ELSEVIER

Decision Support Systems 35 (2003) 311–333

Decision Support Systems

www.elsevier.com/locate/dsw

Agent-based merchandise management in Business-to-Business Electronic Commerce

Jae Heon Park*, Sang Chan Park

Department of Industrial Engineering, Korea Advanced Institute of Science and Technology, 373-1, Guseong-dong, Yuseong-gu, Daejeon 305-701, Republic of Korea

Accepted 1 April 2002

Abstract

Currently, there is cutthroat competition in the retail industry, and retail companies struggle for survival. Merchandise management—selecting desirable merchandise, disposing of slow-selling goods and ordering and distributing them—is important to a retailer's success because merchandise is the basis of retailing. Particularly because in an Electronic Commerce (EC) environment, customer preferences are very diverse and their merchant loyalty level is very low, companies should acknowledge the changes in customer demand patterns quickly and respond to them appropriately. However, until now, most retailers have depended on humans for merchandise management. Because there are too many merchandise and brands, it is impossible for merchandise managers to evaluate, compare, select and dispose of merchandise effectively. Retailers need a system that can perform merchandise managers' jobs autonomously, continuously and efficiently. In this paper, we propose an agent-based system for merchandise management, which performs evaluating and selecting merchandise and predicting seasons and building purchase schedules autonomously in place of human merchandise managers under a Business-to-Business (B2B) EC environment. In order to facilitate the agent's intelligent behavior, several analysis tools such as Data Envelopment Analysis (DEA), Genetic Algorithm (GA), Linear Regression and Rule Induction Algorithm are incorporated into the system. Lastly, the proposed system is verified in its application to a duty-free shop. The proposed system would accomplish merchandise management timely, autonomously and efficiently, and the effective merchandise management would reduce the inventory level while increasing sales and profits. The agent-based merchandise management system will enhance a retail company's potential for success. Moreover, it will be necessary for survival in the B2B EC.

Keywords: Merchandise management; Intelligent software agent; Business-to-Business Electronic Commerce; Retail industry; Data Envelopment Analysis; Genetic Algorithm; Rule Induction Algorithm

1. Introduction

The major activities of merchandise management, including selecting, ordering and distributing merchandise, are important to a retailer's success because merchandise is the basis of retailing. Especially, retailers should select popular merchandise and dispose of unpopular ones. Though there have been a lot of systems

* Corresponding author. Tel.: +82-42-869-5920; fax: +82-42-869-5920.

E-mail addresses: dewy@major.kaist.ac.kr (J.H. Park), sangpark@kaist.ac.kr (S.C. Park).

0167-9236/02/$ - see front matter © 2002 Elsevier Science B.V. All rights reserved.
doi:10.1016/S0167-9236(02)00111-2

supporting the replenishment of merchandise, selecting goods have been carried out by human beings in most retail companies. Retailers need a new system that can undertake merchandise managers' jobs—evaluating and selecting merchandise and searching for new, popular merchandise, and accomplishing those tasks autonomously. Moreover, the automation of those tasks will be an indispensable condition for retailers to survive in the Electronic Commerce (EC) environment, in which transactions are growing very rapidly with a great increase of Internet usage, because customer demand patterns change quickly. Because in the EC environment, customer preferences are very diverse and their merchant loyalty level is very low, companies should acknowledge the changes of the patterns quickly and respond to them appropriately. Currently, however, merchandise management, including evaluating, selecting and ordering, is almost entirely driven by human beings, and it will not be possible for retailers to cope effectively with the dynamic changes of customer demand patterns in the EC environment without intelligent and autonomous merchandise management systems.

The automation of tasks can be realized by intelligent software agents because autonomy is the most important property of intelligent software agents, and the concept of the intelligent software agent is useful for developing a software system, especially for solving difficult, time-consuming problems. Moreover, in a virtual marketplace in the Business-to-Business (B2B) EC, buying and selling of products between companies are carried out by autonomous agents, and, therefore, other related tasks of retailers such as evaluating, selecting, and ordering merchandise also need to be placed in the hands of intelligent agents for a successful operation of the whole process of retailing.

We will propose an agent-based system for merchandise management under the B2B EC environment, which performs the functions of evaluating and selecting merchandise and building schedules for tasks. For that purpose, this research achieves the following objectives.

1. To analyze and configure processes of merchandise management.
2. To design and develop an agent-based system for merchandise management and the architecture and the knowledge of each agent in the system.

The proposed system will perform merchandise management autonomously and continuously in place of a human merchandise manager. In order to facilitate the agent's intelligent behavior, several tools such as Data Envelopment Analysis (DEA), Genetic Algorithm (GA), Linear Regression and Rule Induction Algorithm are incorporated into the system.

This paper consists of five sections. Section 1 introduces background, motivation and objectives of this research. Section 2 explains previous works related to merchandise management systems and supply chain management. Section 3 describes the components of the proposed system and the architecture and functions of agents. Section 4 shows an application of the system using data from a real retail company. In Section 5, we conclude with limitations of this study and further works.

2. Literature review

2.1. Merchandise management system

Merchandise management consists of three major functions—Demand Forecasting, which involves Determining Needs; Purchasing, which includes Select Supplier and Negotiate Purchase; and Evaluating and Selecting, which includes Follow-up, from a functional point of view as shown in Fig. 1. In this section, we will explain those functions and introduce previously proposed systems by other researchers for each function.

2.1.1. Demand forecasting

The aim of demand forecasting is to estimate the amount of product and accompanying services that customers will require at some point in the future by using subjective analyses and/or conducting scientific statistical studies on the relevant historical data of the product [25]. Forecasting techniques can be grouped into three categories—qualitative methods, time series methods and casual methods [12]. Qualitative methods use qualitative data such as expert opinion and special information to forecast future needs. The Delphi technique is an example of a qualitative method. Time series methods are statistical techniques that are used when historical sales data are available with relatively clear and stable relationships and trends. However, because it assumes that the future