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A Study of Building B2B EC Business Model for Shipping Industry Using Expert System

*Song Jin Yu**

***Division of Shipping Management, National Korea Maritime University, Busan 606-791, Korea*

ABSTRACT : The use of the internet to facilitate commerce among companies promises vast benefits. Lots of e-marketplaces are building for several industries such as chemistry, airplane, and automobile industries. This study proposed new B2B EC business model for the shipping industry which concerns relatively massive fixed assets to be fully utilized. To be successful the proposed model gives participants to support useful information. To do this the expert system is constructed as the hybrid prediction system of neural network (NN) and memory based reasoning (MBR) with self-organizing map (SOM) and knowledge augmentation technique using qualitative reasoning (QR). The expert system supports participants useful information coping with dynamic market environment. with this transportation companies are induced to participate in the proposed e-marketplace and helped for exchanges easily. Also participants would utilize their assets fully through B2B exchanges.

KEY WORDS : Shipping *industry, B2B EC, expert system, neural network, qualitative reasoning*

1. Introduction

Electronic marketplaces are becoming important players in several industries because they promise to greatly improve economic efficiently, reduce margins between price and cost, and speed up complicated business deals. The services they provide will expand many companies' purchasing and selling abilities, and will make prices more dynamic and responsive to economic conditions.

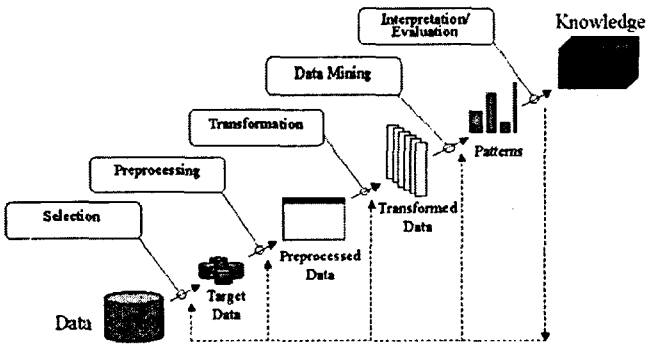
E-marketplaces are fascinating because they present serious technical challenges. Several vendors offer software and services to support them, but requirements are expanding and shifting as markets develop. E-marketplaces are sensitive to business details, and small changes in the rules of engagement can profoundly alter a marketplace's attractiveness and profitability. A successful exchange can aggregate more activity than an individual buyer's or seller's site, but a marketplace's structure determines whether it is a desirable place to do business. E-marketplaces should manage participants, information, and business processes the flow of information and the business transactions that are the heart of the activity. More formally, an exchange should support security, liquidity, transparency, efficiency, and anonymity. Therefore, for the participants of e-marketplace customer relationship management (CRM) is needed.

The customer is the core of CRM. CRM is nothing more than one-to-one relationship marketing, but that is a lot. Effective CRM is much more than great customer service or high-quality products. It's about building powerful and personal relationships. It's about learning from a company's customers and acting on what it knows

Usually, CRM initiatives are launched to strengthen relationships with customers and ensure they become more profitable. Success depends on managing customers across front-office functions (Sales, Marketing and Service) and channels (direct sales force, call centers, the Web, retail outlets, resellers, etc).

Many companies continue to have silos of customer information dispersed throughout the enterprise. Under these circumstances, data unification becomes the first priority. Once a company has developed this informational foundation, it is critical to begin initial efforts at customer analysis. Afterwards, it is on this foundation of knowledge that they can begin to enhance their channel and customer interaction strategies. Anyway, customer differentiation and valuation is first step of CRM and so important. To do this, data mining is needed and web mining is needed especially for e-marketplaces.

Fig. 1 an Outline of the Steps of the KDD Process



Adapted from Advances in *Knowledge Discovery and Data Mining*, AAAI Press, 1995(pp.10)

Web mining is an important part where a company initiates eCRM. Data mining, or knowledge discovery in databases (KDD), is a term usually applied to techniques that can be used to find underlying structures and relationships in large amounts of data. The unifying goal of the KDD process is to extract knowledge from data in the context of large databases. It does this by using data mining methods (algorithms) to extract (identify) what is deemed knowledge, according to the specifications of measures and thresholds, using a database along with any required preprocessing, sub-sampling, and transformations of that database. It is becoming more important as computer automation spreads and as the processing and storage capabilities of computer increase. Widely available, low-cost computer technology now makes it possible to both collect historical data and to institute on-line analysis and controls for newly arriving data.

This study is organized as follows. In section 2 flaws in traditional B2B model and current states of transportation industry in B2B EC are reviewed. Section 3 describes core systems of the proposed B2B business model which support useful information for decision-making through data-driven approach in dynamic environment. With designed systems in section 3, new B2B business model for transportation is constructed and described in section 4. And conclusion will be followed.

2. Literature Review

Like as Alvin Toffler's forecast, "21th century will be new marine era," the sea is appearing the front of history. Especially, with advent of WTO in 1995 trade barriers among countries are being collapsed and unlimited competition and continuous economic growth with rapid progress of hi-tech change continuously maritime environments.

Recently B2B EC is going to be introduced and boosted in maritime industry. With this trading mechanism of traditional maritime industry and roles of intermediate organization within this mechanism are going to be changed. On the other hand, most of B2B activity to date has centered on online exchanges and auctions, and most observers have assumed that these e-marketplaces would come to dominate the B2B landscape. However, they suffer from meager transaction volume and equally meager revenues, and they face a raft of competitors.

Richard Wise and David Morrison (2000) pointed out that the current B2B model has three fatal flaws. First, the value proposition offered by most exchanges competitive bidding among suppliers allows buyers to get the lowest possible prices runs counter to the best recent thinking on buyer-supplier relations. Second, the exchanges deliver little benefit to sellers. Finally, the business models of most B2B exchanges are, at best, half-baked.

The current B2B model, propped up by cheap investment capital, is not sustainable. As the markets mature, they will have to evolve in ways that fix the problems of the existing system. New structures will enable buyers and suppliers to form tight relationships while still enjoying the reach and efficiency of e-commerce.

3. Design of Expert System Using AI Tools

3.1 MBR-and Neural Network-Based Expert System

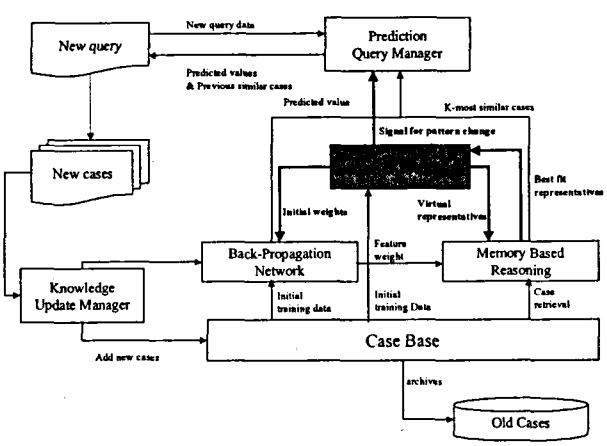


Fig. 2 Framework of memory- and neural network- based expert system with a unified approach

While it is important that general B2B EC business models give a relevant service for buyers according to

their needs, it is important that B2B EC business model for shipping industry helps suppliers to fully utilizing their assets. Therefore, in a proposed business model building up knowledge bases for supplier is the core.

In developing and refining knowledge base, pattern analysis of input data using SOM(Self-Organizing Map) is performed at first as shown in Fig. 2.

SOM gives us useful information in two ways. At first, we can discriminate using SOM whether several sets of data have same distribution. With the theoretical background of Shannon's information theory, we can compare feature maps of them is the same and infer different maps means different sets. We can also do it indirectly by mapping onto discrete output space for several sets of data using a same feature map. If the results of mapping are different, they have different distribution functions. This ability of SOM helps expert system to adapt in dynamic environments.

Secondly, an analysis of feature map itself diminishes learning burden of BPN(Back-Propagation Network) and gives MBR(Memory Based Reasoning) virtual cases that are meaningful features of data. Since there is no formal method to settle the network architecture of BPN, exploratory experiments are performed iteratively until the proper network is obtained. Since initial weights of network are randomized values near zero in training, more experiments are required to avoid local minimum. Features of input patterns can help to setup initial weights and threshold values of BPN, and inform whether training of partial data divided by features of input patterns is more efficient for acquiring good knowledge than training of whole dat

For the development of a knowledge base, BPN and MBR can be used for both of classification and regression tasks without any converting mechanism. BPN generally generates one real-valued output per output node. One can set some threshold values to interpret the value as a predicted class for classification tasks. MBR retrieves a set of k most similar previous cases and assigns the class that is most frequent in the set. As for regression tasks, the output of BPN can be directly interpreted as the predicted value. MBR generally averages the target value of similar cases. Both of methods can easily refine their knowledge as new cases are appeared. BPN can modify the weight set as more data are newly introduced. On-line learning is possible for the memory-based reasoning. One can update the case base with new and fresh data and exclude old data from the case base whenever SOM warns that the features of new data are different from them of old.

In our architecture of memory- and neural network-based prediction system, integration of prediction result is carried by the Prediction Query Manager (PQM). PQM receives new data and consult to BPN and MBR concurrently. When both predictors coincidein prediction, PQM answers with predicted values. When the results are different largely from each other, PQM answers the suspicious result with most similar previous cases. When disagreement of both methods occurs frequently, PQM might sent a warning signal which indicates that the knowledge base may not cover the whole space of data or that something wrong is going on the prediction system itself. Knowledge Update Manager (KUP) takes the role of providing new cases for knowledge refinement. For MBR old cases may just take unnecessary storage space in a case base and delay searching similar cases, and they may even hinder MBR from correct prediction in a dynamic situation like semiconductor industry. Besides, old knowledge of BPN may not fit new cases of current environments or processes. Whenever SOM module catches a signal of any change about application areas, KUP provides new cases for retraining of BPN and adjusting a case base of MBR.

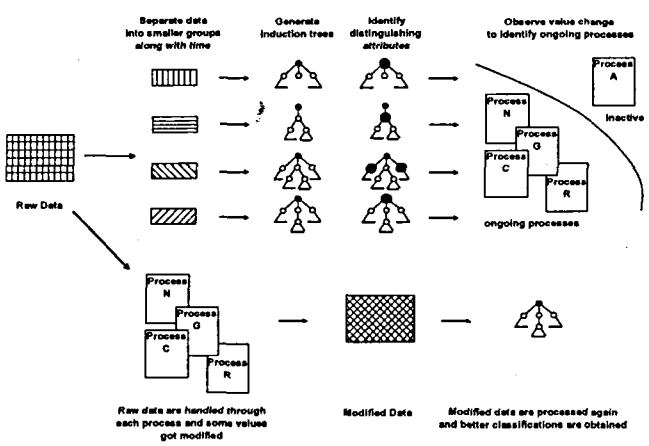


Fig. 3 Data and control flow of Decision Support System

3.2 Decision Support System Using Qualitative Learning

The proposed expert system mentioned above has a good capability for prediction adapting to highly dynamic environment such as shipping industry. But expert systems have limitation that their prediction abilities are good only in definite time period. It is difficult that the knowledge base built up with the existing data have long-term knowledge and qualitative knowledge. To overcome these

limitation, the decision support system using qualitative reasoning is introduced.

General data and control flows are illustrated in Fig. 3. The data and control flow can be traced in two separate paths. Following the upper path, it is the *analysis mode;* and the one in the bottom of the figure is called the *application mode.* In the analysis mode, we look at the data and pay attention to the changes among data values. These changes will serve as a clue during the procedure of identifying which processes are currently active. Once the active processes are identified, we then proceed to the application mode. In this mode, the effects due to any active process will be applied to the data samples and some attribute values will be modified. The modification is aiming at making the existing phenomena more prominent so that they can be captured by the concept classification system.

In identifying the underlying processes which are affecting the values of each company's data, we need to pick distinguishing attributes from among the attributes to be observed. These attributes are determined by comparing decision trees obtained from different subgroups of the data.

In the following, we present out method of identifying the distinctive attributes from the attributes of an entire data set. In general, it takes two stages to complete the task. The first is to compare, and the second to verify. In the first stage we make up two less general yet contrasting concepts and represent these two concepts in the form of decision trees. In generating the decision trees, we may need to feed in all or only a portion of the entire data set, depending on the characteristics of the concept in question. After the trees are generated, we then look closely at the attributes that constitute each tree. Since each tree is made up of different attributes, the comparison of the presence and absence of each attribute in each decision tree, and of the ranking of those attributes appearing in a tree will help us identify what attributes play a more significant role in a decision tree.

The attributes being identified as distinctive in the first stage are only good when considering each decision tree alone. Furthermore, as we mentioned above, each of the trees represents nothing but a less general concept, or a sub-concept, of the final concept in which we are interested. Thus in the second stage, we will need to verify that those attributes selected in the first stage are important for the final concept as well. To do so, we compare the trees for sub-concepts with the decision tree generated for the final concept. The idea is that some attributes, while being distinctive for an individual decision tree, may provide conflicting information when considered collectively with attributes present in other decision trees. The purpose of conducting the comparison in the second stage is to guard against this kind of side effect. More detail description about the second stage is as following.

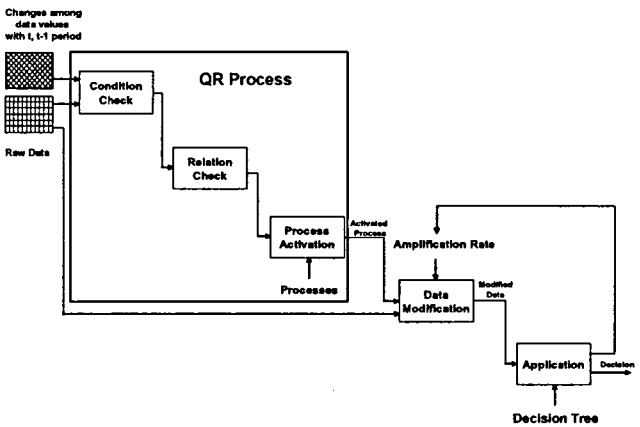


Fig. 4 Knowledge augmentation procedure using QR

Fig .4 describes a knowledge augmentation procedure from static-valued data using QR we call it the *application mode.* First the same company's data at different times were checked to see whether they were activating a certain ongoing process or not, which describes qualitative changes during the time unit. When the whole activation condition of the process was satisfied, an activated process was fired. This means that the next financial data will be changed following it, and it is proposed that the company's strategy not be changed. But it will not tell how much it is changed. So we modify the related attributes of the financial data with a meaningful amplification rate. Modified data are inputs in a decision tree and give us the decision information. Here the decision tree is the concept by which companies are more likely to make claims at current time. We repeat the above process with various amplification rates and settle on the appropriate value that gives the best correct prediction ratio (CPR).

4. New B2B EC Business Model For Shipping Industry

Many B2B transactions will be consist of sell-side asset exchanges, in which suppliers will trade orders among themselves, sometimes after initial transactions with

customers are made on general B2B sites. Sell-side swapping will be most valuable where markets are highly fragmented, both on the buyer and seller sides where, for geographic or information reasons, demand and supply are often mismatched and where suppliers can benefit greatly from keeping expensive fixed assets fully utilized. Industries with these characteristics include transportation, metalworking, plastic molding, farming, and construction. Shipping Industry also have these characteristics.

A company seeking to pursue the asset-exchange model will need to have strong relationships with the supplier community, since success will hinge on its gaining a critical mass of supplier transactions. It will also need to be adept at understanding supplier problems; sales of products and services that solve them will likely be an important source of profits.

The business model for shipping industry is depicted in Fig. 5. While it is important that a traditional model give a relevant service for buyers according to their needs, it is important that the proposed model helps firms to fully utilizing their assets. Therefore, in the proposed model building up knowledge bases for shipping lines is the core.

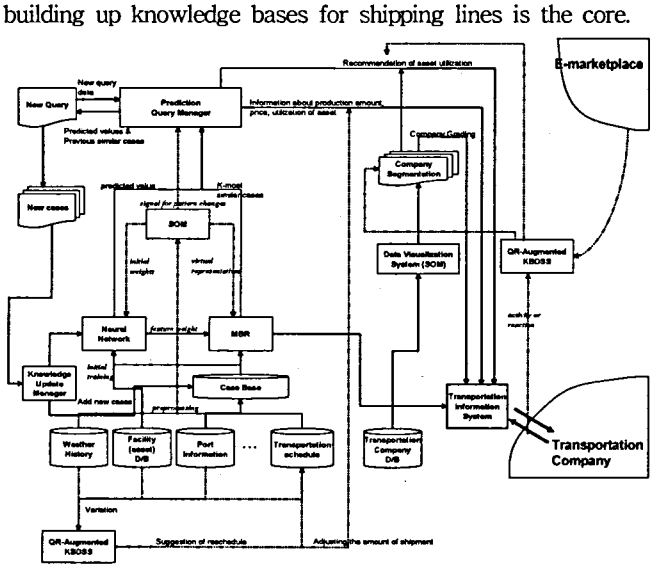


Fig. 5 Business model of B2B EC for Shipping Industry

The SOM-augmented memory-based and neural network-based expert system is developed for building up knowledge bases. Databases of weather history, facility (asset), transporting status, transportation schedule, port capability and so on may be useful resources for building up knowledge bases. After these data are preprocessed as relevant forms for neural network training, they are inputted into a neural network. A neural network saves domain knowledge in weights of a trained network. Feature weights of a trained network identify how much impact each variables affects to domain knowledge and give MBR the information. The SOM is not a tool that makes a prediction of unseen cases but it supports for building better knowledge bases. Any change of environments or internal processes in an application area induces changes of features of data. With this result, knowledge bases of expert systems have to be refined for accurate prediction.

With appropriate knowledge bases, the expert system supports firms for decision-making. Each firm wants to know how much transporting goods are scheduled in next period and whether utilization of assets is acceptable or not.

On the other hand, the utilization of fixed assets may be different with each firm for geographic or information reasons. In the case of shipping business, the mismatch of supply and demand is often occurred. The expert system solves these problems with aggregation of data along with regions by building knowledge bases. Using them, the deviation among several regions may be decreased.

However, it is impossible that an expert system build the knowledge base to cope with the variation of all external environment. Qualitative reasoning helps us to infer impacts on transporting schedules in next period with variations of weather, port & ship status. Data visualization system is also used for company segmentation in a sell-side asset exchange. To keep expensive fixed assets fully utilized, it is desirable that firm communities are composed of firms that have similar characteristics. And these communities would be more active than that consisted of diverse companies. If a small firm community have appropriate portfolio of ships, it can find one or more buyer communities whose demands are matched up with it supplies

5. Conclusion

No one deny most of exchanges will be achieved in e-marketplaces in the future. Technical obstacles of building up e-marketplaces were being put away one by one and are nearly vanished. Nevertheless, many companies hesitate to join in exchanges of e-marketplaces although they know advantages of electronic commerce

sufficiently.

This study proposed new B2B EC business model for the shipping industry which concerns relatively massive fixed assets to be fully utilized. Shipping industry has different characteristics - high fixed costs, relatively fragmented supplier and customer base - in comparison with other industries. So the e-marketplace of shipping industries should have ability to offer additional relevant services including general services provided by other e-marketplaces and have strong relationships with the shipping lines. The proposed e-marketplace, which gives lots of useful information on every process using data mining approach, is designed to solve these problems.

The developed MBR- and NN-based expert system supports information about when and how much shipping lines utilized fixed assets.. And it helps one to acquire customer information and to understand the trend of target market. The mature template can be spinning off as an independent system for prediction. The developed knowledge augmentation system supports time-dependent knowledge that gives one the information about future status of interest things or customers or shipping lines.

Whether a company is hoping to play a role as a B2B service provider or simply needs to transact business with other companies, it will have to develop a deep knowledge of the emerging landscape and the various business models it will contain. For many companies, traditional skills in such areas as product development, manufacturing, and marketing may become less important, while the ability to understand and capitalize on market dynamics may become considerably more important. The proposed data mining modules help it to have to a deep knowledge of its own areas.

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