



## Exploring consumer adoption of new services by analyzing the behavior of 3G subscribers: An empirical case study

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### ABSTRACT

As the profit margins of 3G mobile network operators gradually decline, and market competition becomes increasingly intensive, they must develop rich and diverse varieties of brand new application services to attract new subscribers and retain old ones. Understanding the customer's purchasing behavior is a key issue in this process. The operator must accurately grasp movements in the market based on analysis of the behavior of 3G subscribers. This study proposes a comprehensive customer relationship management strategy framework to furnish a beneficial plan to overcome such challenges. First, we propose a new model to identify who are the high-value customers related to the characteristics of new telecommunication services. After segmenting the customers, we propose a procedure to provide different kinds of usage analysis, including inter-cluster analysis and intra-cluster analysis. The experimental results are determined based on rules extracted from a large number of call detail records generated by the mobile subscribers of leading 3G mobile system operators in Taiwan. The dependency network demonstrates the relationship between voice services, data communications, message services, micro-payments and entertainment. Finally, we propose some marketing recommendations for 3G system operators based on these interesting rules.

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### 1. Introduction

Diverse mobile applications and services undoubtedly influence the daily life of mobile users around the world significantly. Furthermore, the maturing of mobile technologies effectuates e-commerce over mobile platforms. Mobile commerce (m-commerce) means that any activity can be transacted business via a mobile device (Clarke 2001). M-commerce can be considered an extension of e-commerce (Coursaris and Hassanein 2002, Ngai and Gunasekaran 2007). According to a study by Juniper Research, the global m-commerce market will total an industry worth of US\$115 billion by 2015 (Juniper Research 2011). 3G telecommunication operators have an important role in the m-commerce value chain, according to Kuo and Yu (2006). Several studies have suggested that the next phase of e-business growth will occur in wireless services and m-commerce (Fouskas et al. 2005, Smith 2006, Baldwin et al. 2007). This trend is creating promising new business opportunities for m-commerce development.

The International Telecommunication Union (ITU) reported that in 2009 mobile global subscriptions numbered 4.6 billion users (ITU 2010). The ITU expected this number to reach 5 billion in 2010, while the world population in April 2010 was 6.8 billion

people. Though the number of 3G subscribers is raising rapidly, average mobile revenue per user (ARPU) is dropping in the majority of Asian Pacific markets. Mobile operators must manage non-voice ARPU more effectively to overcome this business challenge (Kuo and Yen 2009, Deng et al. 2010). To fulfill this requirement, the telecommunications industry is constantly developing new and innovative 3G value-added services to meet the various needs of consumers. Although a variety of mobile value-added services have been released, whether consumers will purchase these services remains unknown (Teng et al. 2009). Understanding customer-purchasing behavior has become a key issue. 3G operators employing objective data analysis to identify heavy users of new products and investigate the behavioral differences between heavy and non-heavy users has become a critical exercise (Koivumaki et al. 2006, Schierza et al. 2010). These results will support the development of different consumption behavior models, providing differentiated products and services regarding marketing and maintenance of customer relationships, which will significantly enhance future marketing strategies (Wu and Wang 2005).

Data mining generally entails technologies discovering previously unknown information and summarizing relevant information from a vast number of databases to assist business decisions (Cabana et al. 2008). Appropriate customer relationship management (CRM) strategies can be adopted with the assistance of data mining technologies, which can manage the data required to

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enhance understanding of customers (Ngai 2005). Successful applications of data mining techniques in CRM include churn prediction, fraud detection, cross selling, customer segmentation, and customer retention (Berson et al. 2000, Wei and Chiu 2002, Liu and Shih 2005, Hung et al. 2006, Cheng and Chen 2009, Chen et al. 2009). One of the most well-known examples is that of Wal-Mart, which used association rules to discover that beer and diapers are often purchased together (Hughes 1994, Groth 2000, Han and Kamber 2007). This study uses the data mining technique of association rules due to its efficiency (Agrawal et al. 1993, Liu and Shih 2005).

Previous research in the area of m-commerce focused on exploring mobile consumer intention or acceptance (Hsu et al. 2007, Wang et al. 2006, Koivumaki et al. 2006, Schierza et al. 2010). There is a lack of knowledge about how to investigate the consumption behavioral differences between early adopters and other users. Studies of the behaviors that analyze the behaviors of valuable 3G mobile consumers and real consumer usage are rare and a fitting methodology for analysis of consumer behaviors in the case of 3G telecommunications needs to be developed (Bose and Chen 2010).

This paper provides two main contributions: from a conceptual viewpoint, this study proposes a comprehensive CRM strategy framework that contains a customer segmentation process and a behavior analysis process. The proposed framework can address the lack of knowledge regarding consumption behavioral differences between early adopters and other users. Firstly, we built a customer segmentation model, the TFM, which depends on the value determinations of 3G mobile services. We define heavy users as early adopters who use 3G services frequently ( $F$ ), accumulate a greater volume of service time ( $T$ ), and have large bills for a time period of one month ( $M$ ). Other studies also define heavy users similarly (Lim et al. 2005, Gensler et al. 2007). This study then proposes a procedure for consumer behavioral analysis and a comparison of different behavioral clusters. 3G operators can use these tools to understand the behaviors of valuable users and propose novel marketing strategies to increase customer adoption.

From an empirical viewpoint, the proposed framework draws on 3G value-added usage data obtained from a leading telecommunications firm in Taiwan. To the best of our knowledge, no behavioral analysis of 3G mobile subscribers using association rules extracted from real usage patterns exists for understanding behavioral differences between valuable clusters. Taiwan is one of the most crucial m-commerce markets in the world. At the end of December 2009, the number of mobile phone subscriptions in Taiwan had risen to 26.96 million, a penetration rate of 116.6% (in other words, 116 mobile phone numbers for every 100 people). Furthermore, 58.7% of subscribers used 3G services. This rate implies a potential representative market for enhancing understanding of 3G value-added service adoption. This paper hence provides sound strategies to increase new service adoption for 3G companies.

The rest of the paper is organized as follows: Section 2 briefly reviews existing literature; Section 3 describes the proposed research modules; Section 4 presents an analysis of the proposed procedures in a series of experiments; Section 5 provides several managerial implications for marketing reference; and finally, the last section offers conclusions such as the limitations of this study and considerations for future research.

## 2. Related work

After the application of customer value analysis for customer segmentation, this study conducted behavioral analysis of the different segments to propose marketing recommendations for mobile operators. This section reviews literature related to customer relationship management, customer segmentation, association rule studies, and research studies of 3G mobile service adoption.

### 2.1. Data mining in customer relationship management

After surveying several studies, Ngai (2005) argued that CRM is a comprehensive set of strategies managing relationships with customers related to the overall process of marketing, sales, service, and support within the organization. Payne and Frow (2005) proposed a strategic framework for successful CRM implementation that contains five key processes: strategy development, value creation, channel and media integration, information management, and performance assessment. In Payne's framework, the most critical customer strategy should comprise examining the existing and potential customer base and identifying which forms of segmentation is most appropriate. Upon conducting customer segmentation, enterprises could focus on the character of different user groups to propose more efficient operations when acquiring and retaining the relationship to increase overall business profits (Payne and Frow 2005, Thomas and Sullivan 2005). The objective of these strategic operations is to build long-term relationships for increasing customer satisfaction, strengthening customer loyalty, and raising profitability (Swift 2000, Mithas et al. 2005).

Data mining is regarded as a powerful tool to find relevant rules and behavior patterns from the analysis of a large amount of data (Ngai et al. 2009). Appropriate data mining tools, which are suitable for extracting and identifying useful information and knowledge from massive customer databases, are one of the best support tools for forming various CRM decisions (Berson et al. 2000, Bose and Chen 2010). Association rule is the best-known technique for customer purchase analysis. Liu applied association rules to extract knowledge from customer purchase history for the development of one-to-one marketing (Liu and Shih 2005). The method has been widely used in various areas, such as for mining user access patterns on websites, using POS information to extract interorganizational retailing knowledge, recommending products to users, and cross sailing (Berson et al. 2000, Lin et al. 2003, Sohn and Kim 2003, Liu and Shih 2005, Chen et al. 2009). The American Management Association estimates that attracting new customers costs five times the amount of retaining existing ones. Therefore, business organizations can also use association rules to study customer behaviors and provide healthier management of customer relationships.

### 2.2. Customer segmentation and RFM models

Customer segmentation divides all customers into an appropriate number of clusters to effect customized strategies for meeting different customer needs. Early approaches for segmentation include the use of demographic, geographic, situation (Gehrt and Shim 2003), lifestyle and behavioral characteristics of consumers (Plummer 1974, Assael and Roscoe 1976, Punj and Stewart 1983, Hoek et al. 1996, Schijns and Schroder 1996, Gehrt and Shim 2003, Bose and Chen 2010). However, Gupta et al. (2006) suggests that the past purchases of consumers are superior predictors for determining future purchase behavior compared to demographics. Enterprises can apply proper techniques to discover consumer-purchasing patterns by examining the customer sales records to propose useful marketing strategies (Chandon et al. 2005, Bose and Chen 2010).

Recency, frequency, and monetary (RFM) variables are the most frequently used behavioral data in marketing research (Bult and Wansbeek 1995). Hughes defines recency as the period since a customer's last purchase, frequency as the number of purchases made within a certain time period; and monetary as the amount of money that a customer spent during a certain period (1994). The RFM model as a market segmentation tool not only quantifies customer behavior, but also identifies the most profitable customers (Goodman 1992, Miglautsch 2000). Incorporating the concept of

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