
# Towards Effective Churn Prediction: A Study of Influential Features in Telecommunications

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**Abstract**

This report explores the phenomenon of customer churn in telecommunication companies. The study emphasizes the importance of predicting churn, as it directly impacts a company's understanding of Customer Lifetime Value (CLV), a key metric in determining the company's health and long-term profitability. It discusses various determinants of churn, including service usage, service quality, satisfaction, and value, switching costs and barriers, tariff characteristics, customer-related, socio-demographics, and market environment. It also highlights the importance of customer care and the number of complaints as indicators of customer satisfaction and potential churn. The report suggests that understanding these determinants and choosing them carefully can help companies predict the occurrence of churn with good accuracy/ performance and, consequently develop targeted strategies to reduce churn and enhance customer retention.

## Keywords

customer churn, telecommunications, CLV, determinants of churn, accuracy, performance, customer retention.

# 1 Introduction

Arriving at chapter 10 in the tutorial "AI-Powered Business Intelligence" by Tobias Zwingmann [29] we find a use case scenario of a telecommunications provider facing challenges with customer churn.

As per the business definition, churn happens at the moment a customer cancels their contract, no matter the remaining duration of the contract. [29]

This phenomenon affects companies in various industries frequently. For a business to expand, it needs to make an investment to acquire new customers. Every time a customer leaves, a sizable investment is lost. It is necessary to put time and effort into finding replacements. [5] Another reason why being able to predict churn is so important is due to the customer lifetime value (CLV). While there are a few different ways to approach calculating CLV, they all start with the following customer lifetime value formula:

$$CLV = \frac{1}{\text{ChurnRate}} \times ARPA$$

- **CLV:** Customer Lifetime Value
- **Churn Rate:** The rate at which customers cancel their subscription
- **ARPA:** Average revenue per account (customer) for a defined period of time (e.g, monthly)

This way, we can see that the total revenue a business can reasonably expect from a single customer account decreases when churn occurs. This affects the company's understanding of Customer Lifetime Value, a key metric in determining the company's health and long-term profitability. [11]

Sometimes what happens is that marketing and sales can't really make sense out of measured churn rates, nor get any meaningful insight from the churn metrics. Also, as an effective measure to counter churn, businesses can identify counteroffers to be a viable strategy. Offers can be presented to customers who are quitting their contracts as a means to win them back or prevent them from quitting at all. Usually, the offers turn out to be effective, but costly. Therefore, we need to know which customers are most lucrative to be targeted by such counter-churn offers and would ideally like to predict churn before it happens to ensure a good fit between the offer type and the customer segments. Finally, it is also important to get a certain level of interactivity to comb through the data in order to get a feeling for what's happening with regard to customer churn in various customer segments. [29]

However, predicting churn can have some challenges. Some typical challenges in developing a predicted churn model include:

1. **Data Quality and Availability:** The quality and quantity of available data always play a crucial role in building a predictive model. The data should be accurate, up-to-date, and relevant to the factors influencing customer churn.
2. **Model Selection and Evaluation:** There is no "silver bullet" methodology. The most relevant model must be selected, and its performance must be accurately assessed, this is a critical point. Different types of predictive models may be suited for different types of data and business scenarios.
3. **Change in Customer Behavior Over Time:** Predicting human behavior can be complex. Various reasons, such as shifting demands, shifting market trends, or external events, might cause changes in customer behavior over time. Predicting churn may become more difficult as a result of these developments.

4. **Interpretability:** The model must be interpretable in addition to being accurate. Business stakeholders should be able to comprehend the model's operation and how to respond to its forecasts.

5. **Integration with Business Processes:** For the churn model's predictions to be implemented effectively, the business operations of the company must be integrated. This integration may be a challenging task involving many parties.

[7]

A company can save a ton of money if it can foresee when a client is most likely to leave and give them incentives to stay. Understanding what keeps consumers engaged is therefore very important information since it may help a company to create retention strategies and implement operational procedures meant to prevent customers from leaving. Any subscription business must forecast churn since even small changes in churn can have a big impact on a company's bottom line. This challenge involves binary classification. [5]

To predict churn, it's important to understand why customers are leaving in the first place. While exit surveys can provide some insight, the real answer often lies in the data. In this report, we aim to find some insightful indicators to make this prediction. Again, there isn't a unique correct answer or a perfect list of indicators.

Consulting the data in the file available on the Tobias Zwingmann's tutorial website [1] "$costumers\_factTable$ we can see the input features that were used for such prediction:

| | |
|---|---|
| **Tenure** | The length of time (in months) that a customer has been with the company. |
| **Contract** | The type of contract a customer has with the company (e.g., month-to-month, one-year, two-year). |
| **Monthly Charges** | The amount charged to the customer each month for the services they receive. |
| **Churn** | A binary variable indicating whether or not a customer has churned before. |

Table 1: Features used in Zwingmann's tutorial. [29]

Besides these variables, the company also uses feedback from customers. More specifically, they use sentiment analysis on the customer feedback provided as raw text in the file "$survey\_responses\_Jan - May\_2022.csv$". The sentiment labels obtained from the analysis are then used to improve the performance of the predictive model.

For our feature exploration, we will make an analysis of the article "Determinants of churn in telecommunication services: a systematic literature review" [25], commenting on which features we could add to the model performed in the tutorial [29] to get better performance in our churn prediction. We will turn our attention to the features mentioned in figure 3, "Integrative Framework on Switching intention and Churn determinants", of the article [25], and opine on which features we think are most important for churn prediction and why. By considering these, a company can develop targeted strategies to reduce this problem and enhance customer retention.

## 2 Determinants of Churn based on Service Usage

Service usage can play a crucial role in the telecommunications field in order to understand why churn is happening and how customers make use of the services. Here we can acknowledge the customers patterns, preferences and needs, for instance how they engage with data, voice or messaging. Analyzing service usage data helps companies enhance customer experience, optimize offerings, and prevent churn. [3] On the table Service usage variables in the Appendix we can see the features studied by Carrizo et al. [25]. We will select the one we find the most relevant for our study.

Around the Service Usage theme, *Usage Behaviour* seems to be the most important feature, as it adresses most of the other variables in this section as well. It often refers to the patterns and characteristics of how a customer uses a particular product or service. It could include various aspects such as the frequency of usage, the duration of usage, the features of the product or service used, and the intensity of usage. The goal of monitoring and analyzing usage behavior is to spot trends that can suggest a customer's satisfaction or dissatisfaction, which could then predict whether they'll stick with the service they're using now or whether they'll churn. For example, a sudden decrease in usage could signal that a customer is not finding value in the service, while consistent usage could indicate that a customer is likely to continue their subscription. Similarly, if a customer is only using a fraction of the available features, it might suggest that they're not fully engaged, which could increase their likelihood of churning. [3] [4]

## 3 Determinants of Churn based on Service Quality, Satisfaction, and Service Value

The theme "Service quality, Satisfaction and Service value" has the second highest number of occurrences. [25] We will explore the variables we find most influential from the table Service quality, Satisfaction and Service Value variables in the Appendix.

*Customer Satisfaction* is strongly connected to the customer's expectations and demands. This feature is significant because it might influence whether a customer has favorable or negative thoughts about a certain product or service as it also depends on the customer's experience. [17] Customer satisfaction is crucial because it reflects the total service experience and perception. Satisfied customers are more likely to remain loyal and are less inclined to churn. However, when a customer shows negativity towards the service, the chances are higher that the customer will switch to another service. This idea is also supported by Becker, Spann, and Schulze [18]. Service quality, price, and the benefits offered by the service, as well as the actual need to use the service, all have a direct effect on customer satisfaction. [26]

*Service Quality* is often understood by comparing what customers expect with what they actually receive. If the service is better than expected, it's considered to have high quality. If it meets expectations, it's satisfactory, and if it falls short, it's low quality. When telecom providers offer better bundled services, customers tend to be more satisfied and trust the provider more. [13] Many studies have found that service quality indirectly affects the churn probability. Instead, they directly affect customer satisfaction. [26] [25] In terms of specific variables related to service quality, Carrizo et al. [25] identified mobile network quality as the most important reason for customers to switch from one operator to another. This way, we can say that high-quality service contributes to a positive customer experience and reduces the likelihood of churn.

Another aspect we have considered important is the *Service Value*, which refers to the value that a customer derives from a company's service. This could include factors such as the pricing, data

speed, customer support, network coverage, call quality, and other functions. Customers are more likely to remain devoted and renew their service agreements when they consider that what they receive is valuable. Yet, if they are unsatisfied or are convinced the services are of low value, they may be prone to switch to a competitor or cancel their deal, leading to churn.

*Customer Care* is crucial for attending customer concerns, providing assistance, and resolving complaints promptly, it also significantly affects customer satisfaction and loyalty. Offering good customer care is dependent on being responsive, providing proactive post-sale support, guaranteeing that the client trusts the company and that they feel their opinions and issues are being heard. As we have experience in the group on the customer care area, we can affirm that this area is one of the first contacts/interactions that the user has with the company. Depending on the customer service they receive, if satisfied, they are more willing to share their good experience with others, therefore less likely to change providers. Conversely, if they receive poor customer service they will be dissatisfied and more prone to leave. [9]

Following, we chose the *Number of Complaints* feature to also be relevant. It can measure the level of dissatisfaction among customers. Higher complaint rates may suggest that customers are experiencing issues or are unsatisfied with the service. [16] Tracking and addressing these complaints can help identify areas of improvement and reduce churn. Although receiving a significant number of complaints may be perceived negatively, the truth is that a customer who complains is more probable to utilize the service again. Nevertheless, a customer who does not complain is more likely to churn since they are dissatisfied with the service and will look for another that can fulfill their needs. Again, as we have customer care experience within the group, we notice that customers who complain multiple times are willing to continue using the service despite the fact that they are experiencing an issue. Typically, they want the problem to be solved as well as receive compensation for the inconvenience caused. If the problem is solved and the customer service efficient, this can bring more satisfaction to the customer.

Lastly, *Trustworthiness* is an important factor in customer retention. Customers wish to have a sense of confidence in the communications service provider's reliability, security, and integrity. The foundations of establishing and sustaining trust are transparency, privacy protection, and keeping agreements. [6]

# 4 Determinants of Churn based on Switching Costs and Barriers

Switching costs and barriers have an important influence on switching behavior and customer loyalty since they are essential constraints that prevent customers from easily switching to other service providers. [19] [24] Let's have a look at the features we found more relevant from table Switching Costs and Barriers in the Appendix.

We realize that these variables are very important for telecommunication services, as *switching costs and barriers* allow us to prevent churn. We believe that if there is a considerable cost associated with switching, people may be unwilling to give up the service since normally customers often avoid paying an extra fee and even complain about being charged for those additional expenses resulting from the penalties. This circumstance can be used to retain customers and we can confirm that in reality, this is one of the most commonly received calls in customer support call centers. So, the barriers operate as a way to make it harder for customers to give up the service in order to switch to another one.

As we stated, switching costs and barriers encompass various factors that influence a customer's decision to switch providers. One such factor is the *Contractual Lock-in and Minimum Contract Du-*

*ration* that imposes a minimum contract duration or early cancellation costs that prevent customers from switching to another provider before the contract expires. The contractual lock-in and minimum contract also works as a way to retain customers. For instance, if they decide to stop using the service, they will be subject to a penalty that may be quite expensive because typically they are obligated to pay the remaining months if they do not intend to use the service. For example, in Portugal, the telecommunications company Vodafone has a policy where the customer will have to pay as "an initial period of loyalty: 50% of the value of the outstanding monthly installments if the termination occurs in the first year of the contract's validity; or 30% of the value of the outstanding monthly installments if the termination occurs in the second year of the contract's validity". [8]

Additionally, *Accumulated Loyalty Points* can increase loyalty points, and build customer engagement and satisfaction, indicating a lower likelihood of churn, as it encourages clients to use the service by offering rewards like discounts or free services. As a result, this can make them want to make more use of the service knowing they will be compensated, thereby making them feel valued as a customer.

To finish, another feature we found relevant was the *Transaction Costs*. This includes the financial fees or time-related costs associated with the process of switching, for example paying for fees, changing numbers, doing paperwork, activating new services, canceling a contract, setting up new accounts, or signing up with a new provider. These factors can all act as a barrier to churn, especially when the transaction costs are higher. However, some customers might consent to pay transaction charges if they believe it will have more value and benefits. [15]

# 5 Determinants of Churn based on Tariff Characteristics

Tariff characteristics refer to the various features and attributes of a mobile service provider's pricing plans or rate plans and include customer payment behavior. Some of those are presented in the table Tariff Characteristics variables in the Appendix.

One crucial tariff characteristic to examine is the *Monthly Billed Amount* variable. For example, customers who receive a higher monthly bill may lead to dissatisfaction and prompting customers to explore alternative providers with more cost-effective options. Customers can review their monthly bills to understand the breakdown of charges and ensure accuracy. It's also important for service providers to communicate pricing details clearly to customers and provide transparency in billing practices, without this consumer trust is broken and there's a higher probability of occuring churn.

The *Rate Plan Discounts* variable relates to customers who have access to attractive rate plan discounts or are using the latest rate plans introduced by the provider. They may be more inclined to stay, as they perceive added value and cost savings. Some situations are offering discounts on certain rate plans based on factors like loyalty (for example, years of contract) or bundling various services together. This not only values the client but also encourages them to continue with the service in the long term.

We also found the *Rate Plan Suitability* to be very relevant. According to this, customers can choose a tariff plan based on how well it meets their specific requirements and usage tendencies. Telecommunication companies should take this feature into account by providing diverse tariff plans since all customers demand different needs. For example, some users might request more data than others, so offering a plan with unlimited data might be a good option. Others might not even want data, so offering a pay-as-you-go or pay-per-use plan is very suitable. [27]

Finally, we would like to highlight the *Service Payout* feature, which refers to any compensation or benefits that a customer might receive if they change service providers. Incentives like bill credits or free

devices can be offered by providers to attract customers to switch. For example, WOO is a Portuguese telecommunications service provider and we have found out that they offer tariff plans for new clients, in which they offer an incentive, a cost-free experimental month on all plans. This way, if they are unsatisfied with the experience, they can always stop after the experimental period. Another benefit is that they still have the opportunity to get an additional 6GB free for 24 months if they keep the same number. [12]

# 6 Determinants of Churn based on Customer-Related Variables

Costumer-related variables can have a valuable impact on the performance of churn prediction and are also highlighted in the literature as determinants of customer churn. [25]

From the variables outlined in the article in study [25], that we outlined in the table Customer Related Variables in the Appendix, we can select a few that in our opinion would bring important value to the intended prediction.

The *Active/Non-use or Suspended status* variable likely refers to the status of a customer's account or subscription with a service, where "Active" status typically means that the customer is currently using the service and their account is in good standing, "Non-use" status could indicate that the customer has an active account but isn't currently using the service. This could be a sign that the customer might churn soon, as they are not engaging with the service. Finally, the "Suspended" status usually means that the customer's account is temporarily disabled, maybe due to non-payment or a violation of terms of service. In other words, we can see that this variable translates into customer engagement with the service, turning into a crucial feature for the prediction of churn in telecommunication services. As stated, customers with "Suspended" or "Non-use" status are more likely to churn as they are not actively using the service. However, even so, we associate a higher probability of churn with the "Non-use" status, because here the lack of use of the service is by the customer's own will and not by other factors as happens with the "Suspended" status. Ahn et al. [16] concluded that customer status (active, inactive, and suspended for non-payment) had a significant impact on churn, with a change from active to inactive or suspended status increasing the probability of switching by 14.7 and 4.5 times, respectively.

The *Breadth - additional services* variable usually refers to the number or variety of additional services that a customer uses or has signed up for in addition to their main service. This could include add-on packages, like international callings, internet services, television services, premium channels, among others. The underlying premise is that customers who consume a wider range of services are more integrated into the ecosystem of the company and may be less prone to churn because they probably wouldn't have access to these extra services if they left. Again, this feature also translates to how engaged customers are with the service and how dependent they are on its offerings.

The *User sophistication* variable seems to refer to the level of knowledge, experience, or comfort a customer has with a particular service or product. We can think of two scenarios based on this variable. First, we can deduce that more sophisticated users might be more likely to stay with a service because we know they made a thoughtful and conscious choice before affiliating with the service, so they understand its value better. However, on the other hand, this could also mean that they might be more likely to churn because they are more informed and updated and, consequently, have a better understanding of the alternatives available. In either scenario, this seems to be a good indicator for the prediction of churn.

The *Word of mouth (WOM)* variable refers to the impact of customers sharing their experience

with a particular service with others. We expect this variable to have a big impact on client churn and retention. As satisfied customers are more inclined to suggest the service to others, potentially drawing new customers, and reinforcing the positive opinions of present customers, positive word of mouth can enhance customer retention. In contrast, negative word of mouth can cause current consumers to reevaluate their relationship with the service provider and raise the probability of churn by influencing unsatisfied customers to discourage others from using the service. Dierkes et al. [14] found that information on the churn of network neighbors significantly improved the predictive accuracy and sensitivity of churn models. This provides evidence that WOM has a considerable impact on customers' churn decisions and also on purchase decisions, leading to a 19.5% and 8.4% increase in the sensitivity of predictive models respectively. So, here they highlighted the significant role of WOM in influencing churn decisions.

When applied to this context, the variable *Continuance commitment* is interpreted as a customer's commitment to continue to use a service because they perceive a high cost associated with stopping use, such as losing access to unique features, high switching costs, or potential losses from invested time and effort. [2]. In other words, customers with high continuance commitment may feel that they have more to lose by leaving the organization than by staying, giving a good indicator of the probability of churn also.

Finally, we also consider *Customer loyalty* and *Loyalty commitment* variables to be very relevant in this case. We should note that these two focus on slightly different dimensions of loyalty. *Customer loyalty* frequently refers to a customer's behavioral loyalty, which can be measured by things like how long they've been a customer of the service provider, how frequently they use the service, or how frequently they make purchases. This kind of loyalty is observable and quantifiable.

On the other side, *Loyalty Commitment* focuses more on emotional loyalty. It speaks to the emotional or psychological connection a client has with the service provider. Although it could be more challenging to evaluate this kind of loyalty directly, it can be inferred from replies to customer surveys or from other indirect indicators, such as how much customers interact with service providers on social media.

However, if including both features leads to redundancy or multicollinearity in the model (meaning the two features are highly correlated), we might be better off choosing just one, like *Customer loyalty*, for example, as it is more tangible.

# 7 Determinants of Churn based on Socio Demographics

Socio-demographics comprise the most popular theme of churn determinants explored by the literature. This theme is composed of determinants with the highest number of identified occurrences. [25] We will explore the variables we find most influential from the table Customer Related Variables in the Appendix.

The *Age* variable refers to the age of the customer. We find this to be impactful on the likelihood of a customer discontinuing a service. A younger customer usually is more informed and has specific needs that need to be satisfied. For example, nowadays, with the gaming generation, streaming, and online work, or classes, the younger ones may need a higher velocity of the internet. This way, we can infer that younger people may be more likely to switch between different services due to factors like price sensitivity or desire for novelty. On the other hand, older people tend to find comfort in habit or reluctance to change, thus, they are not as concerned about being informed about other services as young people are, for example.

The *Employment Status* usually refers to whether a customer is employed, and if so, what kind

of employment they have. This could include categories such as full-time, part-time, self-employed, unemployed, retired, student, etc. This feature can reflect a customer's purchasing power, stability of income, and therefore their likelihood to continue or not with a service. Customers who are unemployed or students, for instance, may be more price sensitive and more likely to stop using a service if they think it is too expensive. A full-time employee, on the other hand, may have a more secure salary and be less prone to churn for financial reasons. Lunn and Lyons [23] concluded that those who reported being retired were less likely to churn, which is in line with our conclusion regarding *Age*.

Related to this, we also find the *Income* variable to be important. It is used to indicate a customer's earning power or financial status. This can help predict their ability to continue affording a service or product. It makes sense to believe that, in comparison to consumers with lower income levels, those with higher income levels may be less inclined to churn for financial reasons, as this could potentially influence their ability to afford different service plans, their sensitivity to price changes, and their likelihood finding better deals from different services.

The *Marital Status* variable typically refers to whether a customer is married, single, divorced, separated, or widowed. This feature can influence purchasing decisions and behavior. For example, married or single customers must be more settled and accustomed to a service. In contrast, divorced, separated, or widowed customers probably, at some point have to rethink their spending and the plan or service they want, therefore, being more likely to churn.

The *Household Members* variable refers to the number of individuals living in a customer's household. This attribute can provide valuable information about a customer's lifestyle, consumption habits, and potential needs, which in turn can influence their likelihood to continue or discontinue a service. For example, a household with many members might need more extensive or varied services and might be more likely to switch if they find a provider that offers a better deal for their needs, for example, family-oriented service packages. Madden et al. [21] and Lee [20] also observed that households with multiple members are more likely to change operators.

Finally, the *Residing Location* variable also seems very important to us. It refers to the geographical location where a customer lives. One thing we have to check as a customer right before we subscribe to a telecommunications service is whether it has coverage in our area of residence. This is a decisive point. For example, a customer living in a rural area might have fewer options for service providers and might be less likely to switch. Even having coverage in a certain location, the quality of service could vary, for example. Thus, in the end, this feature would have a big influence on the consumer's likelihood of switching services.

# 8 Determinants of Churn based on Market Environment

The authors of the article in study [25] discuss several determinants of churn based on the market environment. We presented them in the table Market Environment variables in the Appendix.

The *Attractiveness Alternatives* variable refers to the perceived value or benefits of other options available to a customer. These other options can consist of services offered by competitors, or different and more economical ways of fulfilling the same need that the current service provides. For example, if a different service offers a better plan, better coverage, and better customer service, and if a customer perceives these as more attractive, then it is likely that he will churn from the previous service. However, this "attractiveness" is highly subjective. From the previous example, most customers would agree those options were "attractive", but there may be options that cause more division. It all depended on the customer's individual needs, preferences, and, of course, previous experiences. This opinion can be

supported by Keaveney [19] and Yin et al. [28], as they agree that when customers feel that competing firms offer better services that are worth more than their current benefits, their intention to switch increases.

The *Promotional Campaigns* also seem to be important when predicting the churn of a company. These are marketing efforts aimed at promoting a company's service. The purpose of these campaigns is to draw in new customers and keep existing ones. They may contain exclusive discounts, deals, or new product features. The effectiveness of these campaigns most certainly has an impact on customer churn. These successful promotional campaigns, that call the consumer's attention, might reduce churn, while ineffective or poorly-received campaigns might increase it. This really influences the brand image a customer perceives from a company. Miranda-Gumucio et al. [22] agree with this opinion. In their investigation, the authors found that advertising efforts were among the most crucial factors in the decision to move. Customers will stop using services if there aren't any interesting promotions if they've had bad rewards and promotions experiences, or if the operator ends current programs and/or promotions.

To finish, we also found *Accessibility* to be very valuable. It refers to how easily a customer can access a company's services or products. For example, as a consumer, it is important to be able to use the company's website without much difficulty and intuitively. It would also be a good bet for the company to also have an app and not only a website, in order to be able to access the services in a fast and versatile way. Another important point is, for instance, the availability and responsiveness of customer service and the number of retail locations, in case a consumer needs any help. It is always good that this one does not forget to meet all the needs. For a young person, for example, it is quite intuitive to look for customer service online or by calling. Older customers, on the other hand, may prefer to go to physical stores to deal with the issue in person, as this is how they feel more comfortable and associate greater trust. This is a broad term that can encompass many aspects of a customer's interaction with a company. Generally, if these aspects of accessibility fail, a consumer is more likely to "give up" on the company in question.

# 9 Conclusion

By thoroughly examining and understanding these characteristics, any data analytics team can actually provide actionable insights to the sales and marketing department. This knowledge will aid in the development of targeted strategies and retention initiatives that address specific customer needs and mitigate churn. Reducing churn is crucial for the long-term success and growth of the telecommunications business. By considering these characteristics, a customer-oriented approach that enhances satisfaction, addresses the problems, and builds customer loyalty, ultimately leading to improved retention rates and business performance can be developed.

Many of the features we selected as important for the telecommunication churn prediction can be categorized as qualitative. However, we can quantify these and represent them numerically for analysis purposes. For example, we can transform a qualitative classification into a binary classification or use the Likert Scale [10] for quantification, representing it as a score based on survey results.

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# A Service Usage

| | |
|---|---|
| **Usage Behaviour** | Describes how a customer uses a product or service. |
| **Type of Use** | What a customer uses a product or service for. For example, in the case of a smartphone, the type of use could be for making calls, sending texts, browsing the internet, watching videos, etc. |
| **Consumption of Value-Added Service** | Whether a customer uses additional services provided by a company that are not part of the core product (like caller tunes, extra data packs, etc.) |
| **Minutes of Monthly Use** | Total amount of time a customer uses a service within a month. |
| **Number of Calls** | Total number of calls a customer makes within a specific time period. |
| **Number of Short Messages (SMS)** | Total number of text messages a customer sends within a specific time period. |
| **Mobile Internet Monthly Use** | Amount of mobile data a customer uses in a month. |
| **Number of Distinct Calls** | Total number of unique phone numbers a customer calls within a specific time period. |
| **Frequency of Watching Videos on Smartphone** | How often a customer watches videos on their smartphone. |
| **Type of Use (Email, Web Surfing, Educational Activities, Work)** | Specific activities a customer uses a product or service for. |
| **Use Habits** | Routine or pattern of a customer's use of a product or service. |

Table 2: Service Usage variables. [25]

# B Service quality, Satisfaction and Service Value

| | |
|---|---|
| **Satisfaction** | Overall customer satisfaction with the service. |
| **Service Quality** | Measure of how well a service meets or exceeds customer expectations. |
| **Number of Complaints** | Counts the number of complaints a customer has made. |
| **Service Value** | Perceived value the customer gets from the service, taking into account the cost and quality of the service. |
| **Consumer Care** | Quality of customer service, including responsiveness, helpfulness, and how well issues are resolved. |
| **Trustworthiness** | Perceived reliability and integrity of the service provider. |
| **Call Drop Rates** | Frequency with which calls are dropped or disconnected unexpectedly. |
| **Call Failure Rates** | Measures how often calls fail to connect or get cut off. |
| **Network Reliability** | Measures how reliable the network service is, for example, how often it's available and doesn't have issues. |
| **Billing Issues** | If a customer has had issues with billing, such as incorrect charges or complicated billing processes. |
| **Affective Customer Experience** | Emotional reaction or feelings of a customer towards the service. |
| **Network Quality** | Performance of the telecom network, including factors like signal strength, call quality, and data speed. |
| **Customer Service Factor** | Measure of the overall quality of customer service, including factors like responsiveness, helpfulness, and effectiveness at resolving issues. |
| **Proactive Post Sales Service** | Measures how proactive a company is in providing service and support after a sale, including follow-up calls, customer check-ins, and proactive resolution of potential issues. |
| **Responsiveness** | Measures how quickly and effectively the service provider responds to customer queries and issues. |
| **Technological Capability** | Service provider's ability to provide up-to-date and cutting-edge technology. |

Table 3: Service quality, Satisfaction and Service Value variables. [25]

# C Switching Costs and Barriers

| | |
|---|---|
| **Switching Costs and Barriers** | Perceived or actual costs and difficulties associated with switching from one provider to another. |
| **Contractual Lock-in, Minimum Contract Duration** | Situation where a customer is bound to a service provider by a contract for a specified period of time. |
| **Accumulated Loyalty Points** | Points a customer earns as part of a loyalty program. |
| **Transaction Costs** | Costs associated with conducting a business operation. |
| **Mobile Number Portability** | Ability of a customer to retain their existing mobile phone number when switching from one mobile phone network provider to another. |
| **Complexity of Service Plans** | How complicated or easy to understand a service provider's plans or packages are. |
| **Perceived Risk** | Customer's perception of the potential negative outcomes of switching to or staying with a service. These risks could be financial, functional (the new service doesn't work as expected), or psychological (stress or dissatisfaction). |
| **Learning Costs** | Effort and time a customer needs to invest to understand and use a new service or product effectively after switching. |
| **Handset Sophistication** | Level of advanced features and capabilities of a mobile device. Higher sophistication often correlates with higher prices and a greater learning curve. |
| **Loyalty Program Membership** | Whether a customer is a member of a service provider's loyalty program, which often offers rewards and incentives for continued use of the service. |
| **VPMN Network** | Could refer to a type of mobile network |
| **Family Package** | Service plans that bundle services for a family or multiple users together, often at a discounted rate. |
| **Terminal Bounded Contract** | Contract that is tied to a specific device or "terminal" |
| **Sector Knowledge** | Customer's knowledge and understanding of the telecom sector. |
| **Expected Savings** | Savings a customer anticipates they would achieve by switching to a different service or plan. |

Table 4: Switching Costs and Barriers. [25]

# D Tariff Characteristics

| | |
|---|---|
| **Monthly Billed Amounts** | The amount charged to the customer on a monthly basis for the services provided. |
| **Rate Plan Suitability** | How well a rate plan fits the needs of the customer. |
| **Service Payout** | The amount paid out by the service provider for services rendered. |
| **Rate Plan Discounts** | Discounts applied to the cost of the rate plan. |
| **Bundle Services** | A package of multiple services offered together at a discounted rate. |
| **Unpaid Balances** | The amount owed by the customer that has not yet been paid. |
| **Calling plan** | A plan that determines the cost of making phone calls. |
| **Plan Type (Pre-paid/Post-paid)** | Pre-paid plans require payment upfront for services, while post-paid plans are billed after services are used. |
| **Payment Type (Post/Prepayment)** | Post-payment refers to paying after services are used, while prepayment refers to paying upfront for services. |
| **Tarif Plan (Pay Per Use Vs. Two Part Tariff)** | Pay Per Use plans charge based on usage, while Two Part Tariff plans have a fixed fee plus a variable fee based on usage. |
| **Rate Plan Novelty (New Vs. Old Rate Plans)** | Refers to whether the rate plan is new or has been available for some time. |
| **Mobile Voice Flat Rate (Unmetered)** | A flat rate for unlimited voice calls. |
| **SMS Flat Rate (Unmetered)** | A flat rate for unlimited text messages. |
| **Mobile Internet Flat Rate (Unmetered)** | A flat rate for unlimited mobile internet usage. |
| **Payment method (Direct Debit / Other)** | The method by which the customer pays their bill, such as direct debit or other methods. |
| **Number of unpaid monthly bills** | The number of monthly bills that have not been paid by the customer. |
| **Monthly Average Data Services Cost** | The average monthly cost of data services for the customer. |

Table 5: Tariff Characteristics Variables

# E Customer Related Variables

| | |
|---|---|
| **Active/Non-use or Suspended status** | Current status of the customer's account with the service provider. |
| **Breadth - additional services** | Range of additional services that a customer has subscribed to, beyond the basic telecom service. |
| **User sophistication** | Extent of a customer's knowledge of the telecom service offered by the operator and its features. |
| **Word of mouth** | Impact of customer recommendations or negative feedback on the decision to switch service providers. |
| **Continuance commitment** | Evaluation of the costs associated with switching and the need to maintain the relationship with the service provider. |
| **Customer loyalty** | Degree of loyalty a customer has towards the service provider. |
| **Loyalty commitment** | Psychological attachment a customer has toward the service provider. |
| **Consumer innovativeness** | Degree of a customer's intrinsic motivation, the personality trait of making more active exploration and having higher expectations. |
| **Handset manufacturer** | Company that manufactures the mobile device used by the customer. |
| **Hardware acquisition (i.e. Mobile handset)** | Method of acquiring the mobile device, whether it was purchased separately or as part of a telecom service contract. |
| **Previous churning attempt** | Customer's previous attempt to switch service providers. |
| **Wireless orientation** | Degree to which a customer is oriented towards using wireless services. |

Table 6: Customer Related Variables. [25]

# F Socio Demographics Variables

| | |
|---|---|
| **Age** | Age of the individual. |
| **Employment Status** | Whether the individual is currently employed, and if so, what type of employment they have. |
| **Income** | Amount of money an individual earns, typically on an annual basis. |
| **Marital Status** | Whether an individual is single, married, divorced, separated, or widowed. |
| **Household Members** | Number of people living in the same household. |
| **Residing Location** | Where the individual lives. |
| **Education** | The highest level of education an individual has completed. |
| **Children at Home** | Whether the individual has any children living at home. |
| **Gender** | Sex of the individual (i.e., male, female, or other). |

Table 7: Socio-demographic variables. [25]

# G Market Environment

| | |
|---|---|
| **Attractiveness Alternatives** | How appealing the products or services offered by other companies are to the customer. |
| **Promotional Campaigns** | Marketing efforts by a company to promote its products or services. |
| **Accessibility** | How easy it is for customers to access the company's products or services. |
| **Competitor Advertising** | Advertising efforts of competing companies. |
| **Technology** | Technology used in a company's products or services. |
| **Brand Image** | How customers perceive a particular brand. |

Table 8: Market Environment variables. [25]