Impact of Network Externalities and Churn Analysis of Indian Telecom Market

Manan Bhatia
Business Analyst, SHUTTL, Gurgaon, India
Udayan Chanda
Business Analyst, SHUTTL, Gurgaon, India
Department of Management, BITS- Pilani, Pilani, India

Abstract:
Network externality is the effect that one user of a good or service has on the value of that product to other people. This effect in turn influences the decision making behavior of the user when it comes to using the product or accessing the service. In reference to the telecom industry, network externality comes into picture at various conjectures such as the user's preference of subscription to a particular network operator, to a particular tariff plan or to a particular Internet bandwidth among 2G/3G/4G. Further, this behavior drives the churn ratio for the network operators, which is the percentage of people expected to leave or change their network operator in the near future. This paper has been an attempt to understand such consumer behavioral patterns and identify the determinants of churn and the impact of network externality in the Indian Telecom Market by conducting an empirical analysis based on the data collected through a structured survey questionnaire.

Keywords: Churn Analysis, Network Externalities, Bayesian Network Analysis, Customer Satisfaction Ratings

1. Introduction

Telecommunications is one of the fastest-growing industries in India. Today India stands as the second largest telecommunications market in the world with a total subscriber base of 933.00 million, out of which 904.51 million are wireless subscribers. That makes wireless telecom market a whopping 97% of the total telecommunication consumer base.

No doubt, the telecommunications industry is one of the fastest growing in the world, and India seems to be no exception to this. Regulatory framework and government policies implemented by the Telecom Regulatory Authority of India (TRAI) have provided quite a conducive environment to the various private players in the telecommunications market. This has however made the sector more competitive while enhancing the accessibility of telecom services at affordable tariffs to the consumers. With multiple options to choose from in this increasingly competitive market, more and more subscribers are now switching their network operators to one that better suits their needs and pockets. This phenomenon is further catalysed by the liberal and open regulatory framework being imposed by the TRAI such as that of zero switching costs and the option of number portability, where a user can switch his network carrier while keeping his mobile number the same.

This phenomenon is called as "Churn" which simply means the percentage of customers, who will be changing their network operator in the near future. If we are able to predict in advance, the attributes and characteristics of customers whom we are going to lose in near future one can take corrective action so that we can minimize this phenomenon.
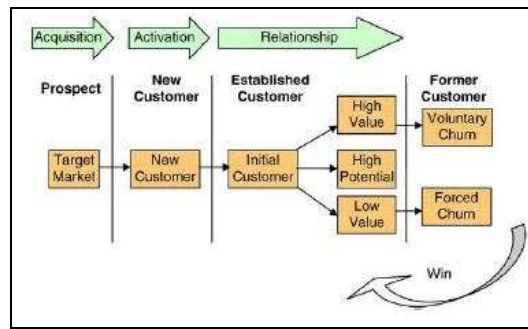
Figure 1: Illustration of a customer life-cycle.
Source: Olafsson, Li & Wu, 2008

The Internet subscriber base in the country as on 31st March 2014 stood at 251.59 million as compared to 164.81 million as on 31st March 2013. This translates to a growth rate of 34.5%, however, the internet subscription still remains limited to only 27.8% of the entire wireless subscribers. Also, as per research firm IDC India, India's smartphone market grew by 171 per cent in 2013, to 44 million smartphone devices from 16.2 million in 2012. According to another report by Cisco, "In India, the number of smartphones grew 54 per cent during 2014, reaching 140 million in number and the number of smartphones is expected to grow 4.7-fold between 2014 and 2019, reaching 651 million in number." These combined factors offer an exciting growth opportunity to the telecom operators in the budding data subscription segment.

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The acceleration of internet growth in India can be gauged from the fact that India took 10 years to move from 10 to 100 million users and 3 years to move from 100 to 200 million users, whereas the next 100 million (from 200 to 300M) milestone was achieved in just 1 year. Even if the same growth is maintained, India will reach 500 million users before the end of 2016. The report also suggests that most of the users access internet for general search, social networking browsing and entertainment.

Figure 2: Internet Users Growth in India (Rural and Urban: Source: IAMAI-IMRB I-cube estimates)

With social networking and communications being a key driver of internet subscription in India, Network Externality is poised to play a significant role in influencing the subscriber's behavior and preference towards internet subscription and bandwidth of the subscribed internet plan.

2. Explanation of Key Terms

2.1. Churn
Churn is a common phenomenon that is quite vividly observed in the telecom market. By Churn we basically mean those customers, who will be leaving or switching their particular network operator in the near future. If we are able to predict in advance, the attributes and characteristics of those customers whom we are going to lose in the near future, corrective action can be taken so that we can minimize this phenomenon as it is almost always cheaper and easier for a company to retain customers than it is to go through the process of acquiring new ones. Monitoring churn therefore, is the first step and an important metric in understanding how good a company is at retaining customers and identifying what actions might result in a higher retention rate.

2.2. Churn Analysis
Most of the marketing done by companies is towards acquiring new customers. However, when a market reaches close to its saturation level, the marketing dynamics shift towards retaining customers. In a highly competitive and dense telecom market such as that of

India with the saturation levels approaching in the head sight, market share becomes the key focus and indicator of a company's prowess and churn rate, a tantamount to its success.

2.3. Network Externalities
Network externality has been defined in various literatures as a change in the benefit, or surplus, that an agent derives from a good when the number of other agents consuming the same kind of good changes. In the context of telecom market, network externality can be observed in action when a subscriber's preference towards a particular network carrier gets influenced by the fact that a lot of people in his network and circle use that carrier. This may be because of more economic inter – network call plans that subscribers are offered by the network operators or because of the strong recommendations from the existing subscribers. Similarly, one unsatisfied customer can influence the preferences of others in his network thereby increasing the churn. So on one hand, the positive network externalities can play a significant role in acquiring new customers and strengthening the market share. While on the other hand the negative externalities can take the customers away and weaken the market share. There are many ways to classify networks effects. One segmentation views network effects as being of three kinds:
→ Two-sided
→ Direct network effects
→ Local network effects

Bayesian Network: Bayesian Networks are a probabilistic graphical model that represents the relations and probabilistic dependencies among a set of variables. Bayesian Networks basically are directed acyclic graphs whose nodes represent variables, and whose arcs encode the conditional dependencies between the variables. Nodes can represent any kind of variable, be it a latent variable or a measured parameter. They are not restricted to representing random variables, which forms the "Bayesian" aspect of a Bayesian network. In many practical settings, the Bayesian Network is unknown and one needs to learn it from the data. This problem is known as the BN learning problem.
Bayesian Networks offer advantages in implementing models of cause and effect over other statistical techniques designed primarily for testing hypotheses. Other advantages include the ability to conduct probabilistic inference for prediction and diagnostic purposes with an output that can be intuitively understood by managers.

3. Objective of the Study
To study and develop a basic understanding of the research requisites and topics such as Indian Telecom Market, Network Externality, Churn, Consumer Behavior Pattern, Questionnaire Designing, Primary Data collection through Surveys, Churn Analysis, Bayesian Network Analysis etc. from the existing literature in previous research papers, journals, consulting papers, articles etc.
- To study the Indian Telecom Market and analyze the consumer v/s network operator trend.
- To understand the consumer behavior pattern when it comes to accessing internet services through cell phone.
- To find the impact of network externalities in the Indian Telecom Market.
- To find and analyse the determinants of subscriber churn and customer loyalty in the Indian Telecom Market.
- To study the attributes and characteristics that drive churn in the Indian Telecom Market.
- To study the attributes and characteristics of the consumers influenced by the effects of network externality.

4. Methodology

4.1. Literature Study
Various research papers, reports, websites, consulting papers, journals and magazine articles were studied to gain an understanding of the topics ranging from Network Externality and its effects, Churn Analysis etc. to Questionnaire designing, data collection, data analysis and the likes.

4.2. Questionnaire Preparation
A structured questionnaire was designed to cover the broad variables that were considered for the study. The language of the questionnaire was kept simple and self-explanatory enough for a layman. The respondents were asked to fill 32 answers. 6 of these were binary with only two options of "Yes" and "No", 13 were multiple choice options, 10 were based on rating scales from 0 to 10, for 2 questions the respondent had to impute the numbers, and 1 was to be answered in text.

4.3. Primary Data Collection
Survey method using the structured questionnaire was adopted for collecting the primary data. The survey was designed using Typeform, an online survey design and distribution tool. Sample size of 300 was considered for the survey.

4.4. Secondary Data Collection
The secondary data were collected from the earlier research findings, scholarly reports, websites and annual, quarterly reports of the various network operators, and telecommunication reports such as TRAI, COAI, Journals, Magazines, and Newspapers etc.

| Variables	Description	Value
Churn	Dummy for switching	=1: Subscribers with intentions to switch in the near future; =0: Otherwise
NE	Dummy for the influence of Network Externality	=1: Subscribers influenced by the effects of Network Externality; =0: Otherwise
Gender	Dummy for gender	=1: Males; =0: Females
Recommend	Dummy for Recommendation Likelihood	=1: Subscribers who recommended their network carrier to others; =0: Otherwise
H Churn	Dummy for Handset Switching	=1: Subscribers with intentions to switch their handset in near future; =0: Otherwise
Age	Subscriber's Age	Subscriber's Age in Years
Prepaid	Dummy for subscriber type	=1: Prepaid subscribers; =0: Otherwise
T Network	Duration of subscription	Duration of subscription (in months) with the present network carrier
Income	Subscriber's monthly Income	Midpoint of the income group each subscriber belongs to
Edu	Proxy for subscriber's education level	=1 : High School; =2 : Bachelors / Graduate; =3 : Masters / Post Graduate; =4 : Less than High School; =5 : Diploma / Certification; =6 : Doctorate
Emp Status	Proxy for subscriber's employment status	=1 : Student; =2 : Employed full time; =3 : Employed part time; =4 : Self Employed; =5 : Homemaker; =6 : Retired; =7 : Unemployed
2G 3G	Proxy for subscriber's data plan	=1 : 2G; =2 : 3G; =3 : 4G; =4 : Use Wi-Fi to access internet on cell phone; =5 : No data plan
Upgrade	Dummy for subscriber's intention to upgrade bandwidth	=1: Subscribers with intentions to upgrade in the near future; =0: Otherwise
Signal	Proxy for level of signal issues subscriber faces	=1 : Only while traveling; =2 : Occasionally; =3 : Frequently; =0 : Never
Exp	Subscriber's monthly expenditure on network services	Midpoint of the expenditure group each subscriber belongs to
Exp Internet	Subscriber's monthly expenditure on network data services	Midpoint of the expenditure group each subscriber belongs to
Handset type	Proxy for subscriber's handset type	=1 : Android; =2 : Windows; =3 : I Phone; =4 : BlackBerry;

Table 1: Description of variables
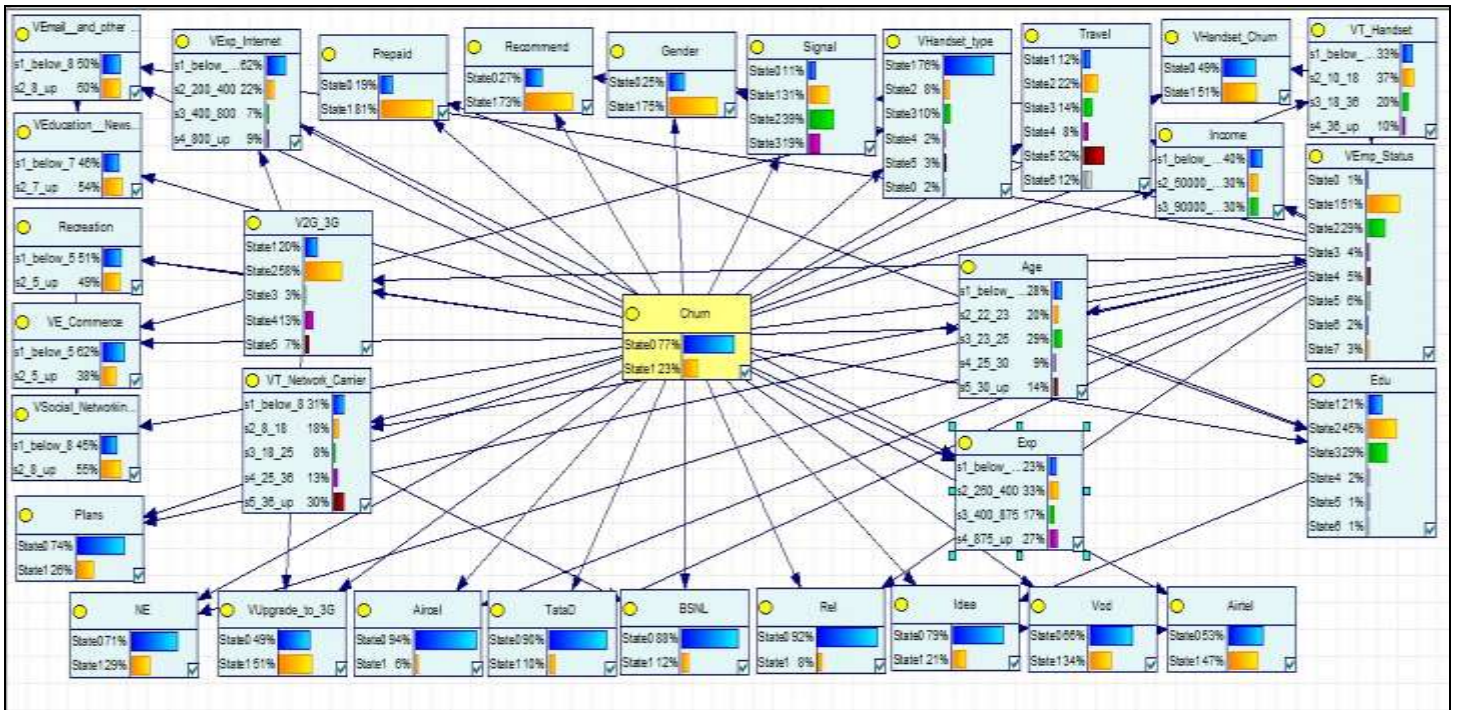
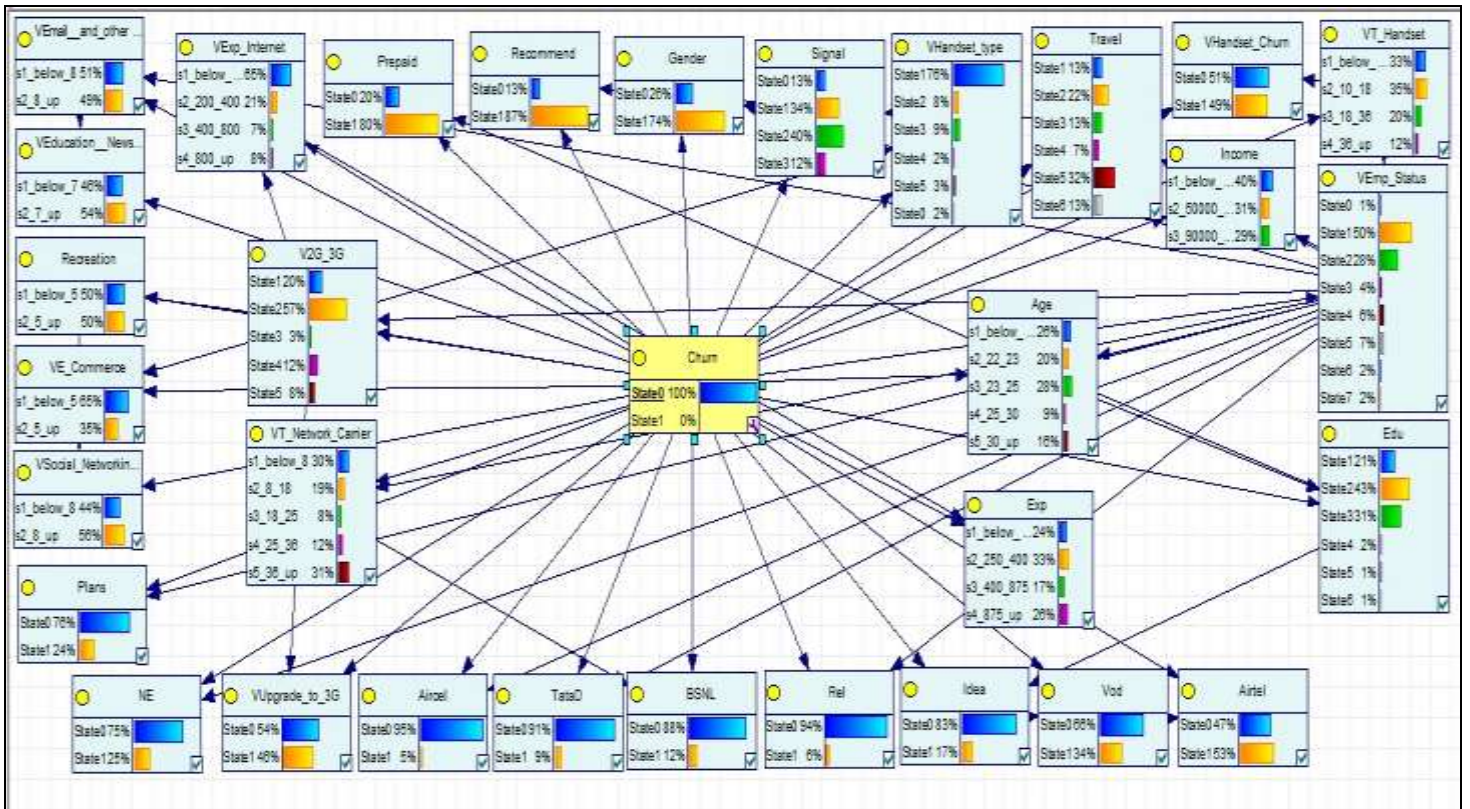*Figure 3: Bayesian network on Churn Analysis survey data*

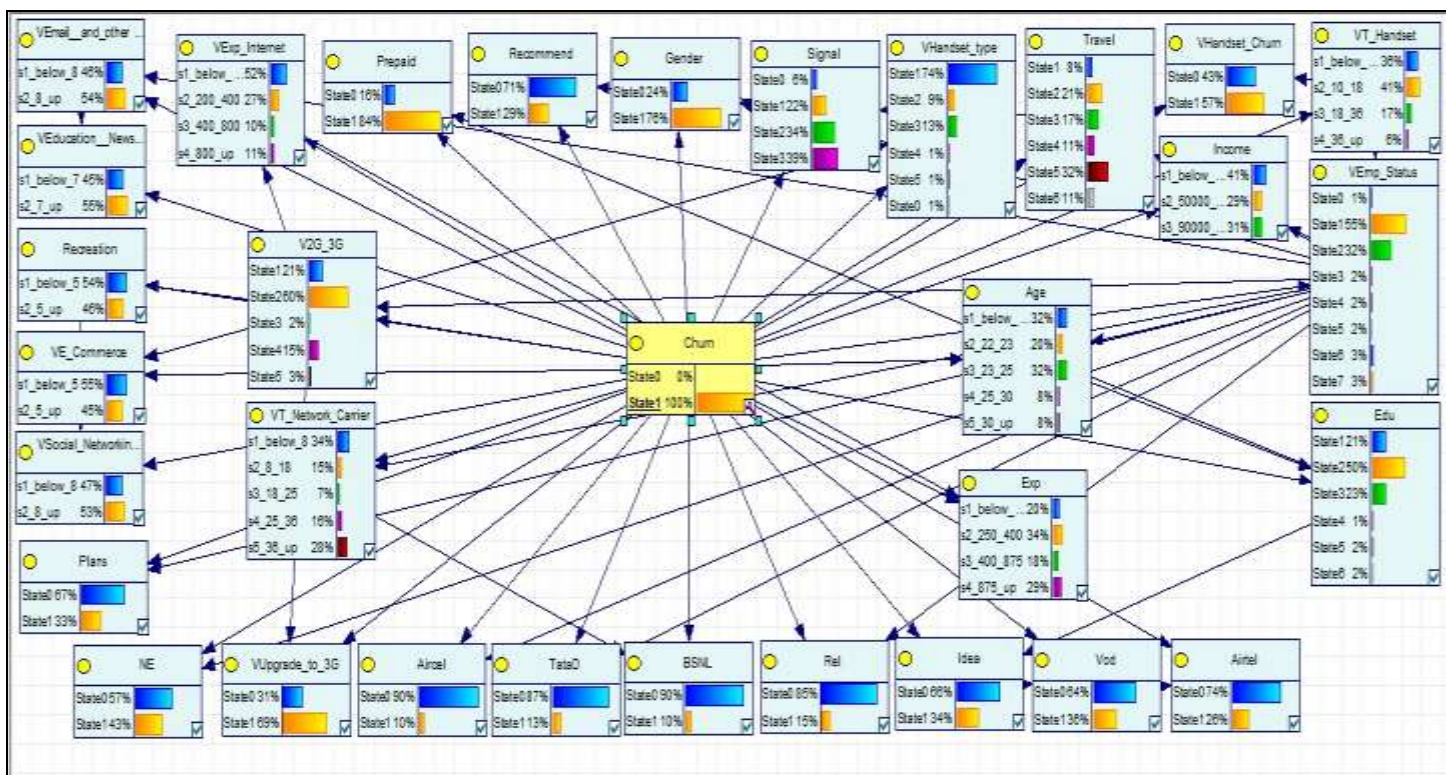*Figure 4: Sensitivity Analysis by controlling churn rate at State 0*

Figure 5: Sensitivity Analysis by controlling churn rate at State1

5. Data Analysis

Data was first collected and assimilated in MS Excel. Further, the data was cleaned and organised to make it compatible with the software to be used for analysis (Genie 2.0), which requires the data to be discretized. So all the continuous variables had to be converted to a discrete representation.

Following table gives a clear description of all the variables used for the analysis and study: Further, the each of the variable was treated as a node to create an inter-connected network such as one shown on the next page:

The variations in probability values of various nodes was analysed by controlling the state of the churn variable. Following network was generated by controlling the state 0 i.e. Non churners

The above was compared with the network generated by controlling the state=1 (i.e. Churners) of the churn variable:

6. Key Findings from the Survey

- Participant distribution among different network operators followed the similar pattern as that of the market share of these operators.
- 28% of the respondents admitted to the fact that network externality has a major role to play when it comes to subscribing to a particular network operator. Also, 7% of the respondents stated it as the reason for not upgrading to a higher data bandwidth.
- 59% of the respondents were using 3G to access Internet on their cellphone. Around 20% were using 2G, while only a handful had upgraded to 4G.
- The Churn Rate based on the survey data turns out to be close to 23% as 23% of the respondents showed inclination towards changing their network operator in the near future. The high ratio can be attributed to the introduction of number portability facility across different network operators.
- Along the same lines, 26% of the respondents marked "NO" to the question "Would you recommend your network carrier to others?" which further strengthens the value of our churn rate at 23%.
- Also, it was observed that churn was slightly more common in the case of males as compared to females. Churn rate was observed to be 24.23% in males as compared to 20.55% in females.
- Similarly churn seems to be a phenomenon more evident among younger people. For people in the age group of 18-23, churn rate was observed to be 27.41% while for people aged 24 and above, it was observed to be 16.67%.
- A stark relationship was also observed between the churners and the people who wanted to upgrade their internet bandwidth. Upgraders constituted almost 70% of the churners. Churn rate was observed to be 31.61% among the people who wanted to upgrade their internet bandwidth, while it was 14.48% among the non-upgraders.

- Another interesting insight shows that almost 43% of the churners stated network externality as a factor that influenced their choice of network operator. However for non-churners, the same figure turns out to be 24%. Does this imply that churn is more probable among those who get influenced by the effects of network? Well, since we do not have enough data points to establish a strong and clear cause-effect relationship, this question remains pretty much beyond the scope of this paper.

6.1. Churn Rate among Different Network Operators
The trend in the variation of churn rate across different parameters and variables has been reaffirmed by observing the same variations with the recommendation likelihoods. Naturally, those who recommended their network operators to others were less likely to churn themselves.

Network Operator	Churn Rate	Customer Care Services Rating
Airtel	12.95%	5.63
Vodafone	24.27%	5.14
Idea	37.70%	5.56
Reliance	42.11%	4.11
Tata Docomo	28.00%	6.00
BSNL	15.63%	5.93
Aircel	33.33%	4.83

Table 2: Churn Rate among different network operators

A clear transparent relationship was observed between how often one faced signal issues on his network and his behavior to churn. A 50% Churn Rate was observed among respondents who frequently faced signal issues on their network. While the churn rate was 16% among the respondents who faced signal issues only when they travelled. On the same lines, the churn rate was observed to be only 9% among the respondents who never faced signal issues.

Signal Issues	Churn Rate	Recommendation Likelihood
Frequently	50%	48%
Occasionally	20%	70%
Only while traveling	16%	85%
Never	9%	94%

Table 3: Churn Rate & Recommendation Likelihood v/s Frequency of signal problems)

This quite clearly shows that the less a customer faces signal problems on his network carrier, the less is his probability of churning and more likely he is to recommend his network operator to others. These insights hold quite a strong practical relevance; they serve to remind the network operators that an intervention to improve the network signal quality can significantly increase the recommendation likelihood and decrease the churn rate.

- It was observed that among all the different attributes, poor Customer Care Services contributed the most towards driving the churn behavior.

	Internet Services	Call Quality	Tariff Plans	VAS	Customer Services	Overall Rating
Churners	5.33	5.8	5.50	3.87	3.71	4.85
Non-Churners	6.75	7.72	6.18	5.19	5.86	6.34

Table 4: Churning Behavior

Further analysis revealed an almost linear inverse relationship between the customer care rating and the churn rate. The churn rate seems to increase exponentially with the decreasing customer care services rating. A churn rate of 51% is observed among the people who are most frustrated with the customer care services

Customer Care Services Rating	Churn Rate
0-2	51%
3-5	26%
6-8	14%
9-10	6%

Table 5: Churn Rate v/s Customer Services Rating

This quite strongly validates the hypothesis that ensuring smooth customer care services are the first step for network operators in ensuring the customer retention. An analysis of the average customer care services ratings among the users of different network operators further strengthens the above hypothesis as it reveals that the network operators with low churn rate have higher ratings as compared to operators with high churn rate.

7. Key Attributes of Customers Influenced by Network Externalities
With reference to the Indian Telecom Market, and based on the primary data collected through the survey, it was observed that there are certain distinct characteristics and attributes of customers who are influenced by the effects of network, such as:
1. Effect of network externalities seems to be more evident among females as compared to males. Close to 40% of the females responded that their decision of choosing the particular network operator was influenced by network externalities.
2. Effects of network externality were seen to be more evident among the subscribers of Vodafone than any other network. 45% of the Vodafone subscribers admitted to have been influenced by their network while choosing the network operator. Consequently, 54% of all the respondents who were influenced by NE were from Vodafone.
3. Interestingly, the effects of network externality were seen to be more strongly present among Homemakers and Self-Employed people. 50% of both the Homemakers and the Self-Employed marked NE as one of the factors that influenced their decision of subscribing to the particular network carrier.
4. Another interesting insight that the data reveals, shows that 61.63% of the users who were influenced by the effects of network externalities were subscribed to the higher bandwidths of 3G and 4G. This clearly serves as a testimony to the fact that the consumer behavior towards higher internet bandwidth gets influenced by the effects of network externality.

8. Conclusion
The increasing penetration of telecom in the Indian market followed by the high degree of competition is changing the marketing dynamics for telecom operators. Almost zero switching costs and number portability feature has made it made it now more convenient than ever for a consumer to change his network operator. It has now become more important for companies to control their churn rate. In this pursuit, network operators are gearing their focus towards customer retention and understanding the behavioral pattern that drives churn, making churn analysis of paramount importance.

However, as it is with most products and services, telecom customers tend to stick with their present network carrier unless they experience grave dissatisfaction or find a serious flaw with the services offered by that company. The analysis of this study reveals that the poor customer care services have been one of the key drivers of churn in the Indian Telecom Market. This is followed by the frequency of signal problem, which was also found to have a significant direct relation with the churn rate. Also, it seems that churn is more probable among the consumers who get influenced by the effects of network externality.

An analytical meditation on this subtle play of network externality in the Indian Telecom Market, with a special focus on churn analysis revealed the following interesting insights:
* Quality of customer care services directly influences the churn rate.
* The more frequently a user faces signal strength problems with his network carrier, the more likely he is to churn.
* Customers who wanted to upgrade their internet bandwidth were more likely to churn.
* Effects of Network Externality are significantly more dominant in females as compared to males,

8.1. Research Limitations
* Data points: As the time period of study was roughly 15 weeks of which 7-8 weeks were utilised for literature study, questionnaire preparation, survey designing, data analysis and reporting, it left only 7-8 weeks in hand for survey distribution and primary data collection. With this constraint, the data points were not large enough to establish a strong hypothesis.
* Sample Size: As the survey covered only select few urban cities such as Delhi NCR, Bangalore, and Dehradun etc. with a restricted sample size of only 300, a diverse demographical sample could not be collected. For example:
  → Only 24% of the respondents were females.
  → Only 5% of the respondents were Self Employed and Homemaker each.
  → Most of the respondents were reached through the restricted and closed social network.
  → Almost all of the respondents were representative of the educated urban class population.
  → All the respondents answered the survey in the time period of February to March

If the survey were to be distributed more widely and for a longer time period, the analysis and the findings would have been validated even more strongly and would have been a representative opinion of a larger consumer base.

A case in point is the observed relation between Network Externality and the Churn Rate, where although a clear trend was observed, but due to the lack of enough data points a strong cause – effect relationship could not be established. (Refer page 18, point 1).

However, in spite of all the limitations and constraints, the findings of this study turned out to be quite close to the expected values and the actual market scenario.

9. References
 i. Jill Sweeney, Joffre Swait. (2008). The effects of brand credibility on customer loyalty (179-194)
 ii. Hee-Su Kim, Choong-Han Yoon. (2004). Determinants of subscriber churn and customer loyalty in the Korean mobile telephony market (1-15)
 iii. P.S. Rajeswari, P. Ravilochanan. (2014). Churn Analytics on Indian Prepaid Mobile Services (1-15)
 iv. Ali Tamaddoni Jahromi. (2009). Predicting Customer Churn in Telecommunications Service Providers. (9-18)
 v. Silvia Salini, Ron S. Kenett. (2009.) Bayesian Networks of Customer Satisfaction Survey Data. (1-14)
 vi. S. J. Liebowitz, Stephen E. Margolis. (1994) Network Externalities (Effects). (1-4)
 vii. Prof S. Chandrasekhar (IIT Kanpur). Predicting the churn in Indian Telecom Industry (1-9)
 viii. James E. Bartlett, Joe W. Kotrlik, Chadwick C. Higginss. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. (1-8)
 ix. Annual Report published by Telecom Regulatory Authority of India (TRAI)