

Chapter 1. Introduction

1.1 Background and motivations

The currently accepted definition of relationship marketing as being based on building, maintaining and enhancing customer relationships in multi-service organizations was developed by Berry (1983). Relationship management is emerging as the core marketing activity for businesses operating in fiercely competitive environments. In addition, customer relationship management (CRM) is a customer oriented business philosophy that involves analyzing, planning and controlling customer relationships by means of modern information and communication techniques. It has become a buzzword especially among business practitioners and consultants since the late 1990s (Sonja and Moedritscher, 2002). Therefore, the purpose of attracting customers is considered to be an intermediate step in the relationship building process with the ultimate objective being to increase the loyalty of profitable customers in CRM.

Intense competition is forcing companies to develop innovative marketing activities to capture customer needs and improve customer satisfaction and retention. The use of the Internet and the explosive growth of e-commerce have expanded marketing activities and made large volumes of customer data available for analysis. Businesses can benefit significantly from analyzing customer data to determine their preferences and thus improve marketing decision support. Providing adequate support to meet customer needs can boost the success of on-line e-stores (Liang and Lai, 2002) and web site success depends on enhancing information and service quality to serve customers better (Liu and Arnett, 2000).

Recently, IT has been utilized to help companies maintain competitive advantage (Stone and Good, 2001). Data mining techniques (Chen et al., 1996) are a widely used information technology for extracting marketing knowledge and further supporting marketing decisions (Bose and Mahapatra, 2001; Brachman et al., 1996; Shaw et al., 2001). The applications include market basket analysis, retail sales analysis, and market segmentation analysis. Lin et al. (2003) applied data mining techniques to extract inter-organizational retailing knowledge from POS information in retail store chains. Moreover, Hui and Jha (2000) employed it to provide customer service support. The knowledge can support marketing decisions and customer relationship management.

The buying patterns of individual customers and groups can be identified via analyzing customer data (Wells et al., 1999), but also allows a company to develop one-to-one marketing strategies that provide individual marketing decisions for each customer (Peppers and Rogers, 1997). Recommender systems are technologies that assist businesses to implement such strategies. They have emerged in e-commerce applications to support product recommendation (Schafer et al., 2001; Zeng et al., 2004). The systems use customer purchase history to determine preferences and identify products that a customer may wish to purchase. Schafer et al. presented a detailed taxonomy of recommender systems in e-commerce, and determined how they can provide personalization to establish customer loyalty. Generally, recommender systems increase the probability of cross-selling; establish customer loyalty; and fulfill customer needs by discovering products in which they may be interested.

Various recommendation methods have been proposed for recommender systems. Collaborative filtering (CF) has been successfully used in various applications. The CF method utilizes preference ratings given by various customers to determine recommendations to a target customer based on the opinions of other similar customers. A typical CF method employs K-nearest neighbors approach to derive top- N recommendations (KNN-based CF method). The GroupLens system (Resnick et al., 1994) applied CF method to recommend Usenet News and movies. Video recommender (Hill et al., 1995) also used the collaborative approach to generate recommendations on movies. Examples of music recommender systems are Ringo (Shardanand and Maes, 1995) and MRS (Chen and Chen, 2001). SiteSeer (Rucker and Polanco, 1997) provided Web page recommendations based on the bookmarks of the user's virtual neighbors. Moreover, Changchien and Lu (2001) developed a procedure for mining association rules to support on-line product recommendations. Amazon.com employed item-to-item collaborative filtering to provide recommendations of those products that are similar to the customer's purchased and rated products (Linden et al., 2003). Generally however, collaborative filtering has difficulty for the first register onto the system and providing accurate recommendations under sparse data conditions.

A differing approach to collaborative filtering is content-based filtering (CBF) method provides recommendations by matching customer profiles (e.g. interests) with features of the content (e.g. product attributes). Krakotoa Chronicle system (Kamba et al., 1995) is an example of this system. However, the CBF method suffers the limitations of not being able to provide serendipitous recommendations, and in some domains, like movies and music, it cannot successfully analyze the content.

From the perspective of niche marketing, all customers are not equal (they have different lifetime value or purchase behaviors), even if they purchase identical products or services; market segmentation is therefore necessary. Firms are increasingly recognizing the importance of the lifetime value of customers (Berger and Nasr, 1998). Several studies have considered the use of CLV. Generally, RFM (Recency, Frequency, and Monetary) methods have been used to measure it (Kahan, 1998; Miglautsch, 2000). The concept has been applied to cluster customers for niche marketing (Ha and Park, 1998). Furthermore, Stone (1995) suggested that different weights should be assigned to RFM variables depending on the characteristics of the industry, but without employing a systematic approach.

1.2 Goals

According to motivations, this dissertation lists major goals as follows:

- Proposed a weighted-RFM based method to make recommendations.
 - Explored the difference of recommendation accuracy between different CLV.
- Proposed hybrid methods of product recommendation based on WRFM-based and preference-based methods to enhance the quality of recommendation.
- Applying hybrid methods of combining collaborative filtering and content-based filtering methods to improve the recommendation accuracy.
 - To verify the usefulness of re-ranking candidate products based on customer demands.
 - To verify that method based on extended-preferences is useful in sparse information.

1.3 Approaches

Basing on the motivation introduced in Chapter 1. Although various recommender systems have been proposed, few have addressed the lifetime value of customer to a firm. Furthermore, the relative importance among them varies with the characteristics of the product and industry. Therefore, this work proposes a novel product recommendation methodology that combines group decision-making and data mining, named WRFM-based method. The analytic hierarchy process (AHP, Saaty, 1980; 1994) was applied to evaluate the importance (weight) of each RFM variable, according to a group of decision-makers. Clustering was then employed to

group customers based on their weighted RFM value. Finally, association rule mining was used to provide recommendations for each group of customers.

According to analytical results, the WRFM-based method not only outperforms the non-weighted RFM method, the non-clustering method and the KNN-based CF method, but also identifies effective rules for making recommendations to customers with high lifetime value or loyalty, generating recommendation rules for less loyal customers is difficult. Similar to WRFM-based method, a preference-based CF method can be derived that employs association rule mining to extract recommendation rules from customer groups which are clustered according to customers' purchase preferences. A pilot experiment of this study revealed that the preference-based CF method may suggest some useful recommendations that the WRFM-based method can not provide, and thus may improve the quality of recommendations to less loyal customers. Accordingly, this work also proposed hybrid methods that incorporate the advantages of the WRFM-based method and the preference-based CF method.

Although various approaches for making recommendations have been proposed, both the CF and CBF methods suffer from limitations. Unlike the CBF method, CF is sensitive to whether users generally prefer a product. CBF makes recommendations by analyzing the description of the items that have been rated by the user. Several researchers are exploring hybrid methods of combining CF and CBF to smooth out the disadvantages of each (Basu et al., 1998; Claypool et al., 1999; Good et al., 1999). This work uses customer demands derived from the frequently purchased products in each industry as valuable content information to integrate CF for making recommendations. This work also combines customer demands and past purchasing preferences to reduce the sparsity of customer-item matrix, named extended-preferences to improve recommendation accuracy. Customer demands are then included as a factor in making recommendations for re-ranking candidate products.

This dissertation makes contributions on one-to-one marketing and customer relationship management of electronic commerce. Enterprises can focus on target market to reduce costs of advertisements to strengthen their profit and market competitive.

1.4 Organization

The dissertation is composed of six chapters. The research architecture is organized and described as follows.

Chapter 1: Background and motivations

This chapter details the backgrounds behind the development of various recommender systems. Furthermore, the motivations for studying recommender systems are elucidated in this chapter.

Chapter 2: Related works

This chapter presents the related works on customer lifetime value, market segmentation and different recommender systems, such as collaborative filtering, content-based filtering, hybrid recommender systems and the association rule based recommendation methods. This chapter described the evaluation metrics used to evaluate the accuracy of recommendations. Furthermore, the analytic hierarchy process used to determine the relative weightings of CLV is also introduced.

Chapter 3: Integrating AHP, clustering and association rule mining

Based on the motivations introduced in Chapter 1, this chapter presents a WRFM-based method that integrates AHP, clustering and association rule mining to make recommendations.

Chapter 4: Combining WRFM and purchased preferences

This chapter introduces two hybrid methods that combine customer lifetime and purchased preferences to make recommendations of improved quality to less loyal customers, and to enhance the overall recommendation accuracy.

Chapter 5: Collaborative filtering via customer demands

Since collaborative filtering and content-based filtering suffer from limitations, so this chapter presents methods of WRFMCD and WRFMEP combining the WRFM-based CF method and the incorporation of customer demands to make recommendations. In these methods, customer demands are included as a factor in making recommendations for re-ranking candidate products.

Chapter 6: Conclusions and future works

Chapter 6 draws conclusions and makes suggestions for future work.

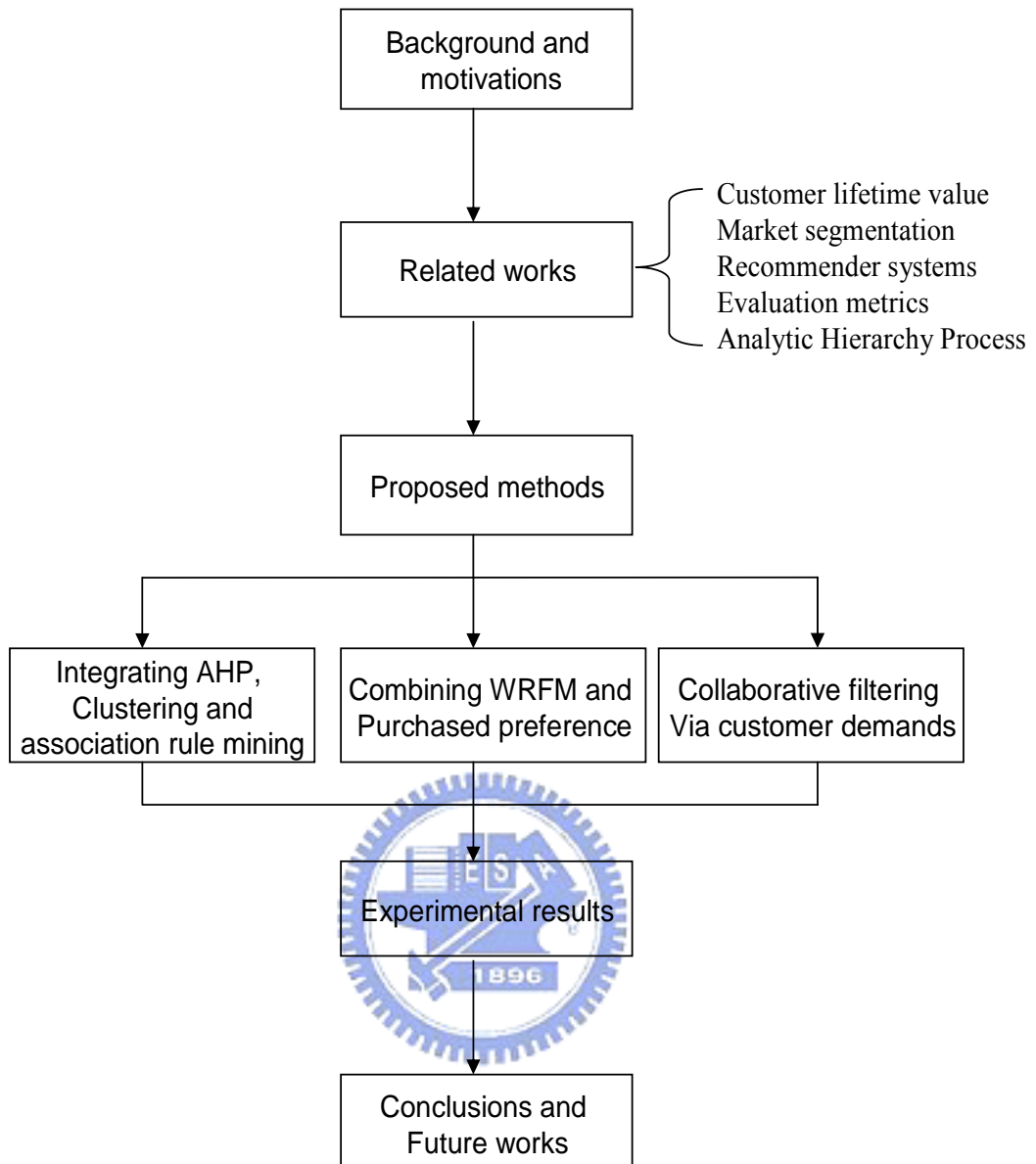


Figure 1. The research architecture