Modeling for intelligent tourism e-marketplace based on ontology

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Ⅰ. Introduction

40% of all business transactions on the Internet are e-Tourism related transactions all over the world. In 2003, more than 64 million Americans-30% of the U.S. adult population-used the Internet to look for information about destinations or to check prices and schedules. And two thirds of them-42 million-booked travel via the Internet, and 8% gain over 2002, according to Travel Industry Association of America (www.tia.org). In the same period, travel sale of European online increased

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by 44%, reaching over $14 billions, according to the Regional and Tourism Research(www.crt..dk) by the Danish Center.

On the other hand, the World Wide Web (WWW) based on the Internet, as we know it today, is a huge collection of information. The number of websites on the WWW is growing daily. Still, this increase of information is not tantamount to an increase of functionality, that is, information extraction has become a difficult task. Finding a certain piece of information is like looking for a needle in a haystack. Common search engines can perform searching based on keyword. Still, the number of results usually is enormous and not manageable by the human reader. For the human user it is simply impossible to go though all the websites that are delivered as results to a query. The Semantic Web promises a solution to this problem. The Semantic Web site contains additional metadata for describing the existing web site semantically. Semantically annotated websites can not only be understood by the human reader but also by machines. Enriching websites with machine-readable semantics will enable more intelligent and efficient searching and further processing of data without requiring the human user to interfere.

The area of e-Tourism is an area where the benefits of applying Semantic Web technologies can be shown easily. For example, when tourists want the personalized tour package, they prefer to stay at accommodations that are as close as possible to an infrastructure where they can partake in activities. Because the existing web technology enables the infrastructure and accommodation to be searched independently, human user has to find out accommodations that are as close as possible to an infrastructure where they can partake in activities. This is cumbersome work. But, it is possible to find out accommodations with adjacent infrastructure or the other related information by the Semantic Web technology. In other words, it is possible to provide the customized tour package information owing to semantic search engine by Semantic Web technology.

But, in order to search the information of websites semantically, the existing web sites have to be updated or changed to semantic websites enriched with machine-readable semantics. The search engine, which can search over the semantic

websites, also has to be developed. These works might be difficult and massive so that they might be actually impossible. In another device, we might consider that the all tourism information over the existing websites might be gathered and stored into integrated RDB(relational database) by additional operations. Then, the RDB is retrieved and processed being based on semantic. But, it is necessary to gather the dynamic tourism information continuously with constant time interval because the tourism information might be changed dynamically. Thus, this method also requires massive and difficult tasks.

In efficient and desirable device, we consider tourism e-marketplace based on semantic in order to provide the tourism information over existing websites semantically. Tourism suppliers, who are owners of accommodation, transportation facilities, tourism infrastructure and so on, enroll information of their tourism products into the tourism e-marketplace. Tourism purchasers, who are travel agencies, tourists and so on, use and buy information of their tourism products in the tourism e-marketplace. The tourism suppliers might be good owing to getting opportunity for selling their tourism products. The tourism purchasers might be good owing to using and processing the tourism information efficiently. Specially, the tourism information is automatically accumulated into RDB in e-marketplace by the tourism supplier. It is possible to retrieve and process the tourism information semantically if ontology technology of Semantic Web technologies is applied into RDB of e-marketplace.

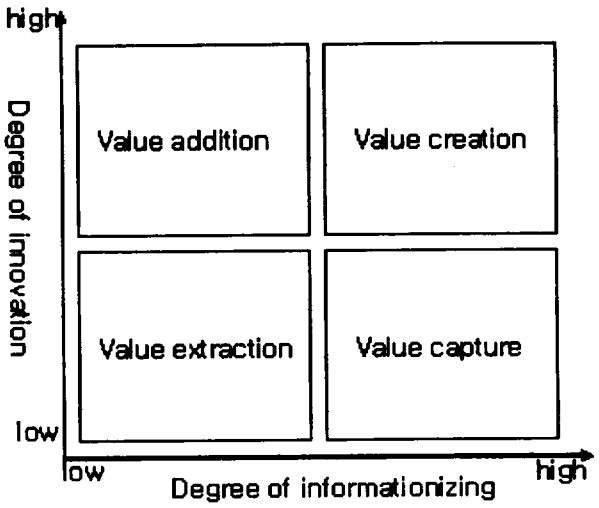
In this paper, we will not only propose model for tourism e-marketplace, but also propose methodology for applying the ontology technology into the tourism e-marketplace in order to reduce functional complexity, which is one of factors that influence the success of the tourism e-marketplace. In chapter 2, we will observe about e-Tourism, Semantic Web and e-marketplace. In chapter 3, we will propose model of tourism e-marketplace and methodology for the ontology technology to it. At last, we will conclude inn chapter 4.

Ⅱ. Background

2.1 e-Tourism

E-Tourism is an Internet based business system including tourism and its distribution system carried out by electronics, based on tourism information and e-commerce(Si-qing Lui,2005). Generally speaking, consumers use tourism industry Web sites to obtain road maps(59%), accommodation(54%), activity programming(46%), air fares(45%), restaurants and entertainment(36%) and calendars of local events(26%) (Scott's Business Directory, 2002). When being considered with this actuality, e-tourism might be defined as business that transacts tourism products using business models like B2B(business-to-business), B2C(business-to-consumer), C2C(consumer-to-consumer) and B2B2C(business-to-business-consumer) through Internet. B2B2C describes companies that sell products or services to companies that in turn sell to consumers, all via the Internet. In another word, it describes transactions in which a business sells a service or product to a consumer using another business as an intermediary. Because tourism products, which are accommodations, transportation facilities and tourism infrastructures, are distributed into tourists through intermediary like travel agency, we insist that the tourism products are traded through B2B2C business.

<Fig.1> expresses types of e-Tourism model which is divided into four IT (Information Technology) methodologies, which are Value extraction, Value capture, Value addition and Value creation, being based on basis of horizontal and vertical axis (Si-qing Lui,2005). The degree of innovation is represented in the vertical viewpoint. The degree of innovation in terms of information technology can be divided into adopting traditional information technology and adopting information technology based on Internet. The horizontal axis represents the degree of informationizing the value chain in tourism industry.



<Fig.1> e-Tourism Model

We can derive e-Tourism strategies by knowing what each type of e-Tourism model means. Value extraction is strategy which increases efficiency and reduces costs, include process automation and client outsourcing, such as self-check-in of hotel guests or airline passengers. Data mining for forecast or yield management is an example of Value capture strategy, in which client and sales information supports marketing goals. Value addition strategy involves a linear combination of products and services to create richer product bundles. One example is the linkage of mobile services and existing Web sites, to advise tourists during their travel. Value creation is strategy that the focus here is on network effects, involving, for example, tourists participating in service definition and destination planning.

The best model for e-Tourism is to adopt the strategy of Value Creation so that the tourism information is to be searched semantically and processed intelligently. Technology for enabling Value creation strategy is Semantic Web technology, which is focused on ontology technology.

2.2 Semantic Web

Semantic Web, which is next web technology, is to add meta data to the existing

web sites in order to search and process information semantically and intelligently. The Semantic Web is an extension of the current Web, in which data is given a well-defined meaning by representing it in RDF/OWL/DAML+OIL and linking it to commonly accepted ontologies. This semantic enrichment allows data to be shared, exchanged or integrated from different sources and enables applications to use data in different contexts.

There are many researches related with the Semantic Web. In (Christian Bizer, 2003), technique was proposed to extract automatically ontology from relational database. Model was proposed to map between heterogeneous ontologies(A.Dogac, Y.Kabak, G.Laleci, S.Sinir, A.Yildiz, S.Kirbas, Y.Gurcan, 2004). In (Michael Dittenbach, Helmut Berger and Dieter Merkl,2004), method was proposed to improve knowledge in ontology by text mining. In (Sven Abels, Liane Haak and Axel Hahn, 2005), method was proposed to integrate heterogeneous ontologies. In (Zhan Cui, Dean Jones and Paul O'Brien,2002), methods were proposed to query from heterogeneous database by using ontology. In (Michael Uschold, Michael Gruniger, 2004), it was described to connect heterogeneous environments being based on ontology. In order to support to search effectively in portal site, method was proposed to build ontology analyzing patterns of browsing portal site(Nenal Stojanovic, Jorge Gonzalez and Ljijana Stojanovic, 2003). Algorithm was proposed to translate ontology in OWL into relational data(Anuradha. Gali, Cindy X. Chen, 2004). These researches are classified into three categories, which are area for generating ontology efficiently(A.Dogac, et. al, 2004; Christian Bizer, 2003; Michael Dittenbach, et.al, 2004; Sven Abels, et.al; 2005), area for processing information intelligently using ontology(Michael Uschold, et.al, 2004; Nenal Stojanovic,et.al, 2003; Zhan Cui,et.al, 2002) and area for managing ontologies efficiently(Anuradha. Gali, et. al, 2004).

2.3 e-marketplace

E-marketplace is defined as cyber space in Internet that suppliers and purchasers

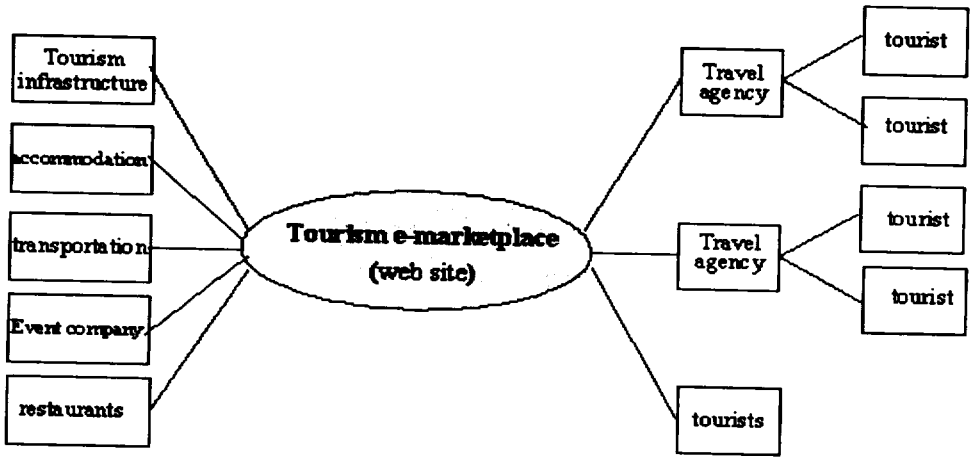
in many companies can buy and sell products and services of their companies with satisfactions through diverse method(.Soh Ho Ik, 2000). That is, e-marketplace means space in Internet for e-commerce between companies. In viewpoint of suppliers, there exist many opportunities to sell their products because there are many purchasers in the e-marketplace. In viewpoint of purchasers, they have broad range to select the preferred products. E-marketplace does not only change methods of the existing transactions, but also derives innovation of business process so that it will change business process efficiently. It changes complex and inefficient existing transaction processes in off-line into efficient and reasonable processes. It reduces transaction cost considerably through innovative and transparent transactions. E-marketplace is different concept from simple B2B shopping mall sites, which contain simple function for only e-commerce. It connects and integrates between supplier company and purchaser company

For successful e-marketplace, first of all, many companies, which are more than critical mass, have to participate in the e-marketplace. In (Soh Chang Kyo, et al., 2001), the paper discusses about factors that influence on participating in e-marketplace. The factors are explained in being divided into four characteristics, which are characteristic of environment, characteristic of organization, characteristic of innovation and characteristic between organizations. The characteristic of environment includes factor of competition strength and factor of uncertainty. The characteristic of organization includes factor of CEO's support and factor of information system infrastructure. The characteristic of innovation includes factor of relative advantage, factor of compatibility with legacy system and factor of functional complexity. The characteristic between organizations includes factor of dependency between companies and factor of transaction custom.

Ⅲ. Tourism e-marketplace model based on ontology

3.1 tourism e-marketplace

Tourism e-marketplace is the concept that applies the concept of e-marketplace to tourism industry. In this paper, we define the tourism e-marketplace as web site that supports to buy and sell tourism products between tourism suppliers and tourism purchasers through diverse purchase ways with providing optimal negotiation between supplier and purchaser. In tourism industry, the suppliers might be company of providing tourism infrastructure, accommodation like hotel, transportation company like airplane and rental cars, company of planning tourism activities, company of providing restaurant business. The purchasers might be travel agencies and tourists. <Fig.2> shows tourism e-marketplace model.



<Fig. 2> tourism e-marketplace model

When we consider factors of influencing on participating in e-marketplace, we expect high degree of participating in tourism e-marketplace because the factors exist also in tourism industry. In viewpoint of environmental characteristic, the competition strength will become stronger because the number of tourists becomes increased all over the world, tourism industry become more important so that the number of

tourism companies also become increased. Analyzing in viewpoint of organizational characteristic, we think that the information system infrastructure was built because most of tourism companies own their web sites.

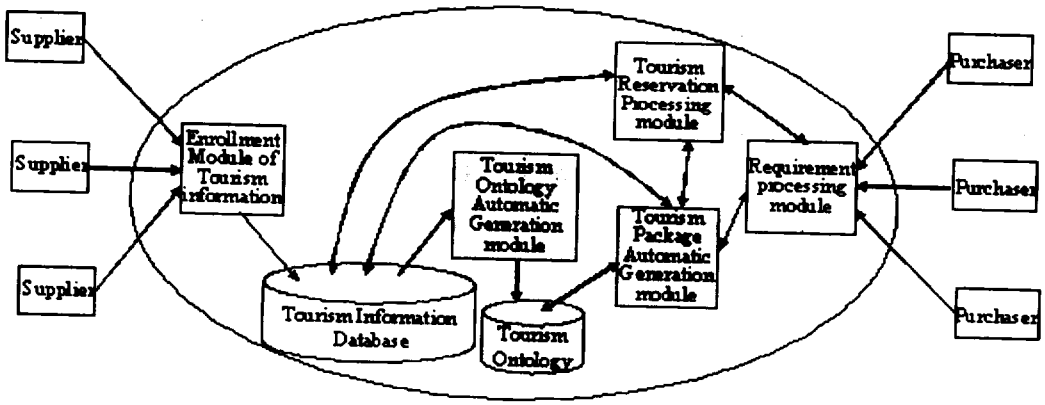
When we analyze in terms of innovation, we consider that the existing web site can be compatible with tourism e-marketplace because the existing web site will be still needed although the tourism e-marketplace is introduced. When tourism reservation requests are demanded from tourists into travel agency through web site, operators of the travel agency reserved the request through telephone, fax and so on before the tourism e-marketplace is introduced. But, when there exists tourism e-marketplace, the reservation processes might be processed through the tourism e-marketplace more efficiently. This situation also has relative advantages being compared with being processed through telephone and fax. If the tourism e-marketplace is built being based on semantic, it enable users to use the tourism e-marketplace more easily so that the functional complexity of it might be alleviated. When we analyze in terms of characteristic between organizations, dependency between tourism companies might be strong because the tourism companies participate together in constituting the tourism package. Thus, we expect that tourism e-marketplace becomes successful e-marketplace in which many companies participate.

3.2 tourism e-marketplace model based on ontology

Tourism e-marketplace is a kind of e-tourism because of business system in Internet which is for trading tourism products. As we discuss in the front, the best model for e-Tourism is to introduce Value Creation strategy through adopting the Semantic Web focusing on the ontology technology so that the tourism information is to be searched semantically and processed intelligently. When the request of tourism reservation comes into the tourism e-marketplace, it is example of intelligent processing to generate customized tourism package automatically by understanding requirements of tourists semantically in the tourism e-marketplace. Because intelligent

processing of tourism information enables users to utilize the tourism e-marketplace more easily, the functional complexity of the tourism e-marketplace is relieved so that it might enable more companies to participate in it.

Thus, it is necessary to build the tourism e-marketplace being based on ontology. <Fig.3> shows the model of the tourism e-marketplace being based on ontology. <Fig.4> shows scenario for processing information being based on ontology in the tourism e-marketplace.



<Fig.3>Model of Tourism e-marketplace based on ontology

1. Suppliers enroll the tourism reservation information into [Tourism Information Database]. The diverse tourism information are integrated and stored into Tourism Information Database.
2. [Tourism Ontology Automatic Generation module] generates ontologies based on OWL by deriving class, properties and inference rules through using GROUP BY SQL query or data mining technology. [Tourism Ontology Automatic Generation module] utilizes up-to-date data through being executed within regular interval.
3. Purchasers do not only process the reservation request by retrieving tourism reservation information from tourism information database, but also can accomplish the reservation request through generating the customized tourism package automatically by utilizing [Tourism Package Automation Generation Module]

<Fig.4> information processing scenario of tourism e-marketplace

Ⅳ. Conclusion

Ontology is meta data and knowledge framework of specific domain. The ontology is more effective when it is applied to narrow domain rather than broad domain. Thus, it is desirable to apply ontology to tourism.

We analyzed that the tourism e-marketplace might be successful because factors, which influence on participating in it, also exists in tourism industry. It was desirable for tourism e-marketplace to adopt Value Creation strategy because tourism e-marketplace is a kind of e-tourism. Value Creation strategy might be accomplished through Semantic Web focusing on Ontology technology. It was also necessary for the tourism e-marketplace to adopt ontology in order to relieve the functional complexity of the tourism e-marketplace.

In this paper, we proposed the model of tourism e-marketplace into which ontology technology was applied. The model used technologies that generate OWL ontology automatically from relational database and generate the customized tourism package automatically.

After this, we will execute empirical study in order to observe how the factors influence practically on the tourism e-marketplace. Also, we will devise algorithms that generate OWL ontology automatically from relational database and the customized tourism package automatically.

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