A Construction Method for the Ontology of Customer Information in Consumer Support Systems

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Abstract: For enterprises, customer relationships have been commonly recognized as a critical factor to succeed their business. Effective customer relationships could help enterprises deliver services to customers based on their needs, preferences, or past transactions. In this context, many discussions have already been presented where Consumer Support Systems (CSS) is most recently introduced that alleviates the shortcomings in other approaches by a 4-layer framework of collaborative mechanisms to support effective information/service provision between enterprises and customers. Since in CSS customers get used to participate in various communities to share or co-learn information about their experiences or requests on enterprises, a comprehensive structure for such information is therefore necessary for its easy sharing or co-learning among these customers. For this need and as a pristine way for knowledge-sharing by ontology, we present in this paper a method for the construction of an ontology that describes customer information with an easy understood structure. The method starts from the specification of the ontology based on the experiences of customers, through the browsing of their new ideas, and ends with the verification of its consistency. To illustrate, the method is applied in an exemplified application for travel arrangement.

Keywords: customer relationship management, community, customer information, ontology, method

1 Introduction

For enterprises, customer relationships have been commonly recognized as a critical factor to succeed their business. Effective customer relationships could help enterprises deliver services to customers based on their needs, preferences, or past transactions. In this context, many discussions have already been presented (1) Customer Decision Support (CDS) [1,2]; (2) Customer Relationship Management (CRM) [3-6]; (3) Customer Knowledge Management (CKM) [7-13]; (4) Recommendation System [14-16]; (5) Intelligent Agent [17,18]; and (6) Consumer Support Systems (CSS) [19].

In general, these approaches focus on using knowledge about customers (e.g., characteristics or preferences derived from their past transactions) or knowledge from customers (i.e., knowledge residing in themselves) to catch more customer information; their usefulness on enhancing customer relationships has already been demonstrated [7]. Among these customer-oriented discussions, CSS is most recently introduced that alleviates the shortcomings in other approaches by a 4-layer framework of collaborative mechanisms to support effective information/service provision between enterprises and customers. Based on its framework, further ideas about its architecture and development method can be found in [24-26] where the semantic architecture in [26] is particularly presented to address those inherent integration issues in CSS (e.g., customers get used to participate in various communities to share or co-learn information about their experiences or requests on enterprises, a comprehensive structure like semantic ontology for such information is therefore necessary for its easy sharing or co-learning among these customers).

After identifying semantic architectures for CSS, the construction of an ontology for describing customer information (e.g., about experiences or requests) or enterprise services becomes critical in that (1) as a pristine way for knowledge-sharing, ontology makes descriptions of customer or enterprise artifacts easy understood; and (2) ontology makes the matching of customer requests with enterprise services easy undertaken. For this need, we present in this paper a method for the construction of an ontology that describes customer information with an easy understood structure. The method is based in the well-known approach in [27] with emphasizing on collections of existing experiences and new ideas of customers. Thus, it starts from the specification of the ontology based on the experiences of customers, through
the browsing of their new ideas, and ends with the verification of its consistency. With such an ontology, customers can not only easily share/co-learn their words based on its structure and vocabularies, but also issue their requests in terms of its structure and vocabularies that make the matching of these requests with enterprise services easy undertaken. To illustrate, the method is applied in an exemplified application for travel arrangement. It should be noticed that in our method the constructed ontology will be expressed in convenient distinguishable notations; although there are already many ontology tools in the literature [28-30], we do not concern herein the notational comparisons between our work and these existing tools.

This paper is organized as follows. Section 2 presents our method that result in the creation of a graphical representation of an ontology that includes its classes, properties, and instances. To illustrate, the method is applied in an exemplified application for travel arrangement. Section 3 shows the usefulness of the ontology by making customer requests based on its easy understood structure. Finally, Section 4 has conclusions and our future work.

2. The development method

Our method elaborates on the approach in [27] with the following three phases:

Phase 1 – specifying ontology based on experiences of customers
1. determining domain and scope of the ontology that clarifies the domain and scope of the ontology being constructed.
2. defining classes and their hierarchy in the ontology that identifies a hierarchical structure of classes that describe representative concepts in the scope determined above.
3. defining properties and instances of classes that identifies internal structures and conceived instances of these new/revised classes.

Phase 2 – enhancing ontology by browsing new ideas from customers
1. soliciting new ideas about the scope that gets new ideas about the scope from customers.
2. defining new or revised classes and their hierarchy that identifies a revised hierarchy of classes to encompass those representative concepts in the new ideas determined above.

Phase 3 – ensuring consistency among components created above
1. determining consistency of components from the above phases that clarifies the consistency among those components created above.

where these three phases are usually repeated as many times as needed to make the constructed ontology encompass more complete representative concepts and conceived instances in the scope.

2.1 Phase 1 – specifying ontology based on experiences of customers

The first phase is to specify an initial ontology based on past experiences of customers (travel arrangement and relevant applications are used for illustration):

1. determining domain and scope of the ontology: clarifies the domain and scope of the ontology and which kinds of components will be included in the ontology. In this step, we consider: (1) what domain the ontology will cover; (2) what scope the ontology will be applied for; (3) who will use the ontology; and (4) what experiences under the scope these users have. These four considerations would result in statements about what the ontology will have that can be used to retrieve important terms about the ontology.

In our exemplified application for travel arrangement, these four considerations may have the following illustrative situations: (1) the ontology will cover travel domain; (2) the ontology will be applied for the scope of travel arrangement; (3) the ontology will be used by members in specific travel communities; and (4) these members will share or co-learn experiences about travel arrangement with expressive statements (e.g., experiences about transportation and accommodation for sight seeing at specific locations).

2. defining classes and their hierarchy in ontology: identifies a hierarchical structure of classes that describe representative concepts in the scope determined above. In this step, important terms in those statements derived above are first enumerated that represent critical concepts in the scope to be included in the ontology. Then, based on these terms and their representing concepts, a classified (from general to specific) structure of classes can be identified as the class hierarchy in the ontology.
For our example, after examining instances conceivable in travel arrangement and their intrinsic attributes or extrinsic links among each other, part of their defining classes may have properties and instances as shown in Figure 2 (may be interpreted as: ‘The Grand’ class has three attributes and two instances where ‘The Grand – Taipei’ instance has specific attribute values of which ‘location’ has value of a link to ‘Address’ instance of ‘Taipei City’ class).

2.2 Phase 2 – enhancing ontology by browsing new ideas from customers

This phase focuses on enhancing the ontology by browsing new ideas from customers which may be derived from their experiences or knowledge from other sharing/co-learning resources:

1. soliciting new ideas about the scope : identifies new ideas about the scope from customers. In this step, we emphasize on the fact that customers have usually innovative ideas derived from their experiences or from other sharing/co-learning resources; although these ideas may not be practical or feasible in the current domain or scope, their potential benefits still possibly make them attractive for discussions among customers such that enterprises may notice them and take into accounts whenever devising new services.

Therefore, we consider herein what new ideas ontology users may have that would extend or enhance applicable applications in the scope. For our example, after soliciting customers about travel arrangement, some new ideas may be identified that result in new or enhanced terms as shown below with underlines.

For our example, after examining instances conceivable in travel arrangement and their intrinsic attributes or extrinsic links among each other, part of their defining classes may have properties and instances as shown in Figure 2 (may be interpreted as: ‘The Grand’ class has three attributes and two instances where ‘The Grand – Taipei’ instance has specific attribute values of which ‘location’ has value of a link to ‘Address’ instance of ‘Taipei City’ class).

transportation Bus, Taxi, MRT
accommodation Grand Hyatt, The Grand, Grand Formosa, Wego Boutique
sight Palace museum, CKS memorial hall, 101 building, Shih-ling night market
location Taipei City

Based on these terms and their representing concepts, a classified structure of classes can be identified as shown in Figure 1.
3. **defining properties and instances of new/revised classes**: identifies internal structures and conceived instances of these new/revised classes. In this step, we consider: (1) what internal structure each new/revised class has that describes its intrinsic attributes or extrinsic links to other classes; (2) what instances each new/revised class has in the scope that can be conceived by ontology users. In our example, we consider those new/revised classes in Figure 3 for identifying their conceivable instances, intrinsic attributes, and extrinsic links as shown in Figure 4 (may be interpreted as: ‘The Grand’ class has a newly 4th attribute that makes its ‘The Grand – Taipei’ instance has a connection to ‘Trail – BaLi’ instance of ‘Riverside trail’ class and also Riverside trail’ class has two new attributes that make its ‘Trail – BaLi’ instance has a connection to ‘Bicycle – BaLi’ instance of ‘Bicycle’ class).

### 2.3 Phase 3 – ensuring consistency among components created above

The last phase is to verify the consistency among those components identified above for ensuring the usefulness of the ontology:

1. **determining consistency of components from phases above**: clarifies the consistency among those components created above. In this step, we consider if those components created above are consistent in terms of the reflection, transmission, contradiction, and redundancy relationships among them [31]. In case there are violations among these components, modifications on them must be made to ensure their consistency for usefulness. In our example, for those components in Figure 4, their consistency can be easily verified by examining their relationships among each other.

3. **Applying the ontology for making requests**

In this section, we illustrate the usefulness of the ontology created above by making customer requests based on its easy understood structure.

**customer requests for travel arrangement**

In our example, each customer may desire some services about travel arrangement after sharing or learning related experiences from other members in specific travel communities. For instance, he/she may desire to have a travel with the following arrangement: _The travel is accommodated at the Grand hotel in Taipei that arranges a tour for biking along riverside trail around the BaLi township_. Once such a desire is identified, a formal request for satisfying it can then be made based on the ontology as shown in Figure 5.
In our best knowledge, with this formal customer request, its being satisfied by possible enterprise services can be simply identified in an automatic manner in case these services and their instances and properties are specified also in ontologies (e.g., traversing the service ontology to ensure each desired instance or property in the request is matched with a corresponding component in the service ontology). With such mechanisms that specify customer information/requests and enterprise services by ontologies, and that ensure matches between them by automatic ways, CSS could provide customers with enhanced supports on (1) participating in various communities for sharing or co-learning information about their experiences or requests on enterprises; and (2) ensuring matches of their requests with enterprise services where they make final selections to satisfy these requests.

4 conclusions and future work

In this paper, we present a development method for constructing an ontology in CSS that describes customer information with easy understood structure. The method starts from the specification of ontology based on experiences of customers, through the browsing of their new ideas, and ends with the verification of its consistency. For a CSS with such a formal ontology, customers could get enhanced supports on (1) participating in various communities for sharing or co-learning information about their experiences or requests on enterprises; and (2) ensuring matches of their requests with enterprise services where they make final selections to satisfy these requests. In our best knowledge, this makes CSS good for enhancing customer relationships by providing effective supports on their decision making that is usually accomplished through such steps as information gathering, request making, and service ensuring. As our future work, we will continue to explore the construction of the ontology for enterprise services and also the matching between request and service ontologies (e.g., traversing the service ontology to ensure each desired instance or property in the request ontology is matched with a corresponding component in the service ontology). As one may conceive, this complete work makes CSS good for enhancing customer relationships by providing effective supports on their decision making that is usually accomplished through such steps as information gathering, request making, and service ensuring. Thereafter, in addition to travel arrangement, we will look also forward to the practical use of our work in other domains like executive information systems; its usability on such decision support systems will also be carefully experienced.

References


