

REVISITING CUSTOMER VALUE BY FORECASTING E-SERVICE USAGE

WEI-LUN CHANG

Tamkang University
New Taipei City 25137, Taiwan

SUNG-SHUN WENG

National Taipei University of Technology
Taipei 10608, Taiwan

ABSTRACT

In the past, firms focused on stimulating consumption and acquiring customers while neglecting the significance of customer retention. This study delaminated customer value based on previous literature and blended the evolution of the CRM concept to build a customer value model. This work applied a Markov Chain and Bayesian theorem to forecast and recommend appropriate CRM e-services to customers, using Apple iTunes as a case study. Findings revealed that precision was the highest for 52 samples of customer behavior. The precision of a typical student or addicted worker can reach 70.6%, 60.4% for an addicted student, and 50% for a typical worker. The performance of Bayesian theorem is insignificantly influenced by customer type and sample. The adequacy was as high as 90%. The proposed framework not only revisits the value on needs, but also helps firms recommend appropriate services.

Keywords: E-Service; CRM; Markov Chain; Bayesian Approach

1. INTRODUCTION

Due to recent developments in the continuing expansion of the Internet, consumer behavior has changed and new needs have emerged. Enterprises devoted to combining new technologies with traditional service concepts have created a new type of service called e-service. According to Järvinen and Lehtinen [17], e-service delivers particular intangible products and services through interaction with online users. Firms attempting to deliver products or services electronically do so to enhance operational efficiency and profit. Customer relationship management shows particular potential as a burgeoning e-service [32]. In a traditional business model, profits can be enhanced 25% to 80% by increasing customer loyalty by only 5% [28]. Gupta et al. [10] also state that a 1% increase in the customer retention rate had a 5% influence on the company's profit. The cost required to discover a new customer is 6 to 7 times greater than that required to retain existing customers.

According to a report from Bain & Company (www.bain.com), the average annual rate of customer loss is approximately 20% to 30% for U.S. enterprises. Even among the top 500 enterprises, at least half the customer base is lost every five years. Most existing e-CRM literature investigates e-CRM activities regarding service quality from the perspective of enterprises. These studies seek to identify the factors involved in customer satisfaction, loyalty, and trust [34], as well as the resources and technology required to achieve that end [11]. Edvardsson et al. [8] also focused on the significance of service experience. Ling and Yen [21] examined

CRM implementation strategies. This research considers experience with e-service to be a critical aspect of e-CRM, and focuses on the means by which customer needs can be satisfied and customers can be retained through the implementation of appropriate e-CRM services.

Finnegan and Currie [9] also proposed a conceptual CRM framework to assist companies in the development and implementation of CRM strategies. Dimitriadis and Stevens [7] devised an integrated framework for designing, implementing, and evaluating CRM systems in service companies. Before revising business strategy, companies must completely recognize customer expectations and examine the differences between expectations and perceptions. The objectives of this study are as follows: (1) to revisit the value of e-services by level based on customer usage; (2) to propose a customer value framework connecting customer needs with CRM e-services; and (3) to anticipate customer needs and furnish combined CRM e-services using an approach combining Markov chain and Bayesian probability. The final goal of this research is to assist companies in their aim to enhance customer satisfaction and loyalty regarding e-CRM issues. The remainder of this paper is organized as follows: Section 2 discusses the extant literature discussing topics such as e-service, customer value, and CRM; In Section 3, we devise a customer value framework and present the proposed approach using a Markov Chain and Bayesian probability; Section 4 provides an evaluation of the simulation; and lastly, Section 5 and Section 6 offer implication and conclusion.

2. RELATED LITERATURE

2.1 E-Service

Currently, services delivered over the Internet offer entirely new opportunities in the era of the digital economy. E-service has become increasingly significant, not only for determining the success or failure of e-commerce ventures, but of furnishing customers with a superior overall experience [32]. Tiwana and Ramesh [36] defined e-service as Internet-based applications for distributing and personalizing resources in real-time. Rust and Lemon [31] described e-service as the provision of an enhanced consumer experience through positive interactions and the flow of information. Heinonen [13] specified e-service as a service (tangible or intangible) delivered by technology. Williams et al. [40] specified digital services as services obtained and arranged through digital transactions employing Internet protocols.

The emergence of the Internet has enhanced cost benefits for enterprises, as well as the speed, efficiency, and flexibility of online transactions. Furthermore, this unique approach to

delivering services provides a novel experience and alters customer expectations [31]. Pine and Gilmore [27] indicated that the delivery of e-service is a new experience for most customers, adding value from the perspectives of experience, self-control, and customization. Previous literature also indicated the relationship of perceived value to customer satisfaction and loyalty [18]. Moreover, Kim et al. [19] discussed the opportunities made available by intelligent services concerning business ecosystems. This research integrates existing definitions of e-service and, in doing so, redefines it as a service that is produced, furnished, or consumed through the use of Internet-based technology and mobile solutions.

2.2 Customer Value

Customer value is regarded a critical outcome of customer experience [12]. Holbrook [14] indicated that customer value should be the basis of all marketing activities. Many researchers believe that customer value can be divided into two types [6][23]. The first type is the value of customer concern, known as customer perceived value. The second type is the contribution customers provide enterprises, known as customer lifetime value. This study investigated the first type of customer value regarding e-services. Zeithaml [43] indicated that the definition of customer perceived value is an overall assessment of a product based on the means by which it is acquired, the cost, and the perceived utility to them. Woodruff [41] defined customer perceived value as a subjective interpretation of the consumption process. Holbrook [15] specified that customer value can be interactive, preferred, experienced, and relative, further elaborating by stating that customer value represents the interactive experience between customers and firms [14]. This study defines customer value as the difference between expectation and perception based on subjective awareness.

The delivery of value is a significant consideration because customers are the source of profit. Yan [42] believed that customer value is a reflection of the behavior of consumption, which

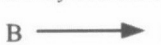
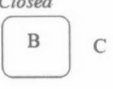
influences the order of preference. In 1954, Maslow proposed the hierarchy of needs theory, which states that motivation drives individuals comprising five levels of need. Albrecht [2] expanded upon Maslow's theory by proposing a hierarchy of customer values, which he used when explaining how to deliver expected services through the recognition of customer value. Weingand [64] differentiated four categories of customer value (basic value, expected value, desired value, and unexpected value), and applied them to the services provided by libraries. This study employed the concepts presented by Albrecht [2] to establish our customer value framework based on the four categories of value.

2.3 Customer Relationship Management

The concept of customer relationship management (CRM) emerged from contact management in the late 1980s. The McKinsey Company (1999) defined CRM as sustainable relationship management to discover the most valuable customers according to micro-segmentation of the customer base. Bhatia [4] stated that CRM utilizes software and technology to support marketing, sales, and customer service while integrating multiple channels of communication. Tseng and Hwang [37] proposed an automatic online customer service system to reduce service cost and provide more efficient and effective customer service over the Internet. Payne [25] specified that CRM is an approach to management, in which customer relationships are created, developed, and enhanced to maximize customer value and company profit. Kumar and Reinartz [20] viewed CRM as the development of a complete database, in which customer transaction data are gathered and analyzed to maximize customer value throughout their lifetime.

The notion of electronic CRM (E-CRM) emerged in the late 1990s and has matured since 2000. Romano and Fjermestad [30] claimed that E-CRM provides the ability to analyze and extract business intelligence by combining software and hardware with processes and management. Rigby and Reichheld [29]

TABLE 1. Customer value framework

Concept	Pre-Sale Transaction Post-Sale			
	←----- -----→			
Process for Creating Customer Value	Acquire	Use	Feedback	Retain
Process for Creating Business Value	Marketing	Sale	Post-Service	Revise
CRM E-Service Process				
Level of Customer Value	Attract	Interact	Retain	
Surprise from customers (CRM 3.0 concept: Self-problem solving and self-control)	Self-actualized value (Unexpected Value)	Products and services provide self-actualized value.	Customer-centric radiation 	Customer domination
Satisfaction from customers (CRM 2.0 concept: Value co-creation from social network)	Social and emotional value (Desired Value)	Products and services provide belongingness.	Two-way interaction 	Social and emotional satisfaction
Comprehensiveness from customers (CRM 1.0 concept: E-service standard)	Added value (Expectant Value)	Products and services are comprehensive.	One-way communication 	Completeness
Usefulness from customers (CRM 1.0 concept: Basic functions of e-services)	Functional value (Basic Value)	Products and services provide functional value.	Closed 	Perceived usefulness

specified that E-CRM connects business processes and customer marketing strategies through the application of software and technology. Peppers and Rogers [26] divided CRM processes into identification of the customer, classification, interaction, and customization. CRM is a sustainable, dynamic, and iterative process, directly influencing customer perceived value from the initial purchase through post-purchase service. Self-service is a popular concept across the Internet, where e-CRM is currently applied. This study focuses on the domain of e-CRM services according to the principle of attracting customers, interacting with them, and retaining them.

3. RESEARCH METHODS

3.1 Framework of Customer Value

This research proposes a novel customer value framework (Table 1) based on the research of Peppers and Rogers [26] and Albrecht [2]. The first dimension is customer e-service process. This study defines e-services as Internet-based services delivered by technology. Thus, CRM e-services can be classified into attract (pre-sale), interact (transaction), and retain (post-sale). The processes for creating customer value are acquire, use and feedback, and retain. The processes for creating business value are marketing, sale and post-service, and revise. The second dimension is customer value, which can be classified into four categories: self-actualized value, social and emotional value, added value, and functional value. The lowest level of customer value is concrete, and the highest level of customer value is abstract. All levels of customer value are interconnected, and higher levels of customer value must be satisfied from lower levels of customer value.

The two lowest levels of customer value are functional and added value, which encompass the concept of CRM 1.0. CRM 1.0 allowed only closed or one-way communication, indicating that only firms could decide when to communicate with customers. At this level, customers desire useful e-services with basic functions and a few extended e-services to obtain added value. The third level of value is social and emotional. These are emphasized in CRM 2.0, in which value co-creation is a two-way interaction. At this level, companies provide e-services to fulfill the value desired by customers and enhance the sense of belonging perceived by customers, and the influence of word-of-mouth is most noticeable at this level. The highest level of value is self-actualized, which is also expected by customers. At this level, customers expect pleasant surprises from the companies they interact with. This concept is promoted in CRM 3.0, where customers are encouraged to solve problems on their own, as well as furnish suggestions and comments to improve the e-services, thereby enhancing their sustainability.

The proposed conceptual framework provides a different perspective by integrating customer value and CRM e-service process. This research aims to identify customer value and predict the appropriate CRM e-services to customers. First, the Markov chain is used to identify customer value. Since the number of states is few (four), Markov chain can furnish effective prediction with low complexity. Particularly, the efficiency of the Markov chain is also superior, according to existing studies. Next, the Bayesian theorem is used to forecast CRM e-services. The reason is that the Bayesian theorem can infer behavior of usage by basic statistical inferences. Hence, this research utilizes existing methods to examine the devised conceptual framework.

3.2 Prediction of Customer Value

This research employs a Markov chain to predict the level of customer value with Bayesian theory to forecast appropriate CRM e-services. A Markov chain is a sequence of random variables, which assumes that present state, future state, and past states are independent. Markov chains are described by direct graphs where the edges between two states are labeled by the probabilities. Markov chains are used for the prediction of interrelated states (events) based on time. The major advantage of Markov chains is that the current state may assist in predicting the following state. In this work, the level of customer value changes sequentially through each of the levels. The proposed approach identifies the lower level of customer value, which must be addressed before progressing to higher levels of customer value. Hence, this research utilizes the Markov chain to predict the future level of customer value.

Markov Chains have been applied in many fields, such as medicine [33], finance [1], and entertainment [35]. In this research, we used first-order, finite, and regular Markov Chains. Each consequence represents a state. The set of all states is called a state space, which can be represented as S with $S = \{S_1, S_2, \dots, S_n\}$. In this research, we assumed that the four states were four levels of customer value: self-actualized value (S_4), social and emotional value (S_3), added value (S_2), and functional value (S_1). A transition matrix was another major component of the Markov Chain. If we assume that the current time is t and state is a , the current state is $X_t = a$, and the following state is $X_{t+1} = b$. The probability of progressing from t to $t+1$ can be represented as $P(X_{t+1} = b | X_t = a) = P_{ab}$, which is also referred to as transition probability. In each row, current time t and column indicates the next time slot $t+1$. The sum of probability for each row is 1; that is, $\sum_{b=1}^n P_{ab} = 1$ and $b = 1, 2, \dots, n$.

We provided three indicators to evaluate the performance and accuracy of the Markov Chain approach: precision, recall, and F-measure. Evaluation indices, such as precision, recall, and F-measure, are widely used in the domain of information retrieval. Precision is defined as the proportion of predictions and ideal needs ascribed to each (Eq. (1)). By considering only the uppermost results returned by a system, precision considers all predicted needs above a particular threshold of significance. Recall is defined as the proportion of ideal needs predicted out of all ideal needs available (Eq. (2)). Achieving 100 % recall by returning all needs in response to a given point in time is trivial. That is, recall alone is insufficient; one must measure the number of irrelevant predicted needs. F-measure is the weighted harmonic mean of precision and recall (Eq. (3)). A traditional F-measure or balanced F-score is also known as the F measure, in which recall and precision are evenly weighted. Hence, this research utilizes three indicators to measure the performance of Markov Chains in terms of adequacy.

$$\text{Precision} = \frac{\text{predicted and ideal value}}{\text{all value predicted}} \dots\dots\dots (1)$$

$$\text{Recall} = \frac{\text{predicted and ideal value}}{\text{out of all ideal value available}} \dots\dots\dots (2)$$

$$F - \text{measure} = \frac{\text{predicted and ideal value}}{\text{all value predicted}} \dots\dots\dots (3)$$

TABLE 2. iTunes e-services matched with the proposed framework

	Attract	Interact	Retain
Self-actualized value (S)	• Customized Music Recommendation • Personalized Music Composition • Customized Content and Delivery	Music/Application Evaluation	Personalized Music Channel Management
Social and emotional value (E)	• Music Usage from other Peers in the Community • iTunes Gift Card Delivery • Online Sharing	Online Forum	• Music Recommendation from Good Peers • Comments Sharing for Music
Added value (C)	• Radio or TV programs Subscription • iPod Games • iTunes Scholar Videos • Applications • Movies or Videos • Bundling Service	• iTalk Online Customer Service • Email Service	• New Product and Information via Email • Application Update
Functional value (B)	• Music Update and Download • Free Trial Music) • Music Recording Service	Self-Service (FAQ)	Discount Provision

3.3 Recommendation of CRM E-Services

Bayesian probability models are used to forecast posterior probability according to prior probability and sample probability, in which all events are interrelated. Bayesian inference is an approach of statistical inferences. The probabilities can be adjusted when new evidence occurs. The Bayesian probability model determines what one's probability for the hypothesis is, based on the known outcomes. The advantage of this approach is the ability to infer outcomes despite small sample sizes and limited information. The concept of Bayesian theory is based on conditional probability [16]. The conditional probability $P(A|B)$ stands for the probability of event A under the known condition of the probability of event B. In other words, $P(A|B) = P(A \cap B)/P(B)$ or $P(A \cap B) = P(A|B) \times P(B)$ if $P(B) > 0$. The Bayesian theorem specifies how to use new information to adjust estimated probability, and the basic assumption is that all variables are independent (e.g., $P(A \cap B) = P(A) \times P(B)$). Bayesian theorem is widely used in a variety of domains [38].

In this research, we assumed that three CRM e-services (attraction, interaction, and retention) are dependent events, and each level of customer value could provide a combination of CRM e-services. The reason for this was that, in practice, each process of e-service operates independently. Each user uses a particular combination of CRM e-services, and the concept of Bayesian theory is to estimate the highest number of conditional probability for all CRM e-service combinations for each user. We also used adequacy to measure the performance of Bayesian theory. Adequacy is defined as the percentage of predicted e-services that are actually used (Eq. (4)). For instance, if the proposed approach provides a combination of A1, I2, and R3, and the actual usage of combination is A1, I3, and R3, respectively, the percentage of adequacy would be 66.7%.

$$\text{Adequacy} = \frac{\text{actual usage of e-services}}{\text{all predicted e-services}} \dots\dots\dots (4)$$

4. RESULTS

4.1 A Case Illustration

This research selected iTunes in Taiwan as the e-service platform for the case study, due to the sufficiently high number of users and the variety of e-services they provide. In Table 2, iTunes e-services are matched according to the four levels of customer value (functional value (B), added value (C), social and emotional value (E), self-actualized value (S)), and three types of CRM processes (attraction, interaction, and retention). We attempted to match 29 iTunes e-services with the proposed framework. In the category of attract, e-services are intended to attract users. In the category of interact, e-services can assist users to interact with iTunes. In the category of retain, e-services can provide increased benefit to promote or maintain loyalty.

At the level of functional value (B), we considered Music Update and Download, Free Trial Music, and Music Recording Service as basic e-services of attract. We considered Self-Service (FAQ) as an e-service of interact because users can overcome problems themselves by interacting with iTunes. Discount Provision is an e-service of retain, based on the fact that the simplest approach to retain users is to provide discounts for downloaded music.

At the level of added value (C), Radio or TV program Subscriptions, iPod Games, iTunes Scholar Videos, Applications, Movies or Videos, and Bundling Service were e-services of attract. iTalk Online Customer Service and Email Service were considered e-services of interact at this level because iTalk Online Customer Service provides two-way interaction, while Email Service provide one-way interaction.

At the level of social and emotional value (E), Music Usage from Peers in the Community, iTunes Gift Card Delivery, and Online Sharing were e-services of attraction. Online Forum was categorized as an e-service of interaction, enabling users to interact with peers to share experiences. Music Recommendations from Good Peers and Comment Sharing for Music were e-services that helped retain iTunes users.

At the level of self-actualized value (S), Customized Music Recommendation, Personalized Music Composition, and Customized Content and Delivery were e-services of attraction. Music/Application Evaluation is an e-service of interaction enabling users to interact with other peers by assessing applications or music with which they have experience. Personalized Music Channel Management is an e-service of retention, providing a way for users to control their music and applications. Once users are able to manage their personalized music, they are likely to remain with iTunes for some time to come.

In summation, the proposed value framework covers 18 e-services of attraction, 5 e-services of interaction, and 6 e-services of retention. To reduce complexity, we assumed that each e-service only belonged to one category, although a number of e-services may be classified into more than one category. We attempted to match them to the most reasonable and appropriate category.

4.2 Customer Segmentation and Assumptions

We interviewed 30 iTunes users (15 students and 15 workers) with experience using iTunes services, and collected information on their behavior. The samples were randomly selected and equally segmented for two types of users for generality. The interview process was conducted by face-to-face interaction. This research inquires participants on iTunes service usage, such as how many services were used per day, how long they used these services per day, whether they paid for the services, and what the services were. We discovered that students and workers are distinct regarding paying iTunes services and user preferences. We used economic means and involvement in music to segment the 30 users according to four types. As shown in Table 3, study participants were divided into addicted students (7), typical students (8), addicted workers (6), and typical workers (9).

The behavior of users using the iTunes services varied according to interview results. We consider light involvement in music as a feature of typical users and heavy involvement of music as a feature of addicted users. Limited economic means could result in a limited budget to pay for iTunes services. In contrast, strong economic means may facilitate the usage of iTunes services. Typical students spent less on iTunes services due to monetary concerns and low music involvement, and tended to notice opportunities to obtain free videos and applications.

Addicted students were interested in information related to music, entertainment, and learning services, as well as interacting with peers. However, their spending was limited to e-services. Typical workers considered music a leisure media and paid for music and entertainment products. Addicted workers had a passion for music and were economically stable. They were particularly interested in information regarding music or products, and demanded high quality e-services and customization.

In addition to customer segmentation, we collected information of e-service usage through interviews. We asked participants to provide information regarding e-service usage in the previous 13 days. Based on this information, we attempted to match each used e-service with a category of customer value at a level of CRM process. We also requested that users provide information concerning at least one e-service they used each day. In this manner, we integrated the e-services used by each type of user to simulate a chain (Table 4). The notations in state chain are as follows: functional value (B), added value (C), social and emotional value (E), self-actualized value (S). Due to difficulties in obtaining data concerning long-term e-service usage, we assumed that the usage was routinely repeated over time. We extended the simulated samples to 26, 39, 52, and 65 days based on 13 days of e-service usage. We also assumed that values could move to higher levels only after the lower levels had been satisfied; hence, alternatives with a low level regarding customer value were taken as the basic assumption. For instance, if the customer value was C, then the possible predicted value was B or C. The reason for a lower level and not a higher level value was to ensure a minimal recall rate with strict constraints.

4.3 SIMULATION AND ANALYSIS

4.3.1 Markov Chain Prediction

This research simulated 26, 39, 52, and 65 days of usage for each type of user. Based on the e-service usage we collected, we assumed that each day represented a level of customer value. In other words, each customer used several e-services to fulfill a level of customer value each day. Two-thirds of the data were utilized for building the transition matrix and one-third of the data were employed for verifying validity based on the constructed transition matrix. Indicators for validity were precision, recall, and F-measure. The results of the simulation revealed that 52

TABLE 3. iTunes user type

		Economic Ability	
		Low	High
Involvement of Music	Heavy	Addicted Student	Addicted Worker
	Light	Typical Student	Typical Worker

TABLE 4. State chain of 13 days for each type

	State Chain												
Typical Student	B	C	B	B	B	C	B	C	B	B	B	B	C
Addicted Student	B	E	B	C	E	B	E	E	B	C	B	E	E
Typical Worker	E	B	B	C	C	S	B	C	E	B	B	C	B
Addicted Worker	B	C	E	S	E	S	C	E	E	S	E	S	C

days had the optimal outcome regarding precision, recall, and F-measure. Specifically, precision rates were 70.59% for the typical student and addicted worker, 64.71% for the addicted student, and 50% for the typical worker. The average precision rate percentage was 64.7%. The recall rate was 66.7% for the typical student, 69.57% for the addicted student, 57.41% for the typical worker, and 78.26% for the addicted worker. The average recall rate percentage was 61.48%. The F-measure for 52 days was 67.91%, which was the optimal value among all simulated data.

The results also revealed that the precision rate was high for typical students and addicted workers, reaching 60% to 70% for the various time periods simulated in the study. Typical students had the highest degree of involvement with music, while addicted workers had the lowest. Figure 1 shows that the precision rates were different before the 5 predicted days, and close in the long term for the four types. Meanwhile, the precision rate for typical workers was the lowest. The average precision rate for data was 59.38% (26), 62.52% (39), 64.70% (52), and 59.52% (65). The trend revealed that precision rates increased in conjunction with duration to 52 days, but decreased beyond 52 days. The reason for this was that the transition matrix stabilized as the amount of data increased, and predicted customer value may be the same in the long term. However, actual customer value may still change periodically. Consequently, the optimal outcome of the experimental simulations was 52 days.

The result of recall rate for all data was 57.5% (26 days), 62.5% (39 days), 71.97% (52 days), and 61.84% (65 days). The coverage of predicted customer value was the highest when the

data were extended to simulate 52 days. The trend also revealed that the number of days and precision and recall are inversely proportional. In addition, recall rates were close among the four types of users, as shown in Figure 2. The recall rate for addicted workers was superior to that of the other three types of participants after 9 days. Finally, the F-measure for all data was 3.11% (26 days), 60.71% (39 days), 67.91% (52 days), and 58.20% (65 days). This also indicated that the ability to predict customer value for typical students and addicted workers was the best, and the typical worker was the worst with the number of days set to 52 (Fig. 3). The F-measure value for addicted students was between.

4.3.2 Bayesian Approach Forecast

This research also employed *adequacy* as an indicator for measuring the effectiveness of the Bayesian approach. We collected data regarding 13 days of e-service usage from interviews. After identifying the level of customer value, we forecast the most appropriate combination of e-services. We assumed that each customer used a combination of CRM e-services each day, including services related to attraction, interaction, and retention. However, for a user to utilize all three types of e-services each day was unnecessary. Therefore, we extended the 13 day model to simulate 26, 39, 52, and 65 days for each type of user. We utilized two-thirds of the days to build the model and one-third of the days to verify validity. We employed *adequacy* as the indicator of validity pertaining to the Bayesian approach.

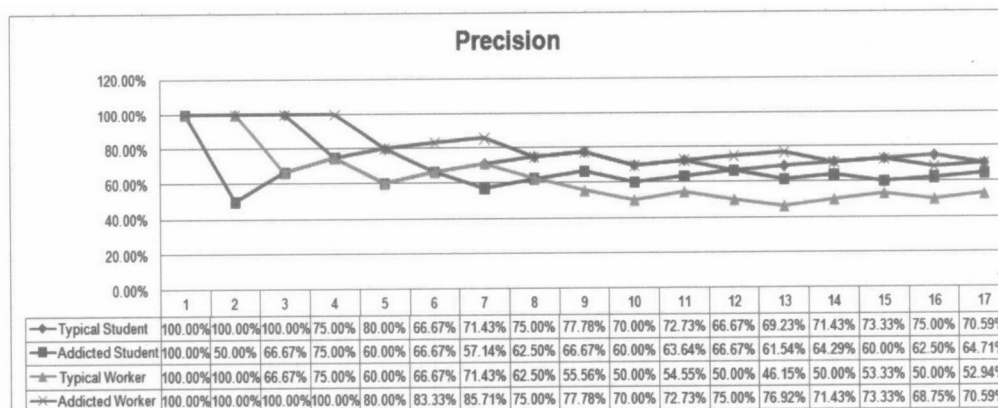


FIGURE 1. Precision rate for 52 days

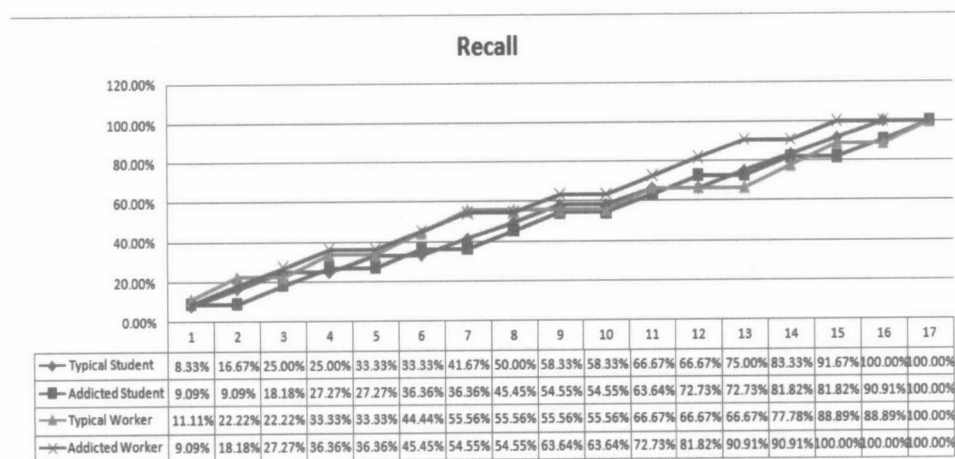


FIGURE 2. Recall rate for 52 days

This study analyzed the results of the Bayesian approach by building a tree. The Bayesian probability model used two-thirds of the days to build the model and construct all conditional probabilities, and the model was incrementally revised occasionally. The average degree of adequacy for levels B (81.6%) and C (89%) was approximately 80% for the typical student. This number was representative of the recommended CRM e-services matching customer value. As for addicted students, the average degree of adequacy for levels C and E was between 80% and 90%, and only the adequacy number for level B was low (approximately 75%). The average degree of adequacy for levels B and C for the typical worker was between 70% and 85%. The average degree of adequacy for level E (approximately 75%) was lower than that of levels B and C. This result was not representative of level S due to an insufficient (one sample) number of days. This was because this type of user merely uses e-services to satisfy value (needs) from level S. As for addicted workers, the average degree of adequacy for level E was between 70% and 80%, and for level S was between 80% and 90%. The average degree of adequacy for level C was low (approximately 50%), possibly because users use e-services mostly from higher levels (E and S). That level B was not representative either was due to an insufficient number of days required for verification because this type of user merely uses e-services to satisfy value (needs) from level B.

From the perspective of data size, 39 days and 52 days for levels B and C of the typical student had a high degree of adequacy. Addicted students at 52 days had a high degree of adequacy for all levels. The typical worker for level B had a good degree of adequacy when the period was set at 26, and good adequacy for other levels when the period was set at 65. The degree of adequacy for addicted workers at all levels was good when the number of days was 65. In brief, the typical student and the addicted student had superior adequacy when the period was 52 days, and the typical worker and the addicted worker had a higher degree of adequacy when the period was 65 days. Consequently, we concluded that the size of data influenced the performance of adequacy. The performance of the Bayesian probability model was superior when the amount of data increased. From the perspective of customer type, the adequacy of level B was approximately 80% for all customer types. The adequacy of level C was approximately 85% for all customer types, and 70% to 80% for level E. Specifically, the adequacy for level E was insufficiently representative due to a limited number of days, with only the addicted worker using e-services at this level. Thus,

various types of customers had less impact on the performance of the Bayesian approach. In summation, the Bayesian probability model provided approximately 80% to 90% adequacy in this research, indicating both stability and validity.

5. IMPLICATIONS

This study proposes a novel conceptual framework for CRM e-services. The derivation of CRM is from passive to proactive. The proposed framework assists firms to identify customer value automatically and efficiently, and the usage of CRM e-services is predicted effectively. The devised framework furnishes a comprehensive viewpoint for applications of CRM system. Specifically, certain existing studies utilize data mining techniques to help companies recognize customer needs. Furthermore, practical applications also have superior customer service management, such as Amazon. This study aims to help enterprises enhance competitive advantage by applying the proposed framework to systematic applications. The used approaches (Markov chain and Bayesian theorem) also examine the effectiveness and efficiency of the proposed framework. Managers can master customer needs and provide appropriate CRM e-services in a timely fashion. In addition, customer segmentation (student and office worker) also helps managers identify customer value promptly and increases the accuracy for recommending CRM e-services.

6. CONCLUSION

This study investigated how to interact with customers efficiently and manage customer needs. We separated customer needs according to level based on observations found in the literature regarding customer value, and embedded CRM processes to build a customer value framework. Our combination of the Markov Chain and Bayesian theory in the domain of CRM was novel and represents the major contribution of this study. We utilized the Markov Chain to predict the level of customer value, and a Bayesian probability model to forecast an appropriate combination of CRM e-services.

This study also used iTunes as a real world case study to verify the validity of the proposed framework. Results from the simulation reveal that the accuracy of the Markov Chain was approximately 60 % to 70 %, providing evidence that this approach is capable of predicting customer value. Moreover, the results of the simulation also revealed that the adequacy

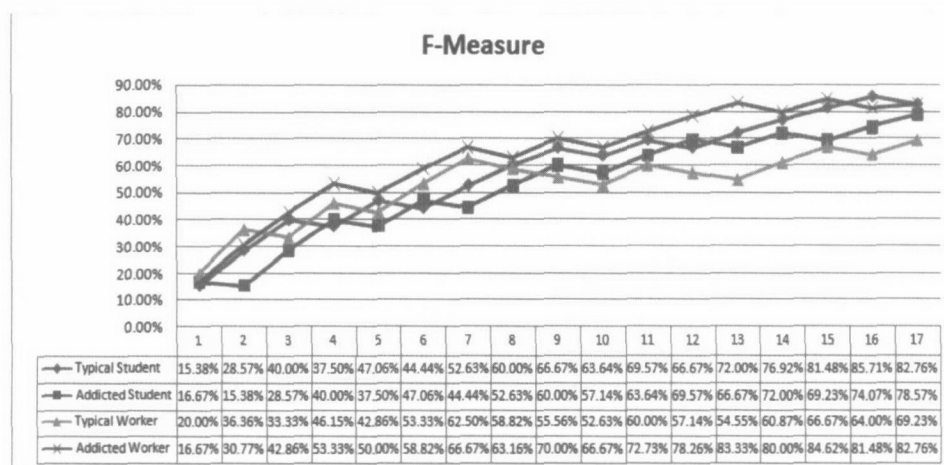


FIGURE 3. F-measure for 52 days

requirement was met for all user types, which means that user type has no direct impact on adequacy. The 80% to 90% adequacy also supports the superior performance of Bayesian probability models for forecasting appropriate combinations of CRM e-service. In summation, this study devises a novel conceptual framework to examine CRM e-service provision by revisiting customer value. The proposed framework not only revisits value on needs, but also helps firms recommend appropriate services. The Markov chain and Bayesian theorem approaches are used with superior efficiency. The proposed framework also provides a basis of e-CRM for future applications of computer information systems.

We identified three limitations in this research. This study collected data by interviewing 30 iTunes users in Taiwan. We segmented the users into four categories, and synthesized e-service usage over 13 days, assuming that the e-service usage was stable and routine for that time period. However, customer behavior may change over time in the real world. In addition, we made assumptions concerning customer needs to satisfy the lower levels of value first before progressing to the next level of value. However, changes in the values of customers frequently occur, and people seek to satisfy their higher level needs without first satisfying their lower level needs. We also simplify our simulation, and the issues of psychological unconditional acceptance and unconditional reject can be considered in the future. This research suggests a long-term data collection process spanning a wider variety of e-services. Furthermore, the proposed approach could be validated through comparison with other approaches (e.g., association rule) for further verification.

REFERENCES

- [1] Aase, K. K., "A Markov model for the pricing of catastrophe insurance futures and spreads," *Journal of Risk and Insurance*, 68, 2001, 25-49.
- [2] Albrecht, K., *The Only thing that Matters: Bringing the Customer to the Center of Your Business*, Harper Business, New York, 1992.
- [3] Bhatia, A., *Customer Relationship Management 1th edition*, toolbox Portal for CRM, 1999.
- [4] Breur, T., "The importance of focus for generating customer value," *Journal of Financial Services Marketing*, 11(1), 2006, 64-71.
- [5] Dimitriadis, S. and Stevens, E., "Integrated customer relationship management for service activities: An internal/external gap model," *Managing Service Quality*, 2008, 18(5), 496-511.
- [6] Edvardsson, B., Enquist, B. and Johnston, R., "Cocreating Customer Value Through Hyperreality in the Prepurchase Service Experience," *Journal of Service Research*, 8(2), 2005, 149-161.
- [7] Finnegan, D. J. and Currie, W. L., "A multi-layered approach to CRM implementation: An integration perspective," *European Management Journal*, 28(2), 2010, 153-167.
- [8] Gupta, S., Lehmann, D. and Stuart, J., "Valuing customer," *Journal of Marketing Research*, 41(1), 2004, 7-18.
- [9] Harrigan, P., Ramsey, E. and Ibbotson, P., "e-CRM in SMEs: an exploratory study in Northern Ireland," *Marketing Intelligence & Planning*, 26(4), 2008, 385-404.
- [10] Heim, G. R., Wentworth, W.R. and Peng, X., "The Value to the Customer of RFID in Service Applications," *Decision Sciences*, 40(3), 2009, 477-512.
- [11] Heinonen, K., "Reconceptualizing customer perceived value: the value of time and place," *Managing Service Quality*, 14(2/3), 2004, 205-215.
- [12] Holbrook, M. B., "Ethics in Consumer research, in C. T. Allen and D. Roedder John (eds) *Advances in Consumer Research*," Vol.21, Provo, UT: Association for Consumer research, 1994.
- [13] Holbrook, M. B., *Consumer Value: a framework for analysis and research*, Routledge, London, 1999.
- [14] Howson, C. and Urbach, P., *Scientific Reasoning: The Bayesian Approach*, Open Court Publishing Company, Chicago, U.S., 1993.
- [15] Järvinen, R. and Lehtinen, U., "Innovative Consumer e-Services in the Financial Sector," *Proceedings of the Nordic Consumer Policy Research Conference*, Helsinki, Oct 3-5, 2007, 1-5.
- [16] Joo, J., "An empirical study on the relationship between customer value and repurchase intention in Korean internet shopping malls," *Journal of Computer Information Systems*, 2007, 53-62.
- [17] Kim, H., Lee, J. and Han, J., "The Role of IT in Business Ecosystems," *Communications of the ACM*, 53(5), 2010, 151-156.
- [18] Kumar, V. and Reinartz, W. J., *Customer Relationship Management: A Databased Approach*, John Wiley & Sons, New Jersey, 2006.
- [19] Ling, R., and Yen, D. C., "Customer relationship management: An analysis framework and implementation strategies," *Journal of Computer Information Systems*, 41, 2001, 82-97.
- [20] Maslow, A. H., *Motivation and Personality*, Harper, New York, 1954.
- [21] Mass, P. and Graf, A., "Customer value analysis in financial services," *Journal of Financial Services Marketing*, 13(2), 2008, 107-120.
- [22] Pan, S. L., Lee, J., "Using e-CRM for a Unified View of the Customer," *Communications of the ACM*, 46(4), 2003, 95-99.
- [23] Payne, A., Frow, P., "A Strategic Framework for Customer Relationship," *Management Journal of Marketing*, 69, 2005, 167-176.
- [24] Peppers, D. and Rogers, M., *The One to One Manager: Real World Lessons in Customer Relationship Management*, Doubleday Business, New York, 1999.
- [25] Pine, B. J. and Gilmore, J. H., "The Experience Economy," *Boston: Harvard Business School Press*, 1999.
- [26] Reichheld, F. F., Sasser, W. E. J., "Zero Defections: Quality Comes to Services," *Harvard Business Review*, 68(5), 1990, 2-9.
- [27] Rigby, D. K., Reichheld, F. F. and Scheffer, P., "Avoid the Four Perils of CRM," *Harvard Business Review*, 2002, 101-109.
- [28] Romano, N. and Fjermestad, J., "Electronic Customer Relationship Management: An Assessment of Research," *International Journal of Electronic Commerce*, 6(3), 2002, 59-111.
- [29] Rust, R. T. and Lemon, K. N., "E-Service and the Consumer," *International Journal of Electronic Commerce*, 5(3), 2001, 85-101.
- [30] Rowley, J., "An analysis of the e-service literature: towards a research agenda," *Internet Research*, 16(3), 2006, 339-359.

- [31] Sonnenberg, F. A. and Beck, J. R. "Markov models in medical decision making: A practical guide," *Medical Decision Making*, 13, 1993, 322-338.
- [32] Srinivassan, S., Anderson, R. and Ponnayolu, K. "Customer loyalty in e-commerce: an exploration of its antecedents and consequents", *Journal of Retailing*, 78(1), 2002, 41-50.
- [33] Swami, S., Martin, L. P. and Charles B. W. "Play It Again: Optimal Replacement Policies for a Motion Picture Exhibitor," *Manufacturing & Service Operations Management*, 3, 2001, 369.
- [34] Tiwana, A. and Ramesh, B. "E-services: problems, opportunities, and digital platforms," *Proc. 34th Hawaii International Conference on System Sciences*, Hawaii, 2001.
- [35] Tseng, C. R. and Hwang, G. J. "Development of an automatic customer service system on the internet," *Electronic Commerce Research and Applications*, 6(1), 2007, 19-28.
- [36] Venkatesan, R., Kumar, V. and Bohling, T. "Optimal Customer Relationship Management Using Bayesian Decision Theory: An Application for Customer Select," *Journal of Marketing Research*, 44(4), 2007, 579-594.
- [37] Weingand, D. E. *Customer Service Excellence: A Concise Guide for Librarians*, American Library Association; illustrated edition, Chicago: ALA, 1997.
- [38] Williams, K., Chatterjee, S. and Rossi, M. "Design of emerging digital services: a taxonomy," *European Journal of Information Systems*, 17, 2008, 505-517.
- [39] Woodruff, R. B. "Customer value: The next source for competitive edge," *Journal of the Academy of Marketing Science*, 25(2), 1997, 139-153.
- [40] Yan, O. H. M. *Consumer Behavior in China: Customer Satisfaction and Cultural Value*, Routledge, New York, NY, 1994.
- [41] Zeithaml, V. A. "Consumer Perceptions of Price, Quality, and Value: A Means-End Model and Synthesis of Evidence," *Journal of Marketing*, 52, 1988, 2-22.
-