Decision Science Letters 3 (2014) 187–196

Contents lists available at GrowingScience

Decision Science Letters

homepage: www.GrowingScience.com/dsl

An innovative price plan monitoring and advisory system: A case study of mobile telecom service in Thailand

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C H R O N I C L E

Article history:
Received October 23,2013
Received in revised format
November 25, 2013
Accepted November 27, 2013
Available online
November 27 2013

Keywords:
Innovation
Decision support system
Control chart
Usage behavior
Mobile telecom service

A B S T R A C T

An innovative price plan monitoring and advisory system simulates subscriber usage consumption for offering suitable price plan. The aim of this paper is to develop the decision support system by using Statistical Process Control (SPC) to identify subscriber usage behavior and provide critical visibility into subscriber consumption to detect their inappropriate usage especially in exceeding usage. To explore subscriber usage behavior, a forecasting model and a regression is employed to identify related factors and predictive usage model. The innovative price plan monitoring and advisory system has been verified and validated with one of the largest telecommunication company in Thailand. Using decision support system with effective control chart and real subscriber behavior pattern help mobile network operator grow their revenues and profits by offering an appropriate price plan as well as improve subscriber experience with more flexible choice to meet their individual usage consumption needs.

1. Introduction

Subscriber churn is a fundamental driver of performance for mobile network operators. Understanding of subscribers and the ability to predict their behavior through continuous usage monitoring are vital to improve subscriber retention and performance. Improving quality of product and service is one of the main factor influencing on customer relation management (Azad et al., 2013a). In Thailand, the mobile communication market has been tremendously grown in the past ten years where the adoption of mobile subscribers has been higher. At the end of 2011, Thailand's mobile market had reached 76.6 million mobile subscribers in total (Intelligence, 2012), compared with 2001 when there were just 4 million subscribers. According to statistics reported by the National Broadcasting and Telecommunications Commission (NBTC, the industry regulator), the mobile penetration rate had already reached 109.9 percent of total population (67.7 Million Thai people) and will continue to rise. Service plan optimization is a key element of company strategies in the mobile

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doi: 10.5267/j.dsl.2013.11.004

communication sector to enhance customer satisfaction and retention (Seo et al., 2008). Current CRM practices focus on price plan suggestion based on average subscriber usage without considering variations: both common and special cause variations. Therefore, with increasing variety of services and evolving consumer behavior this paper aims to develop a decision support system to provide a more precise usage prediction with multiple regressions while control chart is adopted to identify usage pattern and provide warning signal for excessive usage. Such tool enables timely and proactive action for subscribers to avoid unexpected expenses. Mobile network operators can utilize these concepts to increase service usage, improve customer satisfaction and ultimately reduce churn.

2. Research background

2.1. Customer Behavior of mobile services

Most consumers seem to find additional innovative benefits through a product's use, and the said advantage may depend on the network externalities adding into the service (Moore, 1999). Therefore, it is believed that what the customers perceived is the most important at the initial adoption stage. With reference to Teng et al. (2009), technology does not count as an important factor influencing consumer's adoption intention, because most consumers do not have insightful information on a distinct service. Considered as core variables in Technology Acceptance Model (TAM), the perceived usefulness and the ease of use affect user view and behavioral intentions in choosing a technology system (Schepers & Wetzels, 2007) and were shown to be important to a user's perceptions of the mobile services. Previous studies (Pagani, 2004; Teng et al., 2009) demonstrated that the correlation between perceived expense and adoption intention is a result from age and financial level. Demographic variables may represent moderating variables with respect to adoption in the model consisting of gender, age, and financial level. In addition, a research on m-commerce adoption reveal that the research in the future should more investigation user demographic profiles, they might show a significant and different role in predicting customers' intention to use m-commerce (Wei et al., 2009). Hence, the developed price plan advisory system takes into account all these concerns.

2.2. Decision Support System

Gorry and Morton (1971) explained a decision support system (DSS) as interactive system based on computer performance helps decision makers or management to effectively utilize specific data and models to solves unorganized problem in the organization. A DSS is a methodology for supporting decision making in all phases of decision process. A knowledge component can be also included in the process. DSS usually employs models and is built by an interactive and iterative process to support the solution of a certain problem or for evaluation of an opportunity. In general, a decision support system is comprise of a four attributes which are data management, model management, knowledge-based and user-friendly interface as key components of the system (Turban & Aronson, 2001). Nevertheless, the technical solution is not the one factor to develop decision support system (Dong & Srinivasan, 2013). There are various important factors that need to be concerned and focus when system development. According to Azad et al. (2013b) presented that system, analysis and transaction were important factors effect to decision supporting system, which operational decisions was a crucial measurement variable for transaction. A Decision Support System (DSS) is designed and utilized for supporting decision making in many areas such as the decision making process by utilizing expert knowledge, spatial data and geographical modeling for wireless communication (Scheibe Jr. et al., 2006), decision making framework based on service delivery for managing complexity of business processes in dynamic organization (Dong & Srinivasan, 2013).

3. Proposed method

3.1 Monitoring service usage

A control chart is a tool for Statistical Process Control (SPC) by using statistical data to control the process was first developed by Shewhart (Shewhart, 1931) and currently is one of the popular techniques of statistical quality control in manufacturing and other industries for controlling and

monitoring processes to indicate that the process currently remains in-control. There are many tools for statistical process controls are data figures, Pareto analysis, cause and effect analysis, trend analysis, histogram, scatter diagrams, and process control charts (Kerzner, 2009).

A process control chart is widely popular tools for monitor process mean and variation with control limits by focusing on the mean and variation of a process. The main objectives are to prevent defects and improving productivity. There are many varieties of standard control chart for variable data, but the main types are included:

- The $\bar{X}$ Chart is a control chart that presents the mean or average value of quality characteristics of the process changed over time and often used to monitor the process average or mean quality level of a quality characteristic (Montgomery, 2005). However, this chart is normally applied for repetitive production with high production rate.
- R-Chart is a one type of control chart to monitor the range (variance) of the process.

Many previous research works on control charts are widely applied to manufacturing, automotive and engineering, but less has been done in service operations. Leveraging the control chart in process improvement with appropriate adjustment of control limits could increase efficiency and result in financial cost saving (Bischak & Silver, 2004). According to Sulek et al. (2006), the control chart is applied to measure performance and identify problem areas in multi-stage service processes in grocery store (Sulek et al., 2006). However, there was none that utilize it to monitor and detect subscriber service usage in Telecommunication Company. This paper will apply the control chart in telecommunication industry to monitor and control individual's subscriber usage as well as using process capability indices to indicate the level of fit between subscriber's usage consumption and their chosen price plan. Additionally, this approach can be used to monitor individual subscriber usage and trigger their exceeding. Regarding the results of control chart development (Amornrattanapaichit & Thawesaengskulthai, 2013), indicated that the control chart can provide critical visibility into subscriber consumption especially in exceeding usage as fig 1. With this reason, the use of this method could improve the overall level of individual subscriber usage fit and the outcome such as customer satisfaction and churn reduction finally.

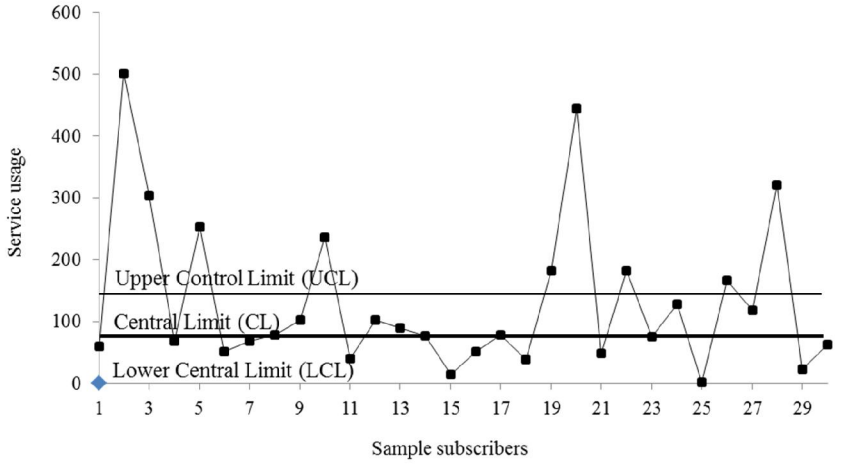

Fig. 1. The proposed control charts are simulated with latest month of subscriber usage to detect potential mismatch price plan

3.2 Predictive subscriber usage model by multiple regression

To determine the factors that contribute to forecast usage as the predictive subscriber usage behavior model, correlation and multiple regressions analyses were conducted to examine the relationship between voice usage and potential predictor variables which there are nine factors as independent

variables and voice usage was treated as dependent variables. Multiple regression analysis (McClave et al., 1998) is constructed as a method to analyze the correlation of the dependent variable (Y) and the independent variable (X). The strength of the relationship between *y* and *x*, and uses the resulting prediction equation to estimate the mean value of *y* or to predict some future value of *y* for a given value of *x*. For this paper, a total of 280 from 340 subscriber usage were analyzed, 60 records were removed due to significant outliers as regression assumption. The regression analysis revealed that three variables predicted the voice usage, R^2 =.810 (adjusted R^2=.808), F (3, 276) = 391.533, p < .01 (using stepwise method). The p-value of the t statistic of the regression coefficient of average usage, attitude and intention are less than 0.01. Hence it was concluded that all three of the predictor variables are useful in the model. In addition, the output presented that all predictor variables have a variance inflation factor (VIF) less than 10. Hence there was no evidence of multicollinearity.

Thus, the regression equation to describe predicted voice usage is as follows:

Predicted (Voice usage) = 365.266 + .689 (AVGVoiceusage) - 27.597 (Attitude) - 23.970 (Intention)

4. System development methodology

With statistical control chart and the proposed of predictive subscriber usage behavior model of Thai mobile market established, the innovative price plan monitoring and advisory system is developed in order to provide warning signal for excessive subscriber usage and bringing next best offering to each subscriber with more precise usage prediction. This application will help marketing strategy team to automate monitoring and price plan advisory process, which would otherwise have to be performed manually.

For the development of innovative price plan monitoring and advisory system, generic product development process (Ulrich & Eppinger, 2008) with six phases of product development processes was introduced.

Phase 0: Planning

Phase 1: Concept Development

Phase 2: System-Level Design

Phase 3: Detailed Design

Phase 4: Testing and Refinement

Phase 5: Production Ramp-up

4.1 System overview

An Innovative Price Plan Monitoring and Advisory System is developed under System Development Life Cycle (SDLC) approach with the Waterfall model (Royce, 1970), based on HTML5 platform. Four main components are describes as follows and Fig 2.

- *Manage price plan*: this part of the system will keep and maintain price plan characteristics and forecasting model
- *Detection condition*: this part of the system will create conditions in each price plan to detect subscriber usage
- *Subscriber monitoring*: to speed up the detection of potential excessive usage, this part of the system works as interactive advisor to help managers analyze their subscriber usage based on designed detection conditions.
- *Package advisory*: this part of the system works as human advisor to calculate and estimate subscriber the potential usage based on predefined usage forecasting pattern as well as to propose and suggest the suitable price plans to the target subscriber.

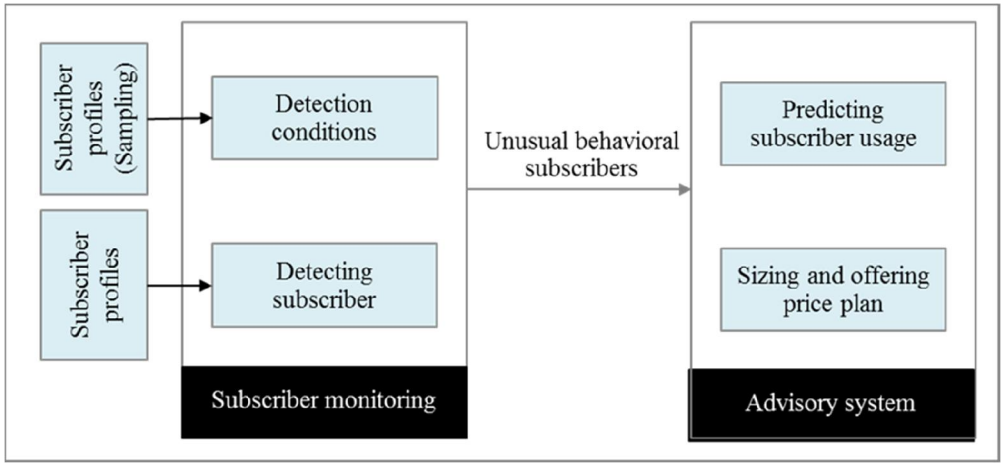

Fig. 2. System overview of Innovative price plan and monitoring and advisory system

4.2 Business flow activity diagram

The diagram below (Fig 3) is a business flow activity diagram of Innovative Price Plan Monitoring and Advisory System. The subscriber profile is entered with its parameter to create price plan condition for detection monitoring tools. After condition is done and characteristic of price plans are filled in, target subscribers are processed and next best offering for unusual behavior subscriber are identified.

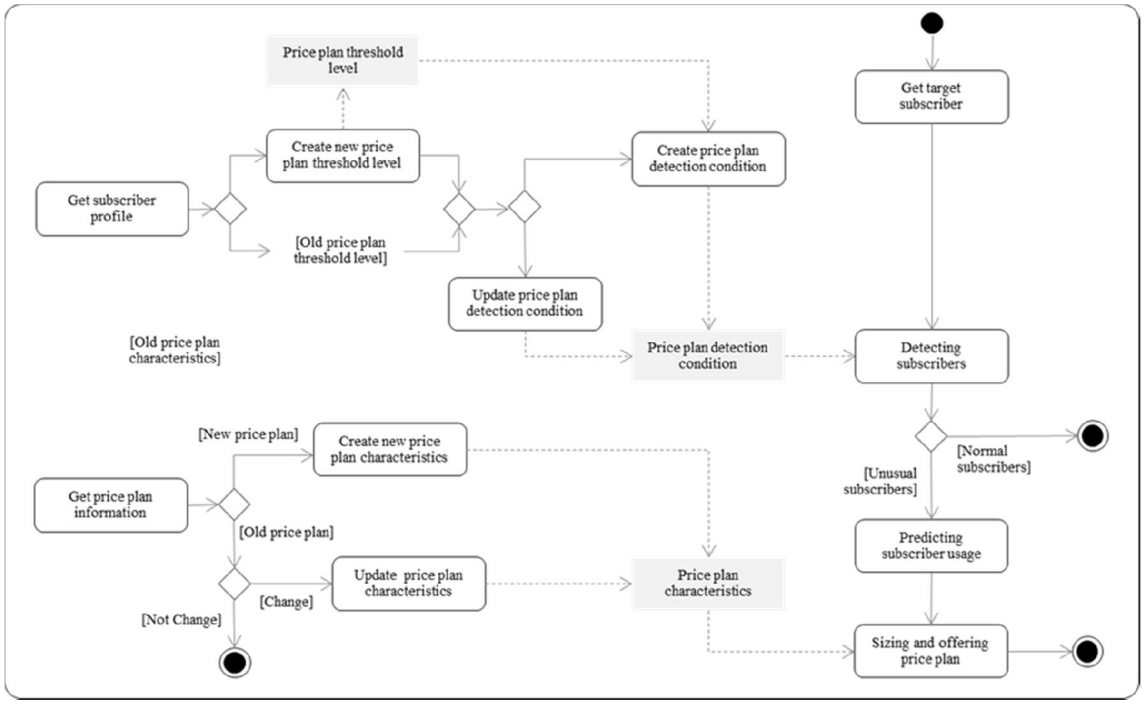

Fig. 3. Activity diagram of Innovative price plan and monitoring and advisory system

4.3 System features and functionalities

Effectively system design for the data model structure and application functionalities, the main three types have been used e.g. Use case diagram, Database model and Sequence diagram (Dix et al., 2004). Below are the details of use cases and functional sequence.

1. Manage price plan

Use case description Create price plan and forecasting usage is a ability to record

	price plan characteristics and its predictive model to use across functionalities
Actor	Marketing analyst
Functional requirement	1. Marketing analyst selects "Manage price plan" action 2. Entry the price plan characteristics and parameters for forecasting usage model 3. The price plan is validated and recorded to the system
Post-conditions	Price plan have been created

2. Detection condition

Use case description	Detection condition is a guideline to monitor and detect unusual behavioral subscriber.
Actor	Marketing analyst
Functional requirement	1. Marketing analyst selects "detection condition" action 2. Upload/retrieve subscriber profile to calculate threshold with criteria 3. The subscriber profile is validated and calculated the price plan threshold
Post-conditions	Detection conditions for each price plan have been created

3. Subscriber monitoring

Use case description	The unusual usage subscriber will be monitored and detected with defined conditions.
Actor	Agent's Manager
Pre-conditions	Detection conditions has been identified
Functional requirement	1. Manager selects "Monitoring subscriber" action 2. Upload/retrieve target subscriber 3. Define segmentation and offering conditions 4. The subscriber profile is validated and calculated with predefined detection condition. 5. System present summary usage behavior breakdown by predefined segmentation and generate list of unusual behavior subscriber for further action
Post-conditions:	Unusual usage subscribers have been monitored and detected

4. Package advisory

Use case description	Package advisory is the ability to calculate and forecast subscriber usage based on their historical usage and individual behavior with innovative price plan prediction model
Actor	Agent
Pre-conditions	List of unusual behavior subscriber is generated

Functional requirement	1. Manager selects "Package advisory" action 2. Select unusual subscribers for predicting usage as segmentation 3. System calculate the for usage prediction as predefined usage forecasting model 4. System present list of unusual behavior subscriber with their predictive usage and matching with most appropriate price plan for proposing to individual subscriber.
Post-conditions:	Individual predictive subscriber usages is generated with suitable price plan

5 Application acceptance test and results

The proposed innovative price plan monitoring and advisory system was tested and validated by a smaller version of pilot in a controlled but real environment with limited agents.

The acceptance testing is preformed through different target users in order to check whether all the system functionalities are working properly, user friendliness of process and transaction flow and evaluate the subscriber acceptance rate with proposed offering. First, application acceptance were participated by six agents who called to target subscribers to propose the new offering, while secondly validity test were evaluated by 254 subscribers considering on subscriber acceptance rate. All agents were asked to rate on TAM dimensions based on 5 point Likert scale consists of 18 structured questions. All subscribers with exceeding limit usage from their own tariff were conducted by outbound call.

5.1 Application acceptance

This methodology aimed to measure the agent's opinion on usability, user interface and its functionalities to use Innovative Price Plan Monitoring and Advisory system. In parallel, efficiency and effectiveness were captured. Technology Acceptance Model (TAM) was employed to find the acceptance of the product and service, also TAM Model (Davis, 1989) is used to foretell a user's acknowledgement of Information Technology (IT) and their usage by applying a measure of BI (behavioral intention to use) that seems to correlate with real usage (Turner et al., 2010) by giving the intention on the perceived usefulness and the perceived ease of use. TAM model is a valid and robust predictive that has been extensively used (King & He, 2006).

The four keys for acceptance testing are measured as below.

1. *Perceived usefulness* (Davis, 1989) refers to the degree of feeling that agents believes that using Innovative price plan monitoring and advisory system would improve their job performance in monitoring and advisory package.
2. *Perceived ease of use (Usability*) (Davis, 1989) refers to the degree of easiness that agents feel when using Innovative price plan monitoring and advisory system.
3. *User Interface* refers to the degree of feeling toward interaction with an Innovative price plan monitoring and advisory system.
4. User satisfaction refers to the degree of satisfy that agents feel when using Innovative price plan monitoring and advisory system

Evaluation of Innovative price plan monitoring and advisory system acceptance and adoption confirmed that Innovative price plan monitoring and advisory system has positively impact on their work performance and effectiveness. With a user-friendly design in term of ease of use and user interface made agents considered to be satisfied and tend to use in the future.

Table 1
The result of application acceptance

Measurement	Score	Standard Deviation
Perceived usefulness	3.88	0.21
Perceived ease of use	3.71	0.00
User Interface	3.79	0.33
User satisfaction	3.89	0.17

With above of supporting information and opportunity/possible to use Innovative price plan monitoring and advisory system in the future average score was 3.83. Therefore, we could conclude that the agents accept the system and agree for future use.

5.2 Validity test

To determine that the subscriber level of acceptance rate to change a new best fit offering to ensure that predictive subscriber usages model is accepted and valid with appropriate level. By the end of the validity testing period, the company will be able to make a decision to launch this application on a larger scale and move on to the rollout phase or not. The procedures and methodologies are described as Fig 4.

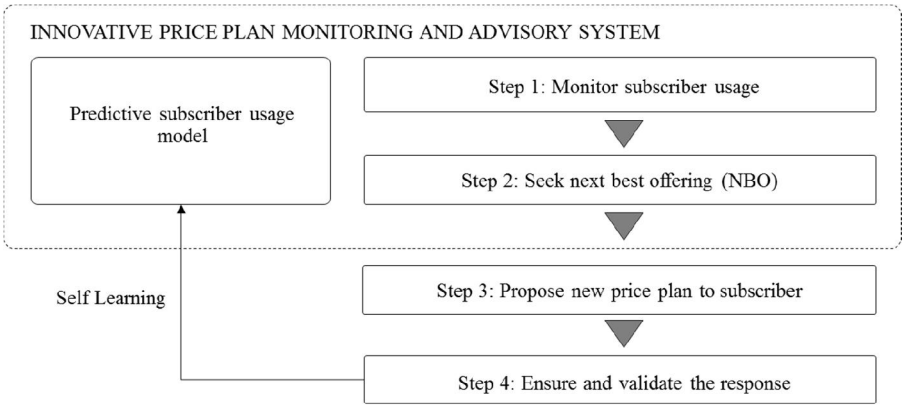

Fig. 4. The procedure and methodology for application validity test

In the validity test, with 254 target subscribers by followed the sampling process, there were 53.5% of subscribers can be reachable, 37.8% outbound call failed due to not reachable subscriber and 8.7% were not illegal criteria for this validity test due to switch off, suspend and already changed their price plan. As Table 2, Forty percent of reachable subscribers were sign up, 30.1% response with later and 29.4% reject the offering. Benchmarking percentage of subscriber sign up with traditional retention, there was a bit higher rate.

Table 2
The result of subscriber response

Response type	No. of subscriber	% of subscriber
Sign up	55	40.4%
Later	41	30.1%
Reject	40	29.4%
Total	136	100.0%

With 40.4% of subscribers sign up to the new price plan that are more suitable due to their usage. There were 90.9% of subscriber were changed to premium price plan with the same family, only 9.1% moved to another family due to their usage behavior tend to be new entry for data user.

Therefore, with the data and observations collected during the validity allow us to conclude that the customer offerings have been predicted and advised subscriber usage from Innovative price plan monitoring and advisory system are valid for company package advisory.

6 Discussion and conclusion

The Innovative price plan monitoring and advisory system is presented in this paper can make an appropriate and timely decision through insight subscriber usage behavior to gain more understand their subscriber demand and propose the best fit offerings. An application prototype includes statistical control chart embedded under monitoring service usage tool and integrate with predictive subscriber usage by multiple regression. This application prototype has shown the interesting result which beyond acceptance rate comparing with current retention process. Therefore, with such an effective tool will help company to retain the subscribers including letting subscribers have their awareness to maintain their usage within selected price plan. In future, the internet usage will be focused to provide the best fit offering as well as predictive usage for healthy subscriber. Additionally, new feature of individual analysis will be introduced and let subscribers can match the price plan by themselves. As a result, the manager can effectively control churn problem which is a major factor to raise customer complaint level.

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