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## Review on factors affecting customer churn in telecom sector

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Vishal Mahajan\*

HCL Technologies,  
Sec-125, Noida, India  
Email: vmahajan@hcl.com  
\*Corresponding author

Richa Misra

Jaipuria Institute of Management,  
Sec-62, Noida, India  
Email: richa.misra@jaipuria.ac.in

Renuka Mahajan

Amity University U.P.,  
Sec-125, Noida, India  
Email: rmahajan@amity.edu

**Abstract:** The communications sector is emerging with new technologies, wireless and wireline services. The industry's success expects a better perception of customer requirements and superior quality of service and models. Customer churn has a huge impact on companies and is the prime focus area for the companies to remain competitive and profitable. Hence, significant research had been undertaken by researchers worldwide to understand the dynamics of customer churn. This paper provides a review of around 75 recent journal articles (starting from year 2000) to identify the various churn factors and their complex relationships, in existing telecom churn literature. It gives detailed discussion of what factors were identified in various studies, the sample sizes used and the method used for the study by different researchers. The gaps identified in the previous studies have also been discussed. A model on churn factors, identified from the study is proposed to serve as a roadmap, to build upon existing churn management techniques.

**Keywords:** customer churn; telecom; churn management; customer switching; customer demographics; churn behaviour; churn determinants.

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**Biographical notes:** Vishal Mahajan is Group Project Manager with an Indian IT Company and a research scholar at Sukhadia University, Udaipur. His current research interests include data mining and e-CRM. He has published in the *Inderscience IJIL*, *IJLEG*, *Springer Journal of Education and Information Technology*, *IJEEEE* and few other professional conference proceedings.

Richa Misra is an Associate Professor of Management at Jaipuria Institute of Management, Noida. She received her PhD in Data Mining from Amity University. Her current research interests include CRM, e-business and e-commerce, and business intelligence.

Renuka Mahajan is an Assistant Professor of Computer Science at Amity University, Uttar Pradesh. She received her PhD from AUUP. Her current research interests include educational data mining and e-CRM. She has published in the Springer *Journal EAIT*, *Inderscience IJIL*, *IJLEG*, *JIOS*, *IJEEEE* and many other journals and few other professional conference proceedings.

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## 1 Introduction

Churn in telecom industry, as defined by Berson et al. (2000), is the movement of existing customers from one service provider to another. Customer churn is basically the inclination of a customer to leave a service provider (Phadke et al., 2013; Kirui et al., 2013; Chandar et al., 2006; Coussement and Poel, 2008; Buckinx and Poel, 2005; Bhambri, 2013; Xie et al., 2009; Chen et al., 2012). According to Umman and Simsek (2010), if an existing subscriber terminates a contract with one service provider and become subscriber of another service provider, then this subscriber is called as 'lost' customer or 'churn' customer. Churn can be active or deliberate, passive or non-voluntary, rotational or incidental (Hung et al., 2006).

The term 'churn management' describes a company's process to retain profitable customers (Umayaparvathi and Iyakutti, 2012). Kentrias (2001) explains that churn management in the telecom industry is a procedure of retaining the most important customers for the company. He also emphasised to anticipate as to how each customer will react to specific offers and predict which customers will be positively influenced. Berson et al. (2000) explained that churn management is a process which involves constructing a churn prediction model using past churn data, and finding key factors affecting the churn.

Customer switching behaviour also varies from industry to industry (Keaveney, 1995; Pilerood and Gholamian, in press). He investigated the customer switching behaviour specific to service industry and found that there is a negative association between the subscriber churn, the profitability and market share. Hence, it is very important for companies to retain their customers to maintain the profitability and market leader (Mohammadi et al., 2013; Tsai and Chen, 2010; Kim et al., 2004; Kim and Yoon, 2004). Kumar and Ravi (2008) found that customer retention can be increased by having a better customer relationship management.

One similar study conducted by Reichheld and Sasser (1990) found that the revenue earned from retained customers increases over the period of time. Authors found that as relationship continues, the existing customer spend increase over period of time and they also do not mind paying more as they become insensitive to price. This also helps companies to earn more revenue and also add to their margins. The trend of repeated purchases increases over period of time. They have found that service providers in service industry can increase their profits by 100% by reducing the churn of their existing

customer by just 5%. This study clearly shows how customer churn can impact business achievement enormously.

The salient facts of the churn related to telecom industry (given by Gartner, 2012):

- churn rate in India is anywhere between 3.5%–6% per month, one of the highest in the Asia-Pacific region
- acquiring a new customer as expensive as \$ 47.02 (USD)
- Indian telecom operators are losing more than \$ 94.03 cr. (USD) yearly due to churn.

### *1.1 Need for understanding customer churn in telecommunication*

It is important to undertake a study on customer retention and corporate profitability (Poel and Larivi, 2004). Reichheld (1993) stated that the role of customer is essential for corporate performance. He stressed that retaining and creating loyal customers should be a part of the organisation strategy. He concluded that economic benefits of high loyalty are important and in many industries this explains the difference among companies.

There are various benefits of lesser churning or maximising the number of retained customers for organisations. A study conducted by Reichheld and Teal (1996), reveals the learning obtained from churned customers. The author explained that if companies focus on retaining a customer, they can save on cost of acquiring a new customer and on top of that an existing customer can bring new customers. Further, he found that existing customers become less sensitive to price and contribute to profits of companies. The author found that companies can double their profits by reducing churning of customer by 5%, i.e., from 15% to 10%. He reported that the customer loyalty can be created by the value which companies provide through their services or products, also customers are more convinced from personal experiences than advertisements and marketing campaigns.

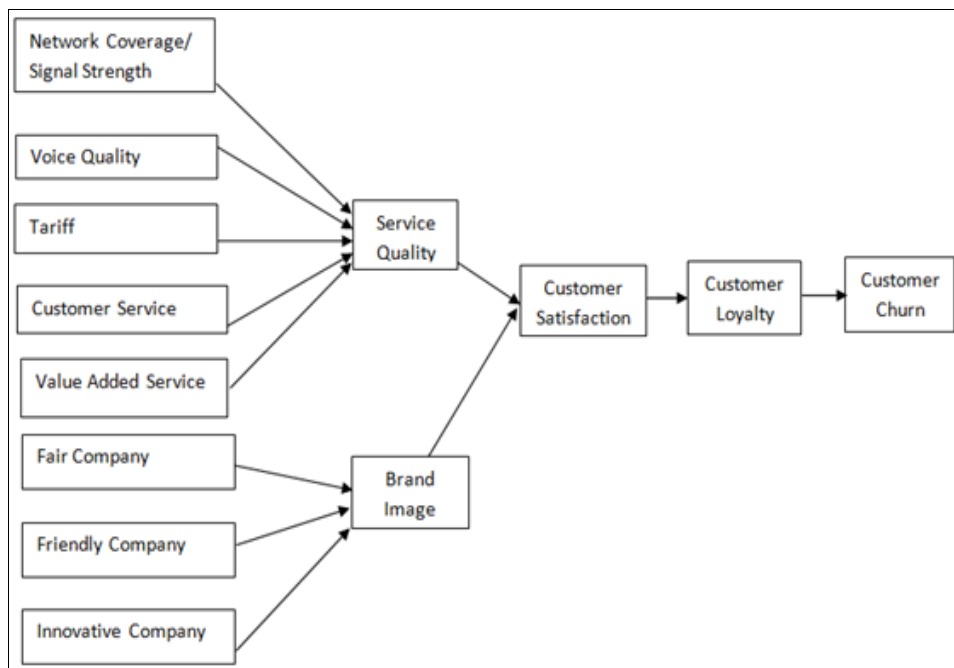
A small increment in customer retention has huge impact on customer net value. Reichheld and Teal (1996) investigated that, if companies enhanced their customer retentions just by 5%, for companies working in advertising area, it helps them to increase customer net present value by 95% and for companies working in software and IT areas it helps them to increase customer net present value by 35%. Overall, if companies are able to increase retention of their customer just by 5%, it will help them to grow their profits to 60% by 5th year, hence if companies are able to manage to increase their retention by small percentages every year, they will be benefitted multifold in years to come.

Interestingly, the corrosion of value which takes place because of churn is primarily determined by the competitive position of the operator, as the loss of value greatly varies and ranges from simply including the cost of re-acquiring a customer (COCA) to inclusion of all the costs associated with the missed churner revenues. The realistic view to gauge the true losses arising out of churn should be a mix of COCA and average revenue per user (ARPU).

There are number of studies conducted on reducing customer churn and maximising retention of customers and it has been concluded that benefits of retention to an organisation are huge. This paper introduces a comprehensive list of factors, extricated by reviewing the existing research intensity during the period of 2000 to October 2014, pertaining to customer churn in telecommunication industry. It gives detailed discussion of what factors were identified in various studies, sample sizes used, method used for the study and their interrelationships. On the basis of detailed review, a theoretical model has been drawn depicting antecedents of churn. Thus, it advances earlier customer churn studies as done by Dass and Jain (2011). The gaps in the previous studies were also reviewed. It can help in designing new models for churn customer analysis and formulating novel churn management techniques. This will provide a foundation to industry experts and scientists for future research.

The research methodology is presented in Section 2. The different dimensions pertaining to churn in telecom are analysed in Section 3 and the discussions on the identified factors and their relationships in Section 4. The conclusions are shown in Section 5. Section 6 gives future scope of the paper.

**Figure 1** A framework on the antecedents of churn



## 2 Research methodology

A literature review was conducted using a key word search of ‘customer churn’, ‘churn factors’, ‘churn analysis’ and ‘telecom’ in the WWW. This investigation revealed international journals as well as reports books, conference papers and the ‘grey’ literature (i.e., popular articles, unpublished reports). The popular scientific databases, internet

portals and websites in the search engine was utilised (see Figure 1 for a description of the methodological approach). Many relevant citations were captured pertaining to telecom and scientific databases for churn management. This exertion resulted in 1,512 citations from which relevant studies were chosen for the review. Their potential significance was examined on the basis of decade survey, i.e., 2000 to 2014 and 1,111 citations were excluded as irrelevant. The full papers of the remaining 401 citations were evaluated to select those primary studies that were directly related to various factors used in churn prediction. These criteria excluded 323 studies and left 78 in the review. They originated from 13 different countries, published in various languages between 2000 and 2014. Of these studies, 75 were relevant to the purpose of review and aided in recognising how researchers' choice on factors pertaining to churn analysis.

**Table 1** Methodological approach

<i>Research strategy</i>	<i>Description</i>
Used key words	'customer churn', 'churn factors', 'churn analysis' and 'telecom'
Time period	2000 to 2014
Search engines	<a href="http://www.google.com">http://www.google.com</a> , <a href="http://www.business.com">http://www.business.com</a> , <a href="http://www.bing.com">http://www.bing.com</a>
Scientific online literature	<ul style="list-style-type: none"> <li>• Emerald Library</li> <li>• ACM Digital Library</li> <li>• Science Direct</li> <li>• IEEE Transaction</li> <li>• Elsevier</li> <li>• SCOPUS</li> <li>• Springerlink</li> <li>• IEEE Xplore</li> <li>• EBSCO (electronic journal service)</li> </ul>
Specific hard copy journal research proceedings	<ul style="list-style-type: none"> <li>• ACM-proceedings</li> <li>• Books (on marketing, customer relationship management, data mining and knowledge discovery)</li> <li>• Market Reports &amp; Telecom Regulatory authority public reports</li> </ul>

Table 1 shows the methodological approach used for this paper. Because journals are considered as the most reliable source of research (Nord and Nord, 1995), so firstly, some renowned online journal databases were explored to get a comprehensive academic literature on the topic. Majority of the articles were from journals like the *Telecommunication Policy*, *Journal of Research in Marketing* and *European Journal of Information Systems*. The articles in these journals were identified using keywords like customer churn, analysis and telecommunications and publication years between 2000 and 2012. Here is a list:

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*List of prominent research Journals*


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- *Expert Systems with Applications*
  - *Journal of Retailing*
  - *International Journal of Research in Finance & Marketing*
  - *International Journal of Research in Commerce, IT & Management*
  - *International Journal of Electronics and Communication Engineering & Technology (IJECET)*
  - *International Review of Management and Business Research*
  - *International Journal of Computer Science Issues (IJCSI)*
  - *International Journal of Research in Computer Application & Management*
  - *International Journal of Management and Social Sciences Research (IJMSSR)*
  - *African Journal of Business Management*
  - *Journal Of Research In Commerce & Management*
  - *Journal of Marketing*
  - *Journal of Engineering*
  - *Journal of Technology Management & Innovation*
  - *Indian Journal of Marketing*
  - *International Journal of Human and Social Sciences*
  - *Journal of Basic and Applied Scientific Research*
  - *Far East Journal of Psychology and Business*
  - *Istanbul University Journal of the School of Business Administration*
  - *Journal of Services Marketing*
- 

The identified literature was then reviewed and a list of key factors related to customer churn was compiled. The impact of each of these factors on customer churn varied in all these studies and was found to be highly interrelated. Hence in order have greater clarity on relationships between the identified factors; they were classified in a table w.r.t to the authors' name.

### **3 Factors influencing customers churn**

Churn is a complicated phenomenon, which involves deciphering each and every nerve of customer behaviour, analysing technological advancements in the handset market (multiple SIM) and taking a comprehensive stock of competitor's product and service offerings.

Worldwide, various researches have been performed to find the effect of service quality on the customers and the service providers. Wong and Sohal (2003) investigated the impact of quality of services on customer loyalty, which eventually helps to retain the customer and reduce customer churn. The authors tried to find this at salesperson to customer level and at store to customer level. For their investigation, authors collected the data from 1,261 customers from a large departmental store. They indicated that the

relation at store level is stronger than at salesperson level. They concluded that quality of service has positive relationship with customer loyalty.

Another study conducted by Antreas (2000), considers service quality, price and convenience as parameters to find their impact on customer satisfaction. Author used five point scale with 1 as 'very dissatisfied' and 5 as 'very satisfied' to collect the customer response from customers and divided customers into different segments. Customers were divided into homogeneous groups using cluster analysis method. The author performed multivariate analysis on particular segment profiles to find out the difference in customer satisfaction among various customer segments and found that each customer segment displays a different behaviour and have different satisfaction level. He also found that customer retention depends on customer satisfaction and socio-demographic characteristics of customers. He concluded that when the industry is in evolution stage, the behaviour of customers is not mature.

Kim and Yoon (2004) sought to find the determinants of subscriber churn and customer loyalty in the Korean mobile telephony market using a binomial logic model. Authors found that level of satisfaction, call quality; tariff level, handsets, brand image, income, and tenure were the main factors influencing the switching behaviour of the customers. Good call quality and brand image made customers brand conscious. The study also found customers who were staying with present service provider are mainly because of switching costs involved.

Misra (2014) investigated the difference in perception of service quality for postpaid and prepaid customers and its impact on their churn. The author found that prepaid customers are more satisfied from the quality of service as compared to postpaid customers. She also concluded that prepaid customers are more price sensitive and switch to other service providers, if they get better price, also they prefer the service provider selected by their family and friends.

Customer retention is very challenging in mobile telecom industry. Ahn et al. (2006) conducted a study, where the author used subscriber's usage, billing data and personal profiles including billed amounts, accumulated loyalty points, call quality-related indicators, handset-related information, calling plans, gender, to find out the factor responsible for customer churn in mobile industry. They collected the data from a leading telecom provider for users who are active for at least three months and tracked those users for data collection for a period of eight months. They found that customer switching to other service provider also depends on switching cost. If the cost of switching to other service provider is high likelihood of customer switching is less. The authors also found that with implementation of mobile number portability (MNP), which allows customers to change the service provider, while retaining existing mobile number has increased the switching of mobile service providers. Customer switching to other service provider is also directly dependent on loyalty points, as the goal of these membership schemes is to increase customer retention. They also ascertained that the customer does not decide to change the service provider abruptly but exhibits a behaviour change in usages of service like non-use or services being suspended. However, the author did not include the subscriber's age and service usage duration for the study.

Chen and Ching (2007) researched the impact of customer relationship management and mobile service on loyalty and how brand image affects this relationship. For mobile services they included mobile usage and mobile coverage as variables for their study. For the study authors collected the responses from 480 subscribers of a telecom provider in Taiwan. The authors used five-point Likert scale to collect the responses. They also used



age, gender and monthly fee as variables to collect the customer response. They found that there is a positive relationship between customer relationship, mobile services, brand image and customer loyalty. They found that brand image plays an important role in building customer loyalty and it has impact only on mobile usage, while mobile coverage cannot be associated with brand image. Similar research was conducted by Cronin et al. (2001) and they agreed with authors that service quality and customer loyalty has direct relationship.

Maintaining customer loyalty is the most important factor for the industry, where the business depends on the long term relationship (Rousan et al., 2010). They found that service quality is directly influenced by customer loyalty, which in turns help to retain customers and increase the market share for the company. They used five-point scales to collect the data. They used respondent's socio-demographic data, perceptions of customers regarding quality of services offered and customer's perception on loyalty. The authors used descriptive statistics to measure perception score. There are number of service quality dimensions which dependent on the particular service being offered, hence author recommended different measures should be developed for different service contexts. Similarly, Kotler and Keller (2006) also explained that good service quality leads to the retention of existing customers and the attracting new ones.

Poku et al. (2013) studied how service quality affects the loyalty of customers. For their study, the authors selected 50 customers randomly from a city in Ghana. They conducted interviews and survey to collect the customer response. They used tangibility, assurance, reliability, responsiveness and empathy as their research parameters to assess the relationship between customer loyalty and service quality. Authors stated that reliability is a measure of service quality and there is a direct and positive relationship between service quality and customer loyalty. They established that customers are always looking for value of their money which has greater impact on their loyalty.

A variety of key factors have to be considered if subscribers are to be retained. A study of relationship between customer service and customer retention in telecom industry by Omotayo and Joachim (2008) identified a strong relationship between customer service, satisfaction and customer retention. The authors used customer service, satisfaction, perceived value and behavioural intention parameters to conduct their research. They conducted a survey to collect data from users of at least one of the major mobile telecommunication service providers in Nigeria. They found that if customers are contented with service, they are more likely to continue with same service provider and hence better service enhances customer retention.

In a competitive market, service providers are expected to compete on both price and quality of services. Rajkumar and Rajkumar (2011) researched out the factors that affect the consumers' perception to select mobile telecommunication service in India. The authors used the Likert scale to collect the responses from the customers. They included five parameters, i.e., image, price, quality, customer satisfaction and loyalty in their study. They used call service, communication, price, facility, customer care, and service provider to measure the customer satisfaction. To measure communication parameter they used the call quality, call drop rate and geographical coverage area aspect of the provider. They used call rate, promotional offers and product range to measure the price aspect. Complaint redressal system and complain resolution was used to measure the customer care. They utilised customer relationship, innovativeness, restoration capability, reliability and responsiveness to measure the service provider aspect. Authors opined that

important factors which influence a customer to choose service provider are communication and price followed by responsiveness to their complaints.

In India, the main focus of the telecom industry is on volumes and has less focus on margins (Ramchandran, 2005). The Indian subscribers are very sensitive to price. Various factors like high GDP, increasing income levels, exponential growth in knowledge sector and population increase in urban areas have contributed towards tremendous magnification of this sector. As per the author, 3 Generation (3G) services is the medium that will tie these things together and create a revolution the mobile industry.

Price plays an important role in growing or emerging market like telecom sector in India (Srivastava et al., 2006). For telecom companies to exist and provide services and to become competitive or even to grow, they continuously need to provide customers extra value added features, high quality services at competitive price, so that customers do not switch to other operators.

Quality of services along with price also plays very important role for customers to switch from one service provider to another (Mittal and Sirohi, 2007). The authors discovered that the services provided by cellular service providers to their customers are of good quality. The price offered by the service providers plays an important role in switching from one operator to another. Hence, authors concluded that the service providers cannot only command market leadership based on quality product, but also has to be matched with attractive pricing.

Another study by Sathish et al. (2011) on switching behaviour of the mobile consumers in Chennai indicated the factors that influence their decision. They included customer service, service problems, usage cost and others. Authors proposed that call rate plays the most important role for making a decision on switching followed by network coverage; value added service and customer care. Authors also determined that advertisement plays the least important role. Authors found that family influence the most important factor and around 41% of customer switch the provider due to family influence, while advertisements on media influences only 2% of the users.

Similar study by Revathy and Padmavathy (2005) discovered the factors which influence the preference of cellular service providers. They observed age, gender, educational qualification occupational status and family income variables for their study. They found that the age and family income impacts the subscribers' decision to choose the service provider, while, qualification; gender and occupation do not influence their decision. Authors discovered that billing issues, connectivity problems, network coverage also influence user's decision in the respective order. Authors concluded that service providers should focus more on female subscribers, reduction in service charges and increase their communication and campaign using mass media.

Another study was performed to find the impact of age of subscriber on usage behaviour and it was concluded that the subscriber belonging to higher age groups make longer calls and the frequency of calls is also higher as compared to younger subscribers, who prefer shorter calls and make use of SMS and other features to communicate (Pandey et al., 2014). For their study authors selected the sample of 200 subscribers from Indore and Ujjain city of Madhya Pradesh, India. Authors used five-point Likert scale for their measurement. Authors also found that the subscribers belonging to lower age groups (20–30 yrs) have more chances to switch the service provider and are influenced by the advertisement and promotional schemes.

Another study by Rajeswari and Ravilochanan (2014) was undertaken to analyse the churn factors in pre-paid mobile subscribers in Tamil Nadu, India. Authors investigated that network coverage, complaint resolution, speed of internet and technology based services are the main factors responsible for customer churn. For their study, authors collected the response from 1,102 pre-paid subscribers for ten different cities in Tamil Nadu state. They considered price, service quality, performance, image, customer relationship management, internet speed, Internet usage and purchasing decision as research variables. Authors concluded that service providers should focus on quality of services and network coverage to retain their subscribers.

Similar study was conducted in Taiwan by Chueh (2011) to uncover the important factors for churn management process. For the purpose of their study, the author randomly selected 400 customers, whose contract was going to expire in near future. Authors explained that not only finding customers to churn is important but to retain them is most important. They divided the customers into different groups depending on the monthly billing amount. Author opined that the time and medium of launching the market campaign is very important to retain the customer and effectiveness of type market campaign varies from one group to another. They remarked that telemarketing done during the month when contract is going to expire had greatest effect on customer retention than telemarketing done a month earlier.

Findings by Seo et al. (2008), realised that the competition in the mobile telecom has increased the cost effectiveness of retaining current customers in USA. Mobile services are not a one-time sale like commodity products but are continuous repeated services and therefore, service providers can offer additional services over the length of a customer's tenure to increase customer loyalty. The study referred to factors such as length of association, service plan complexity, and quality of connectivity that affect switching costs and customer satisfaction. Customer retention also depends upon demographics, service plan complexity and handset sophistication.

Gautam and Chandhok (2011) assessed the impact of MNP on customer switching behaviour. Authors studied various literatures and found that impact of customer satisfaction, user demographics, relational investment and service quality has direct impact on switching behaviour of customers. They also stated that the MNP further increases this behaviour.

Mallikarjuna et al. (2011) determined the factors that motivate the customers to switch the service provider. They collected the response from 1,000 pre-paid customers from the state of Andhra Pradesh, India for the purpose of their research. The authors used customers' demographic profile, purpose of mobile, use of mobile, monthly billing, type of handset and customer satisfaction parameters for their research work. They used Discriminant function analysis and independent-samples t-test to identify the key factors that identifies the churners. They clustered customers into loyal groups and churning groups, to generate a discriminant function. They noticed that the satisfaction levels towards network access, call tariffs, customer care, network coverage and use of mobile for voice calls or MMS have direct impact on customer's switch. They also suggested that customers using mobile for voice call are less likely to switch.

Jacob and Christian (2012) reported the factors responsible for customer loyalty and the reasons for customers to change the telecommunication service providers in Ghana, with a focus on students. They selected a sample of 813 students out of 16,260 students from the University of Cape Coast, to collect the response on the questionnaire shared with them. They used student age, monthly income, subscription tenure, their willingness

to change the provider and willingness to suggest the same provider to someone as parameters for investigation. Authors used Wald test to check the fitness of regression model. They found that the majority of subscribers about 78.5% were willing to suggest the same service provider to someone. They also observed that brand image and call quality impact the customer loyalty, while income and tenure does not have significant impact on customer loyalty. They suggested that subscribers are willing to stay with current subscriber if call quality increase. They also found positive relationship between brand image and customer loyalty. Authors concluded that high service price and service quality are the major reason for churn.

Findings by Vaghela (2012) reveal the awareness on MNP and the factors that motivate customers to choose this option. He collected the responses of 100 subscribers and compiled the data over duration of 3 months from the city of Surat, India. He used number of mobile connections, type of connection (pre-paid, post-paid), service provider, tenure with service provider, monthly billing, satisfaction level, awareness level for MNP as parameters for study. He examined that subscribers are very much aware of the MNP service and subscribers want to switch to other providers due to network problems being on the top factor followed by quality, customer care issues, billing issues and value added service.

Shi et al. (2006) observed the impact of wireless number portability (WNP) in Hong Kong. As per the authors, it is a telecommunication regulatory policy that requires cellular phone service providers to allow customers who wants to switch service providers but will allow retaining their original numbers. They found that MNP leads to lowering of the switching cost for a consumer and hence customers are encouraged to switch the provider. Thus, the aim of the policy is to have fair competition with level playing ground for smaller service providers. They found the policy may result in market concentration due to the discriminatory pricing scheme for the calls connected across two networks. Consumers who subscribes to an operator with larger subscriber base would stand to gain.

Benjamin et al. (2012) investigated the key factors to determine the reason for subscribers to change the existing service provider in Lagos, Nigeria. The authors conducted a survey to collect response from 800 randomly selected subscribers. They used demographic, socio-economic (income, age, education level, employment status) parameters along with willingness to change their service provider for their study. Descriptive statistics and multivariate analysis was used for their investigation. They discovered that the network availability is the major reason for churn. They also recommended other factors which influences the churn in order of importance as call expenses, service facilities, advertising medium, number of mobile connection and type of service plan, while demographic parameters has no impact on subscriber's churn.

Ballings and Poel (2012) conducted a study to find the duration for which customer historical data should be considered for predicting the customer churn. For their investigation they used customer data from a newspaper company for a period of 16 years. They used classification and logical regression techniques for customer prediction. Socio demographic (age, gender, relationship type), frequency and fee related (number of subscriptions, number of newspapers, payment method, price), and duration related parameters (length of subscription, length of relationship, prior churn) were used for their study. They indicated that the performance of churn prediction increases till fifth years and after that the impact of duration is not significant.

Similarly, Pandey (2006) shed light on the satisfaction level of the mobile subscribers across different circles in India. In a random sample of 3,763 mobile subscribers, he observed five broad areas that influence the overall satisfaction level of subscribers including presale and post-sale, network availability, performance and reliability, customer care, value added services and billing issues. He concluded that performance levels of five out of 11 operators, whose customers participated in the survey, had deteriorated. They were unable to match the benchmark set by TRAI (95%) except BPL and MTNL. Author reasoned out that the main contributor for customer dissatisfaction is billing issues. While in Metros, overall satisfaction was directly related to value added services.

Kavipriya and Rengarajan (2012) assessed the satisfaction level of customers based on the services provided by the provider. They selected a random sample of 300 pre-paid subscribers from Tiruppur District and collected their responses. Discriminant analysis, multiple regression and ANOVA was used for their analysis. Parameter selected were age, gender, education qualification, occupation, income, current provider and usage tenure in this study. They discovered that income, tenure and service provider plays an important to group the customers into different groups. Authors found that influence of network quality on customer satisfaction is highest followed by offers, service quality, tariff, free calls and customer care services.

Kamath (2011) figured out the customer satisfaction in Pune and the factors which influences the customer satisfaction. He used gender, age, income, usages pattern, satisfaction level, level of satisfaction, reason for dissatisfaction attributes for his study. Data collection was done using a survey with both pre-paid and post-paid customers and a random sample size of 597 customers was selected. To measure the satisfaction, he used network coverage, call charges, value added services and instinct and impulse parameters. He concluded that the network coverage is the top parameter impacting customer satisfaction and instinct and impulse does not have any impact on satisfaction. He also concluded that there is a difference in satisfaction level for same provider between pre-paid and post-paid customers and pre-paid customers are more satisfied than post-paid customers.

Palkar (2004) considered the factors responsible for customer retention. He investigated the impact of attributes of the quality of service provided on customer satisfaction. He collected data from 400 subscribers. Author used SERVQUAL model and the features of mobile service providers to measure quality based on five dimension. Based on factor and regression analysis, authors concluded that factors responsible for retention of postpaid and prepaid subscribers vary. Author found that customer quality attributes are of prime factors for postpaid subscribers, while usage pattern, billing and service quality are important for prepaid users. He concluded that since customers' perception about quality changes continuously based on experience and evaluation, hence service providers should make an effort to conduct the continuous quality management activity to evaluate quality indices.

Allen (2012) pointed out the major differences between the USA and India markets in terms of the preponderance of prepaid services in India, the dominance of 2 g services in India compared to the advancements in 3 g and 4 g in the USA; the use of wireless handsets that support multiple carriers in India, as compared to the USA where services and devices are generally bundled together; and the much higher churn rate in India as consumers switch to lower-cost plans.

Sandhu et al. (2013) collected the response from 300 subscribers from the city. They used overall satisfaction, image of provider, empathy, technical quality, price, reliability, responsiveness, and assurance as parameters for research to analyse the impact of the service quality on customer satisfaction using five-point Likert scale, where 1 being the lowest and 5 being the highest. They suggested that image, empathy, technical qualities are the important factors for customer satisfaction. They stated that responsiveness, reliability and technical quality has effect on customer satisfaction and that there exists a positive relationship between them, while price does not have any relationship with customer satisfaction.

According to Bhandari (2013), subscribers prefer the company with better call rates, better internet service, reasonable internet cost, and better network coverage. Also prepaid customers are less loyal to the mobile service provider; hence, they shift from one service provider to another frequently and possess more than one SIM cards. Their findings were based on the survey conducted in Karnataka, India. Their main focus was age group from 18–30 years and they specifically targeted student's population. They selected Vodafone, Airtel and Idea service providers for their survey. The strong effect of context and content of application, however, leaves little leverage for universal measures of service quality and satisfaction.

Omar et al. (2014) used multilayer perceptron (MLP) neural networks techniques to analyse the customer churn. Authors used the randomly selected 5,000 customers from a Jordanian telecommunication company. Authors utilised customers billing information (monthly fee, call rate, SMS fee), usage behaviour (minutes of usage, number of SMS), users past churning status, plan type (3G). They found that monthly fees, total minutes of use and 3G service has the most influence churn.

Due to higher cost involved in creating new customers compared to retaining the existing, customer retention is the main focus for companies in their marketing campaigns and strategies (Poel and Larivi, 2004). Author also found a small investment done to retain a customer leads to higher profit margins for companies. They discovered that based on the availability of the feature or the functionality provided by the product purchased a satisfied customer will purchase the future products as well, which will lead to repeated purchase and more revenue for companies.

#### **4 Discussions**

In Indian scenario, researchers have found price (Rajkumar and Rajkumar, 2011; Sandhu et al., 2013), call rate (Rajkumar and Rajkumar, 2011; Sathish et al., 2011; Bhandari, 2013), service quality (Rajkumar and Rajkumar, 2011; Sathish et al., 2011; Gautam and Chandhok, 2011; Vaghela, 2012; Kavipriya and Rengarajan, 2012; Bhandari, 2013), network coverage (Sathish et al., 2011; Bhandari, 2013) as the top three factors for customer churn.

We tried to summarise the various variables and techniques used by researchers globally in their existing work along with their findings chronologically, in Table 2:

**Table 2** Authors and research variables

<i>Author</i>	<i>Research variables</i>	<i>Method used</i>
Antreas (2000)	Customer satisfaction (service quality, price and convenience) socio-demographic (age, education, transaction type)	Questionnaire, cluster analysis, multivariate analysis
Lu (2002)	Demographic data, plan type, billing agency, billing disputes, number of weekly calls, national and international call billing	Survival analysis, statistical analysis
Wong and Sohal (2003)	Quality of service, loyalty	Survey, statistical analysis
Kim and Yoon (2004)	Customer satisfaction, call quality, tariff level, handsets, brand image, income and subscription duration	Binomial logic model
Kim et al. (2004)	Customer satisfaction and the switching barrier	Statistical analysis, factor analysis, confidence analysis and regression analysis
Buckinx and Poel (2005)	Customer demographics	Logistic regression, neural networks and random forests
Ahn et al. (2006)	Usage, billing data and personal profiles including billed amounts, loyalty points, call quality, handset, calling plans, gender	Logistic regressions and binary logistic regression model
Chen and Ching (2007)	Loyalty program, customer service, brand image and coverage	Questionnaire, regression, co-relation
Omotayo and Joachim (2008)	Age, gender, service provider and tenure	Questionnaire, frequency distribution
Rajkumar and Rajkumar (2011)	Communication quality, call service, facilities, price (call rate, promotional offers), customer care and service provider's attributes (responsiveness, reliability, customer care, restoration capability, Innovativeness)	Questionnaire, factor analysis
Rousan et al. (2010)	Socio-demographic, service quality	Questionnaire, descriptive statistics, factor analysis
Chueh (2011)	Contract validity period, monthly billing, Payment method, type of marketing campaign	fuzzy correlation analysis
Mallikarjuna et al. (2011)	Customers demographic, purpose of mobile, use of mobile, monthly billing, type of handset and customer satisfaction	Questionnaire, discriminant function analysis and independent-samples t-test
Gautam and Chandhok (2011)	Service quality, demographic information and customer satisfaction	Association
Sathish et al. (2011)	Customer service, call rate, network coverage service problems, usage cost, error in billing	Descriptive research design, cluster sampling method
Ballings and Poel (2012)	Age, gender, relationship type, number of subscriptions, number of newspapers, payment method, price, length of subscription, length of relationship, prior churn, price	Classification and logical regression techniques

**Table 2** Authors and research variables (continued)

<i>Author</i>	<i>Research variables</i>	<i>Method used</i>
Benjamin et al. (2012)	Income, age, gender, marital status, education level, employment status, network availability, call expenses, service facilities, advertising medium, number of mobile connection and type of service plan	Questionnaire, descriptive statistics and multivariate analysis
Jacob and Christian (2012)	Age, monthly income, subscription tenure, willingness to change the provider and willingness to suggest the same provider to someone	Questionnaire, regression model
Vaghela (2012)	Number of mobile connections, type of connection (pre-paid, post-paid), service provider, tenure, monthly billing, satisfaction level, awareness level for MNP, customer care support	Questionnaire, frequency distribution, statistical analysis
Kavipriya and Rengarajan (2012)	Age, gender, education qualification, occupation, income, current provider, usage tenure, offers, network quality, service quality, tariff and customer care services	Questionnaire, discriminant analysis, multiple regression and ANOVA
Sandhu et al. (2013)	Satisfaction, image of provider, empathy, technical quality, price, reliability, responsiveness, and assurance	Questionnaire, statistical analysis
Bhandari (2013)	Call rate, service quality, cost, and network coverage	Statistical analysis
Poku et al. (2013)	Tangibility, assurance, reliability, responsiveness, empathy, services offered,	SERVQUAL, descriptive analysis, frequency distribution
Misra (2014)	Customer satisfaction	Questionnaire, hypothesis testing
Omar et al. (2014)	Monthly fee, call rate, SMS fee, minutes of usage, number of SMS, past churning status, plan type	Neural networks
Pandey et al. (2014)	Age	Statistical analysis

**Table 3** Classification of extracted factors along with corresponding factor groups and their source

<i>Factor group</i>	<i>Factors</i>	<i>Source</i>
Customer loyalty	Service quality	Wong and Sohal (2003), Antreas (2000), Cronin et al. (2001), Rousan et al. (2010), Poku et al. (2013) and Jacob and Christian (2012)
	Brand image	Chen and Ching (2007) and Jacob and Christian (2012)
	Customer relationship	Chen and Ching (2007)
	Network coverage	Chen and Ching (2007)



**Table 3** Classification of extracted factors along with corresponding factor groups and their source (continued)

<i>Factor group</i>	<i>Factors</i>	<i>Source</i>
Customer satisfaction	Service quality	Misra (2014), Kavipriya and Rengarajan (2012) and Sandhu et al. (2013)
	Network coverage	Kavipriya and Rengarajan (2012) and Kamath (2011)
	Price	Antreas (2000) and Kavipriya and Rengarajan (2012)
	Convenience	Antreas (2000)
	Billing issues	Pandey (2006)
	Brand image	Sandhu et al. (2013)
	VAS	Pandey (2006) and Kavipriya and Rengarajan (2012)
	Customer care services	Kavipriya and Rengarajan (2012) and Sandhu et al. (2013)
Customer churn	Satisfaction	Kim and Yoon (2004), Rajkumar and Rajkumar (2011) and Gautam and Chandhok (2011)
	Service quality	Kim and Yoon (2004), Rajkumar and Rajkumar (2011), Mittal and Sirohi (2007), Gautam and Chandhok (2011), Jacob and Christian (2012), Vaghela (2012) and Benjamin et al. (2012)
	Tariff	Kim and Yoon (2004), Misra (2014), Rajkumar and Rajkumar (2011), Ramchandran (2005), Mittal and Sirohi (2007), Sathish et al. (2011), Mallikarjuna et al. (2011), Jacob and Christian (2012), Benjamin et al. (2012), Allen (2012) and Omar et al. (2014)
	Handsets	Kim and Yoon (2004)
	Brand image	Kim and Yoon (2004) and Rajkumar and Rajkumar (2011)
	Income	Kim and Yoon (2004) and Revathy and Padmavathy (2005)
	Tenure	Kim and Yoon (2004) and Ballings and Poel (2012)
	Family influence	Misra (2014) and Sathish et al. (2011)
	Switching cost	Ahn et al. (2006)
	Mobile number portability	Ahn et al. (2006), Gautam and Chandhok (2011) and Shi et al. (2006)
	Loyalty points	Ahn et al. (2006) and Rajkumar and Rajkumar (2011)
	Usage behaviour	Ahn et al. (2006), Mallikarjuna et al. (2011) and Pura (2005)
	Customer care responsiveness	Rajkumar and Rajkumar (2011), Sathish et al. (2011), Mallikarjuna et al. (2011) and Vaghela (2012)
	VAS	Sathish et al. (2011) and Vaghela (2012)
	Network coverage	Sathish et al. (2011), Revathy and Padmavathy (2005), Mallikarjuna et al. (2011), Vaghela (2012) and Benjamin et al. (2012)
	Age	Revathy and Padmavathy (2005) and Pandey et al. (2014)
	Billing issues	Revathy and Padmavathy (2005) and Vaghela (2012)
	Connectivity problems	Revathy and Padmavathy (2005)
	Promotions	Pandey et al. (2014) and Benjamin et al. (2012)
	User demographics	Gautam and Chandhok (2011)

**Table 3** Classification of extracted factors along with corresponding factor groups and their source (continued)

<i>Factor group</i>	<i>Factors</i>	<i>Source</i>
Customer retention	Customer loyalty	Rousan et al. (2010)
	Service quality	Rousan et al. (2010), Kotler and Keller (2006), Srivastava et al. (2006), Rajeswari and Ravilochanan (2014) and Palkar (2004)
	Customer services	Omotayo and Joachim (2008)
	Satisfaction	Omotayo and Joachim (2008)
	Tariff plans	Srivastava et al. (2006), Seo et al. (2008) and Bhandari (2013)
	Network coverage	Rajeswari and Ravilochanan (2014) and Bhandari (2013)
	VAS	Srivastava et al. (2006)
	Market campaign	Chueh (2011)
	Cost	Seo et al. (2008)
	User demographic	Seo et al. (2008)
	Handset	Seo et al. (2008)
	Customer retention	Gerpott et al. (2001)
Usage behaviour	Age	Pandey et al. (2014)
	Gender	Kim and Yoon (2004), Maicas et al. (2009), Min and Wan (2009), Ranganathan et al. (2006) and Shin and Kim (2008)
	Education	Eshghi et al. (2007)
	Number of cell phones	Eshghi et al. (2007)
	Total spending	Eshghi et al. (2007)
Demographic	Age	Eshghi et al. (2007), Kim and Yoon (2004), Maicas et al. (2009) and Shin and Kim (2008)
	Gender	Kim and Yoon (2004), Maicas et al. (2009), Min and Wan (2009), Ranganathan et al. (2006) and Shin and Kim (2008)
	Education	Eshghi et al. (2007)
	Income	Eshghi et al. (2007) and Kim and Yoon (2004)

Table 3 shows the classification of extracted factors along with corresponding factor groups from the survey. A theoretical model is proposed where the antecedents and the consequents for the churn is illustrated. It describes the relationship between service quality, brand image, customer satisfaction, customer loyalty and customer churn in case of cellular subscribers.

Customer loyalty (dependent variable)	Customer satisfaction
	Service quality
	Brand image
	Customer relation
	Demography (age, gender, education, income)

Customer Satisfaction (dependent variable)	Service quality
	Brand image
	Customer relation
	Billing
	Demography (age, gender, education, income)
Customer churn (dependent variable)	Customer satisfaction
	Service quality
	Customer loyalty
	Brand image
	Mobile number portability
	Switching cost
	Usage behaviour
	Demography (age, gender, education, income)
Service quality (dependent variable)	Network coverage
	Voice quality
	Roaming
	Tariff
	VAS

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## 5 Conclusions

The findings of the survey show that many factors and their complex relationships influence customer churn. In the proposed model (as shown in Figure 1), the service quality is quantified in terms of various services received from the service provider to the subscriber. Service quality is a sum total of the major features like network coverage, voice quality, signal strength, customer service, fair company (Hague and Hague, n.d.) and value added service. If the customer perceives the services received as positive and satisfactory, it leads to higher service quality in terms of reliability, responsiveness and other tangible factors. Higher service quality built confidence and trust with the services received. The brand image of the company is also a very important indicator to measure the customer satisfaction (Aydin and Ozer, 2005; Ashraf et al., 2013). Higher service quality and positive brand image results in increased customer satisfaction (Malik et al., 2012). If the customer is satisfied and contented the dependent factor is increased customer loyalty. Customer loyalty is an output of positive service experience. Customer loyalty gives confidence to the subscriber with their service provider and encourages them to use the services more consistently and there by prevents the subscriber to shift their loyalty to other competitors. A loyal customer reflects rare probability to switch and thereby results in reduced churning rate. There is an inverse relationship between customer loyalty and churning as depicted by the model.

Unlike post-paid customers, prepaid customers are not bound by service contracts and they often churn for simplest reasons. Thus, it is quite difficult to predict their churn rate. Another factor is customer loyalty that may be determined by customer service and product quality offered by the service providers. Issues like network coverage and

reception quality may influence customers to move to the competitor with broader reach and better reception quality. Other factors that increase probability of customers defecting to the competition include slow or inadequate response to complaints and billing errors. Factors such as packaging prices, inadequate features, and older technology may also cause customers to defect to the competition. Customers often compare their providers with others and churn to whoever they feel provides better overall value.

Thus, this paper finds features that have high effect on customer churn. The model proposed could be investigated in forthcoming studies. It will help in designing multidimensional churn customer dataset and devising new churn management techniques in telecommunications industry.

## 6 Future scope

All these studies are based on subscribers belonging to some specific area and no study was conducted on subscribers in New Delhi region. Moreover, researchers have not considered the duration on the customer churn. Duration or tenure with service providers and its relation with prediction of customer churn performance is investigated in some other industries, e.g., newspaper industry, but whether it holds for other service industries, is still to be investigated. Moreover, further research should help in distinguishing common churn determinants that are valid globally, in the telecom industry. This would help telecom operators worldwide to reconsider as well as enhance their quality of services thereby building more effective CRM strategies, benchmarking with the global practices.

## References

- Ahn, J.H., Han, S.P. and Lee, Y.S. (2006) 'Customer churn analysis: churn determinants and mediation effects of partial defection in the Korean mobile telecommunications service industry', *Telecomm Policy*, Vol. 30, No. 10, pp.552–568.
- Allen, W.B. (2012) *India's Experience with Mobile Number Portability* [online] [http://www.trai.gov.in/WriteReadData/ConsultationPaper/Document/Consultation\\_Paper\\_on\\_Deactivation\\_of\\_SIMs\\_due\\_to\\_Non-usage.pdf](http://www.trai.gov.in/WriteReadData/ConsultationPaper/Document/Consultation_Paper_on_Deactivation_of_SIMs_due_to_Non-usage.pdf) (accessed 24 December 2012).
- Antreas, D. (2000) 'Customer satisfaction cues to support market segmentation and explain switching behavior', *Journal of Business Research*, Vol. 47, No. 3, pp.191–207.
- Ashraf, R.U., Saeed, R., Arshad, H.M., Syed, A.H.Z. and Wasim, A. (2013) 'Determinants of customer satisfaction: the case of Pakistan telecom industry', *Journal of Basic and Applied Scientific Research*, Vol. 3, No. 11, pp.251–258.
- Aydin, S. and Ozer, G. (2005) 'The analysis of antecedents of customer loyalty in Turkish mobile telecommunication market', *Eur. Journal Marketing*, Vol. 39, Nos. 7/8, pp.910–925.
- Ballings, M. and Poel, D. (2012) 'The relevant length of customer event history for churn prediction: how long is long enough', *Expert Systems with Applications*, Vol. 39, No. 18, pp.13517–13522.
- Benjamin, O., Mesike, G., Bakarea, R., Omoera, C. and Adeleke, I. (2012) 'Discriminant analysis of factors affecting telecoms customer churn', *International Journal of Business Administration*, Vol. 3, No. 2, pp.59–67.
- Berson, A., Smith, S. and Thearling, K. (2000) *Building Data Mining Applications for CRM*, McGraw-Hill, New York, NY.

- Bhambri, V. (2013) 'Data mining as a tool to predict churn behaviour of customers', *GE-International Journal of Management Research (IJMR)*, Vol. 2, No. 3, pp.59–69.
- Bhandari, R. (2013) *Telecom Industry in India (2013)* [online] <http://dx.doi.org/10.2139/ssrn.2327734> (accessed 18 September 2013).
- Buckinx, W. and Poel, D.V.D. (2005) 'Predicting online-purchasing behavior', *European Journal of Operational Research*, Vol. 166, No. 2, pp.557–575.
- Chandar, M., Arijit, L. and Krishna, P. (2006) 'Modeling churn behavior of bank customers using predictive data mining techniques', *National Conference on Soft Computing Techniques for Engineering Applications*, pp.24–26.
- Chen, J.S. and Ching, R.K.H. (2007) 'The effects of mobile customer relationship management on customer loyalty: brand image does matter', *40th Annual Hawaii International Conference on System Sciences (HICSS'07)*, Hawaii, Vol. 40, No. 5, pp.2502–2511.
- Chen, Z-Y., Fan, Z-P. and Sun, M. (2012) 'A hierarchical multiple kernel support vector machine for customer churn prediction using longitudinal behavioral data', *European Journal of Operational Research*, Vol. 223, No. 2, pp.461–472.
- Chueh, H. (2011) 'Analysis of marketing data to extract key factors of telecom churn management', *African Journal of Business Management*, Vol. 5, No. 20, pp.8242–8247.
- Coussemont, K. and Poel, D.V.D. (2008) 'Churn prediction in subscription services: an application of support vector machines while comparing two parameter-selection techniques', *Expert Systems with Applications*, Vol. 34, No. 1, pp.313–327.
- Cronin, J.J., Brady, M.K. and Hult, G.T.M. (2001) 'Assessing the effects of quality, value, and customer satisfaction on behavioral intentions in service environments', *Journal of Retailing*, Vol. 76, No. 2, pp.193–218.
- Dass, R. and Jain, R. (2011) 'An analysis on the factors causing telecom churn: first findings', *AMCIS 2011 Proceedings*.
- Eshghi, A., Haughton, D. and Topi, H. (2007) 'Determinants of customer loyalty in the wireless telecommunications industry', *Telecommunications Policy*, Vol. 31, No. 2, pp.93–106.
- Gartner (2012) [online] <http://www.gartner.com/it-glossary/teledensity>.
- Gautam, P. and Chandhok, A. (2011) 'Switching behaviour of subscribers in Indian telecom sector', *International Journal of Research in Finance, Marketing*, Vol. 1, No. 3, pp.183–191.
- Gerpott, T.J., Rams, W. and Schindler, A. (2001) 'Customer retention, loyalty, and satisfaction in the German mobile cellular telecommunications market', *Telecommunications Policy*, Vol. 25, No. 4, pp.249–269.
- Hague, P. and Hague, N. (n.d.) *Customer Satisfaction Surveys, Research: How to Measure Customer Satisfaction*, White Paper, B2B International [online] <http://van-haaften.nl/images/documents/pdf/Customer%20satisfaction%20surveys.pdf> (accessed 24 December 2014).
- Hung, S-Y., Yen, D.C. and Wang, H. (2006) 'Applying data mining to telecom', *Expert Systems with Applications*, Vol. 31, No. 3, pp.515–524, Elsevier.
- Jacob, N. and Christian, K. (2012) 'Determinants of customer loyalty and subscriber churn of mobile phone services in Ghana', *International Journal of Research in Commerce, IT, Management*, Vol. 2, No. 12, pp.38–41.
- Kamath, D. (2011) *A Critical Evaluation of Customer Satisfaction of Cellular Phone Services in Pune*, Doctoral Thesis, Symbiosis International University, Pune.
- Kavipriya, T. and Rengarajan, P. (2012) 'User's level of satisfaction with mobile phone service providers – with special reference to Tiruppur District, Tamil Nadu', *National Monthly Refereed Journal of Research in Commerce, Management*, Vol. 1, No. 9, pp.35–52.
- Keaveney, M. (1995) 'Customer switching behavior in service industries: an exploratory study', *Journal of Marketing*, Vol. 59, No. 2, pp.71–82, doi: 10.2307/1252074.
- Kentrias, S. (2001) *Customer Relationship Management: The SAS Perspective* [online] <http://www.cm2day.com> (accessed 24 November 2013).

- Kim, H.S. and Yoon, C.H. (2004) 'Determinants of subscriber churn and customer loyalty in the Korean mobile telephony market', *Telecommunications Policy*, Vol. 28, Nos. 9–10, pp.751–765.
- Kim, M.K., Park, M.C. and Jeong, D.H. (2004) 'The effects of customer satisfaction and switching barrier on customer loyalty in Korean mobile telecommunication services', *Telecommunications Policy*, Vol. 28, No. 2, pp.145–159.
- Kirui, C., Hong, L., Cheruiyot, W. and Kirui, H. (2013) 'Predicting customer churn in mobile telephony industry using probabilistic classifiers in data mining', *International Journal of Computer Science Issues (IJCSI)*, Vol. 10, No. 2, No. 1, pp.165–172.
- Kotler, P. and Keller, K. (2006) *Marketing Management*, 12th ed., Vol. 151, No. 9, pp.89–90, New Jersey Pearson International Edition Management, Upper Saddle River.
- Kumar, D.A. and Ravi, V. (2008) 'Predicting credit card customer churn in banks using data mining', *Inderscience International Journal of Data Analysis Techniques and Strategies*, Vol. 1, No. 1, pp.4–28, doi: 10.1504/IJDATS.2008.020020.
- Lu, J.X. (2002) 'Predicting customer churn in the telecommunications industry – an application of survival analysis modeling using SAS', *Proc. SAS User Group International*, pp.27–33.
- Maicas, J.P., Polo, Y. and Sese, F.J. (2009) 'The role of (personal) network effects and switching costs in determining mobile users' choice', *Journal of Information Technology*, Vol. 24, No. 2, pp.160–171.
- Malik, M.E., Ghafoor, M.M. and Iqbal, H.K. (2012) 'Impact of brand image, service quality and price on customer satisfaction in Pakistan telecommunication sector', *International Journal of Business and Social Science*, Vol. 3, No. 23, pp.123–129, USA.
- Mallikarjuna, V., Mohan, G. and Kumar, D. (2011) 'Customer switching in mobile industry – an analysis of pre-paid mobile customers in AP circle of India', *International Journal of Research in Computer Application, Management*, Vol. 1, No. 3, pp.63–66.
- Min, D. and Wan, L. (2009) 'Switching factors of mobile customers in Korea', *Journal of Service Science*, Vol. 1, No. 1, pp.105–120.
- Misra, R. (2014) *An Empirical Study on the Preference and Satisfaction for the Pre-Paid and Post-Paid Cellular Subscribers*, The Free Library, Abhigyan [online] <http://www.thefreelibrary.com/An+empirical+study+on+the+preference+and+satisfaction+for+the+...-a0315222380> (accessed 24 October 2014).
- Mittal, A. and Sirohi, P. (2007) 'Factor affecting, selection of cell services: a cross-segmental study', *Synergy*, Vol. 4, No. 1, pp.74–85.
- Mohammadi, G., Tavakkoli-Moghaddam, R. and Mohammadi, M. (2013) 'Hierarchical neural regression models for customer churn prediction', *Journal of Engineering*, Article ID 543940, 9pp.
- Nord, J.H. and Nord, G.D. (1995) 'MIS research: journal status and analysis', *Information and Management*, Vol. 29, No. 1, pp.29–42.
- Omar, A., Hossam, F., Khalid, J., Osama, H. and Nazeeh, G. (2014) 'Predicting customer churn in telecom industry using multilayer perceptron neural networks: modeling and analysis', *Life Science Journal*, Vol. 11, No. 3, pp.75–81.
- Omotayo, O. and Joachim, A. (2008) 'Customer service in the retention of mobile phone users in Nigeria', *African Journal of Business Management*, Vol. 2, No. 2, pp.26–31.
- Palkar, A. (2004) 'Determinants of customer satisfaction for cellular service providers', *Udyog Pragati*, Vol. 28, No. 1, pp.35–43.
- Pandey, G.C., Shukla, R. and Singh, K.D. (2014) 'Age effect on usage behavior of mobile phone services', *International Journal of Electronics and Communication Engineering, Technology (IJCET)*, Vol. 5, No. 6, pp.26–32.
- Pandey, S.R. (2006) 'Old horses lose steam', *Voice and Data*, Vol. 12, No. 2, pp.32–36.
- Phadke, C., Uzunalioglu, H., Mendiratta, V.B., Kushnir, D. and Doran, D. (2013) 'Prediction of subscriber churn using social network analysis', *Bell Labs Technical Journal*, Vol. 17, No. 4, pp.63–75.

- Pilerood, A.E. and Gholamian, M.R. (in press) 'An efficient customer classification framework to identify target customers by Bayesian networks in automotive industry', *International Journal of Data Analysis Techniques and Strategies*, Inderscience.
- Poel, D.V. and Larivi, B. (2004) 'Customer attrition analysis for financial services using proportional hazard models', *European Journal of Operational Research*, Vol. 157, No. 1, pp.196–217.
- Poku, K., Zakari, M. and Sonali, A. (2013) 'Impact of service quality on customer loyalty in the hotel industry: an empirical study from Ghana', *International Review of Management and Business Research*, Vol. 2, No. 2, pp.600–609.
- Pura, M. (2005) 'Linking perceived value and loyalty in location-based mobile services', *Managing Service Quality*, Vol. 15, No. 6, pp.509–538.
- Rajeswari, P.S. and Ravilochanan, P. (2014) 'Churn analytics on Indian prepaid mobile services', *Asian Social Science*, Vol. 10, No. 13, pp.169–183.
- Rajkumar, P. and Rajkumar, H. (2011) 'Service quality and customers preference of cellular mobile service providers', *Journal of Technology Management, Innovation*, Vol. 6, No. 1, pp.38–45.
- Ramchandran, T. (2005) *Director-General, Cellular Operators Association of India, Trends and Development*, 15 May 2005 [online] <https://www.coursehero.com/file/p32hgr/A-study-by-Jeanette-Carless-on-and-Salvador-Arias-200410-wireless-substitution/> (accessed 26 January 2014).
- Ranganathan, C., Seo, D. and Babad, Y. (2006) 'Switching behavior of mobile users: do users' relational investments and demographics matter?', *European Journal of Information Systems*, Vol. 15, No. 3, pp.269–276.
- Reichheld, F.F. (1993) 'Loyalty based management', *Harvard Business Review*, Vol. 71, No. 4, pp.64–73.
- Reichheld, F.F. and Teal, T. (1996) *The Loyalty Effect: The Hidden Force Behind Growth, Profits, and Lasting Value*, Harvard Business School Press.
- Reichheld, F.F. and Sasser, W.E. (1990) 'Zero defections: quality comes to services', *Harvard Business Review*, Vol. 68, No. 5, pp.105–111.
- Reichheld, F.F. and Teal, T. (1996) *The Loyalty Effect: The Hidden Force Behind Growth, Profits, and Lasting Value*, Harvard Business School Press, Boston, Massachusetts.
- Revathy, S. and Padmavathy, S. (2005) 'Preference in cellular service providers in the post liberalization era', *Indian Journal of Marketing*, Vol. 2, No. 3, pp.6–10.
- Rousan, A., Ramzi, M. and Mohamed, B. (2010) 'Customer loyalty and the impacts of service quality: the case of five star hotels in Jordan', *International Journal of Human and Social Sciences*, Vol. 5, No. 1, pp.13–23.
- Sandhu, M.A., Mahasan, S.S., Rehman, A. and Muzaffar, S. (2013) 'Service quality dimensions impact on customer satisfaction in telecom sector of Pakistan', *Journal of Basic and Applied Scientific Research*, Vol. 3, No. 8, pp.27–34.
- Sathish, M., Santhosh, K., Naveen, K.J. and Jeevanantham, V. (2011) 'A study on consumer switching behaviour in cellular service provider: a study with reference to Chennai', *Far East Journal of Psychology and Business*, Vol. 2, No. 2, pp.71–81.
- Seo, D., Ranganathan, C. and Babad, Y. (2008) 'Two-level model of customer retention in the US mobile telecommunications service market', *Telecommunications Policy*, Vol. 32, Nos. 3–4, pp.182–196.
- Shi, M., Chiang, J. and Rhee, B.D. (2006) 'Price competition with reduced consumer switching costs: the case of wireless number portability in the cellular phone industry', *Manage. Sci.*, Vol. 52, No. 1, pp.27–38.
- Shin, D-H. and Kim, W-Y. (2008) 'Forecasting customer switching intention in mobile service: an exploratory study of predictive factors in mobile number portability', *Technological Forecasting and Social Change*, Vol. 75, No. 6, pp.854–874.
- Srivastava, R., Jatin, B., Bhatt, N., Gogri, K. and Margatia, H. (2006) 'Role of competition in growing markets: telecom sector', *Indian Journal of Marketing*, Vol. 11, No. 3, pp.8–16.

- Tsai, C-F. and Chen, M-Y. (2010) 'Variable selection by association rules for customer churn prediction of multimedia on demand', *Expert System with Applications*, Vol. 37, No. 3, pp.2006–2015.
- Umayaparvathi, V. and Iyakutti, K. (2012) 'Applications of data mining techniques in telecom churn prediction', *International Journal of Computer Applications* (0975–8887), Vol. 42, No. 20, pp.5–9.
- Umman, T. and Simsek, G. (2010) 'Customer churn analysis in telecommunication sector', *Istanbul University Journal of the School of Business Administration*, Vol. 39, No. 1, pp.35–49.
- Vaghela, P.S. (2012) 'Customer preference for mobile number portability', *International Journal of Management and Social Sciences Research (IJMSSR)*, Vol. 1, No. 3, pp.71–75.
- Wong, A. and Sohal, A. (2003) 'Service quality, customer loyalty; perspectives on two levels of retail relationships', *Journal of Services Marketing*, Vol. 17, No. 5, pp.495–513.
- Xie, Y., Li, X., Ngai, E.W.T. and Ying, W. (2009) 'Customer churn prediction using improved balanced random forests', *Expert Systems with Applications*, Vol. 36, No. 3, pp.5445–5449.