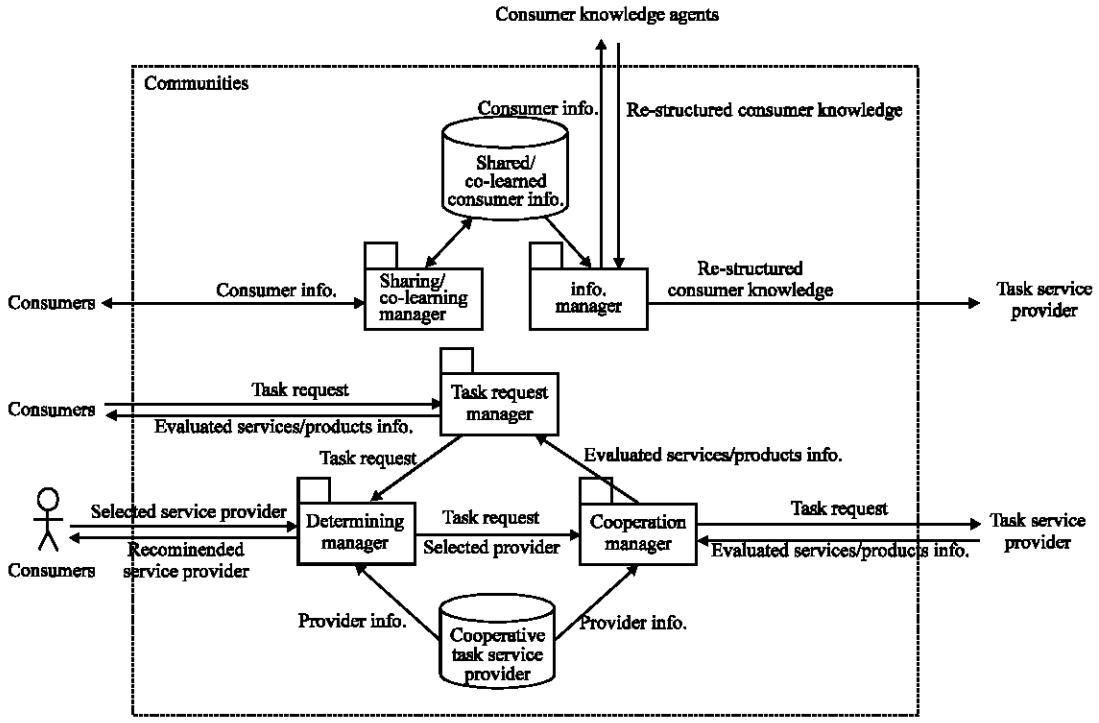

Fig. 8: Communities component for consumer support system

(1) the two Info. manager and Task request manager components are responsible respectively for realizing these two use cases and (2) the Interface manager components is employed particularly to assist the interaction with consumers to access their shared/co-learned information and task requests and then present their desired task-relevant products/services information.

Communities: Communities are organized for consumers to share/co-learn their information about their desired tasks or interested services/products. In addition, communities are also responsible for forwarding the information to some consumer knowledge agents that re-structure it into various styles of consumer knowledge. Communities then forward the knowledge to cooperative task service providers that will in turn pass it to enterprises for capturing what consumers really need. Finally, communities also provide consumers with such services as identification and recommendation of cooperative task service providers that are capable of accomplishing their task requests and negotiation and cooperation with those service providers selected by them to actually accomplish these requests. Therefore, the Communities component has the following five use cases: (1) share/co-learn consumer info.-help on information sharing/co-learning among consumers, (2) process shared/co-learned info.-forward shared/co-learned information to consumer knowledge agents that return re-structured knowledge and then forward the knowledge to cooperative task service providers, (3) process task request-receive task requests from and return desired task-relevant services/products information to consumers, (4) determine task service provider-identify and recommend cooperative task service providers to be selected by consumers and (5) cooperate with task service provider - negotiate and cooperate with selected service providers that actually accomplish task requests by returning evaluated services/products information relevant to these requests.

To realize these use cases, the Communities component has its components as shown in Fig. 8 where, (1) the Sharing/co-learning manager component accesses the Shared/co-learned consumer info. file for information sharing/co-learning among consumers, (2) the Info. Manager component retrieves that information for re-structuring into comprehensible knowledge by consumer knowledge agents, (3) the determining manager component accesses the cooperative task service provider file to recommend task service providers to be selected by consumers and (4) the cooperation manager component accesses it to cooperate with selected service providers that accomplish task requests by returning relevant services/products information.

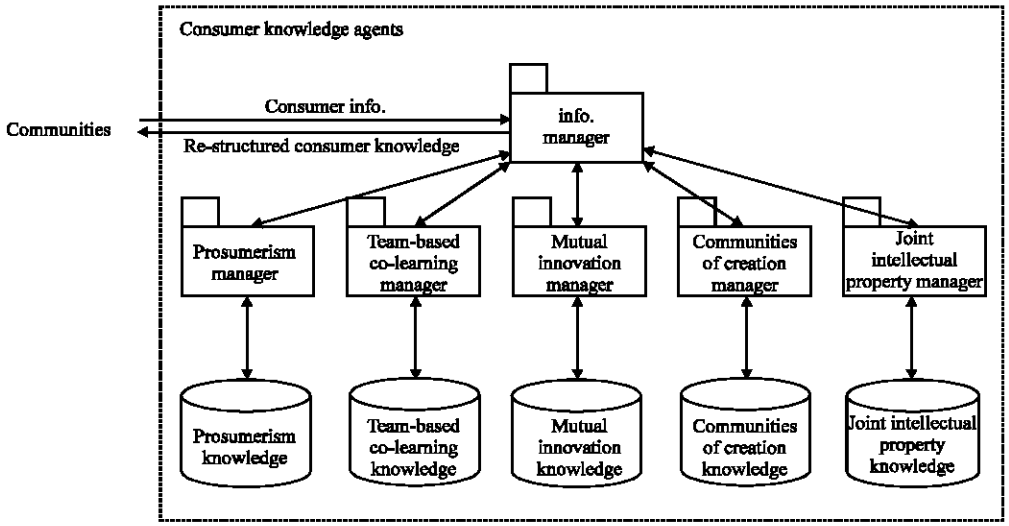

Fig. 9: The comsumer knowledge agents component for consumer support system

Consumer knowledge agents: In CSS, information from consumers is critical for enterprises to capture what they really need in order to provide services/products information truly useful for them. However, such information may initially be unstructured or complex and hence a mechanism for re-structuring it into comprehensible knowledge is necessary as the consumer knowledge agents component has the following two use cases: (1) process consumer info.-identify appropriate style(s) of knowledge where consumer information is categorized to capture truly valuable knowledge from consumers and (2) make consumer knowledge-re-structure consumer information into comprehensible knowledge.

To realize these use cases, the consumer knowledge agents component has its components as shown in Fig. 9 where each of the lower five components is imposed to access a style-specific knowledge file to make the corresponding style of consumer knowledge based on the received shared/co-learned consumer information.

Task service providers: Task service providers are an important intermediary between enterprises and consumers. For enterprises, they receive re-structured consumer knowledge from communities and based on the task-relevant extent, forward the task-relevant part of that knowledge to participant enterprises that utilize it to provide services/products information useful for consumers. For consumers, based on the task requests received from communities, they identify and cooperate with those participant enterprises that may provide services/products information desired by these task requests. Furthermore, with the information about task-desired services/products, they also help to evaluate it in a comprehensive and comparative model that is presented to consumers (via communities) to aid on their analysis and decision making. Therefore, the task service providers component has the following five use cases: (1) Process consumer knowledge-receive re-structured consumer knowledge from communities and forward the knowledge to participant enterprises, (2) process task request - receive task requests from and return evaluated services/products information to communities, (3) determine participant enterprise-identify and select participant enterprises that may provide services/products information desired by task requests, (4) cooperate with participant enterprise-cooperate with those selected enterprises to actually provide desired services/products information; and (5) evaluate services/products info.-structure and evaluate into a comprehensive and comparative model services/products information provided by selected participant enterprises.

To realize these use cases, the task service providers component has its components as shown in Fig. 10 where (1) the Determining manager component accesses the participant enterprise file to determine those participant enterprises that may provide services/products information desired by task requests and (2) the cooperation manager component accesses it to negotiate and cooperate with those selected participant enterprises to provide desired task-relevant services/products information.

Enterprises: Enterprises may respond to consumer task requests from task service providers with information about desired services/products. As mentioned above, to make the information truly useful for consumers,

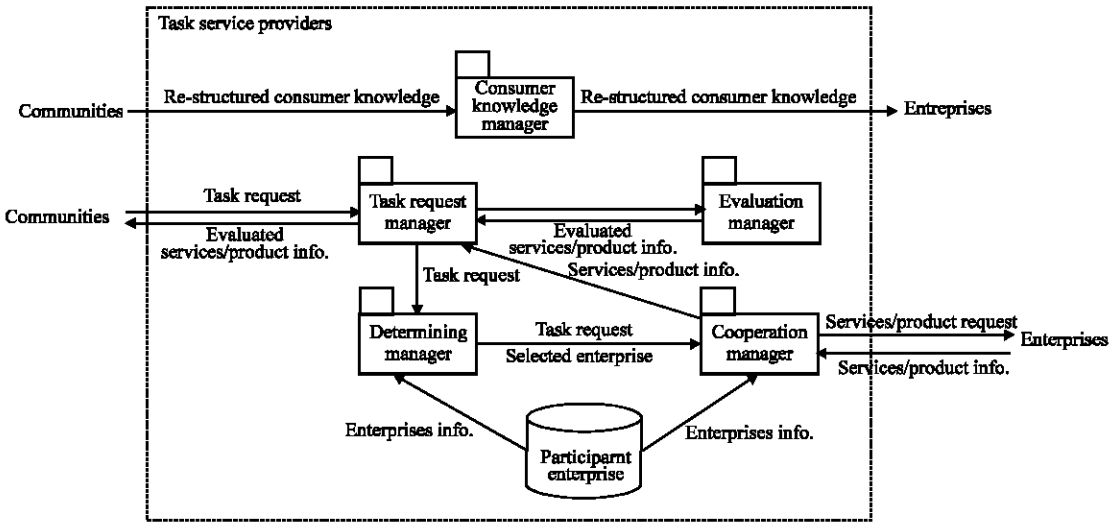

Fig. 10: The task service providers component for consumer support system

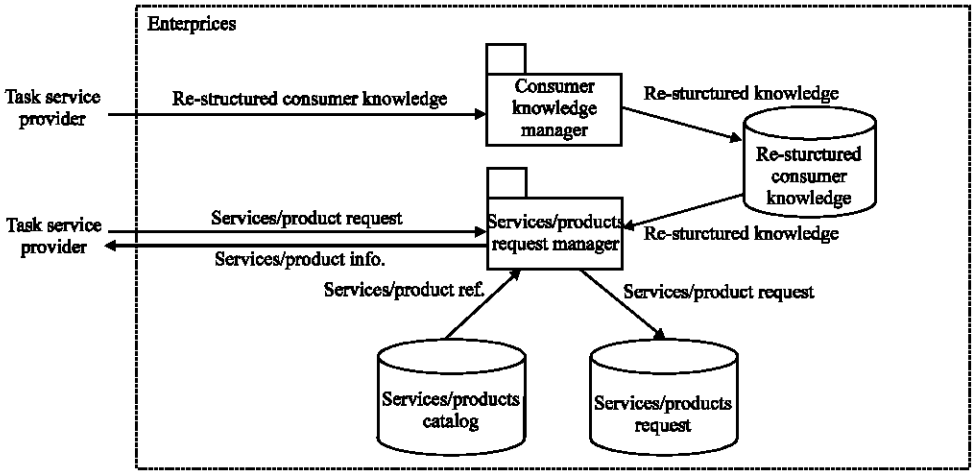

Fig. 11: The enterprises component for consumer support system

enterprises need to reference the re-structured consumer knowledge received from task service providers within the extent of those tasks requested by these consumers. Therefore, the Enterprises component has the following two use cases: (1) process consumer knowledge-store re-structured consumer knowledge for references to provide information truly useful for consumers and (2) accomplish task request-based on the consumer knowledge, accomplish task requests by returning task-desired services/ products information.

To realize these use cases, the task service providers component has its components as shown in Fig. 11 where (1) The consumer knowledge manager component accesses the Re-structured consumer knowledge file to store re-structured consumer knowledge on which information about those services/ products requested by these consumers is decisively based.

CONCLUSIONS

In this study, we review some existing systems by presenting their characteristics and discussing how these characteristics are useful for enhancing customer relationships. Amongst them, in particular, for CKM and CSS that are most recently concerned, we review also their architectures that address on their characteristics to provide guidance on their constructions. In summary, except for CSS, existing systems for enhancing customer relationships emphasize mainly on the information from

customers to enterprises where the reverse delivery of information is somehow insufficient; this results in a notable problem of information asymmetry that hurdles their effectiveness. For this issue, CSS is specifically structured to support effective bi-directional information flow between consumers and enterprises where sophisticated management mechanisms are particularly employed to help consumers on their decision making.

As possible future trends, although CSS enhances information flow from enterprises to customers, it does not address the issue of collaborative business between customers and enterprises where customers can benefit from business collaboration with enterprises by providing services to interested customers. For this need, a new discussion about the collaborative business between customers and enterprises may be presented in the future. Further, for those inherent integration issues in CSS (e.g., customers get used to participate in various communities to share/co-learn information about their experiences or requests on enterprises), comprehensive structures (e.g., semantic ontology) are therefore needed in its architecture to make it easy sharing or co-learning among customers or enterprises.

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