Available online at www.sciencedirect.com
ScienceDirect
Expert Systems with Applications 35 (2008) 1575–1582
Expert Systems with Applications
www.elsevier.com/locate/eswa

A hybrid mining approach for optimizing returns policies in e-retailing

Chien-Chih Yu *, Chen-Shu Wang

Department of Management Information Systems, National Cheng-Chi University, 64 Section 2, Chihnan Road, Mucha Dist., 116 Taipei, Taiwan

Abstract

The returns policy has long been considered as a critical yet controversial issue in the development of supply chain and marketing strategies. Up-stream manufacturers or distributors may offer returns policies to the down-stream retailers or customers to increase order and sales quantities. There are trade-offs between returns policies and customer satisfaction, product sales, and operating costs. The goal of this paper is to use a hybrid mining approach for analyzing return patterns from both the customer and product perspectives, classifying customers and products into levels, and then for adopting proper returns policies and marketing strategies to these customer classes for sustaining better profits. A multi-dimensional framework and an associated model for the hybrid mining approach are provided with a demonstrated example for validation. It is expected that by adopting suitable returns policies, benefits can be created and shared by both e-retailers and customers.

Keywords: Returns policies; e-Retailing; Hybrid data mining approach

1. Introduction

Returns policies have been adopted across various industries such as computer, publication, and pharmaceutical industries (Davis, Hagerty, & Gerstner, 1998; Eduardo & Andres, 2004; Hoffman, Keedy, & Roberts, 2002; Longo, 1995; Padmanabhan & Png, 1997). Researchers have pointed out that the returns policy is a critical yet controversial issue in the planning and implementation of supply chain and marketing strategies (Lau, Lau, & Willett, 2000; Mantrala & Raman, 1999; Padmanabhan & Png, 1995; Yao, Yue, Wang, & Liu, 2005). Up-stream manufacturers or distributors may offer returns policies to the down-stream retailers or customers to increase order and sales quantities. The most generous returns policy offers unconditional refund of wholesale/retail price for returned products, while the less generous returns policy accepts no returns at all or imposes some types of restrictions for returning (Hahn, Hwang, & Shinn, 2004; Mukhopadhyay & Setoputro, 2005; Webster & Weng, 2000). It is noted that the adoption of returns policies may substantially affect product sales and operating costs. A loose returns policy can stimulate customers' buying decisions to leverage sales volume; nevertheless, it can also increase the number of return transactions that incur more handling and logistic costs. In the e-commerce era with more direct channels, customized products, and online shoppings, the returns policy has become an even more important strategic action for e-business to sustain competitiveness and profits.

In the research literature, previous works regarding returns policy tend to formulate this problem as a mathematical model in which sales profits is the objective function to be optimized and the buyback price for returned products is the major decision variable. Among these researches, Padmanabhan and Png (1997) concern the effect of a returns policy on pricing and stocking in a competitive retail sector. They show that manufacturers should accept returns if production costs are sufficiently low and demand uncertainty is not too great. Choi, Li, and Yan (2004) investigate the optimal returns policy (also called a buyback policy) for supply chain with e-marketplace in which returned product can be sold with a higher price.

* Corresponding author. Tel.: +886 2 29387349; fax: +886 2 29393754.
E-mail addresses: ccyu@nccu.edu.tw (C.-C. Yu), 93356506@nccu.edu.tw (C.-S. Wang).

0957-4174/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.eswa.2007.08.099

Mukhopadhyay and Setoputro (2005) develop a manufacturer's profit maximization model to jointly consider level of returns policy (buyback price for returned products) and level of modularity in product design for build-to-order products. Although these optimization approaches for dealing with returns policies do provide partial solutions to the strategic problem, many key factors are still missing in the model set up. For instance, customers' demographic and transaction-based characteristics such as gender, income level, frequency of buying, average monetary of transactions, as well as return patterns are critical for properly classifying customers and selecting returns policies.

In addition, whether product types and complexity of operation are critical factors that would influence the likelihood of customers' return transactions? Are there any associations between customer classes, product types, and return patterns? These questions are no doubt crucial in making decisions related to the adoption and implementation of returns policies. Therefore, in order to make optimal decisions for returns policy, multiple factors from customer, product, and supply chain dimensions must be taken into account. It is reasonable to start from analyzing the return patterns of customers and products.

As the business realizes more about the return patterns, they can offer to their customers better returns policies that can not only increase product sales but also decrease the probability of returns as well as associated handling costs. As a result, adopting returns policies can eventually become a win–win strategic move to benefit the supply chain businesses and customers as well. The goal of this paper is to first propose a multi-dimensional framework for illustrating the key factors of the returns policies, and then to use a hybrid mining approach for analyzing return patterns, classifying customers and products with return ratios, as well as directing suitable returns policies and marketing strategies to associated customer and product classes (Hsieh, 2005; Kuo, Ho, & Hu, 2002). The rest of this paper is organized as follows. The framework and hybrid mining model for returns policies are provided in Section 2. Section 3 demonstrates the mining process using an example with simulated data. Relating returns policies and marketing strategies is also discussed in this section. The final section is a conclusion and directions of future works.

2. The framework and process

Generally speaking, there are several dimensions to be considered for fully addressing the issues of returns policies. For the customer dimension, different customer classes can be specified in different levels of the supply chain. The manufacturers have retailers and/or individual buyers as their target customers. The retailers sell products to general consumers. Customers can be further characterized by demographic data as well as transaction data. Data elements of the demographic data set include gender, age, education, income level, etc. Transaction-based data contain the detailed product purchasing and returning records, and is strongly related to the product dimension. The product dimension mainly considers product type, price, size, level of customization, and ease of operation as data elements that may affect customers' return patterns and businesses' adoption of returns policies. Product types can be categorized as seasonal, perishable, computer, jewellery, and many others. Build-to-order products, in contrast to mass products, have the highest level of customization. The third dimension identifies the types and restrictions of the returns policies. Types of returns policies include loose, tight, and partial policies. The loose or generous returns policy offers unconditional money back guarantee. The tight returns policy accepts no refund whatsoever. The partial returns policy provides store credit for future purchase or offers only percentage of the selling price for returned products. Restrictions impose on returns policies include unused product only, time limit for returning, return in original package, and other instructions. Restrictions on returns also indicate the level of difficulty in returning product items.

As for the marketing channels and strategies dimension, the selling channels can be specified into direct channel, e-marketplace, department store chain, specialty store chain, and single out-let specialty stores. The marketing strategies considered include buy-one-get-one-free, double credits, and price discount. Taking return transactions as the fact to be monitored and analyzed, and associated recency, frequency, and monetary of return transactions as the derived elements for measurement, we then have the customer, product, returns policies, and marketing strategies as the associated dimensions. An integrated framework with simplified scope for structurally representing dimensional factors of return patterns is depicted in Fig. 1.

The hybrid mining model and process for analyzing the return patterns includes three stages. In the first stage, single dimensional clustering analyses are conducted for the customer and product dimensions. In the second stage, resulting clusters of first stage are then segmented into a group of classes in terms of return ratios and other significant data elements. In the third stage, the first set of classification rules for classifying customers and products for selecting proper returns policies and marketing strategies are generated at this stage as intermediary results. In addition, the cross-dimensional analysis is performed to generate association rules with respect to customer and product classes, as well as return ratios. The classification scheme and the assignment of returns policies and marketing strategies are then adjusted to get the final mixed returns and marketing policies. The objective of the mining approach is to classify customers and products for adopting suitable returns policies and marketing strategies in order to increase the monetary of transactions as well as to decrease the return ratios.

For processing the mining approach, an example input dataset is shown in Table 1. In the customer dimension, the recency of returns is the number of days from the latest