
**A SYSTEM DYNAMICS APPROACH TO CUSTOMER CHURN
MANAGEMENT IN THE MOBILE TELECOMMUNICATION
INDUSTRY: THE CASE OF ZAMBIA**

BY

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**A dissertation submitted to the University of Zambia in partial
fulfilment of the requirements for award of degree of Master of
Engineering degree in Telecommunication Systems.**

THE UNIVERSITY OF ZAMBIA

LUSAKA

2016

DECLARATION

I, Patience K. Banda do hereby declare that this dissertation is the result of my own work and investigations. This work has not been submitted for the award of a Master's degree at this, or any other university.

Signed: -----

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CERTIFICATE OF APPROVAL

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“Structure Creates Behaviour.”

DEDICATION

To my family, which has great passion for hard work. Most times if not all, no matter how small the beginning might seem to others, even when you are not sure, you just have to start with whatever you have, and wherever you may be.

Do your best until you bless that day you started, the day of small beginnings that got you a step further than the one sitting on their couch.

The University of Zambia, Patience Kunda Banda (c) 2016

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ABSTRACT

Customer churn is a major challenge in the mobile telecommunications industry today. With one customer leaving for another telecommunication service provider, perceptions about the brand change. There are high chances that a churner is not a promoter, thus they may not promote the brand well after they leave. Consequently, many more customers are potentially at the edge of leaving for another mobile telecommunications service provider. No matter how long the customer has been on a network, the mobile telecommunications service providers feel the impact when they churn. Churners can influence existing and potential customers and this may lead to declines in revenue generation and growth.

The pattern of churn changes over time, arising from different factors that may be known or unknown. The complexity of these factors makes churn management challenging. This study proposes a model that uses system dynamics, a simple yet aggressive approach that gives important insights into managing customer churn in the telecommunication industry. The data used was collected through surveys and interviews from seven hundred mobile subscribers in six districts of Zambia, the three Mobile Network Operators (MNOs) and Zambia Information Communication & Telecommunications Agency (ZICTA). The model uses factors that led to customer churn between 2010 and 2015, and allows for a simulation of a forecasted customer churn rate when mobile network operators take action and when they do not.

The results of the survey show that on average, MNOs on the Zambian telecommunication sector experience annual churn rates between 3.73 and 9.14 percent. The model shows that if the MNOs apply recommendations suggested in this model, annual churn rate can reduce to about 1.02 percent after twenty iterations. Churn rate has the potential to soar to about 86 percent within the same period if MNOs do not take action.

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I am deeply and forever indebted to my family, who believe in me so much. A package of love and blessings is what you are. Your support and encouragement are a driving force from which I draw energy to always do more. May God add more to our gift of unity, and to the many good years well ahead of us.

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LIST OF ABBREVIATIONS

ARPU:	Average Revenue Per User
CRM:	Customer Relationship Management
CSO	Central Statistical Office
FCC	Federal Communications Commission
MNO:	Mobile Network Operator
ZAMTEL	Zambia Telecommunications Limited
ZICTA	Zambia Information Communication & Telecommunications Agency

CHAPTER ONE

INTRODUCTION TO THE RESEARCH

1.1 Introduction

This chapter discusses churn rates experienced by various countries around the world, brief description of mobile customer churn and its impact on businesses. It also gives a brief background to the mobile telecommunication industry in Zambia, and a quick overview on the market shares and other national statistics concerning the mobile telecommunication industry. The statement of the problem, significance, scope, aim and objectives discussed in this chapter are also discussed in this chapter. Other key aspects such as research questions, definition of key terms and organization of the thesis have been outlined in this chapter.

1.2 Background to Customer Churn

In the mobile telecommunications industry, customer churn rate is the ratio of the number of customers that have discontinued subscription to services compared to the mobile subscriber base for a certain period [1]. Customer churn can be internal or external [2]. Internal customer churn occurs when a customer changes their subscription from one service to another within the same MNO while external customer churn occurs when a customer stops subscribing to services offered by one MNO and signs up with another [2]. In this research, unless otherwise stated, the term customer churn refers exclusively to external and not internal churn as defined.

Churn is an enemy, not only to the telecommunications industry, but also in most industries that are customer oriented. In his study, Sarkindaji [3] acknowledged the telecommunications industry to be an important hub of innovations. Over the years, the industry has devised several models to help take care of customer churn. Despite all the efforts, research [1, 3, 4] shows that the telecommunication industry suffers most from customer churn and switching behavior, with global average annual churn rates of between 10 percent and 67 percent.

There are several effects of customer churn on the operations of a business. The most notable effect of customer churn is how it affects the profitability of a corporation. Taking an example of USA telecommunications sector, Mattison [5] points out that the average mobile customer brings in between USD 20 to USD 80 per month [5]. This value is what determines the impact that customer churn has on revenues. To illustrate, annual churn rate of 15 to 60 percent for a service provider that has 4,000,000 customers will lead to revenue losses ranging between USD 12,000,000 and USD 192,000,000 in a year. This is a significant loss to a corporation and it could lead to even greater losses if MNOs do not address the challenges that customers face.

Some researchers [5, 6, 7] proposed that in order to minimize the impact of customer churn on business revenues, organizations must focus on acquiring new customers. Lemmens and Gupta [6] affirmed this proposal when they stated that targeting a future churner offers the MNOs more financial benefit compared to targeting a customer who has no intention to leave [6]. However, Khan, Jamwal and Sepehri [8] bring to light the fact that the cost of obtaining a new customer is five to six times higher than that of maintaining an existing one [2, 8, 9, 10].

Comparing the value addition of new and old customers, Lessmann, et al [10] highlights that long-term customers generate higher profits, they are less sensitive to competitive actions and may act as promoters by word of mouth. Research by Abaidoo [9] and Catanedo [11] agree with this reasoning when they argue that instead of focussing on customer acquisition, telecommunication companies must explore customer retention. Research by Kim and Yoon [12] also shows that compared to a new customer, the customer who gets back after sometime has a much more accurate assessment of the MNO they return to. This could mean that a churner who retracts would have sampled some or all of the products and services on the market and their turning back could be an indication of their resolute choice and decision to stick with that particular service provider. The findings of the research conducted by Kim and Yoon [12] show that a 'longer subscription duration' of a mobile customer to services of a particular MNO 'tends to be associated with a lower probability of churning.' Therefore, it is important that MNOs maintain the balance between keeping the customers they already have satisfied and also obtain acquire new customers to increase their markets share and revenue.

There are many approaches taken by organizations in order to prevent churn. Some approaches offer deals, discounts, distribution of branded materials, freebies, limited-time offers, personalized emailing and numerous other tactics to entice customers and keep them as part of the subscriber base [6]. The objective of all these incentives is to increase the behavioural loyalty of the customers. It is common practice however for competing partners to counter-offer customers with matching or even better advantage packages. Hence, these incentives do not ease the situation but intensify boundaries of competitive advantage of one MNO over the other. The fight against churn becomes even harder because all MNOs on a particular market would want to increase their market share and consequently their revenues.

Sterman [13] openly criticizes the approach of offering incentives when he argued that it alters the state of the system, and competitors react to restore the balance that gets upset. Sterman [13] stated that ‘policy resistance’ is one of the most damaging side effects that can arise from the approach of offering incentives. The policies put into place respond to changes in the state of the system in such a way as to offset the intended effects of the policy [13]. This offset results from the fact that the remedy is directed at the symptom and not the actual problem [5, 13]. Policy resistance arises from assuming that ‘experience is a series of events’ and not paying attention to the feedback from a system [13]. A situation may arise where all policies designed to give incentives may just seem not to be working. Competitors watch as one service plan offers attractive incentives and seems to be on the rise. Competitors develop new networks, new offerings, introduce new technologies and if possible reduce subscription prices [5]. This is the nature of most businesses today, and the telecommunication industry is a victim [14].

1.3 Statement of the Problem

There are many customer churn management approaches in use today. Most of these approaches use the method of segmenting customers and offering them incentives [1, 6, 14, 15, 16, 17, 18]. These methods lack a maintenance strategy, which can be reviewed constantly to measure performance.

The fact that ‘customers do not announce their intentions in advance’ makes churn management an even more difficult task [5, 9]. Castanedo [19], states that

segmentation models are ‘time consuming ‘and do not factor in dynamism of the factors that lead to customer churn in an aggressive manner [17, 18, 20]. The question however, is why should anyone think that churn management with alertness to dynamism could yield better results compared to the models that do not consider dynamism?

In the opening chapter of his book about systems thinking and modelling in business dynamics, Sterman [13] points out that if science ‘were to go on doubling or quadrupling its complexities every 10 years, even mathematics should soon succumb. An average mind had succumbed already in 1850; it could no longer understand the problem in 1900’ [13]. Sterman describes systems as dynamic because they are changing over time. Largely, the complexity of systems is driven by environmental dynamism [21]. If system were the same as from inception, there would be no need to be looking for better ways to address challenges.

Referring to the point made by Sterman shows that complex systems cannot be analyzed overnight. A learning curve needs to be developed, from which informative decisions can be made. In order to develop a learning curve, all factors associated with the system need to be analyzed, if possible over time to establish a pattern [13]. Van der Belt [21] uses the term ‘adaptive management’ to refer to this approach, which is associated with addressing ‘uncertainties of the decisions’ that affect the nature of the system. This calls for the application of ‘integrative thinking,’ [22] which implies looking at a system as not being governed by a static environment, but by factors that are ever changing over time.

The customer segmentation methods used by MNOs in Zambia and many other countries therefore become vulnerable because they lack a feedback system. This method is also time consuming because the process of analyzing factors leading to customer churn becomes time-consuming. Systems thinking becomes important in churn management, especially in mobile customer churn management. The factors that cause customers to churn are ever changing. These factors also interact with each other and the external factors in a complex manner [22]. Hence, it is essential to use an approach that can guide in studying the behaviour of a system whose environment is challenging.

1.4 Significance of the Research

Research [23] shows that customers have the right to switch from one service provider to another. This principle works in most industries, including the mobile telecommunication industry. The MNOs therefore cannot hold a customer against their will. Instead, they need to make their products and services attractive enough to keep their customers satisfied. In a country like Zambia, customers are at will to switch between MNOs, at very low costs and no further implications.

Abaidoo [9] indicates that in developed countries, the mobile telecommunication market has reached a degree of saturation where each new customer must be won over from the competitors [9, 10]. Incumbent MNOs need to ensure the loyalty of their customers while they try to acquire new customers. Competitors will have the same disposition, thereby making new acquisitions and churn management a challenge, especially if customers are comfortable with their serving MNOs. It is in the best interest of the MNOs to ensure that they keep the long serving customers or customers who use a lot of their revenue generating services satisfied.

The complexity, dynamism and uncertainty of the factors that lead to customer churn makes it impossible to be analyzed overnight [5, 14]. A learning curve developed over time to establish a pattern and help management make strategic decisions even with limited resources becomes essential. This aspect is clearly emphasized in this model.

In similarity to others, the model designed in this research can help improve the market share, improve revenue returns, improve brand perception and in effect reduce the operational costs due to the reduced intervention required to win back potential churners. On a rare aspect, this model offers MNOs the opportunity to address churn by resolving the actual problems that customers face and not treat the symptoms. This research is also valuable to the mobile service providers in that it keeps the dynamism and uncertainty of the factors that lead to customer churn in mind.

The model proposed in this research will therefore make significant contributions to strategic decision making in churn management in Zambia. By adaptation, it also offers insight on churn management to MNOs in developed and developing countries.

1.5 Scope of the Research

This research focuses on mobile customer churn for the telecommunication industry in Zambia. The data used is from mobile customers from six districts of Zambia namely Chibombo, Chongwe, Kafue, Luangwa, Lusaka and Mbala, which are shown in Figure 1. Chibombo is a district found in Central province while Mbala is a district found in Northern Province of Zambia. The other districts namely Chongwe, Kafue, Luangwa and Lusaka districts are part of Lusaka province.

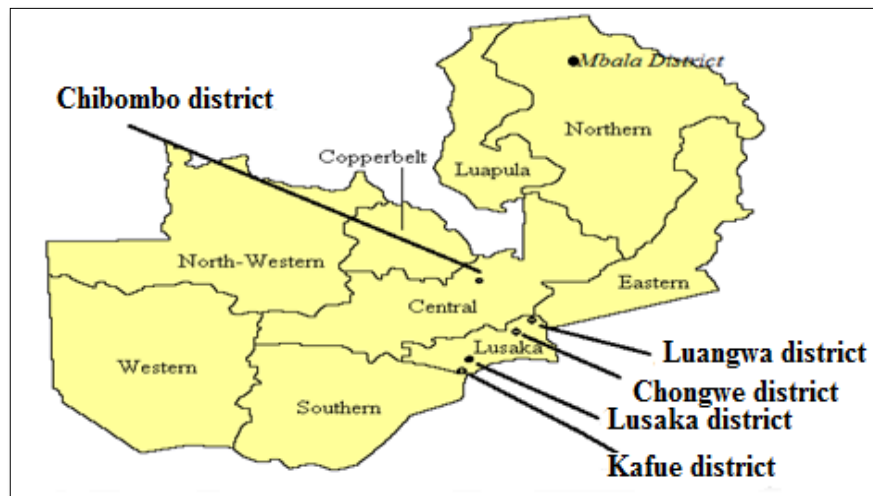


Figure 1: Districts used in this research

While source data is restricted to the districts in Figure 1, the applicability of the results obtained in this study may be usable in other telecommunication markets with similar characteristics. The telecommunications sectors that could benefit from this research may be in other geographical locations in Zambia or other countries. This is because telecommunications markets in both the developed and developing countries all experience customer churn. It is therefore essential that MNOs have proper working strategies that can help them to manage competition.

1.6 Aim of the Research

The aim of this research was to design a strategic churn management model that takes dynamism of factors leading to churn into consideration, and allows for feedback in order to improve performance on churn rate for MNOs.

1.7 Research Objectives

This research will focus on the following objectives:

1. To determine the factors that lead to customer churn on the *Zambian* mobile telecommunication market, the strategies that MNOs use to prevent customer churn and the gap between needs of customers and actions of the MNOs in managing customer churn.
2. To determine the extent to which the dynamic nature and uncertainty of the factors that lead to customer churn affect churn management.
3. To devise and design a system dynamics model using the interactions of the factors that lead to customer churn, that can help in decision making on churn management.

These objectives cover the detailed study that needs to be done in order to determine findings to the research questions raised in section 1.8.

1.8 Research Questions

In order to achieve the aim of this research, there are four areas that need to be clearly understood. These will be addressed via the four research questions as below:

1. What factors lead to customer churn on the *Zambian* mobile telecommunication market?
2. What gap exists between the needs of mobile customers and the actions of MNOs in churn management?
3. How does the uncertainty and dynamic nature of the factors that lead to customer churn affect churn management?
4. How can the dynamism and uncertainty of the factors that lead to customer churn be used to advantage in customer churn management?

1.9 Organization of the Dissertation

There are six chapters in this dissertation. Chapter 1 gives an introductory background to this research, definitions of key terms and a global view of customer churn in the mobile telecommunications industry. It also gives a general overview of the

telecommunications sector in Zambia. Chapter 1 also discusses the significance of this research, the aim, scope, objectives, and research questions tackled in this research.

Chapter 2 gives the theoretical framework by citing definitions and practical applications of common terms used in this research. It discusses the positive and negative sides of customer churn as argued in most literature. Chapter 2 reviews similar works done on mobile customer churn, and the performance methodologies used. It also gives a hypothetical theory on the practicability and suitability of the use of dynamics in churn management modelling as compared to other methodologies.

Chapter 3 gives an overview of the common research methodologies used today. It discusses the differences, strengths and weaknesses between them, and cites why the methodology chosen for this research is suitable. Chapter 3 also discusses the tools used in collecting and processing data in this research, and gives details on the design and implementation of the churn management model that has been designed.

Chapter 4 of this report discusses results from all methodologies used in this research. There are two sets of results in this chapter. The first has results collected from the surveys and interviews while the second set consists of results collected from the simulation model created in Vensim modelling tool.

Chapter 5 discusses how the findings of this research compare to the aim and set objectives. This chapter reviews the research questions and their answers from findings. Chapter 5 also discusses some of the challenges met during the research work and makes recommendations for possible future research on a related subject. The conclusion section in this chapter reviews the results obtained.

1.10 Summary

As discussed under the statement of the problem, the churn management methods that are used in Zambia do not have a proper feedback system that allows MNOs to check their performance and optimize their systems. The methodologies of customer segmentation and offering of incentives that are in practice today seem to resolve the problem for a short period. This research contributes to churn management by demonstration of how system dynamics modelling can help MNOs in mobile telecommunication customer churn management.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This Chapter discusses the key terms used in this research in details. It gives a brief background to the mobile telecommunication industry in Zambia. It gives a thorough review of mobile customer churn, churn management approaches, factors that lead to customer churn and system dynamics from literature. This review of the literature is then used to determine the applicability of system dynamics modelling in mobile telecommunication customer churn.

2.2 The Zambian Telecommunication Industry

Mobile telecommunications in Zambia began in 1994 when ZAMTEL, a government owned MNO obtained the licence to provide services to the public. ZAMTEL began by offering fixed and later on mobile telecommunication services. Telecel now called MTN Zambia was second to emerge on the market when it obtained its licence in 1995. The third entrant was Zamcell, now called Airtel Zambia, which got its operating licence in 1997.

Table 1: Mobile subscribers and penetration rate evolvement

Year	Mobile telephone subscribers [Million]	National Population [Million]	Mobile Penetration Rate
2008	3.2	11.8	27%
2009	4.4	12.9	34%
2010	5.4	13.1	42%
2011	8.2	13.0	60%
2012	10.5	13.5	74%
2013	10.4	14.6	71%
2014	10.1	15.1	65%
2015	10.8	15.5	70%

The number of mobile telecommunication subscribers in Zambia evolved as shown in Table 1 for the years 2008 up to 2015. In 2008, there were only 3.2 million mobile subscribers in Zambia. Compared to the national population, only 27 percent of

Zambians had adopted the mobile telecommunication services. There was significant growth in the consecutive years that followed up to 2012. The mobile subscribers in the years 2013 and 2014 were lesser than those in 2012 due to the sim registration exercise which the MNOs embarked on. This exercise led to a minimization of multiple sim ownership for some of the customers. The mobile subscriber numbers began to grow in 2015 with 10.8 million subscribers, which put mobile penetration rate at 70 percent. It is key to note that this mobile penetration rate is determined as the number of sim connections compared to the annual population.

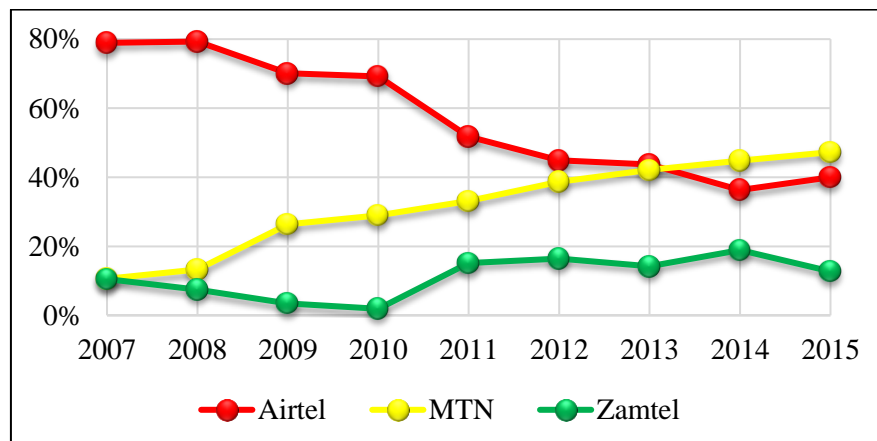


Figure 2: Market Share trend for the MNOs

As of December 2015, there were still three MNOs on the Zambian Telecommunication market namely Airtel, MTN and ZAMTEL. Figure 2 [24] shows the trend in market share for the three MNOs for the years 2007 up to 2015. Prior to the year 2013, Airtel dominated the mobile telecommunications sector [24]. MTN later picked on market share and took the market lead just after the year 2013.

2.3 Theoretical Framework

Generally, churn management focusses on improving the customer behaviour so that customers do not terminate subscription. This research work has the framework shown in Figure 3. The churn management model designed measures churn rate using a closed loop feedback system. There are three major categories of input parameters to this model as shown in Figure 3. The closed loop feedback model then analyses the inputs through system interaction. The output of the system is churn rate, which is constantly measured and optimized to get the desirable outcome.

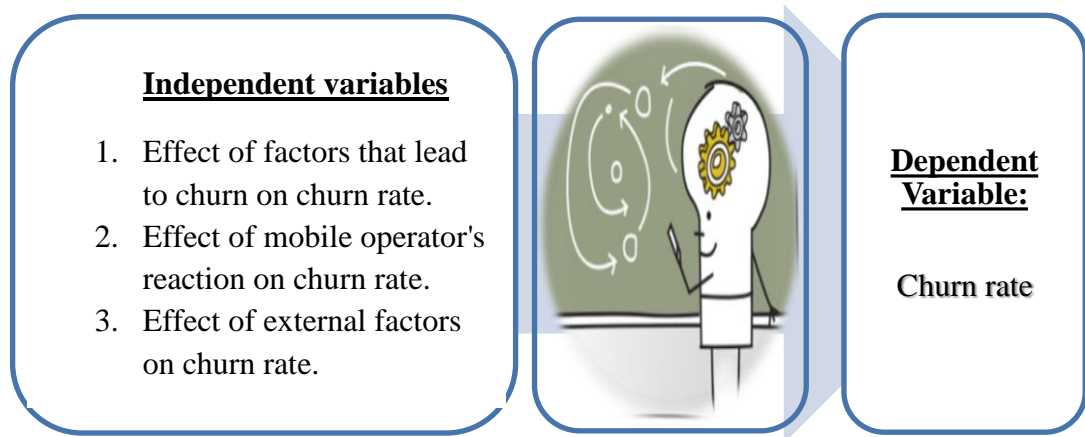


Figure 3: Theoretical Framework of the research

Attributes of Figure 3 make up a high-level summary of the churn management model designed. Churn management is all about the customer, the incumbent and competitor MNOs and any other factors in the external environment. The system will analyze the interactions of all three inputs to observe the changes in the churn rate value.

2.4 Churn in the Mobile Telecommunication Industry

2.4.1 Defining customer churn

Churn is defined by Hughes [1] and Catanedo [11] as the loss of customers to competitors. The Federal Communications Commission (FCC) of the USA [25] points out that mobile customer churn in the mobile wireless sector is a measure of the number of connections that get terminated by the customer during a given time period. The FCC [25] states that churn rate is calculated by ‘dividing the aggregate number of wireless subscriber connections whose service was cancelled during a period by the total number of wireless subscriber connections at the beginning of that period.’ Empirically, churn rate would be expressed as in Equation 1 [2].

$$\text{Churn rate} = \left[\frac{C_0 + A_1 - C_1}{C_0} \right] * 100\% \quad (1)$$

Where:

- C_0 , is the number of customers at the start of a period
- C_1 , is the number of customers at the end of a period
- A_1 is the gross new customers during the period.

In a situation where there are no new customers that subscribe to services in a particular period, $A_1 = 0$, and Equation 2 can be represented as in Equation 2.

$$\text{Churn rate} = \left[\frac{C_0 - C_1}{C_0} \right] * 100\% \quad (2)$$

Where:

- C_0 , is the number of customers at the start of a period
- C_1 , is the number of customers at the end of a period

Setting $C_0 - C_1 = C_x$, which defines the number of customers lost in a particular period, Equation 3 gives a simplified manner of calculating customer churn.

$$\text{Churn rate} = \frac{C_x}{C_0} * 100\% \quad (3)$$

Where;

- C_0 , is the number of customers at the start of a period
- C_x , is the number of actual customers lost during a particular period

Equations 1, 2 and 3 give a definition of customer churn as defined by the federal communications commission [25]. The mathematical expressions in all three equations give a general definition of churn in the mobile telecommunications sector as interpreted in the industry.

Churn is experienced in both the developed and the developing mobile telecommunication markets. Examples of annual churn rates for few MNOs around the world are as presented in Table 2. In 2005, churn rates for the mobile operators on the USA telecommunication market ranged from 8 to 23 percent for the five MNOs presented in Table 2 [9, 26]. At its maximum, mobile customer churn can have damaging effects on the profitability of an MNO.

Table 2 indicates that even in markets that are nearly saturated, customer churn is still a problem. An example of T-Mobile in Britain with annual churn rate of 34.8 percent is quite alarming. Other reports show that T-Mobile USA lost half a million of its most lucrative customers in the first quarter of 2012 [10]. This shows that mobile customer churn can grow to high levels if not controlled in good time.

Table 2: Annual Churn Rates for different MNOs

MNO NAME	OPERATING COUNTRY	YEAR	ANNUAL CHURN RATE (%)
Alltel	USA	2005	16
Cingular	USA	2005	23
Globe	Philippines	2003	31
Hutchison Telecom	India	2005	20
Nextel	USA	2005	16
Sprint	USA	2005	23
T-Mobile	Britain	2005	34.8
U.S. Cellular	USA	2005	8
Virgin Mobile	Britain	2005	14
Vodaphone	Italy	2005	17.2

2.4.2 Factors that lead to customer churn

Circumstances that lead to churn may be voluntary or involuntary circumstances for individual customers. A customer may churn voluntarily when they make a switch to another MNO due to poor customer relationship with the service providers. A customer churns involuntarily due to circumstances beyond their control, such as relocating to a place where the service provider's products and services are not available, death and other factors.

A report by the FCC [25] reviewed that from the MNO's point of view, churn rates may depend on factors such as distribution of customers between postpaid and prepaid service plans, customer satisfaction with the service provider, service provider switching costs and competition.

Other studies have reviewed several other factors that lead to customer churn [12, 20, 27]. Alamana [4] had a different view of the factors that may lead customers to churn. In the case of pre-paid customers, Alamana observed that they may leave even for the 'simplest reasons', because they are not bound by any contracts and could choose any mobile service operator at any time [4].

(i) Network service quality

Arthur, Harris and Annan [28] described poor network service quality as any eventuality that leads to disruption of the primary service of the mobile telecommunication industry. This includes factors such as cell site breakdowns, unreliable network services and even poor network quality. Lack of network connection capabilities or poor quality of the network can to a great extent prompt customers to prefer services of the competition thereby causing them to churn [9]. Network quality of service is one of the key functions of the communication's segment regulators and government ministries [25, 29, 30, 31].

(ii) Billing errors and hidden charges

The issue of wrong billing is a major problem that customers face. Errors in billing makes customers doubtful of the charging methods of a service provider. Arthur, Harris and Annan [28] described billing errors as one of the factors that create a knowledge gap between what the MNO is doing and what the subscriber expects. Mobile customers want to ensure that their resources are well spent. When the expectations of the customer are not met, customers tend to question the consistency and integrity of the mobile network operator.

(iii) Poor customer service

Poor customer service is one of the most common factors that lead to customer churn. It includes factors such as long waiting time on customer care queues, poor reception and complaint handling in service centres, impolite or unknowledgeable employees in service centres and many others [1, 14]. The mobile MNO needs to show that they value the time of their customers and the relationship they share [17].

(iv) Fraud

Abaidoo [9], one in many of the literature reviewed mentions fraud as a cause of churn. Fraud is rampant in many business sectors, following the technological developments. In the mobile telecommunication industry, a customer may become fraudulent in the quest to avoid paying for large usage volumes. Such ones may be affiliated with certain mobile telecommunication service providers depending on convenience, easiness and even gain emanating from their fraudulent actions.

(v) Social influence

Regardless of the industry, almost all marketing people would agree that almost every churner is a potential demoter of a brand [5, 6, 32]. Equally, existing customers may have social interactions with churners or potential churners who may be dissatisfied with the service of a particular service provider. Khan, Sepehri and Jamwal mention that potential churners would not promote the services of the provider with which they are dissatisfied [8]. The mobile operators can leverage on promoters marketing their products and services on their behalf, depending on the customer experience impressions they offer. Kim and Yoon [12] elaborate the necessity of this by mentioning that mobile subscribers hardly differentiate quality of experience among the mobile operators, hence word of mouth can have a huge influence on the subscription decisions of the customers [12]. Increasing promoters in new acquisitions, maximizing the value of a customer as well as retaining the existing subscribers. Such social influence has the potential to cause significant customer numbers to prefer services of the competition rather than those of the provider with a negative brand perception [1, 8, 12]. Social influence has much to do with personal experiences of customers from their interactions with the MNOs.

(vi) Inadequate complaint resolution

Arthur, Harris and Annan [28] argued that customers get dissatisfied when their complaints are barely resolved. This may sound as if it speaks directly to the call centre operations, but as Mattison [5] emphasizes, it involves all functional departments of the mobile telecommunication industry. Whether this has to do with network complaints, billing errors or any other complaints, Abaidoo [9] mentions that a customer appreciates the care and expertise that their complaint receives, especially resolving the issue.

(vii) Brand perception

This may be caused by social influence or the emergence of another service provider with strong brand recognition and reputation onto the market [9]. Brand perception speaks more of the reputation that a service provider 'builds' and 'earns'. Kim and Yoon [12] link brand perception to factors such as network quality and handsets while Abaidoo also links it to advertising, branding and marketing [9].

Brand perception is the impression customers have about all operations of a business. It may take some time to earn a strong reputation in the industry, especially keeping in mind that the competition is eyeing whatever the MNO is doing well and trying to copy it [3, 27]. The MNOs may earn strong brand perceptions of their customers by service leverage peculiar to them as individual operators [5, 33]. Kim and Yoon emphasize that if brand perception is well maintained, it has a great capability to reduce churn, especially after an operator remains the dominant service provider [12]. Hence, MNOs need to ensure that perception about their brand is continually improved.

(viii) Lack of features and innovation

Customers may churn at times due to lack of innovation by their MNO. Arthur, Harris and Annan [28] mentioned that factors such as lack of ‘trendy phones’ or not meeting customer needs for value added services can lead to significant numbers of customers churning. Abaidoo [9] states that customers prefer a service provider that is a ‘one stop shop’. Service providers with packages that meet most of their customer needs would have higher retention than those that do not. Kim and Yoon [12], on their study of factors that lead to customer churn in Korea deduced that the offer of advanced phones along with other incentives by a competing MNOs can lead masses to churn [12]. This may not always be an issue of innovation but also an offer of freebies.

(ix) Lack of latest technology

In the quest to determine what really causes customers to churn, some scholars attributed it to a mobile network operator lagging behind its competitors in rolling out current technologies on the market [5, 15]. Chen and Chin [15] discussed the possibility of customer retention being the case of technology [5]. But Mattison and Oghojafor both dismissed it respectfully when they argued that while technology can provide a competitive advantage for MNOs, this advantage is only provisional as it disappears once the technology becomes readily available to everyone [5, 14, 15]. In their study on a churn management model that was focused on maximizing profits, Lemmens and Gupta highlighted some factors they considered in their churn prediction model [6]. Their findings were that most of the churn cases are triggered by factors related to the quality of the network. Other literature may have mentioned the many other factors that cause customer churn [9, 27, 30, 1, 28].

2.4.3 Effects of customer churn

(i) Loss of brand image

Brand image defines the perception of customers about services of a particular service provider [2]. When dissatisfied customers tell others about their experiences with an MNO, this may lead to influence on the loyalty of certain customers [9, 14, 27]. The MNOs must ensure that they protect their brand value because it has the effect of demoting their services through social interactions.

(ii) Loss of revenues

Loss of revenues for the MNOs is one of the most detrimental effects of customer churn. In terms of revenue, the financial value of a new customer can barely compensate the loss of revenue that emanates from the churn of a long-term customer [1, 11, 33, 2]. The telecommunications sector is one of the main revenue generators not only for itself as an industry, but also for governments through taxes and investments [25, 29]. A loss in revenue for mobile operators therefore will lead to a fall in the revenue contribution and trickle down to the GDP of a country [4, 6, 9].

(iii) Increased activation, deactivation and provisioning costs

Companies incur costs related to the direct processes associated with activation and deactivation of customers, as well as provisioning [18, 33].

(iv) Increased operational costs to win back customers

The cost of acquiring a new customer in terms of advertising, marketing and technical support and other basic requirements is about USD 350 to USD 475 [9]. On the other hand, the cost of retaining a current customer is usually as low as the cost of a single customer retention call or a single mail solicitation [9].

(v) Loss of market share

The immediate result of churn is that the customer base of an MNO becomes less, leading to the loss of their share on the market. Mankum [33] directly links the strength of the market share to brand recognition. He analyzed that the better the market share of a mobile operator, the stronger its brand perception on the market [33].

2.5 Related Works

2.5.1 Introduction

A number of studies have been done on churn management in the telecommunications industry [1, 3, 8, 6, 14, 15, 17, 18, 20, 27]. Some of the studies focussed on analyzing the various factors that lead to customer churn. Others have designed various models aimed at managing churn using prediction models or algorithms that keep the balance between churn rates and revenues.

In his study on the discriminant factors that cause customer churn, Oghojafor [14] concluded with a list of factors that discriminate among subscribers exhibiting willingness to churn. In order of importance, high call rates more often than not tend to induce subscribers to churn followed by poor service facilities, advertising medium, and availability of alternative superior MNOs and ownership of multiple sim connections respectively. Kuusik and Varblane [27] also named satisfaction, trustworthiness, image and importance of relationship as being key factors that lead to customer churn. Although his focus was on prepaid customers, Mankum [33] also named certain factors that lead to customer churn as being customer service quality, mobile tariffs, promotions, prepaid airtime and starter pack availability listed in diminishing order of their contribution respectively.

Ahn, Han and Lee [34] took a different approach of ascertaining factors that lead to customer churn using transaction and billing data rather than surveys on the Korean mobile telecommunication market. Ahn, Han and Lee argued that ‘surveys normally have a limited sample due to cost and time constraints’ [34]. Transaction and billing data however would take a sample as large as the customer base of a service provider. Ahn, Han and Lee felt that this approach improves the reliability and validity of the research results to a great extent [34]. Among the factors with highest propensity of causing customer churn were call service related factors namely dropped calls and low data throughputs [34]. The functional capability of the handset that a customer uses was also flagged as a key determinant in this research. Determinants of customer churn all lead to one thing; ‘customer dissatisfaction,’ which in turn has the possibility of prompting the customer to terminate services. Ahn, Han and Lee concluded that these factors play vital roles in churn prediction.

2.5.2 Churn management by customer engagement

Studies conducted by many scientists and business personnel mostly use the approach of segmenting customers. This is evident in the many churn management models used today [1, 6, 15, 16, 17, 20]. The basis for this segmentation is customer behaviour and usage. The latter case is in most cases targeted at isolating would be churners, then corporations apply corrective measures to prevent churn. At times, reviews are made to assess whether these measures are working as purposed or not.

Mattison [5] however, has a distinctive view of churn. Although Mattison acknowledged that churn is undesirable [5], he called it a ‘golden opportunity’ [5]. Mattison went on to say that ‘the real problem is always that your organization is unable to make an appropriate assessment of the churn situation’ [5]. This means that it is not churn that needs to be managed, but the relationship that MNOs have with customers. Mattison condemned the approach of segmenting customers according to the factors causing churn. He said, when customers churn, it is unlikely that they mention the real reason for their leaving when they are asked upfront by MNOs. People may be embarrassed by their real reasons, or may not want to hurt the feelings of the company employee or interviewer [5]. Kuusik and Varblane also speak against segmentation when they state that it is ‘not accurate to treat all customers equally in terms of methods of increasing their loyalty,’ [27].

Hence, Mattison [5] proposed customer engagement as a means to manage churn. In his model, the MNO needs to know the customer, maintain a healthy relationship and keep alert to warning of would be churners. This acts as a preventive measure to churn so that if possible, ensures that the customer does not terminate subscription. The approach of engaging customers adopts the term Customer Relationship Management (CRM) [5]. CRM focusses on the organizational or business model itself as having an effect on the churn rates. Organizations use different segments of CRM to cure customer churn, with varying results [5]. The perspective Mattison portrayed of churn resonates with that of AUFAR [2], which points out that although churn leads to revenue losses, it also provides opportunities for organizations to learn. This allows MNOs to have a much wider perspective and develop more resilient strategies to win the loyalty of their customers and develop.

2.5.3 Churn management using the binomial logit model

Kim and Yoon [12] explored customer churn prediction using the binomial logit model, which took into consideration demographic, economical and mobile phone usage variables of 973 mobile subscribers in Korea. The age and sex of a consumer defined the demographic variables while economic variables included income and average revenue spent on subscription to mobile services. Mobile phone usage variables included factors such as historical records of switching behaviour of customer, longevity of their subscription with a mobile operator and duration of current handset used.

Kim and Yoon point out that customer switching behaviour can be caused by offer of mobile handsets by competition at cheaper prices or simply competition with more advanced handsets [12]. This also explains the significance of assessing how long the customer has been using the particular handset. Kim and Yoon [12] describe the model they used for churn prediction as an ‘econometric tool’ based on ‘discrete choice theory,’ [12]. This study is an application of mathematics and statistics to the study of economic and financial data directly linked to churning.

The results of this study showed that poor call or network quality and high tariffs would lead to the highest churners in Korea. The third factor was the type of handsets an operator provides. The nature of the handset can to a great extent determine the differentiated services that a mobile subscriber would have. They explain that it makes sense to consider feature of the customer’s handset because of the different capabilities that they have. Some of the customer complaints for example, had to do with limitations in the capabilities of the phone, or just settings. Canale and Nicola [23] of the Collegio Carlo Alberto research institute in Italy also employed a similar but iterative statistical classification method on customer churn prediction, which they termed as ‘bag classification’.

The test was done on customers of the European Telecommunications Company. Customer behaviour was analyzed for a period of ten months. The result in customer prediction had less error as compared to such methods as linear regression, logistic regression, linear discriminant analysis, logistic additive model, a classification tree and a neural network,’ [23].

2.5.4 Churn management using gradient descent analysis

Lemmens and Gupta [6] used the gradient descent analysis using matrix simulation. This approach takes into account the average value of the customer, which speaks to the value of money they spend on buying the services. The value of the customer combined, with a predicted figure of the probability response of the customer to any launched retention programs gives insight on the expected revenues. Lemmens and Gupta apply their methodology by detailed analysis of the customer's future churn behaviour in the absence of a retention action, the value of the customer to the firm, the cost of the retention action and the probability that the customer, if targeted, will respond positively to the retention [6].

The financial benefit of the MNO improves or worsens depending on whether the likeliness of a customer to churn is overestimated or underestimated. Lemmens and Gupta [6] state that 'the higher the value of a customer with a high churn probability but a high response probability to a retention action, the larger the benefits of targeting her or the loss of not targeting her,' [6]. Lemmens and Gupta [6] then use an algorithm called a profit based loss function, whose local minima gives an indication of whether more can be done to improve the retention pattern of such a customer or not. The algorithm is optimized using the stochastic gradient boosting method, a machine learning concept, in an iterative manner.

This method reportedly leads to substantial improvements for MNOs with no additional implementation cost. The testing of the model was on Verizon Wireless, the largest wireless services provider in the United States with 111.3 million subscribers at the time of the study [6]. The gradient descent profit based loss function model gave a predictive performance that would yield a difference of more than USD 28 million. Compared to the traditional classical loss function whose gradient descent is not taken into consideration, this approach yielded better profits (USD 3,700) more than the classical loss function (USD 1,718) across all scenarios. This represented an improvement in profit of equal to 115 percent on average [6]. The limitation of this model, however, is that the profit-based loss function 'leads to more errors in terms of forecasting, which customers are likely to churn,' [6]. This point acknowledges the challenges that arise with knowing what factors may have the biggest weight as a churn contributor.

2.5.5 Churn management in the face of uncertainty

The uncertainty in knowing exactly which customers are most likely to churn as stressed by Almana, Mattison, Oghojafor, Lemmens and Gupta [5, 6, 14, 4] takes us back to the discussions around uncertainties in the behavioural patterns or decisions of the customer. Using interviews, Peighambari [18] proposed a model that focussed on evaluating the loyalty of the customer, switching barriers and keeping environmental dynamism in mind for the case of Iran. Peighambari [18] summarized dynamism under the following statements:

- (i) Customer preferences continually evolve.
- (ii) Customer demand for products varies continuously.
- (iii) Major competitors in the market continually introduce new products.
- (iv) Major competitors in the market continually devise new selling strategies.

Peighambari [18] argued that of all four factors considered in the study, environmental dynamism was the only one that had a negative effect on retention. This was because the more the dynamism in the environment, the harder it was to make customers stay with the company [18]. Peighambari stated that industries are bound to go through environmental dynamism, because MNOs do not control circumstances that may happen in the communities where their customers stay. Hence, it becomes important for MNOs to have proper churn management models, especially so that they can manage competition [18].

Kreher [35], in his study concerning performance states that, 'it is very difficult to calculate a real churn rate,' [35]. With that statement, he elaborates to say that because most of the customers in the mobile telecommunications industry are prepaid customers. There is a possibility that some customers may be temporarily staying abroad [35] and opt to use MNOs wherever they may be. This is because prepaid tariffs are often significantly cheaper than roaming tariffs [35]. The fact that these customers may temporarily be out for a while does not ultimately qualify them as churners. Once they go back home, they will use the services of the local MNOs. Therefore, not every expired contract is a churn. In his conclusion, Kreher [35] mentions, the total number of churners is expected to be much less, [35]. However, this cannot be determined easily, as there is additional information required.

2.5.6 Churn management using data mining

Data mining is a data processing methodology, which uses sophisticated data search capabilities and algorithms to in order to discover patterns, associations and relationships in data. Data mining finds application in establishing patterns in large sets of data where manual methods may be impossible and time consuming. These capabilities make data mining an attractive methodology for businesses that are customer centric. Relationship between internal factors of any system can be used for improving quality of services, solving customer problems, strategic planning as well business continuity measures.

There are mainly two types of data mining techniques used in practice namely supervised learning and unsupervised learning [4]. Supervised learning requires that the data set should contain target variables that represent the classes of data items or the behaviors that are going to be predicted.

The most important decision in customer churn management is the separation of churners from non-churners. Supervised learning is capable of handling this task. Unsupervised learning techniques on the other hand do not require the data set to contain the target variable. Clustering is a type of unsupervised learning technique that can be used to explore data sets in order to discover the natural structure and unknown but valuable behavioral patterns of customers' hidden in it [9].

The outcome of applying data mining supports predictions of those customers most likely to churn and, possibly, when and why. These models help identify intervention strategies that can reduce churn among particular customer segments [9].

In short the predictive capabilities of the data mining methodology paves way for informed marketing strategies, real-time customer-retention strategies from promotions and mailings to direct customer contact, and new service plans. Therefore, mobile network operators can optimize their marketing intervention resources to prevent as many customers as possible from churning. In other words, if the telecom companies know which customers are at high risk of churn and when they will churn, they are able to design customized customer communication and treatment programs in a timely efficient manner.

2.5.7 Churn management using deep learning

Catanedo, et al [11] used a churn prediction model using deep learning techniques based on studying three churn management models; (1) application of auto encoders, (2) deep belief networks and (3) multi-layer feed forward networks with different configurations. The models studied likely behavioural patterns of churners as well as those of existing customers for classifications as new, active, inactive or churning. The nature of activities on the phones of the users over a pre-determined period determined which state the customers assumed. Some of the factors considered are duration of calls, classification of call as incoming or outgoing, expenditure of customer on usage of network resources and their status on the classifier.

The results obtained from this model were a success in that would be churners were able to be predicted. Recommendations were then made on what strategies can be employed to prevent the customers who were likely to churn.

2.5.8 Churn management using stream mining

Stream mining is a supervised learning technique of machine learning. In churn prediction and management, stream mining has the capability of detecting new patterns of churn in real-time streams of high-speed data as well as adaptation to quick changes in real circumstances [36]. This capability of stream mining makes it a powerful methodology in running churn predictions.

In the stream mining model, a prediction takes place when a record not indicating churn arrives. The record with its prediction is stored in the queue for pending predictions, waiting for future confirmation. The first step included searching for records of customers, which indicated churn in the pending predictions queue. The model trainer then processed all positive and negative instances of churn. Negative instances of churn referred to expired records in the pending predictions queue corresponding to subscribers that did not churn within a specified time. All records describing current states of subscribers were passed as a clustering sub module to build subscriber profiles [36]. The record processor then produced profiles of customers as reports indicating their propensity to churn. Churn analysts could then use these reports to determine appropriate actions that would ensure that customers at the verge of churning were retained instead.

2.5.9 Churn Prediction using Decision-Centric Ensemble

Decision centric ensemble is an unsupervised learning method of machine learning that encompasses a predictive process and the ensemble process. Decision centric models are perceived as an intelligent methodology that superior to the mechanical and repetitive methodologies that mostly rely on human decision makers. In contrast to manual processes, the decision centric ensemble has high efficiency because it can process many transactions within a short time.

The decision centric methodology allows for organizations to adapt to changes in many aspects of their business. This is because it is regarded as a highly intelligent, transparent, adaptive and dynamic system, which offers businesses to focus more on the needs of the consumers [37, 7].

Baumann, et al [7] used the decision-centric ensemble method in churn management, in a manner that incorporated campaign plans and business objectives. This approach predicts customers with high propensity to churn by applying the ensemble technique and then proposes retention offers to prevent churn. The objective was to create a model that can be used in marketing decision making and business performance improvement.

The ensemble selection consists of constructing a model library, selecting an appropriate candidate or subset of models for the ensemble and lastly combining the predictions of the chosen models to produce the final prediction. A number of prediction models, which use very independent techniques and parameters, represent the model library. The candidate selection involves selection of the best performing model from those in the library. The final stage involves calculating a weighted average of the churn propensity scores for various customers.

After testing the decision-centric on eight data sets, the decision-centric ensemble method was found to have better results as compared to supervised learning methods which used classifiers or segmentation models in churn prediction. It was found that use of the models designed improved the profitability per customer by 0.47 USD on average. Baumann, et al [7] emphasizes that accurate churn prediction is essential to proper and effective management in corporations.

2.6 Responses of Customers to Churn Management Actions

Ascarza, Iyengar and Schleicher [38] sampled about 64,147 customers of an MNO. Customers received text messages, which recommended that they change to a tariff that would cost them less. While the plan recommendation did not affect customer usage, it significantly increased the propensity of customers to leave the MNO. Comparing the churn rates indicated that only 6 percent of customers in the control condition churned during the three months following the intervention, while 10 percent did so in the treatment group as shown in Figure 4 [38]. This difference in churn propensities translated to around a 30 percent decrease in customer lifetime value from USD 496 to USD 350 expected profit per customer [38].

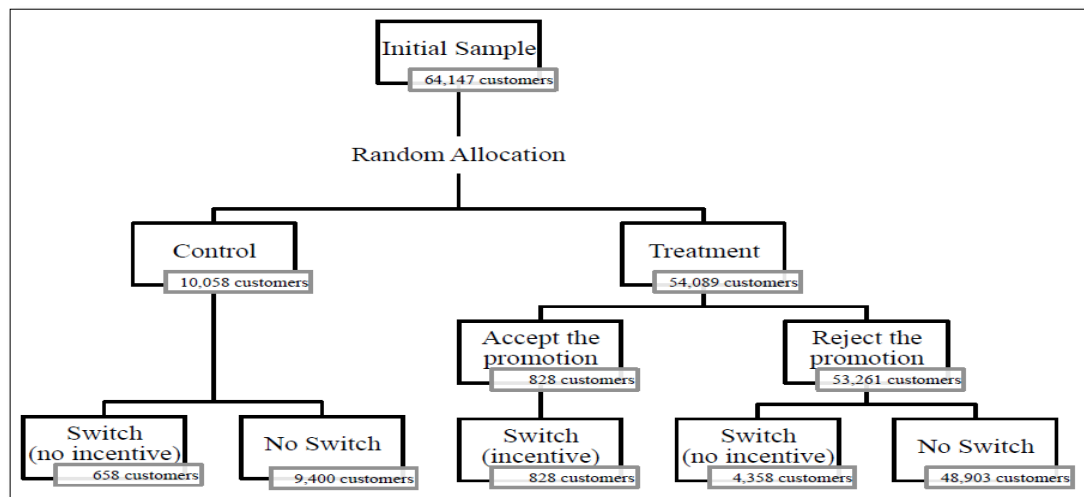


Figure 4: Results of the recommendation programme

Results of Figure 4 show that at times, even if mobile network operators offer certain gifts to counter those of the competition, it may not always work out to their advantage. If such an offer has to be made, it may need to be long term so that the customers build confidence in the product or service. As can be seen, 828 out of 54,089 customers in the treatment group still had high propensity of churning, even after giving them an offer. As emphasized by Mattison [5], some customers actually want to stick to one mobile network operator, if only their needs can be met, and they have a good relationship. This important factor could have fostered the development of customer relationship management measures such as loyalty programs [10]. These programmes are normally long-term, and they cement the confidence that subscribers have in their mobile network operators.

2.7 Challenges with Existing Churn Prediction Models

Sarkindaji, Abdullateef and Hashim [3] conducted a study on inconsistencies in CRM implementations and establish their influence of CRM measurements on customer loyalty effectiveness. They emphasized that these implementations need to be reviewed from time to time to check factors surrounding the decision of the customer at different times [3].

The process of CRM is not a once off exercise, otherwise it would not be possible to deduce whether the customer is satisfied or not. Sarkindaji, Abdullateef and Hashim [3] cited that this situation has led to the inability of the MNOs around the globe to manage relationships and retain long-term loyal customers [8]. Sarkindaji, Abdullateef and Hashim [3] concluded that this lack of feedback leads to high rates of customer churn and subsequently low revenue for the MNOs [3].

As confirmation, the study conducted by Ojasalo [17] attests to the fact that customer dissatisfaction eventually leads to churn [17]. In their proposed model, Sarkindaji, Abdullateef and Hashim [3] developed a CRM model based on practical observations made in the telecommunications industry, reports and reviews of the empirical literature on CRM. This model emphasizes the need for ‘CRM maintenance,’ an attribute promoting assessment of the results that implemented CRM techniques actually yield in terms of customer loyalty and churn.

The significance of the model is that a satisfied customer will be loyal and subscribe to services continuously as compared to a customer who is not [3]. The MNOs must ensure that they minimize the number of customers who are dissatisfied. This may not always be done as quickly as the subscriber expects. MNOs may take long to make decisions, mostly because they minimize the problem. By doing so, they are creating a perception about their brand. Sarkindaji, Abdullateef and Hashim [3] concluded their study with statistical results, which showed the calculated positive changes that this approach could make. The success of a CRM model is highly dependent on factors such as the manner in which it is organized, the knowledge it incorporates about the general market and customers at individual level, evaluation of customer loyalty and satisfaction by analyzing usage and most importantly, constant CRM maintenance [3].

On the Zambian mobile telecommunication sector, MNOs use the churn management strategies, which involve prediction of would-be churners and segmentation models. The objective of segmenting the customers is that their problems can be sorted out distinctively. The method in itself is rather reactive in that MNOs wait until they detect a change in the usage behaviour of customers before they could move in and see if customers have any challenges. There are traditional tools that are used for customer life cycle management, and they lack a feedback system, which can allow the MNOs to detect where they can make improvements. The behavior of the model will give insight into what would happen if MNOs took action or not. The system has a feedback loop that can be used to study the behaviour of the model in cases where customer problems are not addressed by MNOs.

Studies by Mattison [5] and Peighambari [9] show that a good churn prediction system should not only pinpoint potential churners successfully, but also further provide a sufficiently long horizon forecast in its predictions. This highlight does not diminish the significance of a prediction model. Rather, it acknowledges the fact that a prediction tool needs to be used in conjunction with a tool that can be used for decision-making. Management cannot make insightful decisions barely by looking at present values of customers who are at the verge of defecting to competition. It would be valuable to understand the impact that a certain level of churn will have on various performance parameters of an MNO, especially revenue and brand value in the long-term.

The simulation model designed in this research focuses on forecasting churn rate over a period in an iterative process. This study therefore adds a lot of value by incorporating the aspects of feedback, dynamism and uncertainty in mobile customer churn management. The key feature of forecasting the measurable variable, churn rate over a long time becomes very critical. MNOs can have a clear roadmap and assess their performance both in the short term and in the long term.

If MNOs are able to forecast how their decisions affect churn rate over a period, they have a chance of correcting and amending a possible wrong decision before losing customers. This in itself is a proactive approach in that MNOs would resolve problems their customers are facing in good time.

2.8 Systems and System Dynamics

Sterman [13] defines system dynamics as a methodology for studying and managing complex feedback systems while Cai [22] describes system dynamics as an approach to understanding how systems can generate their own problems [22]. Jay Forrester initiated the field of system dynamics when he applied feedback theory to industrial systems around the year 1961 [39, 40].

System dynamics builds two-way communication between mental models and simulation models. Mental models are the basis for everyday decisions. Mental models contain tremendous stores of information about human behaviour [13, 39]. Computer simulation meshes with mental models by taking the mentally stored information and then displaying the dynamic consequences [39].

According to Sterman, system dynamics draws on cognitive and social psychology, economics, and other social sciences [13]. This is because the application of mental models is on the behaviour of human as well as physical and technical systems [13]. System dynamics therefore helps with simulations of facts that are already known, or may be assimilated over time through experience or literature. The difference is that instead of processing them one at a time and probably under differing circumstance, system dynamics meshes the interactions to form a complete system that is susceptible to external disturbances.

System dynamics finds a wide range of applications in analytics, business modelling, crisis management, decision-making, medicine, policy formulation, social behavioural patterns, strategic war planning and many more [13, 21, 22, 37, 40]. Fong, Matsumoto and Lun [41] used system dynamics for making decisions to control future carbon emissions and global warming in Malaysia [41]. Marjan van der Belt [21] used system dynamics in promoting mediated thinking among individuals in the environmental management sector. Marjan van der Belt [21] articulates that certain critical decisions need resources with integrated frameworks and orientations require management to put their thoughts together to arrive at a decision that benefits the entire organization. Sterman states, 'system dynamics has been applied to issues ranging from corporate strategy to the dynamics of diabetes, from the cold war arms race between the US and USSR to the combat between HIV and the human immune system,' [13].

Fabien [37] uses system dynamics in his study of constrained systems, kinematics and network systems analytical modelling. Chao and Zishan [42] applied a system dynamics view to road traffic engineering by designing a system dynamics model that employs system dynamics to study and predict the future evolution of the passenger transportation system in Shanghai city of China.

Sterman [13], explains that system dynamics thinking studies the changes in systems over time that emerge from the interrelatedness of the parts. The changes that the interrelated parts have on the system can ripple throughout a system in ways that may be least expected [13]. The key is that there is no equilibrium in predicting what change will take place, when and how. How factors inter relate or affect one another may take different times. Cai [22] states that the sure thing is that over time, a formidable structure, which create the system behaviour, forms [13, 22]. Marjan van der Belt [21] cites that this behaviour formation is by changes in the system. These changes may ripple through in unpredicted circumstances [21]. The fact that it is hard to determine the rippling through of the change makes this approach quite fitting to handle the dynamism and uncertainty surrounding the factors that lead to mobile customer churn [6, 18, 21, 14].

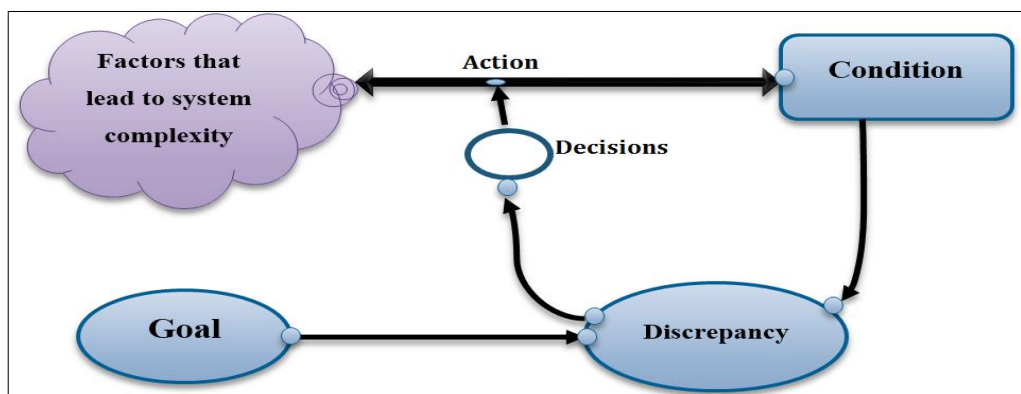


Figure 5: Components of a feedback system

Figure 5 [39] shows the operation of a basic feedback system. To neutralize factors that lead to system complexity, corrective measures are taken. If the desired outcome is not met, the variation is refocused with regard to the goal desired to be achieved. In a system made up of many factors that interrelate, the feedback loops must be as many as possible [13].

2.9 Applicability of System Dynamics in Churn Management

Balle [36] acknowledges that even though the telecommunications sector is one of the knowledge hubs in terms of technology and is a mature market, churn management and control remains one of its major challenges [1, 4].

Studies on customer churn, such as the ones done by Kuusik and Varblane [27], Mattison [5] and Peighambari [18] attest to the complexity of the network of factors that lead to customer churn. The system is not only complex but also constantly evolving depending on many factors that may not be so obvious [5]. This clearly points to the complexities that are faced in curbing churn, which calls for an approach of thinking about systems, how factors interact and keeping in mind that with a little more patience, these interactions can mature into structured patterns from which lessons can be drawn.

There is also a great need to assess the performance of strategies used to counteract churn. The study conducted by Sarkindaji, Abdullateef and bin Hashim [3] brings out the importance of constantly evaluating the performance of the implementations in churn management. Cai [22] describes these effects as presented in Figure 6 [22], which shows what would happen if long-term feedback were ignored. In customer churn management, this could mean not evaluating the performance of the customer retention models put in place.

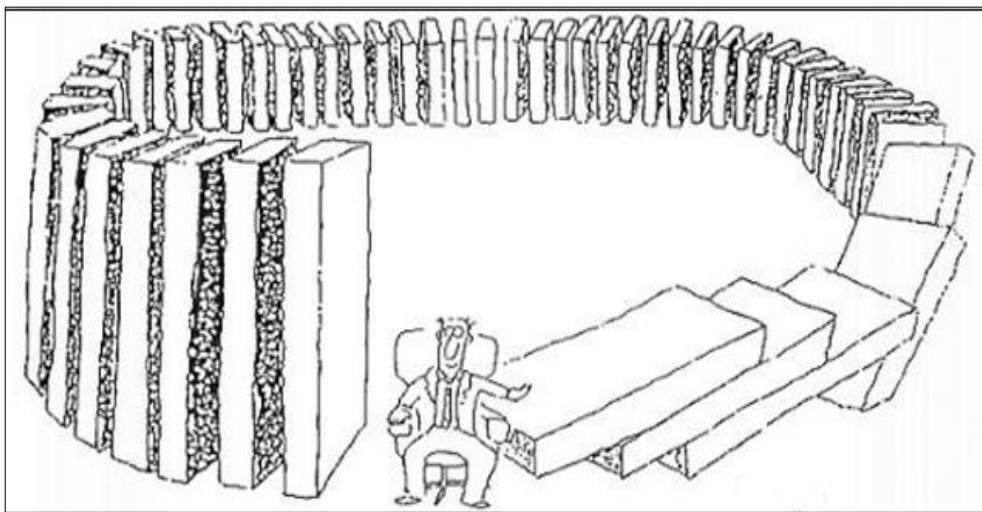


Figure 6: Ignoring long-term feedback

Cai [22] states that the effects of ignoring long run feedback can lead to unintended consequences. Because this is a system, there is need to constantly evaluate the performance of the model and optimize it if need be so that it functions as purposed [3, 21]. Figure 6 brings out the strong correlation of the factors that make up a system. What may work for one factor, might not work for another, or what may work for one factor, may have negative effects on the other factors in the system. A performance model therefore, needs regular evaluation until a desirable outcome is attained.

Ogata [43] defines a system as a combination of components acting together to perform a specific objective. Ogata further makes mention that a system is called dynamic if its present output depends on its current input [43]. This implies that a change in the input of a dynamic system results in a change of the output. If this does not happen, then the system does not qualify to be termed as dynamic but static instead. Another key quality of a system is that the components do not work in isolation but collaboratively to achieve the objective.

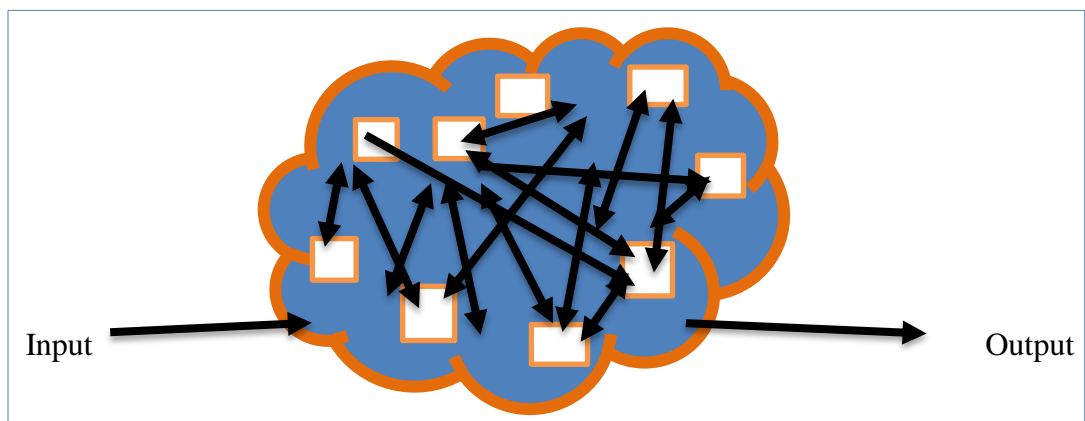


Figure 7: A representation of a system

The various components of the system to be designed have a common objective, to minimize customer churn to the best extent possible. This qualifies the churn management model to be called a system. More importantly, changes in the factors that lead to customer churn or the actions of the MNOs induce a change in the churn rate, which is represented by the goal in Figure 5. This is one of the factors that motivated for use of system dynamics to manage churn.

Another important aspect of why system dynamics is fitting to be used for churn management lies in what makes a system dynamic. Ogata's definition of a system would be illustrated as in Figure 7 [43]. The components of the system, shown as little boxes in Figure 7, interact with one another in different ways for the sole objective of producing an output from an input. This interaction among the components of the system results into 'system behaviour', which in turn produces the output. Ogata also acknowledges that a system interacts with the external environment, which is part of the input. The interactions of the system with the outside environment happens through a well-defined boundary.

A static system gives the same result for the same input, either by quantity, quality or rationality. This means that if the input is adjusted, the output also changes by the same rule as for a fixed input. This is not the case with a dynamic system where different outputs can be realised even while the input remains constant.

Remembering that the interactions of a system determines the output, it is logical to conclude that a static system has behaviour which is constant while a dynamic system has behaviour which is ever changing. Chao and Zishan [42], indicated that this feature allows system dynamics to be capable of predicting how systems are likely to evolve in future [42].

A dynamic system also has the ability to 'learn from memory.' Hence, Ogata defines a dynamic system as one whose output depends on the present input and that of the past and if it has memory [43]. This factor becomes very useful especially when it comes to choosing of the variables used to model a dynamic system such as the one in Figure 7.

Fabien describes the two main types of system dynamics methodology as 'mapping of dynamic relationships' for developing theories and 'simulation' for studying consequences [37]. The works of John Powell are attributed to as mappings of relationship. The main objective of mappings is to draw a conclusion without a simulation. Works done by Forrester [39] and Sterman [13] are some of the renowned simulation works in system dynamics, which are aimed at studying the consequences of the different amounts of intervention [37].

One of the objectives of this research is to study how dynamism and uncertainty of factors that lead to customer churn can be put to advantage in customer churn management. The model acts as a tool that management in the mobile telecommunications sector can use to make strategic decisions. This calls for a careful evaluation of the measures that are taken by mobile network operators to curb churn. The model will be used for gradual step by step actions that can be taken for varying circumstances. When some factors are varied, others will be kept constant so that the change in the churn rate which is the ultimate output is studied. This allows for logical conclusions to be drawn on the findings of the research.

There are two critical features of system dynamics, which further qualify its suitability to manage churn. Firstly, practitioners of system dynamics are interested in the interrelatedness within and among systems. Secondly, the time span of interest is such that patterns have a chance to become clear. Cai [22], stresses the point that ‘structure creates behaviour’ a feature which also relates to feedback structures [13, 22, 40]. It is this principle stated by Cai [22] that forms the backbone of this study. If structure can create behaviours, then there is a chance to learn from the interactions that lead to customer churn over time. The interactions between challenges of the customers and actions of the MNOs creates a pattern over time. This pattern allows for formulation of a learning model that can be used for decision making in churn management.

2.10 Summary

In summary, system dynamics methodology is appropriate for this study as it gives structure to how factors that lead to customer churn interrelate. It also ascertains churn rate by factoring in external factors and the actions that MNOs take. Despite the fact that these factors may or may not be anticipated, a change on any of these factors is anticipated to induce a change on the churn rate. The performance of the system will also be evaluated by constant feedback, allowing for continued improvement and maintenance of the model. System dynamics makes logical conclusions based on a deep understanding of the ‘underlying structure,’ which in this case are the relationships among the various factors that lead to customer churn [40]. This methodology will be a great help in this area in that the strategies MNOs use to prevent churn will be factored in to measure their impact for varying circumstances.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This Chapter discusses the methodologies used to answer the research questions set in section 1.8 of this report. The tools and methods that were used in this study have been described in details in this chapter.

3.2 Research Approach and Methodology

There are different perceptions that exist in the search for knowledge. These perceptions, or how one sees things, have a bearing on the findings of the research. Generally, there are two different approaches that define how one views things and interprets the world around them. Jonker and Pennink [44] name two of these as positivism and post-positivism. A number of factors differentiate these paradigms. According to Comte [45], positivist researchers believe that they can reach a full understanding based on experiment and observation. In positivism, concepts and knowledge are held to be the product of straightforward experience and they can be interpreted through rational deduction. Here, data is analyzed in a statistical manner, and the results are presented in graphs or quantities [45].

Post-positivism on the other hand may place a relationship between the seen and not seen. The fact that post-positivism takes what is not visible to the eye into consideration does not imply that it has no basis. Ryan [46] makes this clear when he states that while post-positivism does not mean judging from nowhere, it requires a fair degree of passion for justice and the ability to subject one's own assumptions to scrutiny. This implies that the researcher's input and assumptions are required to make out the logical relations, but these additions need to be well qualified and supported. Rajasekar [47] links positivism and post-positivism to the two paradigms as affiliated to quantitative and qualitative types of research respectively. Hence, the choice of which paradigm one takes is linked to the nature of a particular research [48].

Jonker and Pennink [44], Khotari [48], Kumar [49], MacDonald and Headlan [50], and Rajasekar [47] made out distinguishing factors between the qualitative and quantitative types of research. Some of these items are summarised in Table 3 for the purposes of comparing and contrasting between the natures of the two types of research. The mixed mode type of research combines attributes of the two methodologies stated in Table 3. The choice of which methodology to use therefore depends on details concerned with these attributes.

Table 3: Factors concerning quantitative and qualitative research

No.	ITEM	A. QUANTITATIVE RESEARCH	B. QUALITATIVE RESEARCH
1	Aim	A.1.1 To count and quantify data and observations. A.1.2 To sort, classify and measure data.	B.1.1 To understand underlying reasons of observations. B.1.2 To describe in details how people interpret their experiences.
2	Purpose	A.2.1 Generalization A.2.2 Prediction A.2.3 Description	B.2.1 Understanding B.2.2 Interpretation B.2.3 Exploration and Discovery
3	Data Collection	A.3.1 Structured	B.3.1 Unstructured
4	Researcher Role	A.4.1 Objective: It seeks precise role and analysis	B.4.1 Subjective: Researcher interpretation is important
5	Nature of data	A.5.1 Variables	B.5.1 Words, text, categories
6	Data Analysis	A.6.1 Statistical	B.6.1 Narrative with descriptions
7	Results Presentation	A.7.1 Results presented in graphs, charts and other methods that represent quantities.	B.7.1 Results not quantifiable, but presented with details.

When discussing the presentation of results in quantitative and qualitative research types, Rajasekar [47] discussed a valid point that could be good guidance when selecting the methodology to use in a study. Rajasekar states that while things in the study of substance and structure can be measured and weighed, patterns could not be measured. Hence, to study patterns we must map a configuration of relationships.

Rajasekar [47] describes structures as entities that quantities whereas patterns involve qualities. A quantity can be expressed in terms of value especially by numbers, frequency, or other factors. A quality on the other hand can be described and discussed in detail using knowledge that is obtained from observations, experiments and other methods. It would therefore be much more applicable to use the quantitative research methodology model when studying structures than it would when studying features or qualities.

Studies conducted by Chen and Ching [15], Jadhavi and Pawar [16], Lemmens and Gupta [6], Ojasalo [17] and Peighambari [18] all used a qualitative approach. Mankum [33] took a quantitative approach in model where he analyzed factors that influence the decision of prepaid customers when choosing a mobile network operator from which they can buy services. The models that were designed under these approaches have made major contributions in the management of customer churn in many industries.

This research focusses on devising a model for churn management using pattern or structural study of the factors that lead to customer churn. This research will be concerned with giving a detailed explanation and interpretation of the factors surrounding customer churn. A study of the interactions between the relationships of the discrete entities will be done. According to Jonker and Pennink [44], quantitative researches are not concerned with giving detailed explanations.

Further, the aim of this research is to understand the interactions of the system that integrate the factors that lead to customer churn and not classification. It involves surveys for both the customer and MNOs and ZICTA to get their views on the factors that lead to churn, mitigation factors and other general information.

To capture views of a larger sample of customers, interviews, group surveys, email surveys will be used. A combination of these factors will be used to create an artificial system of inputs that will be used in the simulation. The simulation and survey results will be presented in various forms that will encompass both graphical and statistical details. The mixed research method therefore is appropriate for this study. The different approaches will complement each other and are a necessity to see this research successful.

3.3 Research Design

Table 4: Methodologies used to achieve the objectives

OBJECTIVE	RESEARCH QUESTION	METHOD
1. To determine the factors that lead to customer churn on the Zambian mobile market, the strategies that MNOs use to prevent customer churn and the gaps that exist between needs of customers and actions of the MNOs in managing customer churn.	1.1 What factors lead to customer churn on the Zambian mobile market? 1.2 What gap exists between the needs of mobile customers and the actions MNOs take to prevent churn?	- Email Survey - Online Survey - Interviews
2. To determine the extent to which the dynamic nature and uncertainty of the factors that lead to customer churn affect churn management.	2.1 How does the uncertainty and dynamic nature of the factors that lead to customer churn affect churn management?	- Email Survey - Online Survey - Interviews -System Dynamics Simulation
3. To devise and design a system dynamics model using the interactions of the factors that lead to customer churn, that can help in decision making on churn management.	3.1 How can the dynamism and uncertainty of the factors that lead to customer churn be used to advantage in customer churn management?	- Email Survey - Online Survey - Interviews -System Dynamics Simulation

This research applies the principle of a model that interrelates the factors that lead to customer churn. It will measure the effects of the MNO's action on churn rate in different circumstances. The focus areas are the delays and effects that the factors that lead to customer churn impose on each other. The feedback then acts as a main basis on which to base observations and optimize performance.

The independent variables used are the factors that lead to customer churn while the dependent variable is churn rate. At each iteration, the impact on churn rate needs to be evaluated. Over several iterations, this approach is expected to give a roadmap of the structure on how such interactions affect customer churn. Varying inputs is expected to give insight on expectations on the final result, churn rate. On this basis, MNOs can make strategic decisions.

3.4 Methods and Tools Used

Dresch, Larceda and Antunes [51] describe modelling as a simplified representation of reality that allow researchers to better comprehend the environment being studied. The model to be designed in this research requires input data on factors that lead to customer churn and information from the MNOs and ZICTA. The essence is to have a model that uses real life data in order to give insight in the future evolution of churn rate when control measures are put in place and when they are not. The data in all three aspects will be sourced from the mobile subscribers, the MNOs and ZICTA. In some cases where stated, data is sourced from literature which will be referenced.

A questionnaire was used for all interviews, email and online surveys conducted in this research. The questionnaire deigned focused on customer churn and usage behavior of mobile services for the three network providers on the Zambian market namely Airtel, MTN and Zambia Telecommunications Limited (ZAMTEL). Aufar [2] noted some of the factors required to determine the likelihood of a customer to churn. These are demographic information (age, gender or location) [2]. This was some of the critical input data required for processing in the simulation model.

The mobile telecommunication customers that were interviewed rated the extent to which a certain factor would make them churn. In another case, the mobile subscribers mentioned the actual factors that made them churn. The customers also gave information related to their usage on particular networks. The MNOs were rated by subscribers on certain aspects as presented in the questionnaire used in this study. The other details of subscribers, which were collected, actions of MNOs and the views of the regulatory body, ZICTA are as presented in the questionnaires in Appendix 3 to 6 of this report.

3.4.1 Vensim modelling tool

There is a wide range of software packages that can be used to analyze system dynamics models. Some of these packages are Structural Thinking, Experiential Learning Laboratory with Animation (STELLA) [40], AnyLogic, Berkeley-Madonna [52], IThink, Modelica and many others. In this research, the simplicity and easiness of Vensim made it a better option to use in this research [42]. Vensim software could also be accessed free on the internet. After an assessment of the available software for systems dynamics simulations, Vensim was chosen because it was sufficient and for use in this study.

Vensim is a visual modelling tool that allows you to conceptualize, document, simulate, analyze and optimize models of dynamic systems. When you have built a model, Vensim lets you thoroughly explore the behavior of the model [53].

When you first open Vensim, the window shown in Figure 8 opens. The top and left side of the window has buttons that serve different function as named.

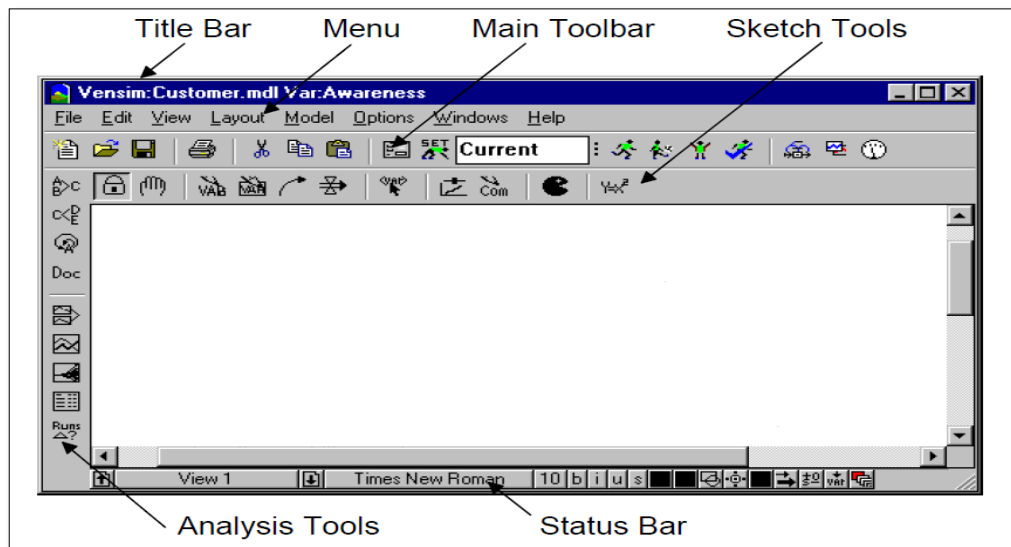


Figure 8: Vensim menu and tool bar

This section will discuss details on each of the functions of the tabs shown in Figure 6. The names may be descriptive of the functions of these tools. The wide space in the middle of the window in Figure 8 is used to sketching the model with the various components of Vensim. This section will introduce each of the function sets shown in Figure 8, and discuss their purposes.

(i) Title Bar

The Title Bar shows two important items. It shows the name of the model that is open and it shows the workbench variable.

From Figure 9, the model that is open has the name Unnamed Var, while the workbench variable is Final time. When the user wants to edit a particular model, it is key to ensure that they have accessed the right one by checking the name displayed in the title bar. The workbench variable displayed is the name of the variable on which the cursor would be placed.

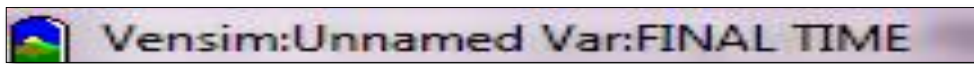


Figure 9: Title bar in Vensim

(ii) Menu

With an exception of analysis and sketching, most of the operations in Vensim can be done using the menu. Figure 10 shows the main contents of the toolbar.

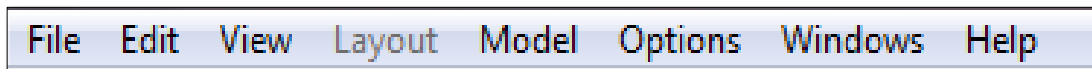


Figure 10: Contents of the menu in Vensim

- (a) The file menu has functions such as open model, save, close, print, publish, exit and others.
- (b) The edit menu allows for the user to perform functions such as copying and pasting.
- (c) The view menu has functions such as zoom, show behaviour, rescale, rename, reorder and changing font and colour.
- (d) The layout menu allows for one to change the position and size of elements in the model as desired.
- (e) The model menu provides access to the simulation control, changing settings, checking logic of units and time bounds and running the model.
- (f) The options menu has language and character settings, as well as other global options for Vensim.
- (g) The windows menu allows for a user to switch among different windows that could be open.

(iii) Toolbar

Functions accessible under the toolbar are as shown in Figure 11.

(a) File and edit features



Figure 11: File and edit features of the toolbar in Vensim

The toolbar provides buttons for some of the most commonly used menu items and simulation features. The first set of buttons are the file and edit functions which include the new model, open model, copy, paste, cut, print and save features.

(b) Simulation features

The next set of buttons after file and edit features on the toolbar are for simulation purposes. Sim setup, simulations results file name, simulate and synthesim buttons shown in Figure 12 are used for simulating Vensim models.



Figure 12: Simulation features of the toolbar in Vensim

(c) Windows classes

The last few buttons on the toolbar shown in Figure 12 are used for accessing windows classes such as shown in Figure 13. The build window is used for constructing new models, or for modifying, navigating, and simulating existing models. The analysis tools of Vensim create the output windows such as graphs, tables and lists. The control panel is a window used to control the internal settings of Vensim.

Hence, the windows classes in Vensim play a vital role in accessibility of objects, constructing models, navigation and navigation. The fact that these window can also be viewed consecutively makes Vensim even more efficient.



Figure 13: Windows classes on the toolbar in Vensim

(iv) Sketch Tools

Figure 14 shows the components of the sketch tools used for building models in Vensim simulation software.

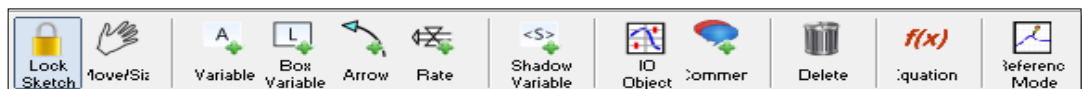


Figure 14: Sketch tools in Vensim

- (a) The lock feature is used for locking the sketch. Once this option is selected, objects of the open model cannot be moved.
- (b) The move and size feature is used for moving and altering the size of objects.
- (c) The variable feature is used for creating various types of Vensim variables such as box variables and auxiliary variables. Editing can be done by double clicking on the name of the variable that the user wants to modify.
- (d) The box variable is used for creating a special type of Vensim variables called levels or stocks. All levels in Vensim are enclosed in a box shape.
- (e) The arrow feature is used for creating arrows of different styles in Vensim.
- (f) The rate feature consists of perpendicular arrows, a valve and sometimes, sources and sinks which are depicted by clouds.
- (g) The shadow variable adds an existing model variable to the sketch view.
- (h) The input output object adds sliders, graphs and tables to the sketch for the inputs and outputs respectively.
- (i) The sketch comment is used for inserting comments and pictures to the sketch.
- (j) The Delete feature is used for deleting variables or comments in the sketch. This feature can also be used to delete the entire sketch.
- (k) The equations feature is used for creating and modifying equations. This feature has imbedded mathematical functions and operators that can be used to write or modify equations.

(v) Analysis tools

The analysis tools contained in the Analysis toolset are essential for investigating models and show information about variables, either its place or value in the model, or its behavior from simulation datasets.

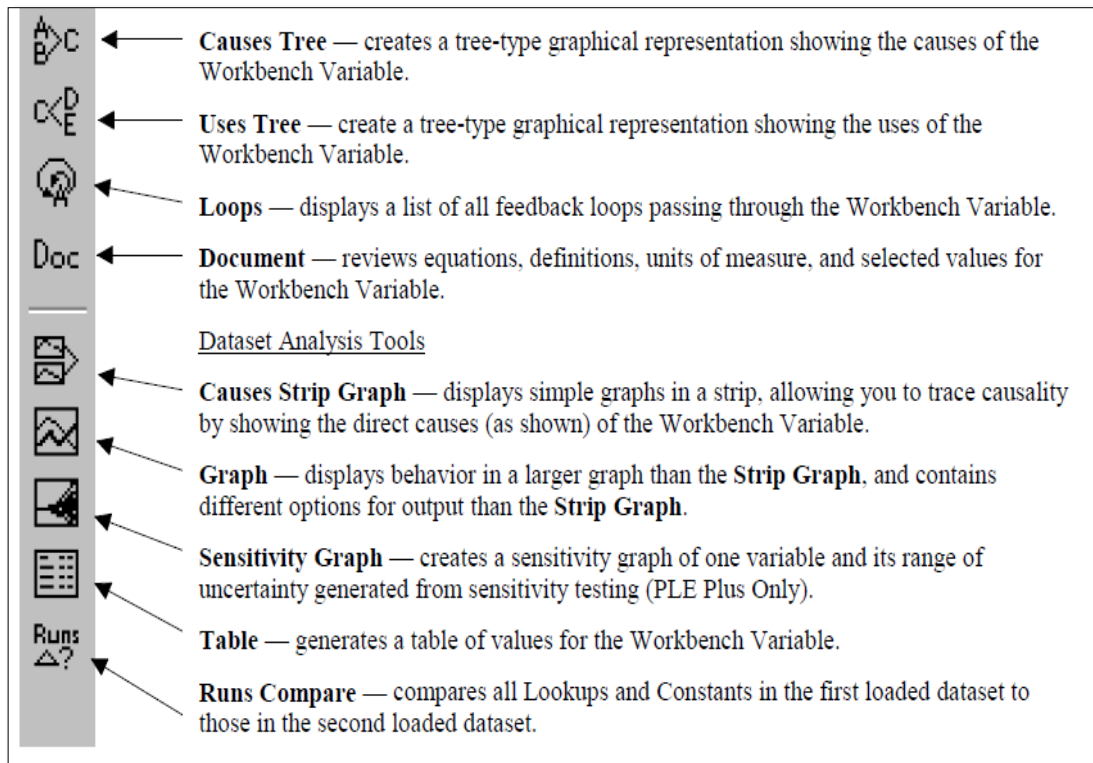


Figure 15: Analysis tools and their functions in Vensim

Some of the analysis tools are as shown in Figure 16 [53]. For each variable, its causes and uses can be easily analysed using the causes and uses tree tools respectively. There are also a number of graphs that can be used for analysis. In this study, the most used analysis tools are the causes trees, which have been used extensively to study the lineage of factors that have an effect on various variables in the simulation. The effects trees analysis tool has been used to study the consequences of certain conditions set in the simulation. Other tools used are graphs as well as several feedback loops.

(i) Status Bar

The status bar shows the state of the sketch and objects in the sketch. The Status Bar contains buttons for changing the state of selected objects. This state can also be checked at the level of variables. Figure 15 shows the components of the status bar.



Figure 16: Contents of the status bar in Vensim

The status bar contains some functions that can be used for modifying the font type, size, bold, italic, underline, strikethrough, variable color, box color; surround shape, text position, arrow color, arrow width, arrow polarity and many others. Therefore, the status bar becomes very useful in formatting of a model especially for presentation purposes. Users can modify appearance of objects using attributes of this bar in Vensim. The functions and features described in this section are all useful when building system dynamics models in Vensim. There are a lot more functions in form of equations imbedded in the system, which are not discussed in this report.

3.4.2 Data collection

Data for this research was collected using the following three methods of survey;

(h) Online Surveys

The ‘Survey Monkey’ online engine was used to facilitate collection of data. A questionnaire as in Appendix 4 was created and the link of the survey was shared via social media platforms such as Facebook, WhatsApp and WeChat. The experience is that online surveys are a smart solution and can work very well in regions where there is a high adoption rate of the internet. The challenge is that the audience is not guaranteed, as there tends to be too many virtual friends on social media platforms. Online surveys are efficient and save a lot of time, especially because all entries are entered into an excel template that can easily be manipulated.

(ii) Email Surveys

Direct emails were sent to some respondents. There was more flexibility for respondents contacted via email. Emails bearing the questionnaire in word, another in PDF and a third as a web link from Survey Monkey were sent to respondents. Some respondents preferred to download, answer and scan the questionnaire while others answered directly in a Microsoft word document and sent it back by email. For respondents who preferred to use the web link, they placed their responses directly online.

(iii) Interviews

Questionnaires to most of the subscribers, all three MNOs and ZICTA were administered using interviews with the designated authorities. In the case of questionnaires to customers, some mobile subscribers needed assistance in order to answer the questionnaires in proper context, while others requested that we do the questionnaires together for various reasons.

Although interviews demanded more resources compared to email surveys, they were highly efficient and shot up the questionnaire success rate. The cost of paper, transport, logistics and high investments in terms of time differentiates interviews from other types of surveys.

3.5 Sampling Techniques

Figure 17 [48] gives a high level summary of the sampling techniques that are used in today. The purpose of sampling is to identify the sample units from which observations can be done, in line with objectives of a study. The two basic types of sampling are probability and non-probability sampling [48].

Under probability sampling, each sample has an equal chance of being selected to take part in the study. This avails one of the greatest advantages of probability sampling in that it removes bias and is easy to implement. Jonker and Pennink elaborated that biased samples are not representative of a relevant population. [44]. A biased sample will therefore not be able to be adequate in making logical conclusions about certain attributes of the entire population [44].

Probability sampling could further be split into simple and complex random sampling methods. Simple random sampling entails drawing samples in a logical manner by some defined statistical rule. Complex probability sampling involves many forms of drawing samples, which only differ by virtue of logic. Systematic sampling implores the method of drawing each i^{th} sample to take part in the studies. Systematic sampling is mostly used for non-homogenous sample populations.

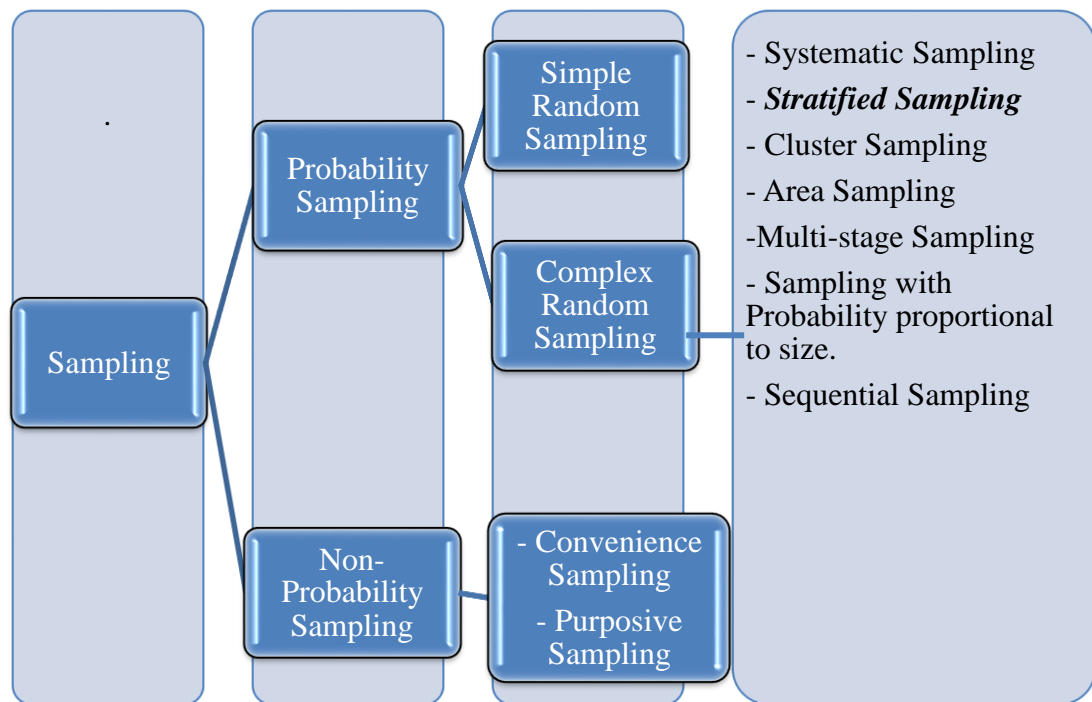


Figure 17: Sampling Techniques

Stratified sampling sub-divides the sample frame into groups called strata, and applies a probabilistic formula to determine how many samples need to be drawn from each stratum. Within each stratum, a simple random method of sampling can be used to draw those samples. Cluster sampling is used when the sample space is huge. In cluster sampling, the researcher selects a number of smaller areas where samples are well represented. For clusters that are chosen geographically, this type of sampling is better known as area sampling. Multi-stage sampling stems from cluster sampling, and is highly used for studies that are industry specific. Another type of probability sampling is done in such a manner that the sample space is proportional to the size of units or samples. Sequential sampling employs a method where the sample size is determined depending on the validity of the results as the research progresses.

Non-probability sampling does not accord an equal representative to each element of the sample taking part in the study. Unlike probability sampling where samples are drawn on statistical logic, Kothari [48] states that in non-probability sampling, the researcher may select a sample, which they anticipate to yield results that are favourable and support their view point. The fact that selection of samples depends on the researcher's convenience, discretion and judgement exposes this type of sampling to bias [48].

3.6 Sample Design

Zambia's total population of 13,092,666 constitutes 49.3 percent (6,454,647) males and 50.7 percent (6,638,019) females [54]. About 60.5 percent of the total population, translating into 7,923,289 people were based in the rural areas while 39.5 percent of the population or 5,169,377 people were based in the urban areas. Lusaka province, being the capital city of Zambia harbours about 16.7 percent of the national population, translating into 2,191,225 persons. Of the 2,191,225 persons in Lusaka, 1,082,998 are males while 1,108,227 are females [54].

In designing the sample, the following steps were taken.

- (i) Type of Universe: This research is concerned with studying the attributes of mobile service subscribers or customers in Zambia. This limits the units in the country to individuals subscribed to mobile services of any of the networks in the country. The target samples were individuals that use mobile services in Zambia. ZICTA reported a mobile penetration rate of 70.3 percent as of 2015. While age could have been a good category to form the strata needed for Zambia, it also raises many questions in that there is not much finding that can support that the mobile penetration rate in general is uniform across all age groups. Hence, for selecting the sample quotas, strata chosen were districts considered under the Zambian 2010 census of population and housing.
- (ii) Sampling unit: The sampling unit chosen in this research was irregular. It is a collection of six districts from three provinces of Zambia shown earlier in Figure 1. The criteria used in choosing the unit involves considerations that some of the towns chosen are among the most densely populated districts of the country [54], which would improve efficiency of conducting the research as well as lessen costs associated with travel and logistical challenges.
- (iii) Sampling frame: The sampling frame or list of the respondents to the survey was chosen using the stratified sampling model to justify the numbers for each of the six districts. The individual samples were individuals subscribed to mobile telecommunication services.

- (iv) Sample size: The size of the sample was chosen using the stratified statistical method of sampling. The populations for each district (as a stratum) were verified with data from the Central Statistical Office (CSO), and this was further used to determine the sample size using the formula in Equation 4 [47].

$$n_i = n \cdot P_i = n \cdot \left(\frac{N_i}{N} \right) \quad (4)$$

Where:

- n Is the sample size or total number of samples to be drawn from the sample space. In this research, n used was 700, which represented the total number of mobile subscribers interviewed.
- n_i is the number of samples to be drawn from the i^{th} stratum. In this research, n_i was represented by the number of samples to be drawn per district.
- N is the total population in a sampling frame. The national population of Zambia was determined as 13,092,666 as shown in Table 3.
- N_i is the population per i^{th} stratum, which in this case was calculated as 70 percent of the population per district as determined by ZICTA for the year 2015. The ZICTA office provided responses on a questionnaire provided to them.
- P_i is the ratio of the total number of samples in the i^{th} stratum (N_i) to the total number of samples in the sampling space N . In this study, it is the ratio of the number of samples per district compared to the number of people that are subscribed to mobile telecommunication services in that particular district.

Using Equation 4, the sample sizes for the six districts considered in this research were determined. Table 5 shows the results of this analysis.

$$n_i = 700 \cdot$$

$$\left(\frac{\left(\frac{70}{100} \right) \cdot 1715032}{\left(\frac{70}{100} \right) \cdot 1715032 + \left(\frac{70}{100} \right) \cdot 181816 + \left(\frac{70}{100} \right) \cdot 219000 + \left(\frac{70}{100} \right) \cdot 23059 + \left(\frac{70}{100} \right) \cdot 192636 + \left(\frac{70}{100} \right) \cdot 290556} \right)$$

$$n_i = n_{Lusaka} = 700 * \frac{1205667}{1843336} = 458$$

This method was used to determine the sample sizes for the other five districts listed in Table 5. As can be seen, the sample sizes are fair among the districts when the number of customers subscribed to mobile services is considered.

Table 5: Sample size selection

DISTRICT	POPULATION	SUBSCRIBERS (Ni)	SAMPLE SIZE
Lusaka	1,715,032	1,205,667	458
Chongwe	181,816	127,817	49
Kafue	219,000	153,957	58
Luangwa	23,059	16,210	6
Mbala	192,636	135,423	51
Chibombo	290,556	204,261	78
Sampling Frame	2,622,099	1,843,336 [N]	700 [n]
Universe [Zambia]	13,092,666	9,164,866	

- (v) Parameters of interest: The main parameters of interest in this research were churn rate, factors that lead to customer churn, actions MNOs take to manage churn, what customers want in order to be satisfied with mobile services and other basic attributes of mobile subscribers.
- (vi) Sampling procedure: The stratified method of probability sampling was chosen at district level within Lusaka province. This is because it was more convenient and efficient to choose strata based on groups whose demographic data was readily available in various governmental reports.

Figure 18 is a summary representing the universe, sampling frame and sampling units for this study. The entire population of Zambia is regarded as the universe in Figure 18. It is however not true that the adoption of mobile network services is hundred percent. Hence, the population not subscribed to mobile network services is excluded from this calculation. About seventy percent of the population, which forms up the population subscribed to mobile services, forms the sampling frame. From this frame, the sampling units are chosen among the three districts. The number of respondents for each of the districts was as determined in Table 5

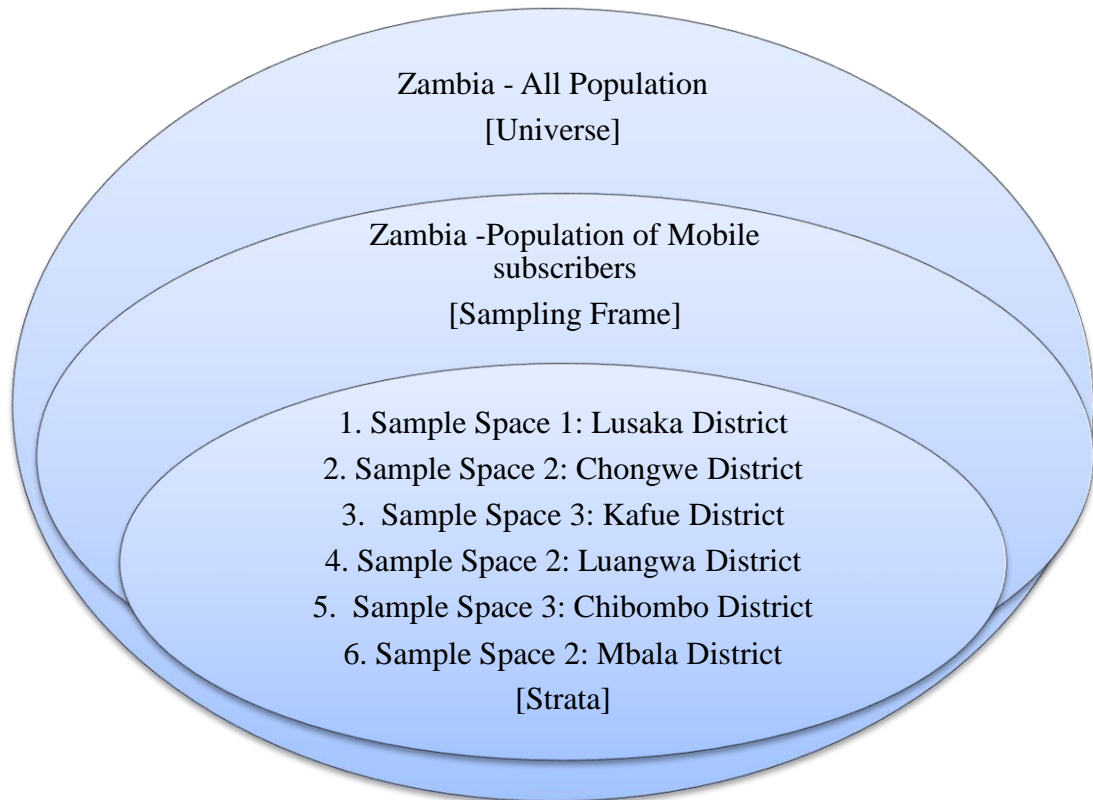


Figure 18: Sampling unit design

A total of 650 printed questionnaires were used to conduct interviews with the mobile subscribers. Other questionnaires used were accessed by subscribers electronically either through emails or by using an internet link powered by the Survey Monkey engine.

Most of the incomplete responses were those done via email. Survey Monkey allows for controls on the questions set, and criteria for a questionnaire to be reported as successfully completed. By email, a respondent had to redo the questionnaires for them to be rendered as complete. It was especially time consuming for respondents to print, provide responses and then scan the questionnaires.

3.7 Ethical Considerations

Permission was sought from all stakeholders such as headmen, chiefs, management for Airtel, MTN, ZAMTEL and ZICTA. For the MNOs, permission and interviews were done with the marketing departments under the distinct sections that handle customer churn and retention. This study also recognizes and acknowledges works cited as done by other researchers.

3.8 Implementation and Design of the Model

3.8.1 Introduction of variables

The two key variables in a system dynamics model are input and output variables. For the case of dynamic systems, a third variable representing the memory of a system is also involved, called the state variable. All types of variables used in the design of the system dynamics model will be discussed in this section.

(a) Input variables $u(t)$

There are two main categories of input variables used in dynamic system modelling.

(b) Control inputs $c(t)$

Control inputs should be as realistic as possible. Control variables, as the name suggests have a dictation on the output realized out of a system, and can normally be termed or controlled.

In the case of mobile customer churn, there are two main types of control inputs. The weighting of the extent to which certain factors lead to customer churn as well as the actions of MNOs.

The MNOs, being the entities that manage customer churn in their respective organizations apply certain tactics that they use to control customer churn. The mobile operators can control customer churn, and therefore, their control mechanisms form the set of the control variables for the churn management model. These two variables play the role of key determinants of the behaviour of the system dynamics model.

(c) Exogenous inputs or Disturbances $e(t)$

These inputs are exerted on the system by the environment. The parties of the system normally have no control over these variables. Therefore, it would be better to prepare for the worst-case scenarios. In the churn management model, exogenous variables encompass the counter efforts of competition and are exclusive to one mobile operator isolated from the other. These factors also include the different dynamics that customers actually face on a daily basis as they interact with the service.

$$\text{Input} = u(t) = c(t) + f(t) - e(t) \quad (5)$$

Equation 5 represents the inputs defined as control and exogenous variables where;

- $f(t) + c(t)$ = factors that lead to churn + MNO actions
- $e(t)$ = competitor efforts + economic fluctuations + others

Results of the survey done show a number of factors encompassing both variables $c(t)$ and $e(t)$. The questions posed in questions for customers, MNOs and ZICTA were targeted at getting actual experiences and information. For the universe, the number of control variables and external disturbances could be infinite for an infinite sample space of mobile subscribers.

Interestingly, MNOs may control some of the factors that lead to customer churn or they may not. An example, if a customer's phone is stolen together with the sim-card, and it is not replaced in 90 days, the MNOs would terminate services for that specific mobile phone number. Operators are normally not likely to follow up on a customer and ask them to make a timely replacement. Unfortunately, the MNOs will still categorize this as churn since they do not filter as to whether service was terminated voluntarily or otherwise. Ultimately, the success rate of the MNO to control churn would be put on the scale and data will be used in the model. In other cases, the factors that lead to customer churn in Zambia may also be controllable. All service providers on the Zambian mobile telecommunication market make outbound calls to customers, to find out what could be done in an effort to rekindle their observable past usage. An example could be less usage by a customer due to deteriorated network quality, which a service provider could then rectify if it is within their capacity.

The dual nature of the factors that lead to customer churn makes it logical to conclude that they are neither control nor exogenous variables but act as exclusive inputs or could fall in either part. The MNO actions will directly feed into the calculation for customer churn. Combining the controllable factors $c(t)$ and vast external disturbances $e(t)$ as Equation 6. Summarization of the wide range of control variables, external disturbances and factors that lead to customer churn transforms Equation 5 to Equation 6.

$$U(t) = \sum_{c=1}^{\infty} c(t) - \sum_{e=1}^{\infty} e(t) \quad (6)$$

3.8.2 Introduction of memory or state variables

Memory or state variables represent the past recollections of a system, which are simply stated in the memory [43]. Mathematical representations of various state variables could be any of the following:

- (i) The time shift operator to represent delay in a system. The time shift operator is the foundation for the fundamental body of knowledge known as discrete time dynamics and control systems theory.
- (ii) Integration with respect to time is a memory operator that can be used for analysis of continuous system dynamics and control.

In the churn management model, the state variables will use past results of cause, remedy and effect relations churn to predict the expected outcome for an input in the present. The churn rate to be calculated in this model would depend on the gravity of the problems that mobile customers face in a real market and subjected to the actions of the MNOs.

The number of actual churners will then be compared to the number of customers at the beginning of a period in order to ascertain churn rate. In order to vary the number of actual churners, the impact of some actions of MNOs may be eliminated or varied. The time shift operators and functions would then be appropriate for use as a memory variable.

$$x(t) = u(t - T) \tag{7}$$

Equation 7 is called the state equation, as it represents the values of the input variables at discrete amounts of time in the past and the present. For a specified time delay, T . Equation 7 implies that the state of the output of a churn management system, churn rate, is a recollection of the inputs over time. These inputs may be subjected to certain delays as churn managers await management and business owners to make decisions on factors such as resource allocation or priority.

Parts of the inputs represent the factors that lead to customer churn and other environmental disturbances. Hence, the delay shown in Equation 7 can also depict the lag that exists between a point that a customer gets displeased with service and the time when they finally terminate all services with an MNO.

3.8.3 Introduction of the output variable

The output variable, $y(t)$, will exclusively represent churn rate in this model.

$$y(t) = x(t) = \sum_{i=1}^n u(t - T) = \sum_{i=1}^n c(t - T_c) - \sum_{i=1}^n e(t - T_e) \quad (8)$$

Equation 8 implies that the output, at a particular time t , is represented by the values of the control and exogenous variables at that particular time, t . Hence, over a long time, the output of this system is dependent on the influx of the input variables over that period. Each of the input variables however can have a variable time delay, T , which will be characterized by the number of simulations or cycles in Vensim...

The main objective of this model is to be able to devise a model that is able to determine the evolution of the mobile customer churn rate in the future. The full descriptions of the inputs making up Equation 8 are as below;

- (i) $c(t - T_c)$, representing measures taken by the mobile operators as having positive intentions therefore adopting a positive sign as $[+ c(t)]$. One, few or all of the MNO actions may be delayed by a time period T_c .
- (ii) $e(t - T_e)$, representing disturbances in the environment that may lead to an increase in or a decrease in churn rate. This therefore entails a critical analysis of the effect of individual disturbances on churn rate. In the model represented in Equation 7, the disturbances $e(t)$ are represented as exclusively positive. The effects of these external factors may also be delayed through a delay, T_e , in order to study its impact on the churn rate. This becomes a very important test because it would allow the MNOs to make their own assumptions and have a forecast on how their decisions impact churn rate.

In the case of $e(t)$, disturbances in the environment having a positive or negative intention on churn is highly objective. This is so because the dynamics of the outside environment may affect churn differently in terms of value and magnitude. Examples are that inflation may have a negative intention on churn while deflation may have the opposite effect. This could become interesting analytics, considering that both are still external factors, which can only interact with the system at the boundary. As depicted in Figure 19, the output of the system dynamics designed under this study is a result of the effects of the control variables and the disturbances experienced at the boundary.

A diagrammatical representation of Equation 8 would look as in Figure 19.

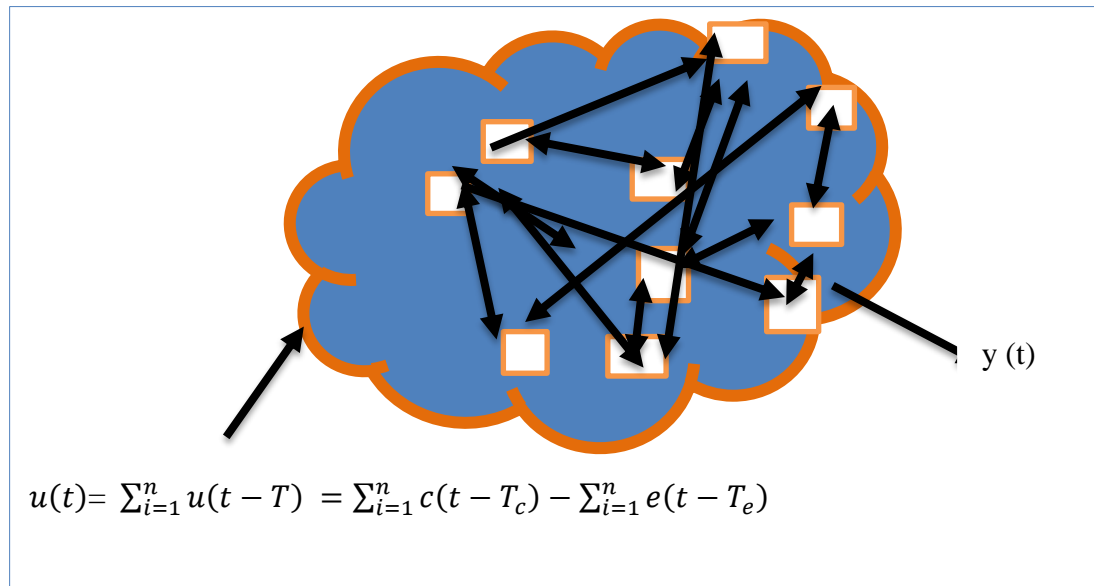


Figure 19: Representation of the system dynamics model

3.8.4 Modelling memory or state variables

- (a) Control inputs or variables: in dynamic system modelling, control inputs are represented by an actuator.
- (b) Modelling output variables: normally represented by sensors and performance variables.
- (c) Identify the state or memory variables. This constitutes the sum of all independent variables that represent memory of a system.
- (d) Use laws to relate state derivatives to inputs and/or state variables.
- (e) Use laws to relate output to inputs and/or state variables, e.g. laws of motion, laws of continuity, etc.

3.8.5 Dataset analysis of the churn management model

A variable measure how much there is of something, in a manner that is quantifiable. This implies that for anything to have a quantity, it must have a magnitude. A particular item can be represented in mathematical expressions by a constant or a variable if it has a value or magnitude. There are various types of variables in Vensim. The function and use of a variable in a model determines the category into which it falls. In Vensim, the variable types are accessed on the dialog box of the equation editor.

- (i) **Auxiliary variable:** An auxiliary variable is one that is expressed in terms of other variables. In Vensim, this is the most common type of variable.
- (ii) **Constant variable:** Constants are variables whose value does not change over time or variables that have no inputs in the system [53].
- (iii) **Data variable:** These variables have values that change over time, but do not depend on other variables in the model. Data variables may be in form of raw data that can be looked up from an excel document and fed into the model.
- (iv) **Initial variable:** initial variables are like a constant, except that it is the result of combining different variables at initialization time.
- (v) **Level variable:** These are the dynamic variables in the model. They all use the integration function. Levels indicate cumulative changes that occur in the model and how they affect the system.
- (vi) **Lookup variable:** these are nonlinear functions with numerical x-axis and y-axis parameters enclosed in round brackets.
- (vii) **Reality Check variable:** This type of variable allows for entering of a condition and consequence. A test input defines the behaviour of a system under different conditions.

The model designed in this research mostly used four types of the variables discussed above. These were the auxiliary, constant, initial and level type of variables.

3.9 Summary

As outlined in this chapter, 700 mobile telecommunication subscribers, three MNOs and ZICTA were interviewed. The subscribers described their usage behaviour of mobile services. Subscribers who had churned between the years 2010 and 2015 also cited the factors that led them to terminate subscription to services with particular MNOs. The MNOs also indicated the strategies they use to manage customer churn. Other institutions interviewed were ZICTA and CSO for other national data. The mathematical model designed in this chapter has three inputs namely factors that lead to mobile customer churn, actions that MNOs take to prevent churn, and the impact of external factors on churn rate. The output variable will be discussed in the next chapter.

CHAPTER FOUR

RESEARCH FINDINGS AND ANALYSIS

4.1 Introduction

This chapter presents the findings of the research from both the surveys and the system dynamics model that was designed. As discussed in the theoretical framework under section 2.3, the findings of the survey were used as input into the system dynamics model. The essence of carrying out the survey was to determine realistic initial values, which represented the actual experiences on the Zambian mobile telecommunication industry. The first section will discuss findings of the survey, while the second part will discuss results obtained from the simulation model.

4.2 Results of the survey

4.2.1 Demographic parameters

The first survey conducted was for mobile customers of the three MNOs available on the Zambian telecommunications market in 2015. Table 5 showed the number of samples taken per each of the six districts. For the 700 samples taken, the subscribers who took part in the survey were of age groups shown in Figure 20.

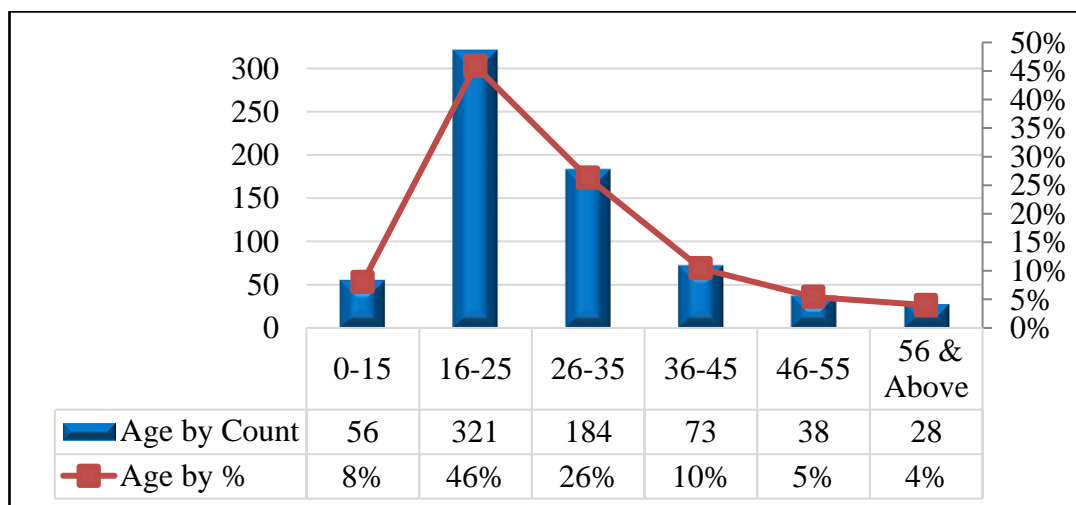


Figure 20: Total sample by age

The majority of the subscribers interviewed in this study were those between the ages of 16 to 25. This age group represented 46 percent of the total subscribers interviewed. About 8 percent of the subscribers were below the age of 15, 26 percent were between the age of 26 and 35, 10 percent were between the age of 36 and 45, 5 percent were between the age of 46 and 55 while 4 percent were above 56 years of age.

Compared to data obtained during the 2010 census, 48 percent of the national population was below the age of 15. About 20 percent were between the age of 16 and 25, 14 percent were between the age of 26 and 35, 8 percent were between the age of 36 and 45, 5 percent were between the age of 46 and 55 while 5 percent were above the age of 56 [54]. The data of Figure 20 does not exactly match the proportions of the 2010 census because of the differences in adoption of mobile services among the age groups. According to Figure 20, mobile adoption in Zambia is highest among individuals aged between 16 to 25 years.

Of the 700 subscribers, 331 were male while 369 were female as shown in Figure 21. The numbers of males and females per age group are as shown in Figure 21.

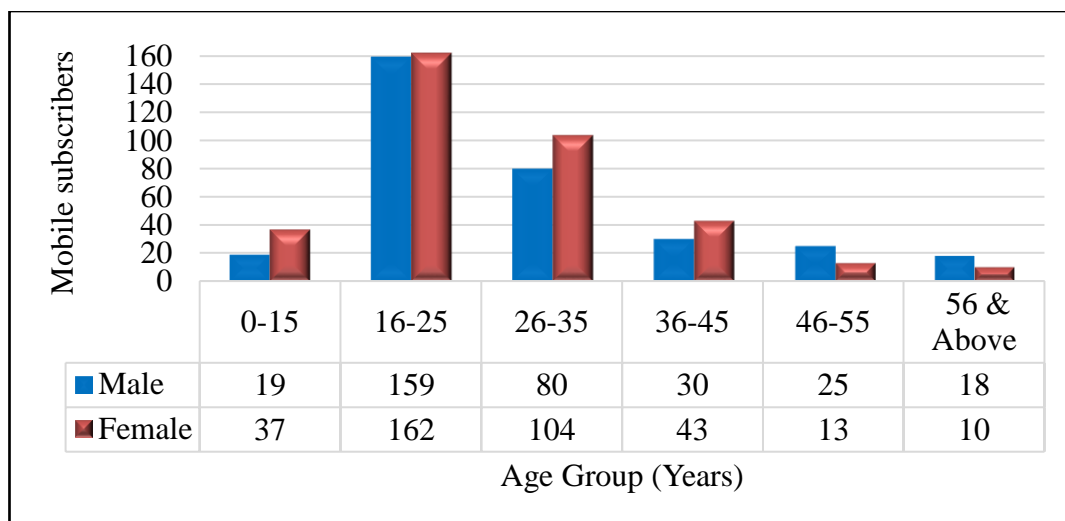


Figure 21: Total sample by age and gender

Data in Figure 22 gives insight on the occupation of the mobile subscribers interviewed in this research. About 39 percent of the subscribers interviewed were in employment, 37 percent were students, and 16 percent were not in employment while 8 percent were in business. Hence, some of the demographic parameters studied in this research were age, gender, geographical location, income and occupation.

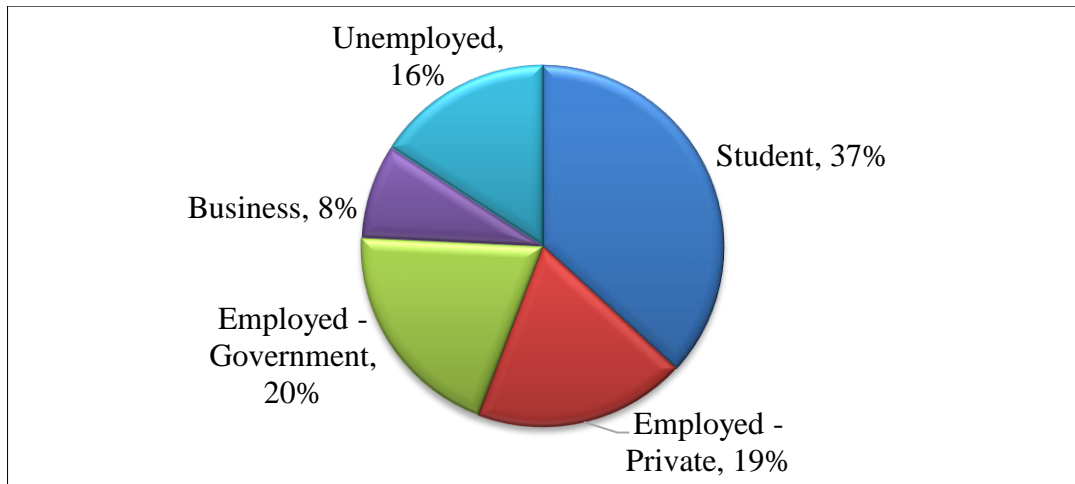


Figure 22: Total sample by occupation

4.2.2 Multi-simming

Results of this research indicate that it is possible for customers to have multiple sim connections with a particular MNO as well as belong to more than one MNO. In this research, the earlier case is referred to as internal multi-simming and the later as external multi-simming respectively. Figure 23 shows the average number of sim cards owned by subscribers in each group while Figures 24 and 25 will further illustrate external and internal multi-simming respectively.

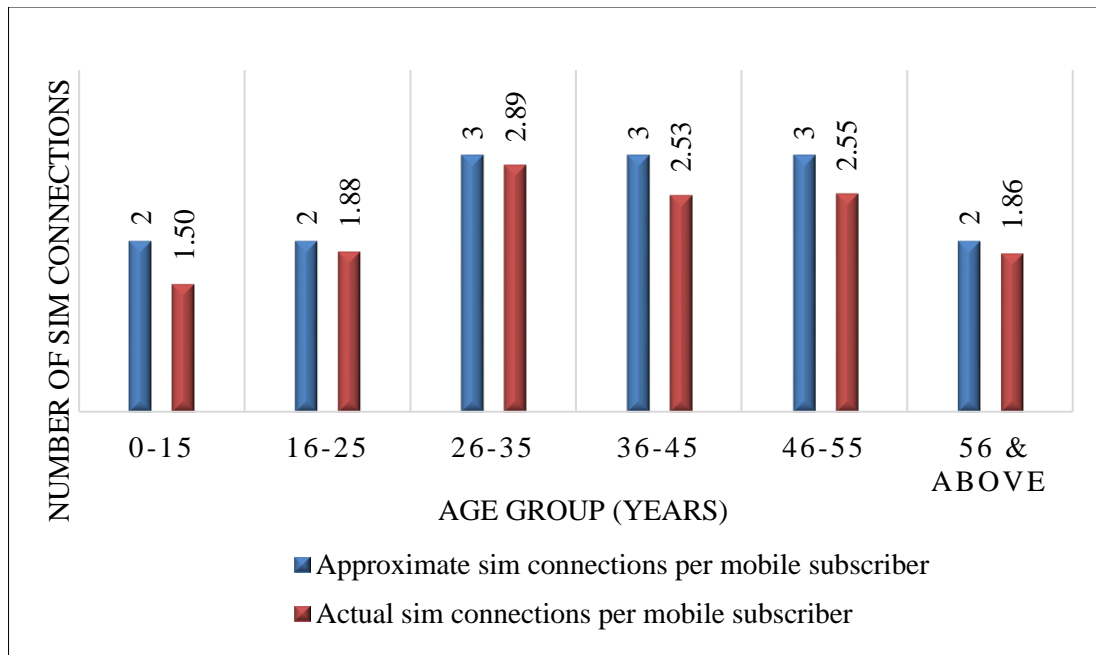


Figure 23: Average number of sim connections per user

Figure 23 shows the average number of sim connections certain age groups own regardless of whether it is with the same or different MNOs. The results show that most of the mobile subscribers aged between 26 and 55 years in Zambia have at least two sim connections each. The rest of the population subscribed to mobile services in Zambia has about two sim connections each.

In Zambia, multi-simmming exists both within and across MNOs referred to as internal and external multi-simmming respectively. Figure 24 shows external multi-simmming, which is the ownership of multiple sim connections for more than one MNO. As shown in Figure 24, only about 38 percent of the population has subscription to services with a single MNO. The other proportion of the population has subscription to services offered by two or three MNOs.

For the 700 subscribers interviewed, 21.9 percent, 18.1 percent and 3.1 percent have exclusive subscription to MTN, Airtel and ZAMTEL services respectively. Of the sampled population of mobile subscribers, about 41.3 percent have subscription to services with two MNOs. MTN and ZAMTEL dual subscribers made up 11 percent of the sample, Airtel and MTN made up 22.4 percent while Airtel and ZAMTEL made up 7.9 percent of dual subscribers. Results of Figure 26 also shown that about 15.6 percent of the mobile subscribers on the Zambian mobile telecommunication market have subscription or sim connections with Airtel, MTN and ZAMTEL simultaneously.

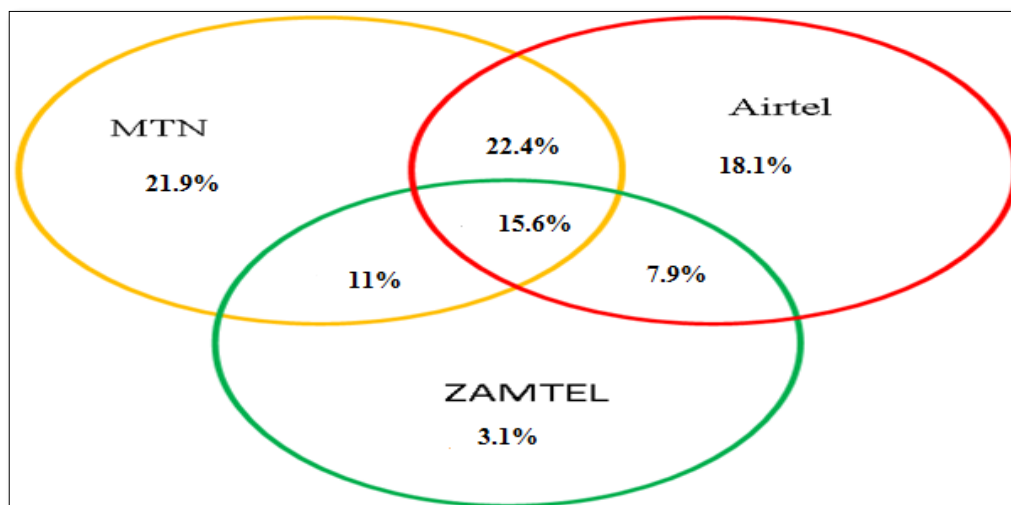


Figure 24: External multi-simmming

Figure 25 shows the extent of multi-simming for the 21.9, 18.1 and 3.1 percent of customers with exclusive subscription to only MTN, Airtel and ZAMTEL mobile services respectively. As shown in Figure 24, these subscribers do belong to one MNO only. This however does not mean that they have only one sim connection within the particular MNOs. According to Figure 25, about 82.6 percent of all subscribers who are exclusively on Airtel have one sim connection each, 15.8 percent have two sim connections each while 1.6 percent have three sim connections each. MTN has 83.3 percent, 15.2 and 1.4 percent of its exclusive customers with 1, 2 and 3 sim connections respectively. ZAMTEL has the lowest internal multi-simming with 92.1 percent having 1 sim connection, 6.6 percent having two and 1.3 percent having three sim connections each.

A result of Figure 25 shows that multi-simming does not only happen across MNOs but also within MNOs. This is so because as confirmed by ZICTA through an interview, there is no regulation, which restricts the number of mobile sim connections that an individual mobile subscriber can own per MNO.

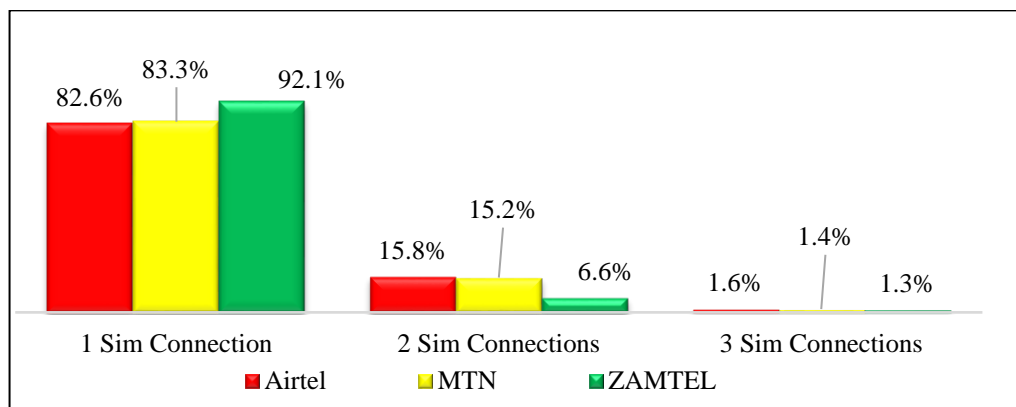


Figure 25: Internal multi-simming

Some subscribers want to experience the best of all three worlds by switching between the promotions they rate to be best among MNOs. Others have multiple sim connections so that they are able to make on-net calls, which are cheaper for all three MNOs. Multiple device ownership by individuals also heightens multi-simming within and across MNOs. Depending on differing experiences, the service of a particular MNO might be preferred over that of its competitor. As a result, subscribers end up having connections with at least one MNO.

For the 700 customers interviewed under this research, about 41 percent of mobile customers stated that the cost of mobile services in Zambia is high. Hence, customers own multiple sim connections to cut down on costs such as off net calls. Poor customer service, promotion seeking, poor network quality and lack of operator’s products on the market followed with 31, 29, 9 and 5 percent of the population feeling that these factors prompted them to have multiple sim connections. One MNO might have poor network quality in an area, but also perceived to be cheaper than the other MNOs. In such a circumstance, subscribers might own sim connections for both MNOs and use them depending on convenience.

4.2.3 Churn and churn rate

One section of the questionnaire focussed on the churn behaviour for the 700 subscribers between 2010 and 2015. Another aspect was that customers were asked to rate the extent to which certain factors can cause them to churn. It also invoked the customers who had churned at any point between the years 2010 and 2015 to state the reasons that prompted them to do so.

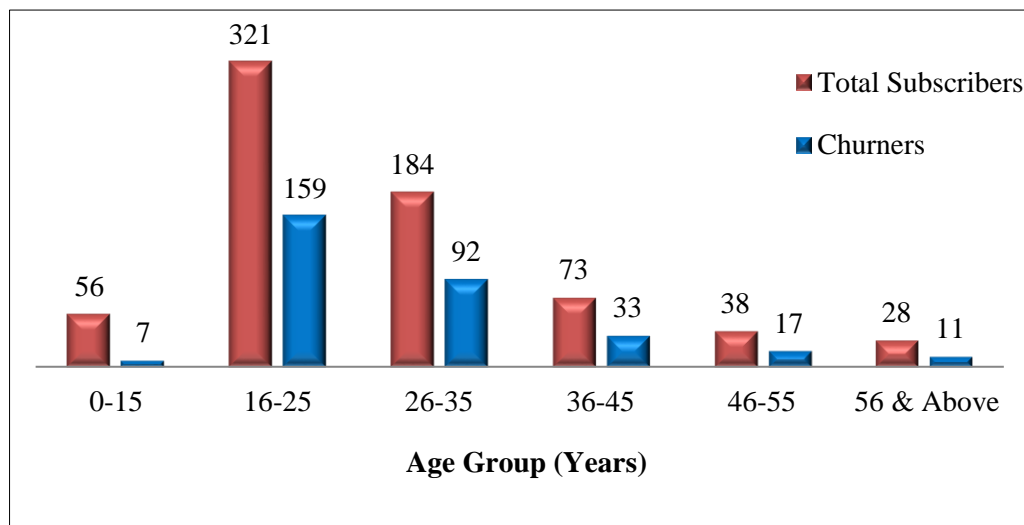


Figure 26: Actual mobile subscription terminations by age

Results shown in Figure 26 indicate that 7 out of the 56 subscribers aged between 0 and 15 years terminated service one or more times between 2010 and 2015. This resulted in an average of 3, 10, 10, 9 and 8 percent of individuals terminating services per year in the respective age groups shown in Figure 26.

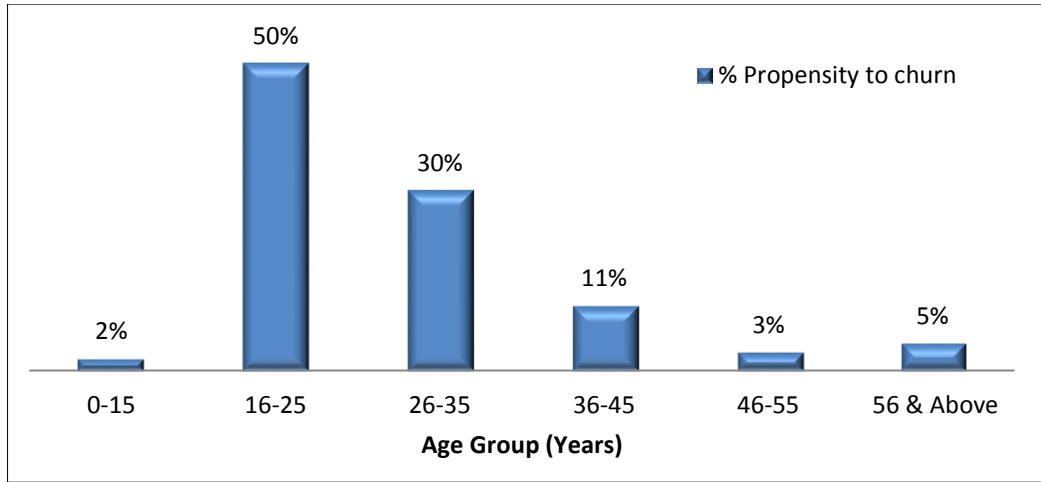


Figure 27: Propensity to churn by age

The churners of Figure 26 may have terminated more than one time between 2010 and 2015. The frequency of terminations gives insight into which age groups have high likelihood or propensity to churn as shown in Figure 27. As indicated in the comments from MNOs, propensity to churn is a great insight into mastering the behaviour of certain segments of customers.

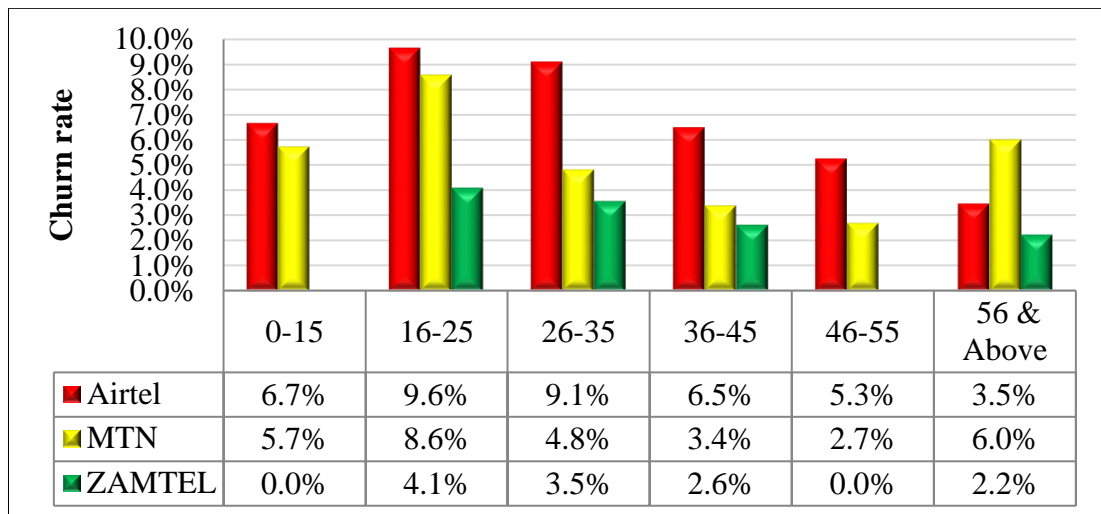


Figure 28: churn rate per age group at town level

Out of the 700 mobile subscribers interviewed, the churn rates at MNO level were as presented in figure 28. For all three MNOs, the most churning population are the mobile subscribers aged between 16 and 35 years of age. The varying churn rates among the age groups are due to different factors that will be discussed later in the section that will follow.

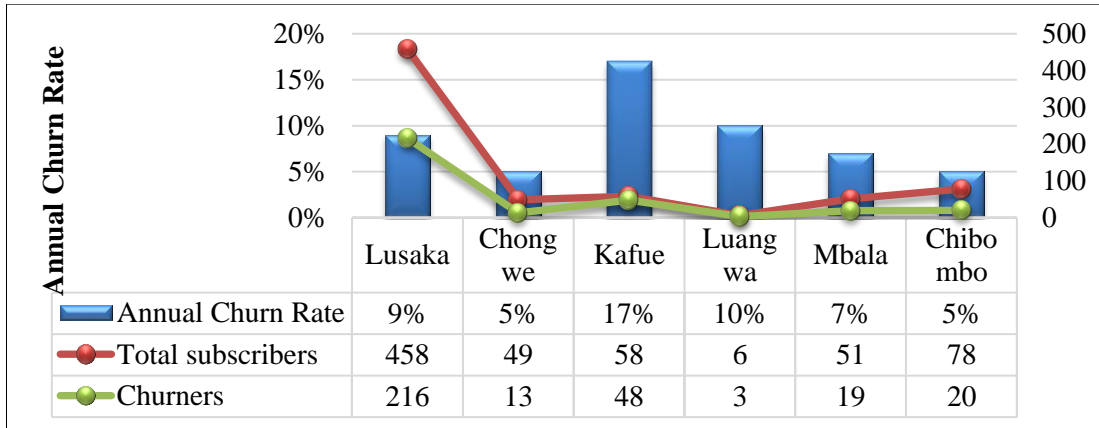


Figure 29: Churn rate by district

The number of subscribers who churned between 2010 and 2015 for the sampled districts was as shown in Figure 29. A case of Lusaka for instance shows that the 458 customers had terminated service once or more times between 2010 and 2015, with a total count of churn coming to 219 for the five years. This means that on average, about 9 percent of the subscribers in Lusaka terminate subscription to mobile services with MNOs every year as shown in Figure 29. This applies on all other districts used in this research, with a result of average annual churn rates as shown in Figure 29.

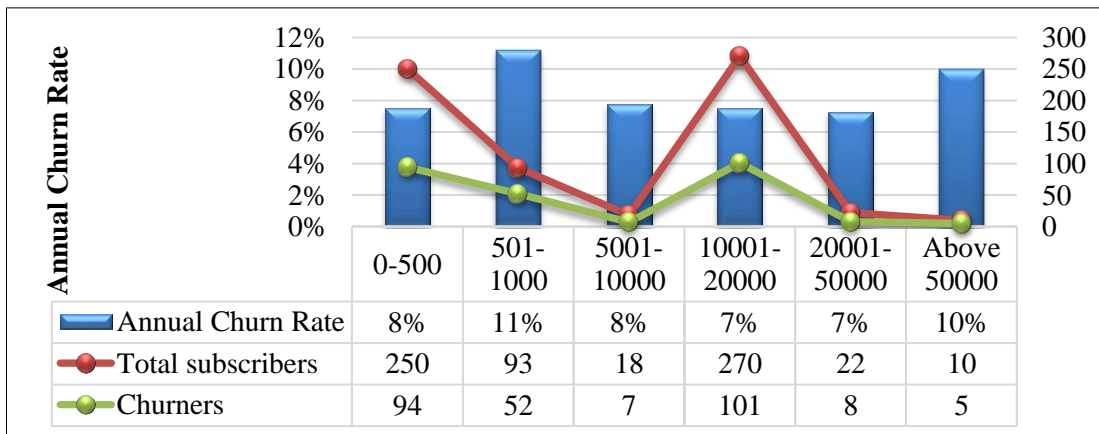


Figure 30: Churn rate by monthly income

Results of Figure 30 show that there is no relationship between the income mobile subscribers to churn. The expectation is that mobile customers who have higher income would be more stable and have the least switching. However, as Figure 30 shows, annual churn rate is at 11 percent for individuals who earn between ZMK 501 and ZMK 1,000. The second highest groups of churners are those who earn above ZMK 50,000 per month, with annual churn rate standing at 10 percent.

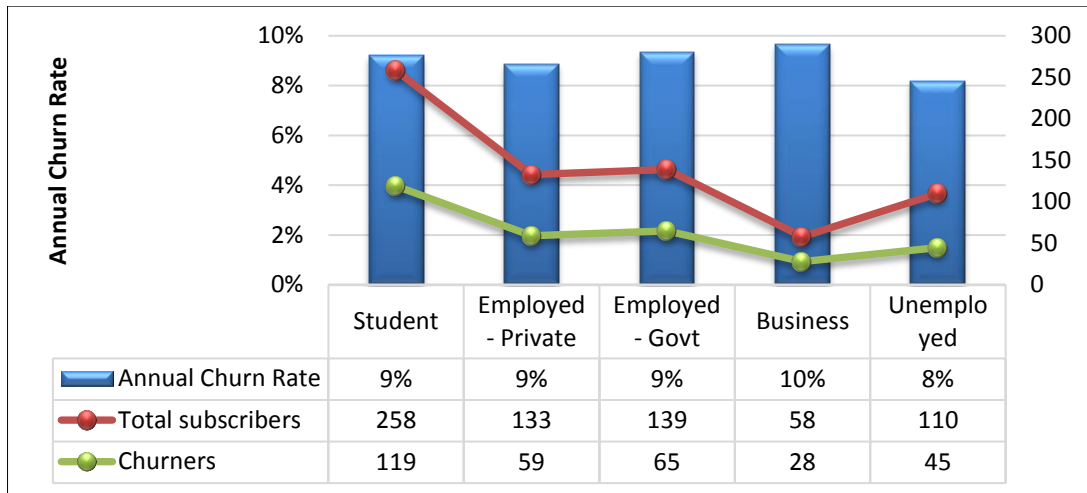


Figure 31: Churn rate by occupation

The result in Figure 31 shows that churn rate across different segments of occupation range between 8 and 10 percent. Hence, on the Zambian mobile telecommunications sector, churn rate is uniform among mobile subscribers of variable occupation classes.

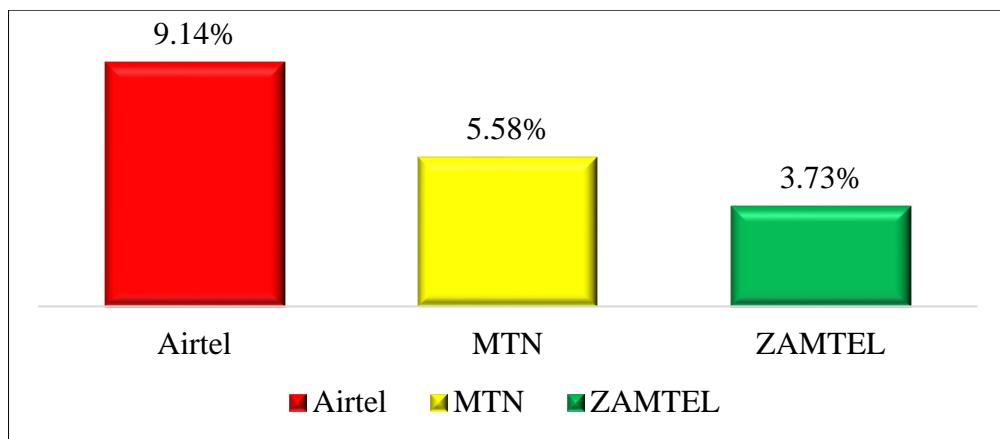


Figure 32: Annual churn rate by MNO

A result of the survey shows that the annual churn rates for the three MNOs on the Zambian telecommunications market are as shown in Figure 32 for the years between 2010 and 2015. On average, there is about 6.15 percent annual churn rate in the mobile telecommunications sector of Zambia. This result is not as measured or stated by the MNOs themselves, but a result calculated from the churning behaviour of the 700 mobile customers that were interviewed. Figure 33 shows the result of Figure 32 at district level.

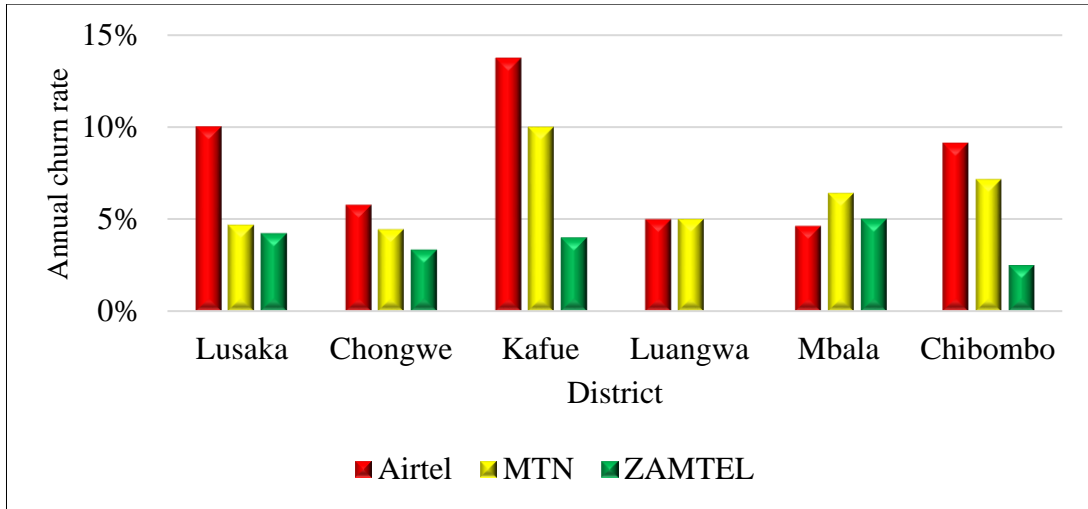


Figure 33: Annual churn rate by district

The factors leading to mobile customer churn are unique per subscriber, but in clusters such as districts, they collectively form a pattern. Some factors were common among subscribers in certain parts of Zambia. The section that follows will discuss the factors that led to customer churn between the years 2010 and 2015 for the result of Figures 28 and 33 at age and district levels respectively.

4.2.4 Factors that lead to mobile churn

The results of Figures 32 and 33 show the average churn rate that each MNO experienced between the years 2010 and 2015. Although the causes of churn were unique per individual customer, similarities gave an indication of the leading factors per district, which as presented in Table 7 for each MNO.

For the 428 churn cases for 700 subscribers, which took place between the years 2010 to 2015, there were 20 factors that led to these churn cases as shown in Table 8. The total number of churn cases for the 428 churners is 667, which implies that about 239 mobile subscribers of the 428 churners terminated subscription to services at least once between 2010 and 2015. One of the leading causes of churn in Zambia is poor network quality.

Poor network quality is the leading cause of churn in Zambia, followed by High cost of services. As earlier shown in Table 7, most mobile subscribers interviewed complained of congestion and call drops on the network.

Table 6: Factors for churn rate per district

	Airtel	MTN	ZAMTEL
Lusaka	-Poor network quality on data.	-High cost of services. -Poor quality on voice.	-Poor quality on voice and data. - Poor coverage.
Chongwe	-Poor coverage. Poor network quality on voice and data.	-High cost of services. -Poor quality on voice.	-Poor coverage.
Kafue	-Network congestion. -High cost of services.	-Poor coverage. -Poor quality on voice and data.	-Poor coverage. -Poor quality on voice and data.
Luangwa	-Poor coverage.	-Poor quality on voice. -Too many unsolicited messages.	-Poor coverage. -High cost of services. -Poor quality on voice and data.
Mbala	-High cost of services. -Better promotions with competitors.	-Poor coverage. -High cost of services.	-Poor coverage.
Chibombo	-Poor quality on data.	-High cost of services. -Poor quality on voice.	-Poor quality on voice and data.

Figure 34 summarizes the results presented in Table 8. Poor customer service of Figure 34 is a combination of items 4, 9, 11, 15 and 18 of Table 8 while the billing errors of Figure 34 are an aggregation of items 5, 10 and 20 of Table 8.

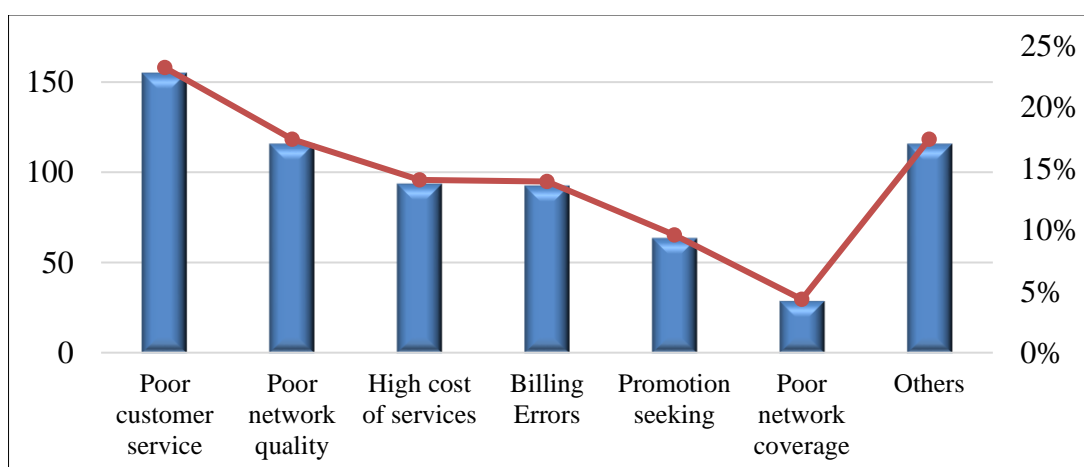


Figure 34: Top factors leading to customer churn

Table 7: Major reasons for churn per district

	Factor leading to customer churn	Lsk	Cng	Kaf	Lng	Mbl	Chb	Total
1	Poor network quality	27	22	12	1	9	6	77
2	High cost of services	26	15	8	0	8	3	60
3	Better promotions with competition	19	8	5	0	6	1	39
4	Poor call centre customer service	20	4	2	0	1	1	28
5	Hidden charges	10	9	7	0	0	0	26
6	Billing errors	10	4	9	0	1	1	25
7	Relocated to a place with poor network coverage	4	2	12	2	2	1	23
8	Not feeling appreciated	6	11	1	0	0	0	18
9	Incomplete or unsatisfying complaint resolution	9	2	7	0	0	0	18
10	Poor service centre customer service	11	2	2	0	1	1	17
11	Unreliable helpline	9	3	3	0	2	0	17
12	Not satisfied with service	7	5	4	0	0	0	16
13	Operators products unavailable on the market	2	6	6	0	1	0	15
14	Inconvenient location of offices	2	1	4	0	1	0	8
15	Impolite service centre employees	3	0	5	0	0	0	8
16	Lack of latest phones	3	2	3	0	0	0	8
17	Operators lack of latest technology trends	2	2	2	0	0	1	7
18	Unknowledgeable call and service centre employees	2	1	4	0	0	0	7
19	Unsolicited messages	4	0	1	0	0	1	6
20	Loss of airtime	1	4	0	0	0	0	5

Key: Lsk is Lusaka, Cng is Chongwe, Kaf is Kafue, Lng is Luangwa, Kaf is Kafue, Mbl is Mbala and Chb is Chibombo.

In Table 8, the total number of churn cases presented is 428 and not 700. This is because not all customers who were interviewed had churned between the years 2010 and 2015. Hence, out of the 700 subscribers who took part in the survey, only 428 individuals churned between these years.

The six factors presented in Figure 34 led to about 83 percent of the total churn cases on the Zambian mobile telecommunication sector while eight other factors listed in Table 8 led to about 17 percent of total churn cases. Figure 34 would play a vital role especially in a case where an MNO has got limited resources dedicated to churn management. It would be in the best interest of the business to prioritize which problems of customers to focus on, so that to maximize the result on churn rate.

While poor network quality is the leading cause of churn as a single factor, the collective issues surrounding poor customer service take the lead as shown in Figure 34. Poor customer service, which includes impolite and unknowledgeable employees in call centres and service centres, poor customer care accorded in call centres and service centres, leads to about 23 percent of customer churn cases in Zambia. Poor network quality experience is the second highest leading cause of mobile customer churn, causing about 17 percent of all churn cases in Zambia.

The results show that high cost of services lead to 14 percent of churn cases. Billing errors, which may be general, loss of airtime or hidden charges lead to about 14 percent of all churn cases in Zambia. Competition promotions cause 10 percent of churn cases while poor network coverage is responsible for 4 percent of churn cases. The rest of the factors listed in Table 7 lead to 17 percent of churn cases on the network.

4.2.5 Strategies MNOs use to prevent churn

Each of the three MNOs on the Zambian mobile telecommunication market has strategies that they use in order to prevent customers from churning. From the surveys conducted with MNOs, 12 main strategies stood out as common in managing churn of mobile telecommunication customers.

The churn managers in each of the MNOs were asked to list the strategies that they use to prevent or manage churn. Table 9 shows the total list of strategies that MNOs use in churn management.

Table 8: Strategies MNOs use to prevent churn

	Strategy
1	Customer loyalty programs
2	Customer life cycle management
3	Segmented customer management
4	Competitive product and service offers
5	Improve brand visibility
6	Churn campaigns and social media campaigns
7	Churn prediction based on usage, age, tenure, etc.
8	Call backs on potential churners
9	Special offers to potential churners
10	Outbound calling
11	Stock trendy phones at stores
12	Counter offering offers from competition

The MNOs in Zambia use loyalty programs, customer life cycle management, segmented customer management, churn prediction models and campaigns to improve customer retention on the network. The churn prediction model studies the usage pattern of a customer over a period, customer's tenure on the network and other parameters such as age or location to determine their propensity to churn. If the measure indicates that a customer has high propensity to churn, MNOs then use initiatives such as outbound calling in order to find out the exact problem the customer could be facing. The MNOs may then give special offers to such a customer or address the issues surrounding the problem that customer could be facing. MNOs also use improvement on brand presence in certain locations as well as improve on stocking trendy phones in their stores.

4.2.6 Gap between customer needs and actions of MNOs

On a scale of 1 to 10, mobile subscribers were asked to rate how likely certain factors would lead them to churn. MNOs also rated the extent to which they felt certain factors would lead subscribers to churn. Question 5 of section III in Appendix 4 and question 8 of section II in Appendix 5 addressed this requirement for opinions of subscribers and MNOs respectively. From the results of Table 10, MNOs feel that the biggest factors leading to customer churn are lack of latest phones, lack of latest technology trends and multi-simming. For each of these top three factors, MNOs feel that these are the contributing factors for six out of every 10 customers that churn.

Table 9: Rating of likelihood of factors to lead to churn

	Factor leading to customer churn	AIR-TEL	MTN	ZAM-TEL	MNOs' average rating	Subs rating (opinion)	Subs rating (actual)
1	Poor network quality	4	3	6	4	10	7
2	High cost of services	3	5	2	3	7	6
3	Poor call centre service	4	2	3	3	6	4
4	Poor service centre customer service	4	2	5	4	5	3
5	Better competitor promotions	3	5	2	3	8	3
6	Not feeling appreciated	3	1	1	2	10	3
7	Operators products unavailable on the market	2	3	5	3	5	2
8	Lack of latest technology trends	7	4	7	6	5	2
9	Inconvenient location of offices	1	2	1	1	4	2
10	Poor network coverage	1	1	3	2	6	2
11	My needs were not met/not satisfied with service	1	2	2	2	6	2
12	Billing errors	4	7	1	4	6	2
13	Hidden charges	3	2	1	2	6	1
14	Loss of airtime	3	4	2	3	6	1
15	Impolite service centre employees	1	2	2	2	4	1
16	Incomplete or unsatisfying complaint resolution	1	4	1	2	3	1
17	Unknowledgeable call and service centre employees	2	2	1	2	3	1
18	Unreliable helpline	1	2	1	1	5	1
19	Lack of latest phones	7	8	4	6	4	1
20	Unsolicited messages	2	4	3	3	2	1
21	Multi-simming	6	4	8	6	0	0

Key: Subs refers to mobile subscribers or mobile customers.

The rating of subscribers on how likely a certain factor would prompt them to churn contrasts the views of the MNOs. The results in Table 10 show that 10 out of every 10 subscribers feel that they would churn if their experience for a particular MNO were poor. The results also show that eight out of every 10 subscribers would defect to competition that offers them better promotions while seven out of every 10 subscribers would churn if a particular MNO offers services at high cost.

Item 18, on the reliability of the customer care helpline, '111,' also shows the difference on the feeling of subscribers and that of MNOs. On average, MNOs feel that only 1 in 10 subscribers would terminated services by frustration resulting from an unreliable helpline. However, half of the population of mobile subscribers interviewed felt that unreliability of the helpline would cause them to churn. The differing perception on this and other items shows that MNOs minimize the effect of some factors on churn, which actually mean a lot to subscribers themselves.

The actual rating of the likelihood of factors to cause churn was analyzed based on the actual churn cases considered under sections 4.2.3 and 4.2.4. The MNOs were interviewed and the average results show that 7 out of 10 customers churned due to poor network quality, 6 out of every 10 customers churned due to high cost of services while poor service in the call and service centres led to 4 and 3 out of every customer that churned.

On common grounds, both the MNOs and the customers seem to feel similarly about churning due to better promotional services by competitors. This is so because as discussed under section 4.2.2, most of the mobile customers in Zambia have more than two sim connections with one or more MNOs. Although customers do not directly feel that ownership of multiple sim connections prompts them to churn, 8 out of 10 felt that better promotions with competitors would prompt them to terminate services. True to that fact, the actual rating shows that three out of every 10 customers who churned cited better competitor promotions as a contributing factor.

The results of Table 10 highlight the fact that MNOs think that most subscribers churn due to the limitations of their products and services as well as multi-simming. The rating of subscribers however shows that subscribers value the experience they get as they interact with MNOs more than the products that MNOs focus so much on.

Network quality, customer care and problem handling in call centres and service centres, billing errors, loss of airtime, hidden charges and feeling appreciated by the MNO are all matters that arise from the experience of individual subscribers.

The findings of this research from the survey give a lot of insight for MNOs and other stakeholders. For example, the high rate of multi-simming on the Zambian mobile telecommunications market could be an indication that MNOs offer the same basic services. In this case, mobile subscribers would have connections with all three MNOs so that in a case that one of them has better offers, they are able to switch.

Mobile customers could also have multiple sim connections because their experience on products and services of each of the three MNOs is different. This is true for the Zambian telecommunications sector and as confirmed by the results of Table 7. Customers in different districts had different problems for distinct MNOs. Multi-simming should prompt MNOs and regulators to look at factors such as market share, mobile penetration, Average Revenue Per User (ARPU) and other factors from a different perspective. The assumption that a unique mobile connection translates to a unique subscriber distorts the facts around these factors.

The MNOs on the Zambian telecommunications market take an approach on churn rate determination that does not consider some of the facts on the ground. Some customers terminate services due to factors beyond their control. When determining churn rate customers who may have died or those that may have travelled to places where the operator has no presence are classified as churners. Hence, voluntary churners and involuntary churners, and those who cease to be possible customers are considered in the same way.

From these findings, it is recommended that the MNOs must not only focus on addressing multiple sim ownership with external MNOs, but also within their entities. If this is aligned, it will allow for an accurate determination of important parameters such as ARPU, market share, mobile penetration rate, gross additions and they will be able to determine the precise impact that an individual customer has on their revenues. It is also recommended that the MNOs introduce a system that allows for those travelling out of the country and are unable to roam to have their number reserved and not terminated.

4.3 Results of the churn management model

4.3.1 Designed customer churn management model

The complete designed churn management model is as shown in Figure 35. It has four major parts that will be isolated and discussed in detail.

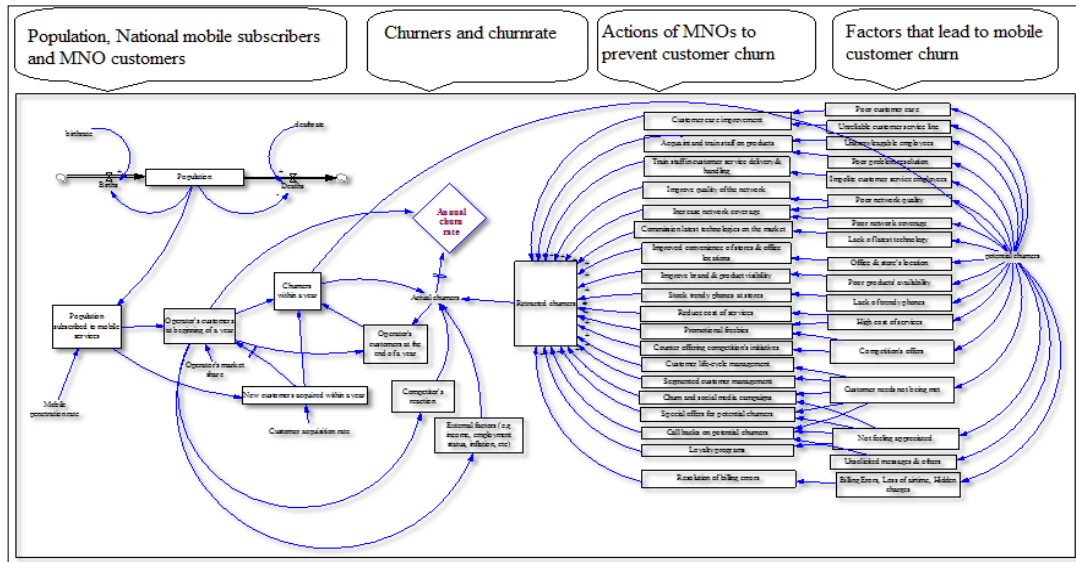


Figure 35: Designed churn management model

The results from the surveys conducted with mobile subscribers, CSO, MNOs and ZICTA were used as input in Figure 35. The annual churn rate is the main output of this model. The object is not to run a simulation that will give same or similar results to those collected under section 4.1, but to use those results as initial values in order to study the behaviour and future evolution of mobile customer churn on the Zambian telecommunications market and propose a strategy to minimize it.

From Figure 18, the entire national population of Zambia forms the universe of the samples under study. The sampling frame used was the population subscribed to mobile services with any MNO. The sampling units were the six districts shown in Table 5 and Figure 18. The sampling universe, frame and units are represented under the ‘Population, National mobile subscribers and MNO customers’ tab of Figure 35. Similarly, the other building blocks use variables related to churn, the factors that lead to customer churn and the actions MNOs take to minimize churn. The distinct building blocks will be discussed in detail in the section that follows.

4.3.2 Structural analysis of the causal and uses tree diagrams

The ‘causal trees’ and ‘uses trees’ features of Vensim allow for analysis of specific variables used in a model. It is a requirement that for a variable to be analysed using the causal and uses tree diagram, a variable must be used at least once in the model under a formula. This section will discuss the causes and uses of the key variables of Figure 36. It is key to note that other mental simulation may not be limited to these factors, but are stated under this section as exclusive factors whose inputs have been considered for the particular simulation and result in this research. This analysis is essential in that before numerical analysis, the relationships of variables used in any model should be logical. The formulas, initial values and results of these variables will not be discussed in this section, but the one that will follow.

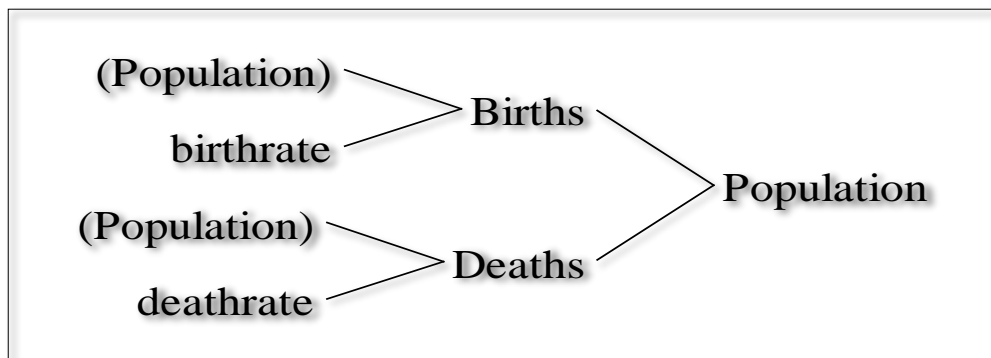


Figure 36: Causes tree for population

Figure 36 shows the factors that influence the value of population used in the model. The births and deaths in a defined area are used to compute population. Figure 36 shows that in the designed churn management model, the causes of population are births and deaths. This Figure also shows that births are determined by a variable called birthrate, which is also a factor of population while deaths are determined by deathrate.

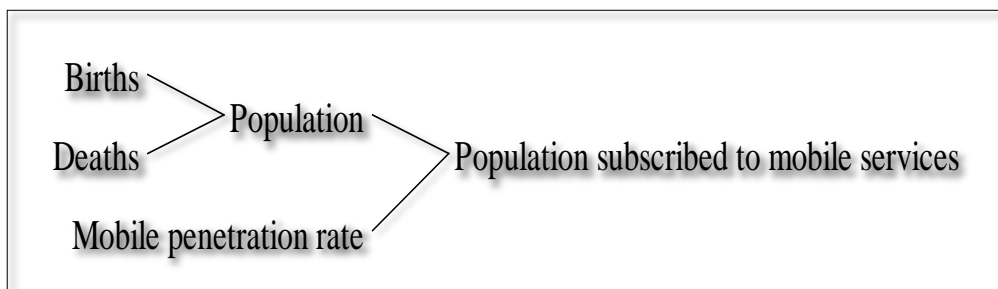


Figure 37: Population subscribed to mobile services

Figure 37 shows that the effective national population has a bearing on the ratio of individuals subscribed to mobile services. The population subscribed to mobile services forms the sampling frame for the entire Zambia in this research. As shown in Figure 37, population subscribed to mobile services is a factor of the national population and the mobile penetration rate. This is a very important parameter in this research because as can be seen from Figure 38, it is the causative factor of subscribers for distinct MNOs, and eventually gives an indication of the subscribers who churn.

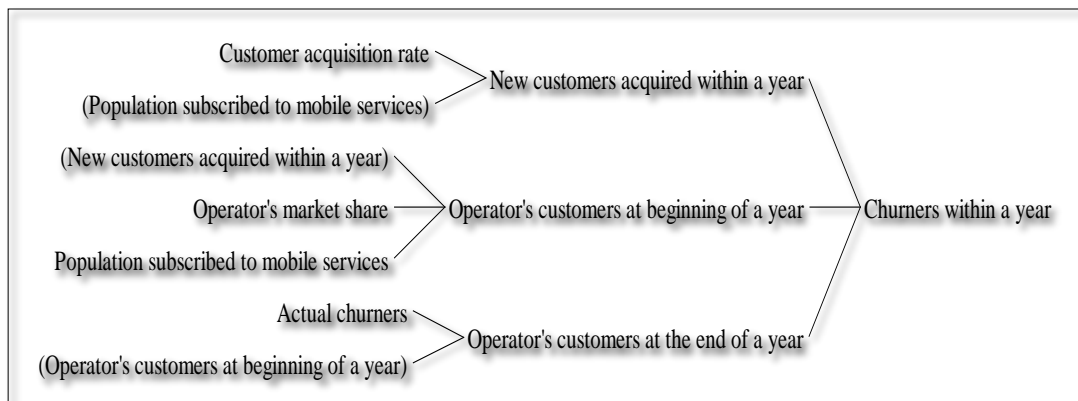


Figure 38: Causes tree for churners

Figure 38 shows the factors, which have a bearing on the ratio of mobile customers who churn. In an empirical sense, Figure 38 is a model representing the numerator of Equation 1.

Eventually, all parameters of Equation 3 play a vital role in determination of churn rate for a particular period. The representation of Equation 3 is as shown in Figure 39.

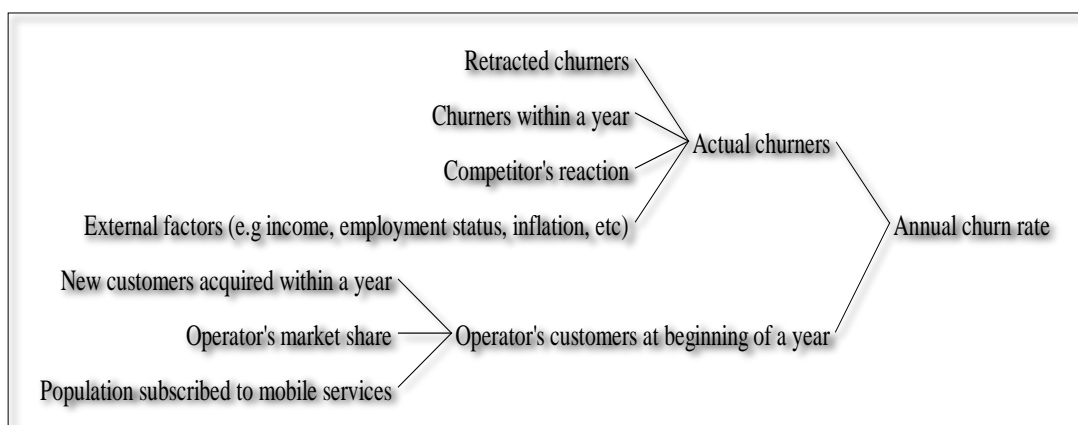


Figure 39: Causes tree for annual churn rate

Annual churn rate depends on a number of factors as shown in Figure 39. The causative factors of Figure 39 are a mental model of the parameters used in Equation 3, which uses the actual churners and mobile customers for a period to determine churn rate. System dynamics allows for formulation of a model that gives a lot more insight into the other factors that influence the value of the immediate factors. For example, we see population subscribed to mobile services being a causative factor on customers of a particular MNO, which is an immediate variable affecting churn rate.

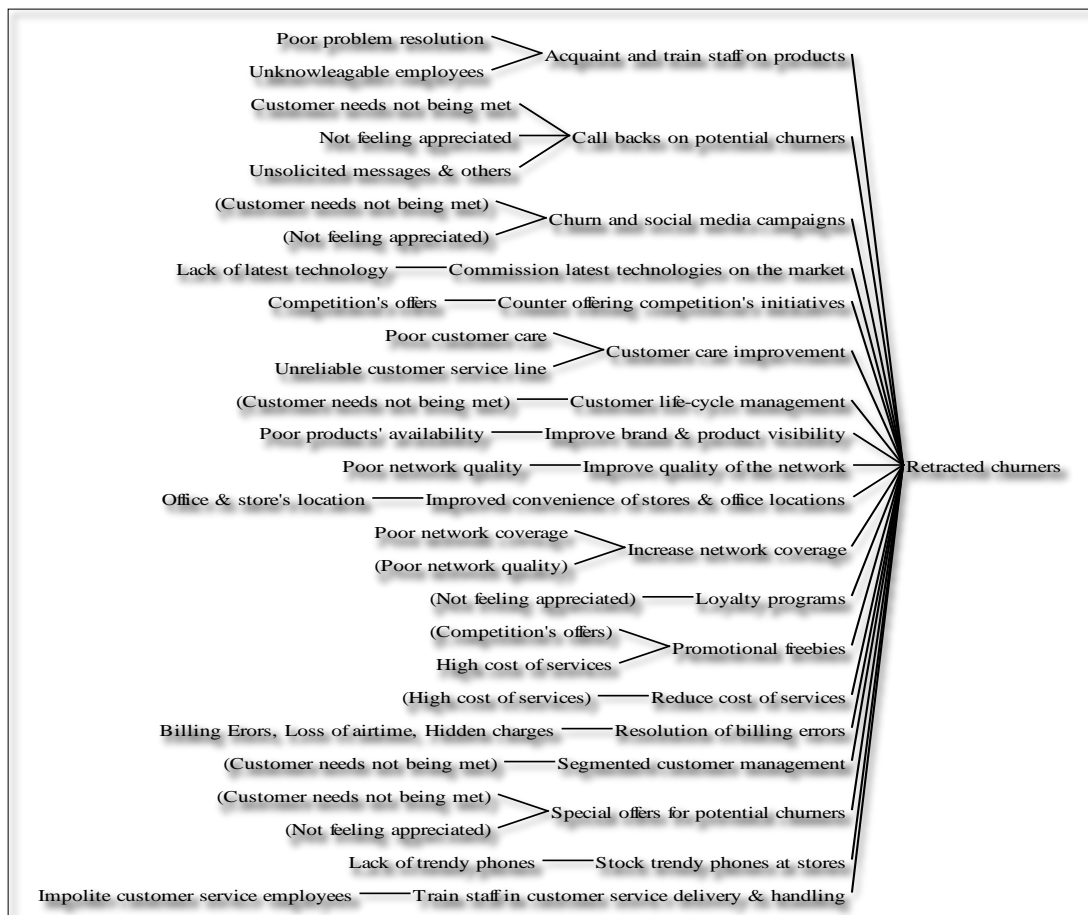


Figure 40: Causes tree for MNO's reactions to factors that lead to churn

Figure 40 gives a little more analysis into relationships that exist among the variables that influence the value of the numerator of Equation 3, the actual churners. From Figure 39, the retracted churners are a causative factor of actual churners among others. For a particular customer to reverse their resolution to churn, MNOs must have applied some mitigation actions to the problem of such a customer. Hence, Figure 40 shows both the problems customers face and the actions of MNOs.

This is the mental model designed as seen in Figure 40. Examining the top tree for example, if there are issues to do with poor problem resolution and or unknowledgeable employees in service centres or other stores, the MNO needs to realize that this would ultimately have a bearing on the experience that customers get. The customers may get frustrated and may possibly lead them to terminate their subscription to services. This is because customers would not want to see some product being advertised, but find that employees at the service have no idea about it, or simply cannot advise how to configure or use that product. In such an instance, the MNO can have deliberate policies of training their service centre employees on products and services before they are launched. In this way, customers will get the necessary information and help at service centres.

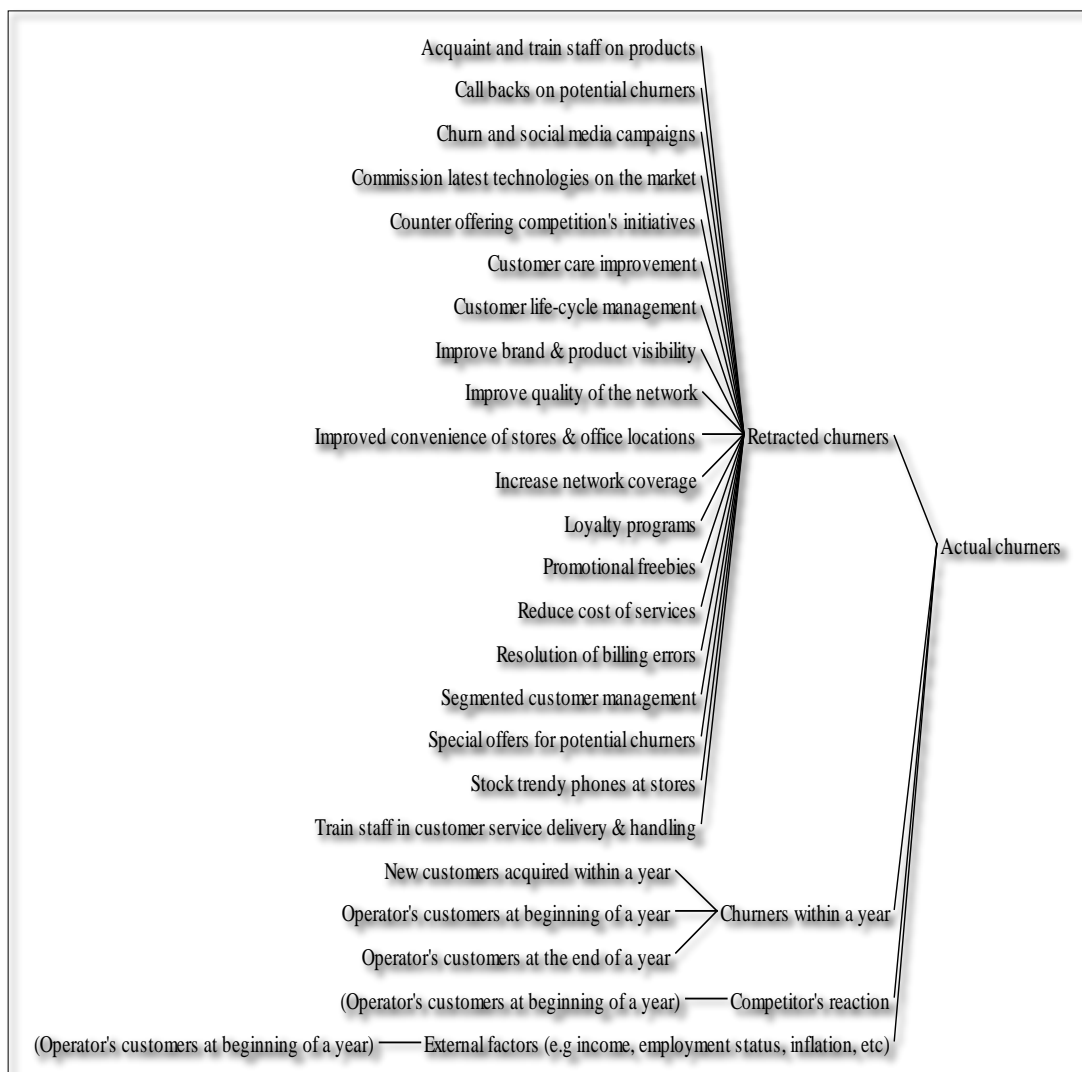


Figure 41: Causes tree for actual churners

Expanding on retracted churners of Figure 40 with a focus on actual churners would give the details shown in Figure 41. Many parameters would affect the value that the actual churners assume such as the ones shown in Figure 41. Competitors monitor the products and services that an MNO has or plans to launch. In this way, they also devise a similar product or service in order to improve retention in their distinctive MNOs. This is so because certain programs would be targeting at poaching the customers that an MNO has, especially those that are always seeking better promotions. Hence, the actions of the competitors have a large bearing on how successfully a churn management program fares.

Figure 40 and 41 become very cardinal in mobile customer churn management. The key is that MNOs must have accurate knowledge of the actual problems that customers are facing. MNOs also need to put in place mitigation actions that do not just resolve the effects of the symptoms but address the actual problems that customers face. If this is not achieved, the customers' frustration heightens and increases the churn rate for a particular MNO.

Mobile customers have other factors that may have an influence on how much they spend on network subscription and usage. Some of these factors may affect the operations of an MNO directly or indirectly. An example is inflation, which can prompt mobile customers to regulate how they spend their money. Others customers may decide to stop subscribing to mobile services and eventually churn. According to information obtained during the interviews with the MNOs, it is difficult to quantify the approximate number of subscribers who churn due to external factors. In a general sense, MNOs are able to observe the effects of external factors on the usage behaviour and average revenue per user, but they still cannot quantify churners.

This section has discussed the causative factors for some of the variables used in the design of Figure 35. The uses tree works in the opposite manner as the causes tree, but in the opposite sense. This analysis feature of Vensim is very cardinal in that it gives a focused analysis of a particular variable. For example, the variables used in Figure 35 are clustered, it is hard to read them, and interactions among themselves are not shown. This section helped to isolate the key variables in order to study the immediate factors influencing their values.

4.3.3 Initiating values and simulation results

This section describes the formulas and initial values used for all variables of the full churn management model shown in Figure 35.

(a) Population

Figure 42 shows the variables that influence the value of population. The number of births affects population positively while the number of deaths affects it negatively. Equation 10 describes how variables of Figure 42 interact to determine the value of population.

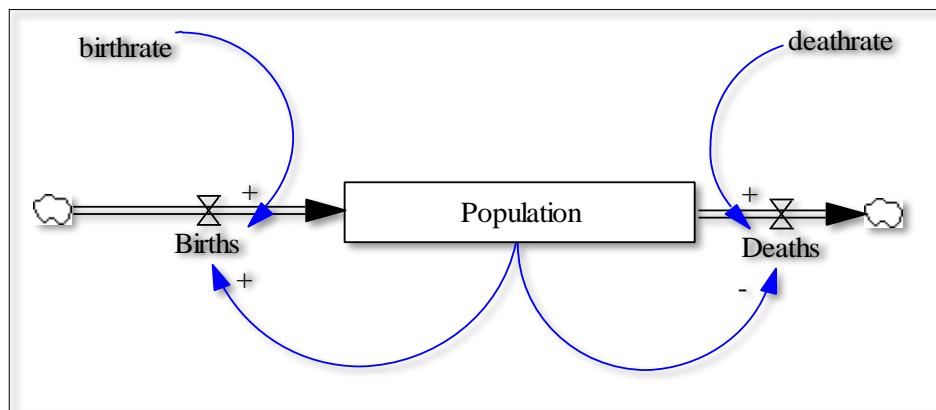


Figure 42: Design of the model for population

$$\text{Population} = \text{Births} - \text{Deaths} \quad (9)$$

$$\text{Population} = ((\text{Population} * \text{birthrate}) - (\text{Population} * \text{deathrate})) \quad (10)$$

Initial values: population: 15,473,905; birthrate=5 percent; deathrate=1.2 percent.

The initial values used are values determined for the year 2015 by CSO. In this simulation, the assumption taken is that the values of birthrate and deathrate remain at 0.05 and 0.09 percent respectively. As can be seen from Equation 10, if the birthrate is higher than the deathrate, population grows. However, when deathrate is higher than birthrate, population declines. For example, a growth in the economy, an improvement in health or diet of people in a community would lead to longer lifespans and reduced deathrate. As a result, the population would grow. In a contrasting scenario, factors such as diseases, famine, low employment levels, war and other factors may lead to increased deathrate, which declines the population.

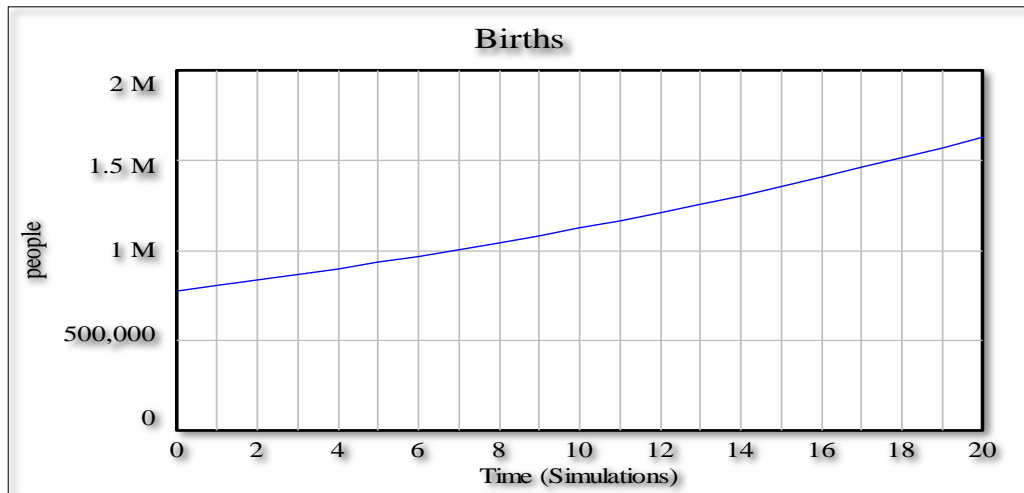


Figure 43: Result of births

Using Equation 10 and the stated initial values, the variation of births and deaths are as shown in Figures 43 and 44 over 20 simulations. The computations for the number of births are not cumulative over the simulations, but are distinct and only dependent on the value of population in that time interval or simulation. Figure 44 shows the results of deaths to be expected using the initial values indicated by CSO.

For the results presented in this section, all time parameters are annual, and referred to as simulation in the results obtained from Vensim. This is because in Vensim, the time intervals do not have a direct bearing on the logical computations of the simulation model. The interval defining the variables chosen determines what notation the time axis assumes.

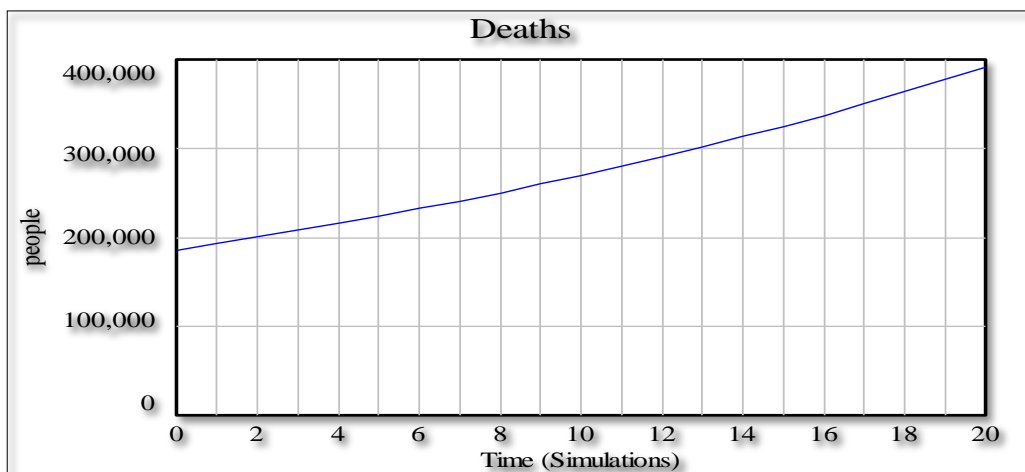


Figure 44: Result of deaths

A combination of data in Figure 43 and 44, interacting as in Equation 10 gives the value of population shown in Figure 45. For this simulation therefore, the population grows sequentially over the span of 20 time intervals or simulations. This shows that if the annual birthrate and deathrate remain as the actuals for the year 2015, the population of Zambia for the twenty years after 2015 will be as shown in Figure 45.

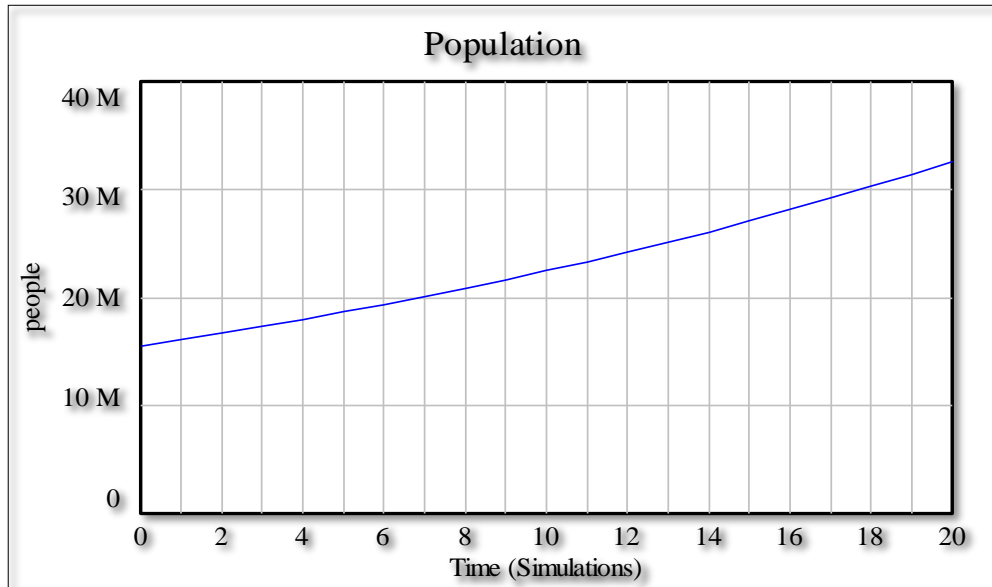


Figure 45: Result of population

(b) Operator's customers at the beginning of a year

Operator's customers at the beginning of a year = ((Operator's market share*(Mobile penetration rate*Population)) + (Customer acquisition rate*Population subscribed to mobile services)) (11)

Where:

- Population subscribed to mobile services = (Mobile penetration rate*Population) (12)

- New customers acquired within a year = (Customer acquisition rate*Population subscribed to mobile services) (13)

Initial values: Operator's market share: 0.4 or 40 percent; Mobile penetration rate=0.7; Customer acquisition rate= 3 percent.

The number of customers of an MNO at the beginning of a particular year does not entirely depend on the growth or decline in population. It is also dependent on the market share that the MNO gains and the number of new customers that it acquires within a certain period. Equation 13 shows how the value of the population subscribed to mobile services is determined, while Equation 14 shows how the number of customers that an MNO acquires within a year is determined. The mobile penetration rate used in this simulation is for the year 2015 as determined by ZICTA during the interviews.

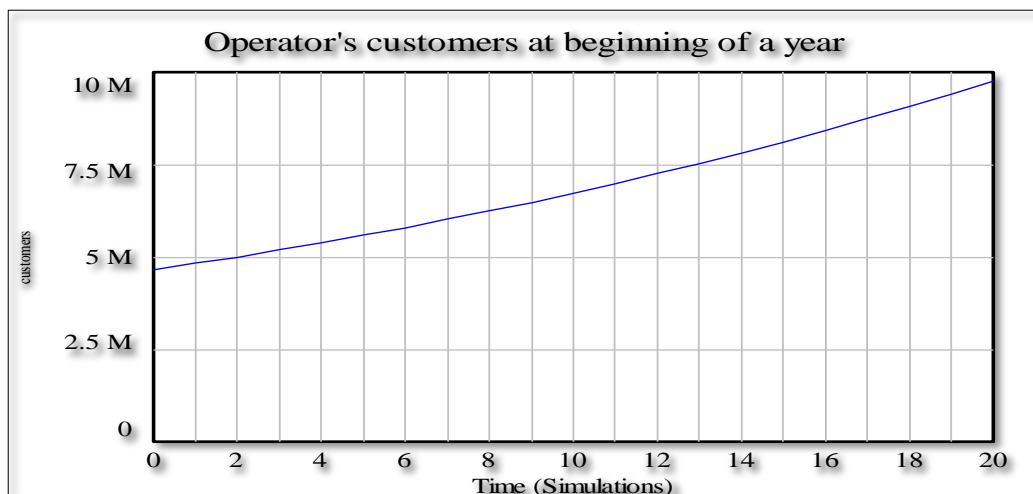


Figure 46: Operator’s customers at beginning of a year

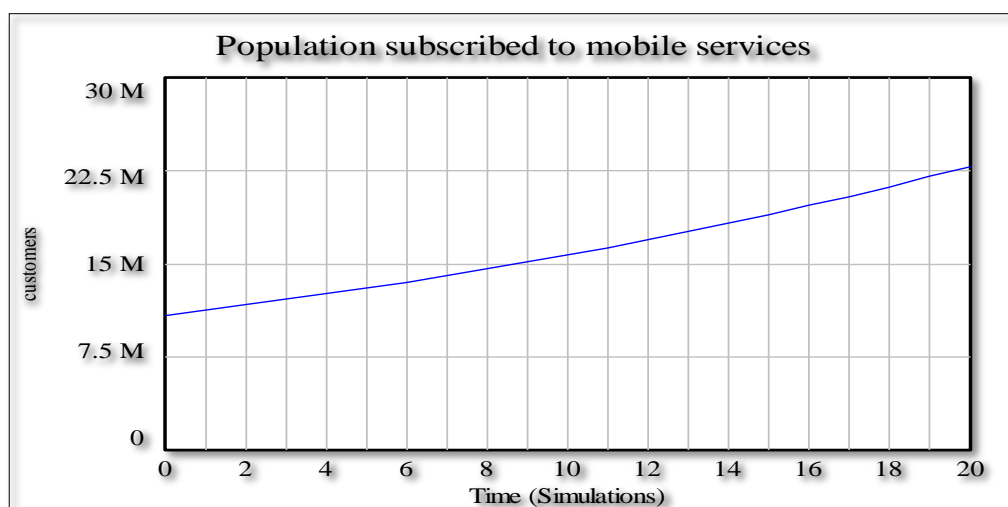


Figure 47: Population subscribed to mobile services

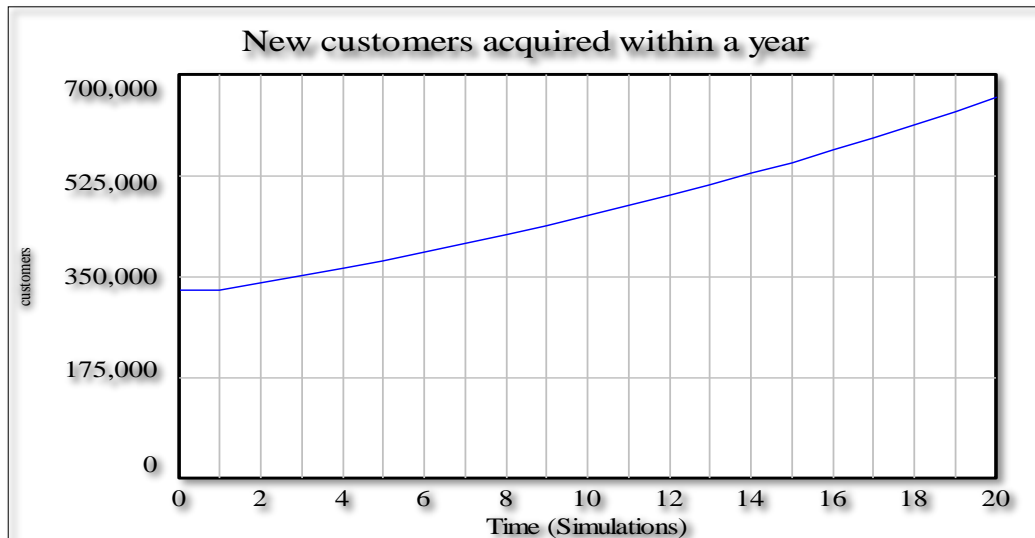


Figure 48: New customers acquired within a year

The results of Equations 12, 13 and 14 are as shown in Figures 47, 48 and 49 respectively. A growth in population subscribed to mobile services, new customers acquired within a year or both leads to a growth in the customers that an MNO has at the beginning of a year. Other factors such as MNO’s market share, mobile penetration rate, national population and the new customer acquisition rate also have a bearing on how an MNO’s subscribers evolve.

In ideal cases, the new customer acquisition rate depends on many factors. The marketing strategies MNOs use, advertisements, brand visibility and perception, customer experience, quality of products and services, what the competition is not doing right and many other factors. Hence, the customer acquisition rate may vary over a wide range, which fluctuates with the changes in the market. These changes may be fostered by the actions of the MNOs, by their competition, or may just be a good word put in the by the existing customers who have enjoyed their relationship with the incumbent MNO.

The value of market share would also vary over time with the dynamics in the market. This is because in reality, the market share of any businesses does not remain constant, especially in the mobile telecommunications market, where there are high rates of multiple sim connections ownership. For the purpose of this study, the results of Figures 48 and 49 are acceptable for constant values of MNOs market share and new customer acquisition rates at 40 and 3 percent respectively.

(c) Annual churn rate with feedback

The design of Figure 35 and 49 have a feedback loop, where the MNOs act on the ratio of customers who have high propensity to churn. The initial value of churners is determined from the average churn rate found during the surveys for the 700 subscribers over the years 2010 to 2015. After the MNO applies proper actions, some customers are likely to change their decision and stay with the MNO. However, if the MNO does not address the actual problems that customers face, churn is inevitable. Under this circumstance, Equations 14 and 15 show how the churn rate is determined.

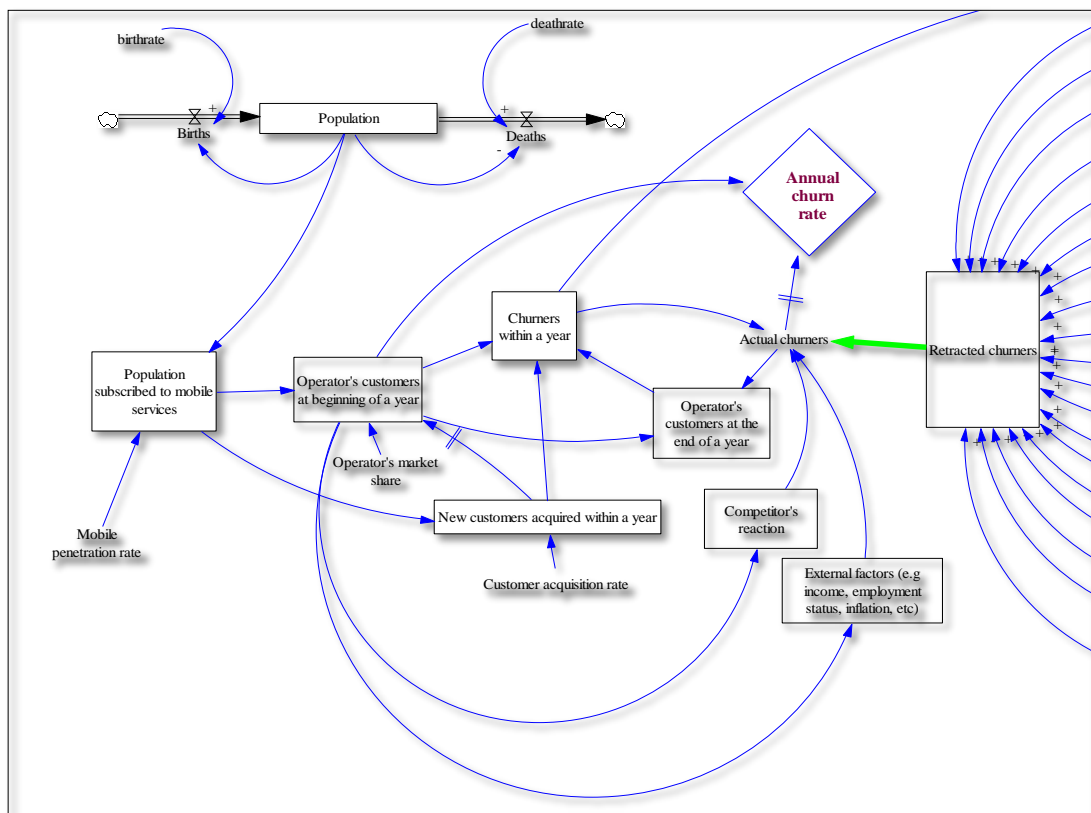


Figure 49: Design of churn management model with feedback

$$\text{Churn rate with feedback} = \left(\frac{\text{Actual churners}}{\text{Operator's customers at beginning of a year}} * 100 \right) \quad (14)$$

Equation 15 gives an expanded view into the parameters surrounding Equation 14. Equations 15 (a) up to (t) further expands the numerator of Equation 14 and 15.

$$\text{Churn rate with feedback} = \left(\frac{(\text{Churners within a year} + \text{External factors} + \text{Competitor reaction} - \text{Retracted churners})}{\text{Operator's customers at beginning of a year}} * 100 \right)$$

(15)

Where;

- (a) Retracted Churners = (Customer care improvement + Acquaint and train staff on products + Call backs on potential churners + Churn and social media campaigns + Commission latest technologies on the market + Counter offering competition's initiatives + "Customer life-cycle management" + "Improve brand & product visibility" + Improve quality of the network + "Improved convenience of stores & office locations" + Increase network coverage + Loyalty programs + Promotional freebies + Reduce cost of services + "Resolution of billing errors" + Segmented customer management + Special offers for potential churners + Stock trendy phones at stores + "Train staff in customer service delivery & handling")
- (b) Customer care improvement = Poor customer care + Unreliable customer service line = ((0.115 * potential churners) + (0.046 * potential churners))
- (c) Acquaint and train staff on products = Unknowledgeable employees + Poor problem resolution = ((0.012 * potential churners) + (0.042 * potential churners))
- (d) Call backs on potential churners = ((0.2 * Customer needs not being met) + (0.2 * Not feeling appreciated) + Unsolicited messages and others) = ((0.2 * 0.037 * potential churners) + (0.2 * 0.04 * potential churners) + (0.013 * potential churners))
- (e) Churn and social media campaigns = ((0.2 * Customer needs not being met) + (0.2 * Not feeling appreciated)) = ((0.2 * 0.037 * potential churners) + (0.2 * 0.04 * potential churners))
- (f) Commission latest technologies on the market = Lack of latest technology = (0.13 * potential churners)
- (g) Counter offering competition's initiatives = (0.4 * Competition's offers) = (0.4 * 0.096 * potential churners)
- (h) Customer Life-cycle management = (0.2 * Customer needs not being met) = (0.2 * 0.037 * potential churners)
- (i) Improve brand & product visibility = Poor products' availability = (0.033 * potential churners)

- (j) Improve quality of the network=Poor network quality = $(0.8*0.174*\text{potential churners})$
- (k) Improved convenience of stores & office locations = Office store's location = $(0.018*\text{potential churners})$
- (l) Increase network coverage = $((0.2*\text{Poor network quality}) + \text{Poor network coverage}) = ((0.2*0.174*\text{potential churners}) + (0.043*\text{potential churners}))$
- (m) Loyalty Programs = $(0.4*\text{Not feeling appreciated}) = (0.4*0.04*\text{potential churners})$
- (n) Promotional freebies = $((0.4*\text{High cost of services}) + (0.6*\text{Competition's offers})) = ((0.4*0.141*\text{potential churners}) + (0.6*0.096*\text{potential churners}))$
- (o) Reduce cost of services = $(0.6*\text{High cost of services}) = (0.6*0.141*\text{potential churners})$
- (p) Resolution of billing errors = Billing errors + Loss of airtime + Hidden charges = $(0.139*\text{potential churners})$
- (q) Segmented Customer Management = Customer needs not being met = $(0.037*\text{potential churners})$
- (r) Special Offers for potential Churners = $((0.2*\text{Customer needs not being met}) + (0.3*\text{Not feeling appreciated})) = ((0.2*0.037*\text{potential churners}) + (0.2*0.04*\text{potential churners}))$
- (s) Stock trendy phones at stores = Lack of trendy phones
- (t) Train staff in customer service delivery & handling = Impolite customer service employees = $(0.016*\text{potential churners})$

All the values used in the sub-expressions (a) up to (t), are actual findings from the survey results in part section 4.2. The rate of contribution of each factor to customer churn is calculated as the number of times it actually led to churn for the customers interviewed, compared to all other factors. If the MNOs have to win the customers back, they need to exert an effort that is equal to, or that exceeds the potential of particular factors to lead to churn. The actions of the MNOs stated in Table 9, were not sufficient to cover especially problems that were related to customer experience. Hence, actions of MNOs used in this model are those of Table 9, as well as additional strategies proposed by the researcher, that MNOs need to explore in order to minimize churn to the barest minimum. Figures 50 up to 54 show the result of the variables in the numerator of Equation 15.

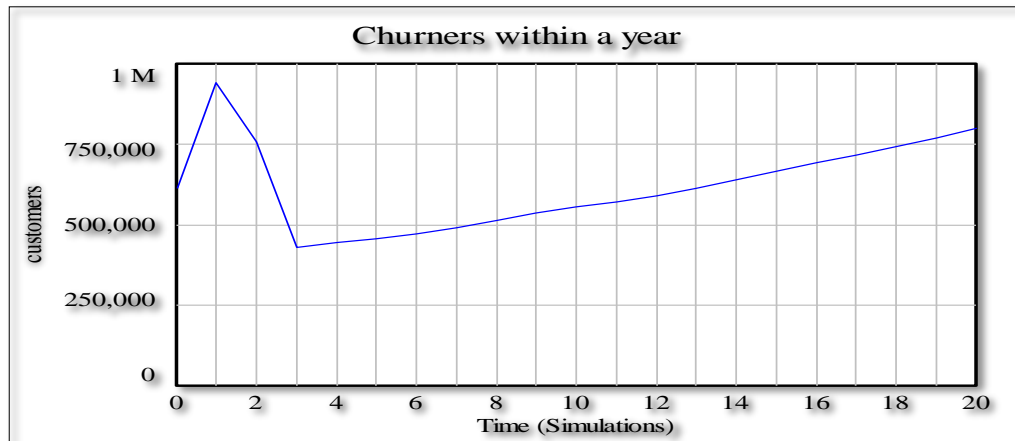


Figure 50: Churners within a year

Churners within a year are calculated from Equation 16 below, with values as indicated in Figure 50. The initial churn rate of 6.15 percent of an MNO’s customers is the average of the annual churn rate experienced by the three MNOs as represented in Figure 32. During the course of the initial year, the MNO does not apply any action, thereby increasing the number of prospective churners. The MNO begins to apply actions to mitigate churn in year 1, and as Figure 50 shows, the number of churners begins to decrease drastically. This is because in the feedback, the large number of churners reduces the effective customers that an MNO has at the end of the year.

$$\text{Churners within a year} = (6.15/100) * \text{Operator's customers at beginning of a year} \quad (16)$$

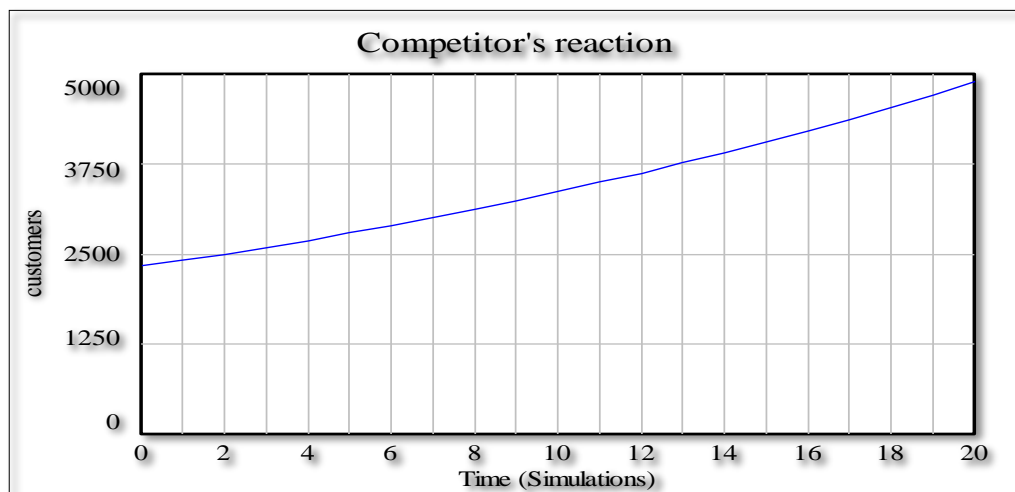


Figure 51: Churners due to competitor reaction

Figure 51 shows the number of customers that churn due to competitor reaction only. The values are determined using Equation 17. The MNOs estimated that between 2010 and 2015, and estimated 0.5 percent of the total customer base churned due to competitor reaction. The ratio of the customers that churned due to competitor reaction was an average of the customers that churned during periods when competitors ran aggressive promotions and the incumbent MNOs. Each MNO felt that the number of customers who defected was not very big. This was because of the various advantages that each MNO felt they had over their competition. Airtel, MTN and ZAMTEL felt that about 0.18, 0.92 and 0.43 percent of customers churned when a competitor launched a promotion.

On average, the MNOs felt that about 0.9 percent of the customer base churn due to direct or indirect economic factors. The number of such customers is as shown in Figure 52. MNOs stressed the point that even though the employment levels are low in Zambia, customers still manage to stay subscribed to mobile services. The heavy weighting of a possible economic factor that could lead to churn was placed on inflation. Based on speculation, the average approximation was that about 0.9 percent of customers would terminate their services due to high cost of living. The MNOs mentioned that in most cases, when the cost of living is high, subscribers only spend less on network resources but rarely terminates subscription to mobile services.

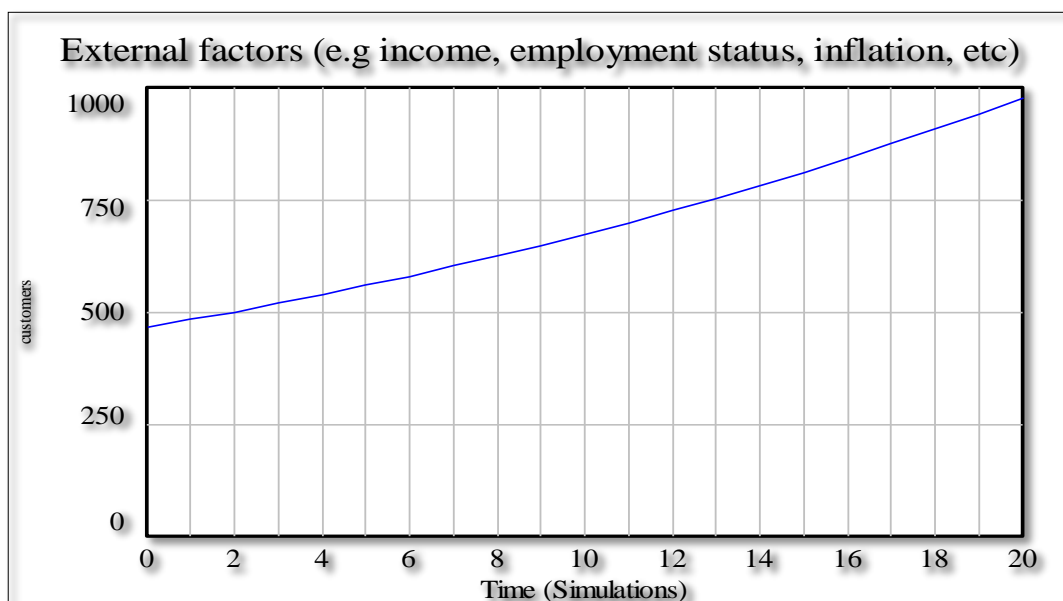


Figure 52: Churners due to external factors

$$\text{Competitor reaction} = (0.0005 * \text{Population subscribed to mobile services}) \quad (17)$$

$$\text{External factors} = (0.0009 * \text{Population subscribed to mobile services}) \quad (18)$$

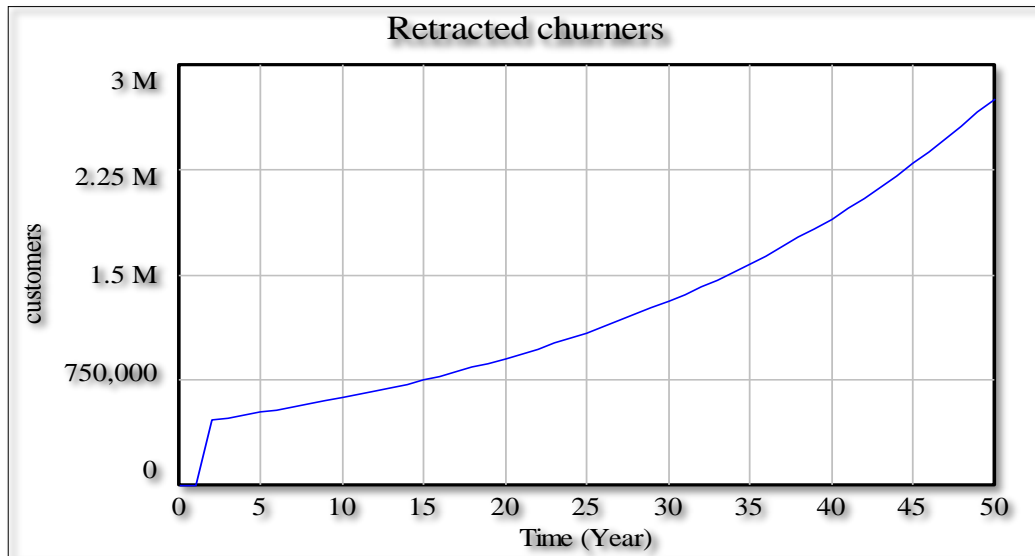


Figure 53: Retracted churners result

The result of Figure 53 shows the number of customers that retract as an effect of the actions of the MNO. This result shows that in the first year when the MNO does not apply any action, no customers retract from churn. Instead, customers churn as shown in Figures 50 and 54. A positive result on customers who retract from churn is observed after the second year after MNOs take mitigation actions.

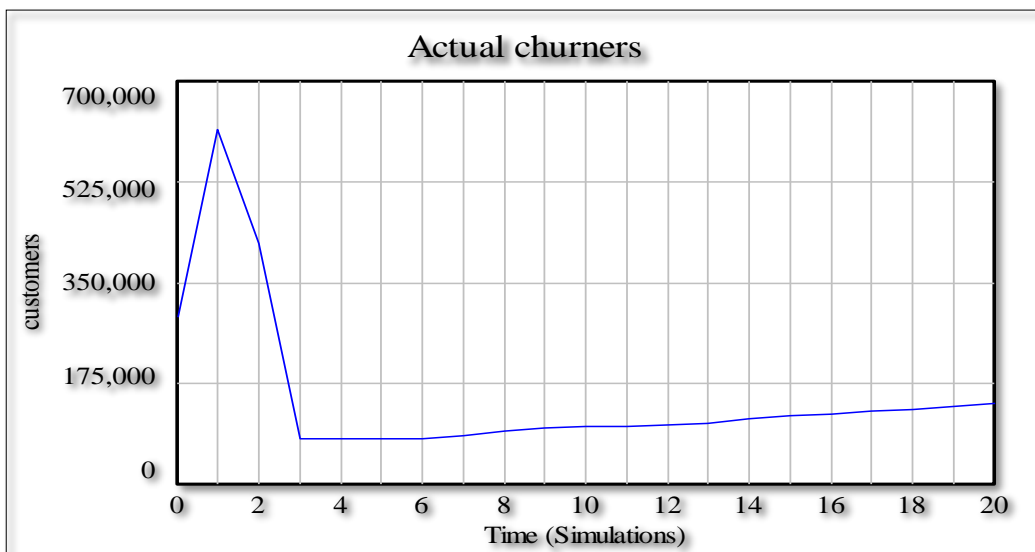


Figure 54: Actual churners with feedback

The annual churn rate of a churn management model with feedback evolves as shown in Figure 55. In the initial simulation or year, which is the area between point A and B, the annual churn rate remains constant at 6.15 percent. During the course of the first year, the MNO does not implement actions that address the challenges that customers face. As a result, churn rate rises as represented by the growth from point B to point C of Figure 54. The annual churn rate begins to reduce in the second year when MNOs apply actions to the problems that the customers face. The points C to D show a gradual decrease in the annual churn rate for the MNO used in the simulation.

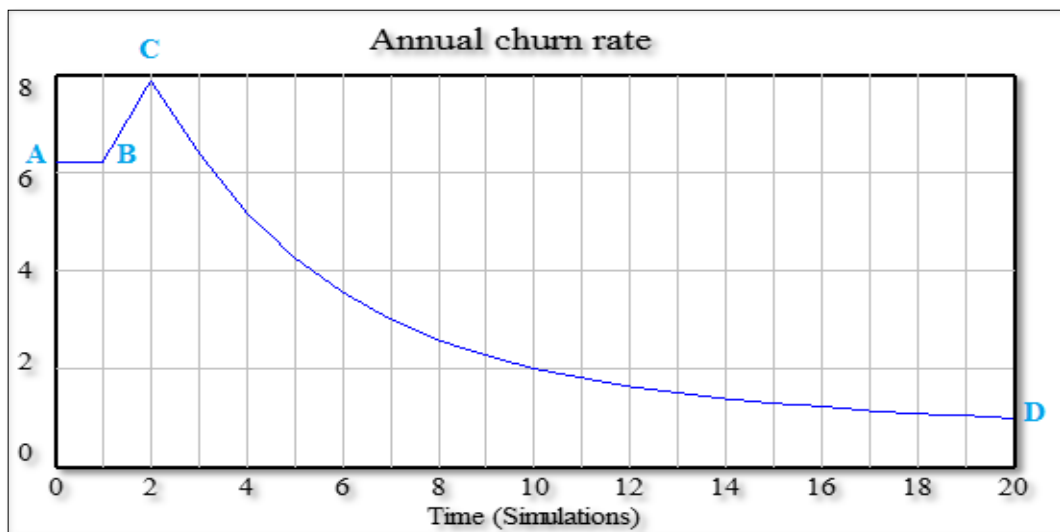


Figure 55: Annual churn rate with feedback

The results of Figures 49 up to 55 show the evolution of variables used in the model designed for use in churn management. The information gives an intelligent indication of how factors such as subscriber trend and churn rate of an MNO would fare in a case where the MNO acts to address the problems customers face. As Figure 55 shows, the churn rate may worsen if mitigation actions are not taken in good time. Churn rate can also increase if the MNO implements actions that do not directly resolve the problems that the customers face.

With the design shown in Figure 35, churn rate can be managed in a case where the MNO knows the exact reasons why their customers want to terminate services and implement actions that directly address them. MNOs need to maintain a good relationship with customers so that they get feedback, which enables them to improve their operations and serve their customers better.

(d) Annual churn rate without feedback

This section discusses the behaviour of the churn management model in a case where there is no feedback. Figure 56 contrasts Figure 49 in that it has no feedback loop. The feedback loop of Figure 49 established the relationship between customers with high propensity of churning and those who actually churn after the intervention of the MNO. In Figure 56, the MNO does not intervene. Instead, customer's challenges remain unresolved. In this scenario, churn rate is determined as shown in Equation 19.

$$\text{Churn rate without feedback} = \left(\frac{(\text{Churners within a year} + \text{External factors} + \text{Competitor reaction})}{\text{Operator's customers at beginning of a year}} * 100 \right) \quad (19)$$

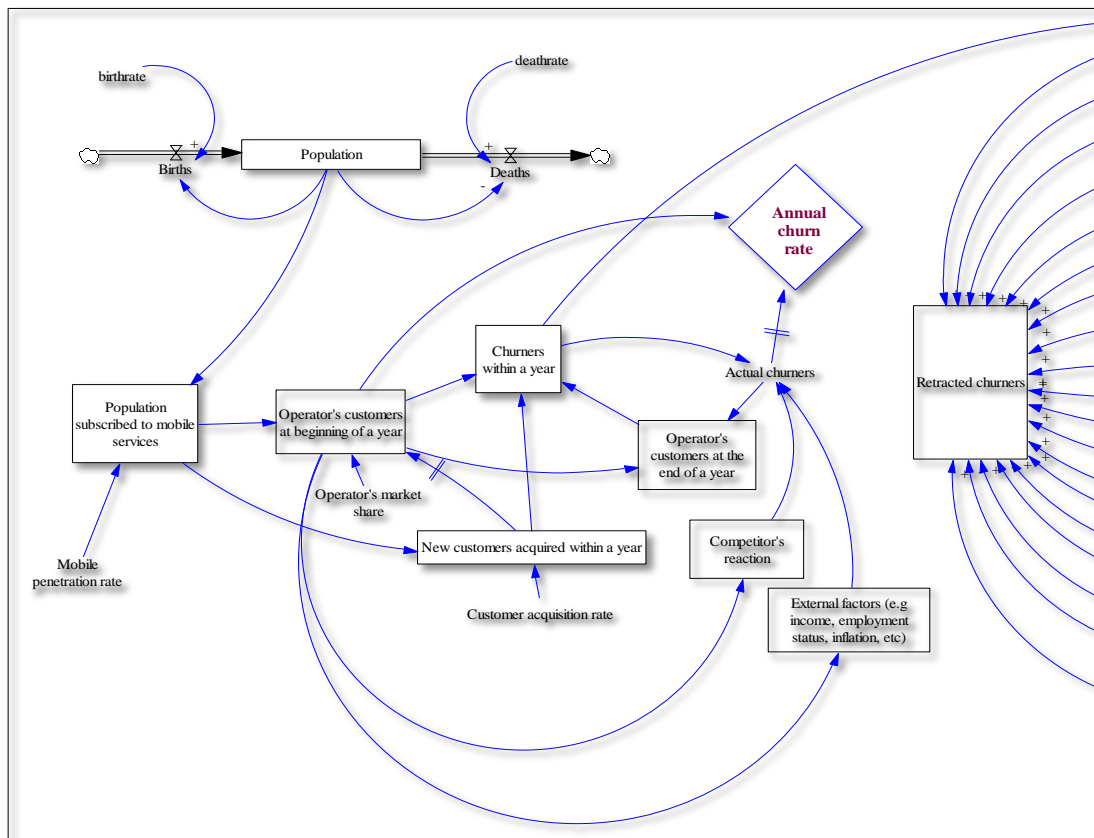


Figure 56: Design of churn management model without feedback

Notice that in contrast to Equation 15, the numerator of Equation 19 has no retracted churners due to the absence of the feedback loop. Compared to Figure 55, the annual churn rate in the initial years of Figure 57 remains constant at 6.15 percent. At the end of the second year, the churn rate is around 8.04 percent.

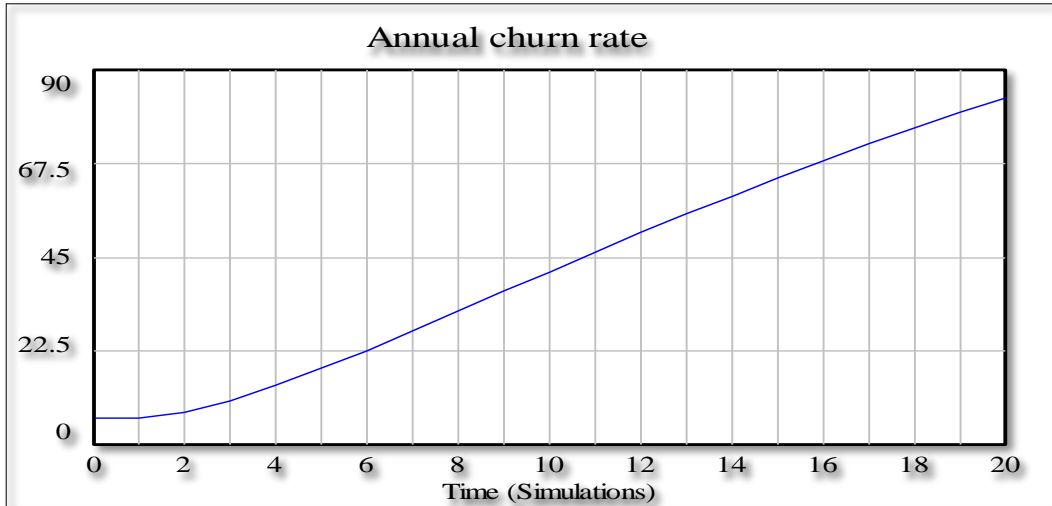


Figure 57: Annual churn rate without feedback

If churn is not controlled, the MNO could risk losing its customers to the competitors. This is shown in Figure 57 where by the 20th simulation time, the churn rate rises to about 83 percent.

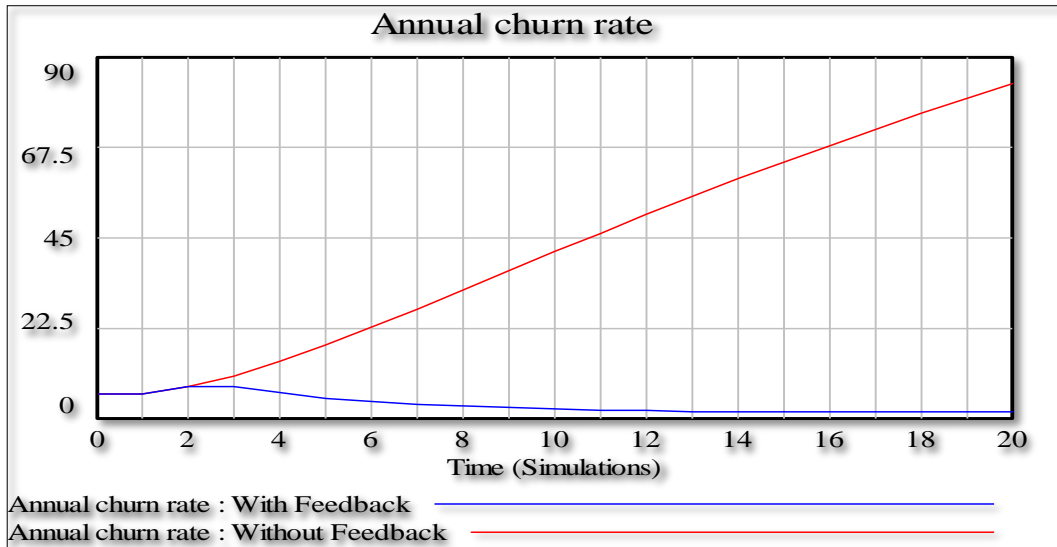


Figure 58: Churn rate with and without feedback

Figure 58 shows the annual churn rates for the cases where the MNO takes action and when it does not by combining Figures 55 and 57. This result shows that it is detrimental for MNOs not to address the problems that customers face. In a case where the customers continue to feel frustrated and their problems not addressed, the MNO may lose revenue and most if not all of its customers to the competitors.

4.3.4 Dynamism of factors that lead to churn

Figure 59 shows how the number of customers who actually churn evolves for variable delays by MNO to take action and resolve problems the customers are facing. Figure 59 shows the number of customers who churn when MNO delays for 1, 5, 10 and 15 years. If the MNO takes action in the second year, the MNO has a maximum of about 1,500,000 churners. If the MNO takes action in the fifth year, the number of churners grows up to a maximum of about 1,900,000 in the fifth year. In all of the years shown in Figure 59, when the MNO intervenes, the churners gradually reduce.

The result of Figure 59 show that the number of churners rises with increasing delay on the part of the MNOs to take action. The more the delay, the more the number of customers who defect to the competitors becomes.

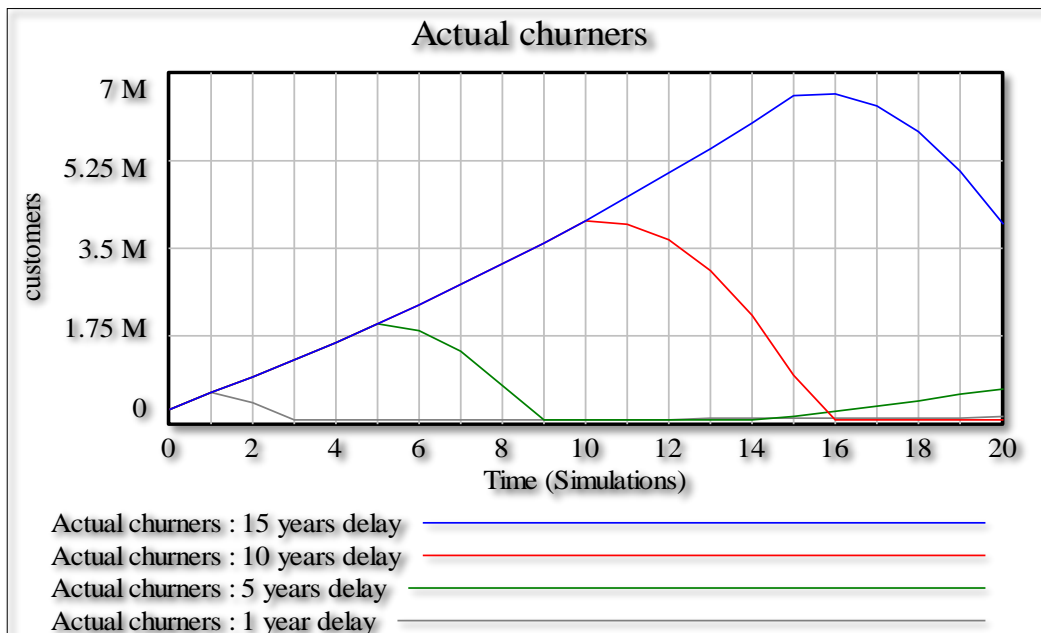


Figure 59: Customers who actually churn with variable delay

The annual churn rates in cases with variable delay are as shown in Figure 60. If the MNO takes action in the second year, the churn rate reaches about 8 percent and begins to fall after second year. If the MNO takes action in the fifth year, the annual churn rates hits 24 percent before it begins to come down. The same happens in cases with 10 and 15 years delay on the part of the MNOs to take action. This is an important result that can help MNOs have a foresight of the churn rates they can anticipate when they do not resolve the customer problems promptly.

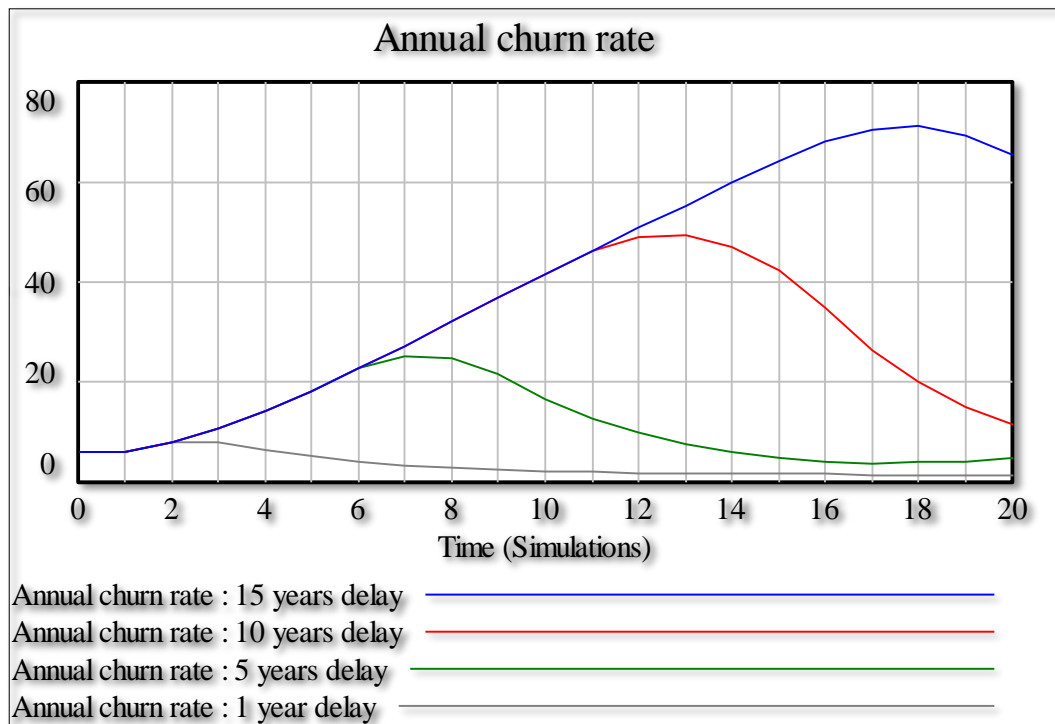


Figure 60: Churn rate with variable delay of MNOs taking action

This result brings to light a very important principle in churn management. Taking an example of the result for 5 years delay, the MNO loses most of its customers in the final year before it takes action. Even so, it is important to note that the MNO still loses many customers both before hitting the peak number of churners as well as during the time when the churn rates undergoes gradual reduction. The impact only minimizes as the annual churn rate approaches the barest minimum.

It is therefore more damaging for business owners to have unavoidable delays on to take action on the problems that customers face. If churn begins to skyrocket, MNOs must ensure that they understand the actual causes before taking actions. It would not be worthwhile to put actions that only address symptoms in place while the actual problem remains unsolved. Implementing actions that do not address the actual problems can lead to a waste of business resources, time and cause unrealistic expectations and unnecessary panic for corporations. If MNOs identify the actual problems in good time, delay will be minimized, leading to reduced churn rate as shown in Figure 60. The challenges customers face will be resolved and they will be in a position to give recommendations to their associates. This will grow the customer base of the MNO and increase their market share and revenues.

4.3.5 Uncertainty of factors that lead to churn

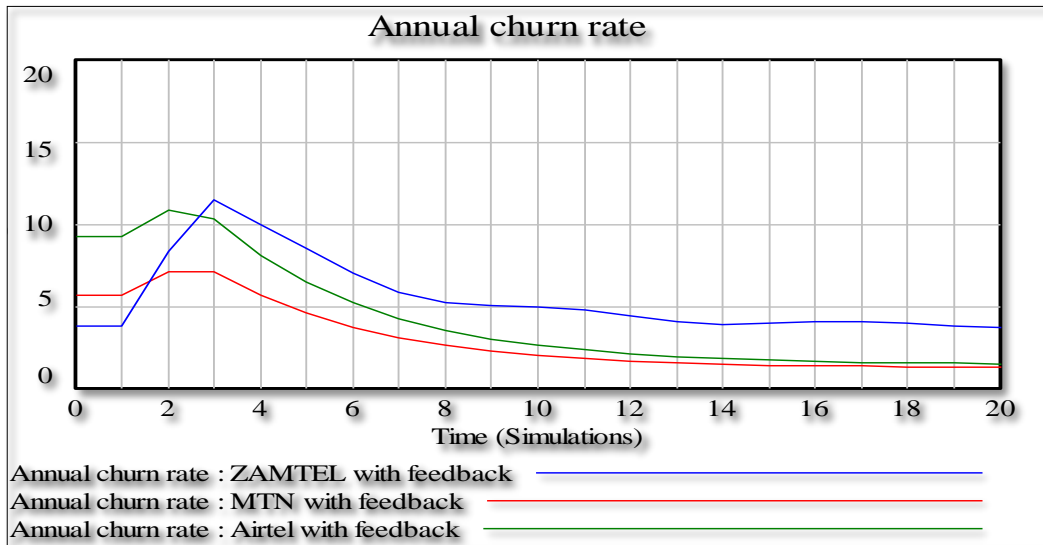


Figure 61: Churn rate over time for the three MNOs with feedback

Initial values: Airtel market share is 40, 47 and 13 percent while annual churn rate is 9.14, 5.58 and 3.73 percent for Airtel, MTN and ZAMTEL respectively. Initial values used in the model are the actual market shares of the three MNOs for the year 2015.

Figure 61 shows annual churn rates for the three MNOs cases where the MNOs take action. This is in contrast to Figure 62 where the MNOs do not take action. For all three MNOs, if action is not taken, the churn rate is expected to grow as shown in Figure 62.

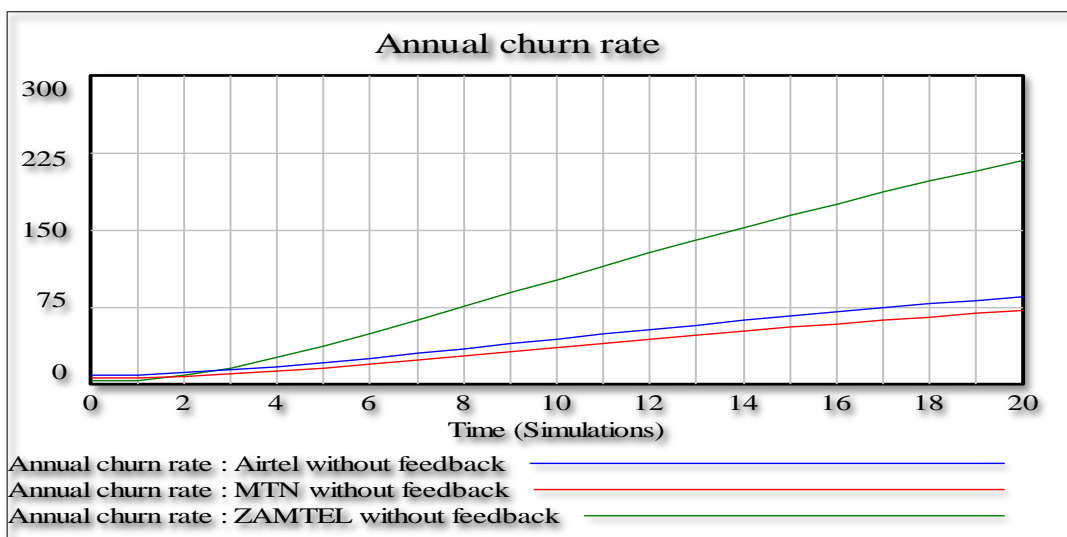


Figure 62: Churn rate over time for the three MNOs without feedback

To study the effects of uncertainty on churn management, the impact of the various factors that lead to churn were altered. In the result shown in Figure 63, the effect of various factors leading to churn is different on the effective annual churn rate.

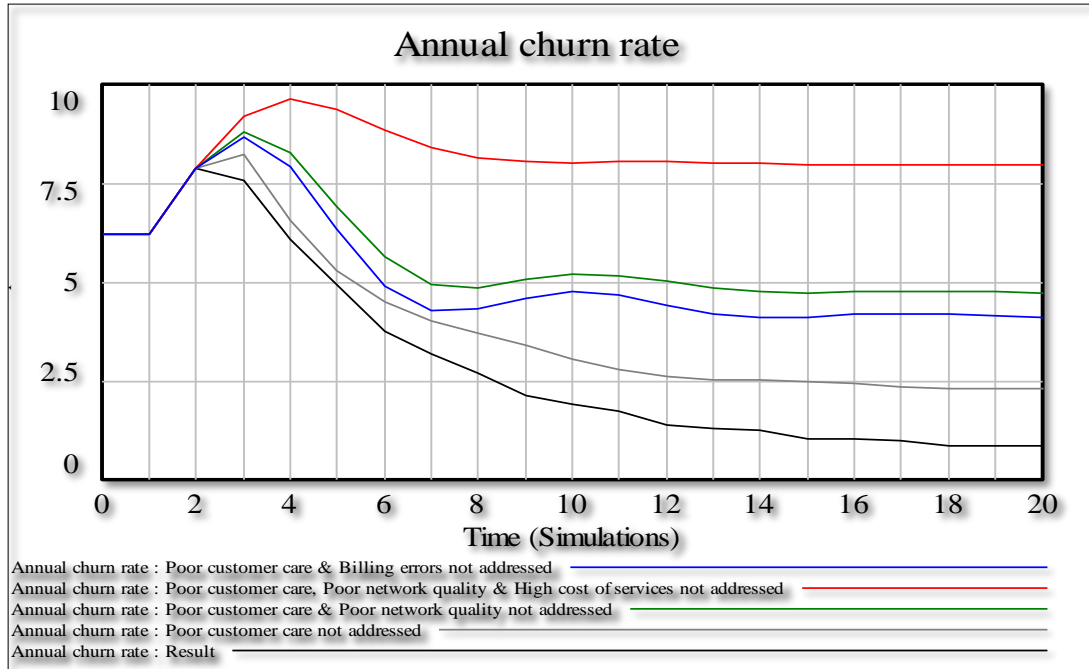


Figure 63: Churn rate with different problems not addressed

The graph at the bottom in Figure 63 is the result obtained when the MNO addresses all problems that customers face as per design in Figure 49. In the case where the MNO does not address poor customer care challenges, the annual churn rate is higher and is shown by the grey graph in Figure 63. In the result of Figure 63 represented by the red line, the MNO does not address challenges related to customer care, network quality and cost of services. The result is that the annual churn rate remains high over a considerable time.

4.4 Summary

The results obtained in this chapter are very essential in that MNOs can study the effect of not addressing certain factors that lead to churn. It can also be useful in a case where the resources required for churn management are not enough to cover all activities required to address all challenges. The next chapter will assess each objectives set in this study and how they were achieved.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

The model designed in this research is able to do churn rate forecasting over a period depending on whether action is taken or not. This chapter describes describe how each of the set objectives were met in this study.

5.2 Discussion

The first objective was to determine the factors that lead to mobile customer churn on the *Zambian telecommunications sector*. Seven hundred mobile subscribers in six district of Zambia were interviewed. The methods used were email surveys, online surveys and interviews using the questionnaire in Appendix 4. Customers who had churned once or more between the years 2010 to 2015 indicated the actual factors that led them to terminate subscription to services.

The results presented in Table 8 shows 20 factors that led to churn between 2010 and 2015. Poor network quality is the leading cause of customer churn in Zambia. It led to about 17 percent of mobile customer churn cases, which took place between 2010 and 2015. The second leading cause of customer churn in Zambia is the high cost of services. The high cost of services logically causes the majority of customers to terminate services with a particular MNO and defect to the one that has cheaper rates under promotions. This logically explains the next result of Table 8, where seeking better promotions with competitors ranks as the third factor leading to mobile telecommunication customer churn in Zambia.

A collection of factors such as the experience of customers in call centres and service centres, how MNO employees handle their concerns and the reception they receive in stores led to about 23 percent of all churn cases as shown in Figure 34. The result of Figure 34 also shows that 54 percent of all churn cases are caused by factors related to customer service, the network or the cost of services. The other 46 percent results 12 other factors related to billing errors, brand visibility, technology and products.

In order to study the strategies that MNOs on the Zambian mobile telecommunication use to prevent churn, the three MNOs that were on the Zambian telecommunications sector as of December 2015 were interviewed. The questionnaire that was used for interviewing MNOs is as shown in Appendix 5.

As discussed under section 4.2.5, there are a number of strategies that MNOs use in order to prevent customers from churning. All three MNOs on the Zambian telecommunications market have invested in tools that are able to predict subscribers who have the highest probability of churning. The tools are able to do so by studying the usage behavioural patterns of subscribers as to whether their revenue contributions to the corporation are increasing, reducing or they remain the same. This set of information, together with other factors such as tenure gives MNOs insight into the likelihood of individual customers to churn.

Once these predictions are run, the MNOs then employ one or more of the actions in Table 9. They may directly contact a customer and ask the specific problems that he or she could be facing. MNOs then take action on the challenges the customer could be facing. They may then give differing freebies or packages to these customers so that they remain loyal on the network. MNOs may also run churn campaigns or market storms, especially for churn observed within a group of customers with similar or same traits such as location, age, or other circumstances.

The results of Table 10 show that while MNOs think that the quality of products and services leads to most churn cases, the subscribers are actually more concerned with the care and courtesy that they receive as customers, as well as the quality of the network. All mobile subscribers felt that they would definitely churn if their incumbent MNO has poor quality of the network. High cost of services was second on the list of factors that subscribers felt would make them churn. About 6 out of 10 customers also felt that they would churn if they experienced poor service and care in the MNOs' call and service centres. The average rating of the MNOs does not reflect the picture of the factors that actually led to customer churn between the years 2010 and 2015. As Table 8 shows, the issues that were highly rated by MNOs led to very small proportions of churn, with opposite priority to the actual picture shown in Table 8.

The last question of the questionnaire in Appendix 3 allowed customers to indicate what MNOs can do in order to satisfy them as an individual customer. Most of the

customers stated that they would like the MNOs to reduce the cost of products and services. The other most frequent factors were that MNOs should offer better network quality on both data and voice. Very few customers touched on the factors on products, services and technology, which are major concerns for the MNOs.

The results of this research show that MNOs speculate and assume the major concerns of the MNOs. The results obtained could be an indication that that the products and services offered by all three MNOs are the same and indistinguishable. Hence, a mobile subscriber would rather have their problems resolved by the incumbent MNO and not switch. MNOs can therefore strike a subscriber in a much greater sense by courtesy and care when handling their concerns. It is important that MNOs understand what customers really want. This could help them to determine and apply the correct remedies to the distinct problems that customers face, so that they remain loyal to the MNO. MNOs can use tools to ensure that they get the accurate details of the problems that the customers are facing.

The second objective focussed on determining the extent of the dynamism and uncertainty of factors that lead to churn on churn management. The simulation model designed in Figure 49, using input from the survey addressed this objective through a simulation. Results obtained show that the MNOs are not proactive to the changes in the environment and the telecommunications market. Most of the times, MNOs normally watch what their competitors are doing and replicate it. The results of Figure 59 also showed that if MNOs are not proactive to changes in these factors, it can lead to long delays and heightened churn rates. It is essential that MNOs are alert to the changes and interactions of the factors that lead to customer churn so that they apply remedy in good time and minimize churn rate. Changes around the factors that lead to churn can reduce or heighten churn rate. In this research, the effect of uncertainty on churn was observed by varying the input variables of the simulation model built in Vensim to see the change in the churn rate value.

As demonstrated in the results obtained under section 4.3.5, variations in the weighting of factors that lead to customer churn can lead to different expectations in the value of churn rate. The results of Figure 62 gives a great insight into what could happen when

the weighting that a certain factor has increased or reduced. This increase or reduction can result from emergence of new factors that arise due to changes in the environment. It can also be caused by emergence of new strategies by competitors on the markets, which could require competing MNOs to change their plans. Hence, uncertainty can increase or reduce the number of churners for a particular MNO.

A learning model, can be built after observing behaviour of a system over time. This objective has been well achieved in this research. The system dynamics model designed in this research has high flexibility in terms of input figures or initial values, and can be used to study the behaviour of a churn model over time. The complete design of the churn management simulation model presented in Figure 35 shows about four major sections.

The factors that lead to customer churn form a cardinal part in the model. This input is weighted on the potential churners that could have been predicted from another model, or ascertained using the average annual churn rate that a corporation would expect. In this research, the model is able to show the evolution of the parameters used in churn management over 20 trading periods represented by simulations.

The factors used in this model interact as outlined in sections 4.3.1 and 4.3.2. The causes tree analysis feature was used to study the relationships that exist between national population, the subscribers that an MNO has, the factors that lead to churn, the actions of the MNOs and the number of churners and retractors. These relationships confirm the definition of the system as defined in Figure 7.

As stated under the aim, the purpose of this model is for strategic decision making by management in MNOs. This objective was achieved through surveys and the simulation model built using the Vensim software. The results of the survey outlined in section 4.2 were used as initial inputs into the churn management model. The model was then subjected to different tests and the results are as discussed in section 4.3.

The simulation churn management model designed is able to ascertain churn rate over 20 simulations or more. The model designed under this research can provide a lot of insight for MNOs' management when making strategic decisions. A simulation model

that accommodates environmental dynamism can assist in deciding which action or MNOs takes priority and which ones can be delayed. The effects and churn rates for the individual factors and actions can be forecasted, from which opportunity costs for distinct decisions can be deduced.

Results of Figure 59 show that the dynamism and uncertainty of the factors that lead to churn can cause delays on the part of the MNOs to take action. In such cases, the churn rates heighten with each trading period that comes, and can lead to significant losses of revenues. On the bright side, this model can be used by MNOs in resource planning and allocation by identifying factors with the most damaging effects on churn. In most businesses where resources need to be economically and efficiently used, this model becomes very useful.

The results of Figures 61, 62 and 63 show valuable insights on what MNOs can expect with or without their intervention. The results also show what churn rates MNOs would expect in the next 20 trading periods after 2015 if they take action and resolve MNO problems or not. On the Zambian market, all MNOs want to keep the subscribers that they have satisfied with products and services.

The use of system dynamics in churn management is a field that has not been exploited. The current approaches that MNOs use in Zambia predict customers who are likely to leave. The churn analysts extract this raw data and segment the customers for the purpose of giving them offers that best suits them. Other models only store the usage pattern of customers, from which churn analysts make decisions. There is no tool in the Zambian mobile telecommunication sector that allows for a forecasted view of churn rate under varying circumstances or feedback review.

In a developing country such as Zambia, MNOs need to grow their market share and they can succeed by retaining the customers they have and acquiring new ones. This is very important because as literature shows, customers with higher tenure offer more financial benefits to MNOs than existing ones. Retaining already existing customers also lessen provisioning and operational costs by the MNOs. Therefore, in order to challenge customer churn, MNOs need to know where to focus their energies and resources in churn management. This model provides the insight just needed to do to win this battle.

5.3 Conclusion

In conclusion, the results of this research have met the set objectives. About 20 factors have been determined as taking the lead in causing mobile customer churn in Zambia. The leading causes of customer churn are related to the quality of the network and the experience that customers receive during any interaction with the MNOs' products, services or even employees. Results also shows that most of the customers terminate services due to high costs of subscription.

MNOs address the problems that customers face using the tactics discussed in section 4.2.5. Results of the survey discussed in section 4.2.6 reveal that usually, MNOs do not clearly understand the problems that customers face. MNOs also indicated that some problems that cannot be managed to the exact satisfaction of all customers. A good example is the high cost of services, which leads to about 14 percent of all churn cases on the Zambian mobile telecommunications market annually. MNOs mentioned that they would not price all their services and products at extremely low rates that may have irrecoverable effects on the profitability of their corporations. This result tallies with the literature discussed in section 2.6, which pointed out that some churn preventive measures can cause havoc on the performance of MNOs, increase churn rate or do both.

The variations in the ratings presented in Figure 34 and Table 10 are a further confirmation on how differently customers and MNOs perceive the degree of the impact these problems have. MNOs worry that customers are not getting the best out of their products and services. Customers however complain about network quality and poor customer care. This is a big gap, because MNOs are applying remedies to the wrong problems.

Different aspects of the environment such as economic factors, delays by MNOs to take action and abrupt changes in terms of which problems take the most weight have differing effects on churn rate. Sections 4.3.4 and 4.3.5 show results of churn rate under differing circumstances. The dynamism and uncertainty of the factors that lead to churn can lead to an increase or a reduction of churn rate. A study of the extent to which these factors affect churn as discussed in Figures 59 and 63, becomes very insightful to MNO management in resource management.

In conclusion, the aim of this research has been achieved. A churn management tool, which takes the dynamism and uncertainty of factors that lead to customer churn, was designed. This model forms a learning model, which is usable in strategic decision making in churn management. The tool can be used in setting priorities when taking action on the problems that customers face. The behaviour of the model can be studied for several trading periods, a feature that MNOs can use when faced with making decisions related to opportunity cost and strategy. Like other corporations, MNOs are interested in maximizing the revenue returns. This can be achieved by maximizing the ARPU, minimizing churn, growing their market share through acquisition of new customers and having a strategic roadmap on the development of their products and services.

5.4 Challenges

One challenge faced, which also cost me a lot of time is in terms of results compilation when using different data collection techniques. I had results on hard copy documents, soft copy documents received via mail as well as online. It was a challenge to compile results for 700 respondents into single format that was easy to analyze.

There are currently not so many applications that have been devised which are using system dynamics. Building the model in itself was quite an exciting challenge, with lots of learnings along the way. At times, it totally drained the energy out of me, because I could be stuck and not know how to proceed. Modelling was also challenging in that I would have hoped for the system to have real time graphics. This would have made it possible for the system to flag the most weighted problem customers face and propose a solution. This however had to be accomplished by use of direct arrows, which are static.

Vensim is also not capable of computing simultaneous equations. This was also a challenge in that simultaneous equations are unavoidable in closed loop feedback. Using the Personal Learning edition (PLE) version of Vensim, there were many functions that I could not fully explore. In higher versions of the software, I could have had an option of varying even the constants that were put into this model.

5.5 Recommendations

One of the many questions I came across during this research was the justification as to whether churn really exists in the telecommunication industry or not. The arguments have much to do with the possibility that a subscriber can have multiple sim connections, hence just switching between alternatives with better offers and not necessarily churning. Results of this research affirmatively attest to the fact that churn exists, with both the MNOs and the mobile subscribers backing this result. However, it would be an interesting research area to undertake, not just for the Zambian market but anywhere else in telecommunications.

To enhance the practicability of this model, it would add a lot of value to be able to couple this model with a tool that actually predicts churners in order to ascertain the potential churners. This in collaboration with other demographic factors such as the location of the customers would form distinct clusters of mobile customers facing the same or similar problems. Some of the factors that mobile subscribers face could be common among age mates, a community or other economic factors. It would also be valuable to test a churn management model that works in conjunction with a mobile application or a prediction tool on a real time network.

A further research can be done on the results of the surveys for both the mobile subscribers and MNOs. In this research, the factors that lead to churn and actions of MNOs have been presented at high-level because it was required as an input into a simulation model. A research can be undertaken to understand the factors surrounding the individual causes of churn and the opinions of the MNOs.

5.6 Summary

A system dynamics model that gives insight to MNOs in the face of uncertainty was successfully designed. This tool can be used by MNOs to make informed strategic decisions. Unlike the churn management approaches used in Zambia, system dynamics provides for feedback loops that allow MNOs to review their performance. This allows MNOs to make amends and lower churn rate to a minimum. System dynamics can also be used to solve challenges in other industries.

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APPENDIX

Appendix 1: Definition of Key Terms

1. **Customer/Subscriber:** A customer is someone who pays for goods or services. In this research, the term customer refers to an individual who subscribes to a certain service in the mobile telecommunications industry [55]. The word subscriber will be used interchangeably with customer in this research.
2. **Churn rate:** The percentage rate at which customers stop subscribing to a service for a defined period. This is calculated as the number of customers who stop subscribing to services compared to the total subscriber base at the beginning of a specific period. In the telecommunication industry, churn rate is commonly measured per monthly or yearly time period referred to as monthly churn rate or annual churn rate.
3. **Dynamic:** Something dynamic is characterized by action, forcefulness, or force of personality [13, 55] . Similar words to dynamic are changing and varying [55].
4. **Feedback:** The process in which part of the output of a system is returned to its input in order to regulate its further output [55].
5. **System:** Instrumentality that combines interrelated interacting artifacts designed to work as a coherent entity or a group of independent but interrelated elements comprising a unified whole [39].
6. **System Dynamics:** System dynamics is a methodology for studying and managing complex feedback systems [22]. These systems have parameters that often change at any point in time, and by so doing have a bearing on the output values.
7. **Telecommunications:** The branch of electrical engineering concerned with the technology of electronic communication at a distance [55]. In this research, the electronic communication section considered is the mobile telecommunications industry.
8. **Mobile Network Operator:** Refers to an institution which provides mobile telecommunication services. These terms will be used interchangeably in the research.

Appendix 2: Budget

RESEARCH ACTIVITY	QUA	UNIT COST (ZMK)	TOTAL COST (ZMK)
1 Questionnaires			
1.1 Printing 700 questionnaires, 20 pages each.	14,000	2	28,000
1.2 Survey monkey operating licence at USD26	1	325	325
			28,325
(v) Questionnaire distribution logistics			
5.1 Mbala			
• Two trips transport	4	200	800
• Six days lodging	6	400	2,400
• Meals	18	50	900
5.2 Luangwa			
One trip transport	4	150	300
• Two days lodging	6	450	900
• Meals	6	50	300
5.3 Chibombo and Chongwe			
• Three trips transport	9	100	900
			6,500
(vi) Questionnaire distribution field work costs			
6.1 Mbala	64	4	256
6.2 Luangwa	16	5	80
6.3 Kafue	68	4	272
6.4 Chibombo	88	5	440
6.5 Chongwe	59	5	295
6.6 Lusaka	478	6	2,868
			4,211
(vii) System design			
7.1 Purchase of computer		4,500	4,500
7.2 Professional simulation software licence purchase		7,800	7,800
			12,300
5 Journal works & report writing			
5.1 Accessibility to reference works for similar works	5	420	2,100
	1	1,200	1,200
5.2 Submissions & acceptance processing fees	260	5	1,300
5.3 130 pages colour printing for two copies	2	450	450
5.4 Binding			5,050
6 System dynamics conference (<i>if accepted</i>)			
6.1 Travel	1	18,000	
6.2 Lodging & Logistics (7 nights)	1	7,000	
6.3 Application Fees	1	1,600	
			26,600
Contingencies	1	500	500
Total			62,486

Appendix 3: Table of tools used to study each research question

OBJECTIVE	METHODOLOGY	METHOD	TOOLS
1. To determine the factors that lead to customer churn on the Zambian mobile telecommunication market, the strategies that MNOs use to prevent customer churn and the gap between needs of customers and actions of the MNOs in managing customer churn.	Mixed mode	- Email Survey -Online Survey - Interviews	-Questionnaire
2. To determine the extent to which the dynamic nature and uncertainty of the factors that lead to customer churn affect churn management.	Mixed mode	- Email Survey -Online Survey - Interviews -System Dynamics Simulation	-Questionnaire
3. To devise and design a system dynamics model using the interactions of the factors that lead to customer churn, that can help in decision making on churn management.	Mixed mode	- Email Survey -Online Survey - Interviews -System Dynamics Simulation	-Questionnaire -Vensim Simulation Software

Appendix 4: Questionnaire used for mobile customers



THE UNIVERSITY OF ZAMBIA

QUESTIONNAIRE: WHAT FACTORS PROMPT MOBILE SUBSCRIBERS TO TERMINATE SERVICES WITH ONE SERVICE PROVIDER AND SIGN UP WITH ANOTHER ON THE ZAMBIAN MARKET?

Hello, I am a student at the University of Zambia. Part of my schooling requires me to do research work. I am doing a survey on studying reasons that cause customers to stop subscribing to services with one mobile service provider and sign up with another. I am grateful that you will be one of the respondents on this study. Your responses will remain highly confidential and will only be used for academic purposes.

INSTRUCTIONS:

Please tick or cross on the applicable choices provided, or write where indicated.

SECTION	NUMBER OF QUESTIONS
I	5
II	6
III	8
IV	4

Section I: Personal Information

1. In what age group are you?

- Below 15
- 16 – 25
- 26 – 35
- 36 – 45
- 46 – 55
- Above 56

2. Gender

- Male
- Female

3. Which of the following best describes your occupation?

- Student
- Employed in government
- Employed in private sector
- Business owner (Self-employed)
- Unemployed

4. In which of these ranges does your average monthly income fall? (choose one only)

- ZMK 0 – ZMK 500
- ZMK 501 – ZMK 1,000
- ZMK 1,001 – ZMK 5,000
- ZMK 5,001 – ZMK 10, 000
- ZMK 10,001 – ZMK 20, 000
- ZMK 20,001 – ZMK 50, 000
- Above ZMK 50,000

5. In which district of Zambia do you stay?

Section II: Mobile Service Operator Affiliation Information

Questions 1, 2 and 3 require information on the number of sim cards you have with each provider. Kindly answer only where applicable.

For example, if you have a sim card only for ZAMTEL, skip questions 1 and 2 of this section and only answer question 3 where there is ZAMTEL. If you have both AIRTEL and ZAMTEL, answer only questions 1 and 3 and skip question 2.

1. (A) For **Airtel**, please tick below where applicable.

AIRTEL				
1.1 Number of sim cards for Airtel	1	2	3	More than 3
1.2 How long you have used your current sim card for this operator?	1 year or less	2 years	3 years	___ years
1.3 Between 2010 and today, have you changed a phone number for this operator?	Yes	No		
1.4 If you answered yes to question 1.3, how many times?	1	2	3	More than 3 _____

1 (B) If you have more than one Airtel Sim card, kindly indicate below what they are used for (tick where applicable and write number);

- Number of sim cards used in the phone _____
- Number of sim cards used in the modem _____
- Other devices

Name of device _____

Number of sim cards in the device _____

2 (A) For **MTN**, please tick below where applicable.

MTN				
1.5 Number of sim cards for MTN	1	2	3	More than 3
1.6 How long you have used your current sim card for this operator?	1 year or less	2 years	3 years	___ years
1.7 Between 2010 and today, have you changed a phone number for this operator?	Yes	No		
1.8 If you answered yes to question 1.3, how many times?	1	2	3	More than 3 _____

2 (B) If you have more than one MTN Sim card, kindly indicate below what they are used for (tick where applicable and write number);

- Number of sim cards used in the phone _____
- Number of sim cards used in the modem _____
- Other devices

Name of device _____

Number of sim cards in the device _____

2. (A) For **ZAMTEL**, please tick below where applicable.

ZAMTEL				
2.1 Number of sim cards for ZAMTEL	1	2	3	More than 3
2.2 How long you have used your current sim card for this operator?	1 year or less	2 years	3 years	___ years
2.3 Between 2010 and today, have you changed a phone number for this operator?	Yes	No		
2.4 If you answered yes to question 1.3, how many times?	1	2	3	More than 3 _____

3 (B) If you have more than one ZAMTEL Sim card, kindly indicate below what they are used for (tick where applicable and write number);

- Number of sim cards used in the phone _____
- Number of sim cards used in the modem _____
- Other devices

Name of device _____

Number of sim cards in the device _____

3. (A) When making a phone call, how often do you use your sim card(s) for this network to do so?

		Not very often	Sometimes	When calling someone on the same network	For Promotions only	Most of the time	All the time
1	Airtel						
2	MTN						
3	ZAMTEL						

(B) With reference to your answer in 4 (A), kindly write reasons below in brief for your usage of each operator's services:

AIRTEL: _____

MTN: _____

ZAMTEL: _____

4. (A) For data services (internet) on your phone, modem, router or other personal devices, how often do you use your sim card(s) for this network to do so?

		Not very often	Sometimes	When calling someone on the same network	For Promotions only	Most of the time	All the time
(1)	Airtel						
(2)	MTN						
(3)	ZAMTEL						

		Not very often	Sometimes	For Promotions only	Most of the time	All the time
1	Airtel					
2	MTN					
3	ZAMTEL					

(B) With reference to your answer in 5 (A), kindly write reasons below in brief for your usage of each operator's services:

AIRTEL: _____

MTN: _____

ZAMTEL: _____

5. On average, how much do you spend for the following networks *per month* to use services (calling, data and messages)?

		K0-K50	K51-K100	K101-K300	K301-K500	K501-K1000	K1,001-K5000	Above K5000	Above K5000
1	Airtel								
2	MTN								
3	ZAMTEL								

		K0-K50	K51-K100	K101-K300	K301-K500	K501-K1,000	K1,001-K,5000
(1)	Airtel						
(2)	MTN						
(3)	ZAMTEL						

SECTION III: Mobile Services Termination Information

- Have you ever terminated services for a mobile operator before?
i.e Changing phone number and mobile operator, e.g From MTN to ZAMTEL or Airtel and vice versa.
 - Yes
 - No
- What influenced you to terminate the services?
 - Personal reasons / experiences
 - Social influence

- Both personal reasons and social influence
 - My employer gave me a new sim card with credit
 - Other involuntary circumstances (please write below)
-

1. If you answered YES to question 1, how many times have you done so between 2010 and 2015?

- 1 time
- 2 times
- 3 times
- 4 times
- 5 or more times

3. A. If your answer to question 2 is “personal reasons”, which of the following reasons made you make this decision? (Please tick all applicable ones).


- Poor network quality
 - High call rates / Expensive services
 - Poor call centre customer service
 - Poor service centre customer service
 - Attractive offers by other networks/better promotions
 - Not feeling appreciated
 - Operator’s products not available on the market
 - Operator’s lack of latest technology trends
 - Operator’s location of offices, service centres and stores not convenient
 - Moved to a place where the particular network had no presence
 - My needs where not met / not satisfied with their services
 - Billing errors
 - Hidden Charges
 - Impolite service centre employees
 - Incomplete / Unsatisfying complaint resolution
 - Unknowledgeable employees
 - Unreliable helpline/customer care line (111)
 - Lack of latest phones and other gadgets
 - Others (**please write below**):
-
-

4. A. If your answer to question 2 is “social influence”, which of the following reasons made you make this decision?

- Poor network quality

- High call rates / Expensive services
- Poor call centre customer service
- Poor service centre customer service
- Competition/other mobile service providers had better promotions
- Not feeling appreciated
- Operator's products not available on the market
- Operator's lack of latest technology trends
- Inconvenient location of offices, service centres and stores
- Billing errors
- Hidden Charges
- Loss of airtime
- Impolite service centre/customer care employees
- Incomplete / Unsatisfying complaint resolution
- Unknowledgeable employees
- Unreliable helpline/customer care line (111)
- Lack of latest phones and other gadgets
- Others (**please write below**):

5. On a scale of 1 to 10, please rate how likely each or some of these factors would make you decide to terminate services with a mobile service provider;



		1	2	3	4	5	6	7	8	9	10
(1)	Poor network quality										
(2)	High call rates / Expensive services										
(3)	Poor call centre customer service										
(4)	Poor service centre customer service										
(5)	Operator's products not available on the market										
(6)	Operator's lack of latest technology trends										
(7)	Operator's location of offices not convenient										

(8)	Billing errors	1	2	3	4	5	6	7	8	9	10
	Others (write below):										
(9)		1	2	3	4	5	6	7	8	9	10
(10)		1	2	3	4	5	6	7	8	9	10
(11)		1	2	3	4	5	6	7	8	9	10
(12)		1	2	3	4	5	6	7	8	9	10
(13)		1	2	3	4	5	6	7	8	9	10
(14)		1	2	3	4	5	6	7	8	9	10
(15)		1	2	3	4	5	6	7	8	9	10

6. On a scale of 1-10, how likely are you to recommend the network below to other people?

(1)	Airtel	1	2	3	4	5	6	7	8	9	10
(2)	MTN	1	2	3	4	5	6	7	8	9	10
(3)	ZAMTEL	1	2	3	4	5	6	7	8	9	10

7. From your experience, observations or otherwise, please rate these service providers per factor below;

		AIRTEL	MTN	ZAMTEL
1	Most expensive for calling services			
2	Most expensive for data (internet) services			
3	Best promotions			
4	Best customer service			
5	Best advertisements			
6	Best in terms of products and services			
7	Best in terms of branding			

8	Leaders in technology and innovation			
9	Best appreciates their customers			
10	Best voice network quality			
11	Best data network (internet) quality			
12	Shortest waiting time on customer care line (111)			

SECTION IV: Customer Satisfaction and Customer Loyalty

1. In which year did you first acquire a sim card of your own?

2. Are you still using the mobile number on your first sim-card?

YES

NO

(If YES, proceed to question 3. If NO, please go to question 4).

3. Why have you stayed loyal to this operator with this mobile subscriber?

It was my first number/most family & friends know this number.

I feel that the process of switching to another operator is/would be inconveniencing and time consuming.

Because it is the only mobile operator with presence in my area.

Because the operator meets all my needs.

Because the operator has better services and products than their competition.

Because they reward me for being loyal.

Because I have linked this phone number to other services e.g mobile banking services.

Others (please write)

4. For you as an individual, what would you like your mobile service provider to do for you to keep you happy and satisfied with their products and services?

END

Thank you for your time!

Appendix 5: Questionnaire used for MNOs



THE UNIVERSITY OF ZAMBIA

QUESTIONNAIRE: WHAT FACTORS PROMPT MOBILE SUBSCRIBERS TO TERMINATE SERVICES WITH ONE SERVICE PROVIDER AND SIGN UP WITH ANOTHER ON THE ZAMBIAN MARKET?

I am a student at the University of Zambia. Part of my schooling requires me to do research work. My research is based on customer churn management using system dynamics. The input to my model requires the perceptions of mobile operators and the customers on factors that lead to customer churn.

Your organization, being one of the 3 mobile operators we have in Zambia becomes cardinal both as an operator and a hub of information for most of the customers on the Zambian market. The information requested here will help me to make reasonable and

accurate analysis of the data with reference to the actual situation as you shall indicate. Kindly help add quality to this research work by providing answers to the questions in the 3 sections. Your responses will remain highly confidential and will only be used for academic purposes.

INSTRUCTIONS:

Please tick or cross on the applicable choices provided, or write where indicated.

SECTION	NUMBER OF QUESTIONS
I	3
II	9
III	7
IV	5

Section I: General Information

1. Mobile Service Operator name.

- Airtel
- MTN
- ZAMTEL

2. What is the market share of your customers compared to the Zambian mobile subscriber base?

3. On average, what is the current average % of mobile subscribers that is active (uses a revenue generating service) on a daily basis?

Section II: Churn and Factors that lead to churn

1. Do you have mobile customer churn in your company?

- Yes
- No

2. What mobile subscribers' behaviours give pointers of potential churners? (Please list them below).

- Network usage_____
- Revenue generating activities_____
- _____
- _____
- _____
- _____
- _____

3. With regard to the factors listed in 2 above, briefly explain when a subscriber is classified as a churner.

4. Please provide information for the years below;

Year	Opening Number of Mobile Subs	Closing Number of Mobile Subs	ARPU (ZMK)	Market Share (%)	Churn Rate (%)	Geographical Coverage (%)
2010						
2011						
2012						
2013						
2014						
2015						

5. Which age group(s) of your customers do you feel churns the most in your organization?

- Below 15
- 16 – 25
- 26 – 35
- 36 – 45
- 46 – 55
- Above 56

6. In terms of tenure, which segment of customers do you think are most likely to churn?

- 1 year or less**
- Between 1-2 years
- Between 2-3 years
- Between 3-4 years
- Between 4-5 years
- Beyond 5 years

7. On a scale of 1-10, please indicate the extent (likelihood) to which these factors have *actually* led mobile subscribers to churn in your organization.



		1	2	3	4	5	6	7	8	9	10
1	Poor network quality										
2	High call rates / Expensive services										
3	Poor call centre customer service										
4	Poor service centre customer service										
5	Operator's products not available on the market										
6	Operator's lack of latest technology trends										
7	Operator's location of offices not convenient										

8	Billing errors	1	2	3	4	5	6	7	8	9	10
9	Competition offering better promotions	1	2	3	4	5	6	7	8	9	10
	Others (Please write below);										
10		1	2	3	4	5	6	7	8	9	10
11		1	2	3	4	5	6	7	8	9	10
12		1	2	3	4	5	6	7	8	9	10
13		1	2	3	4	5	6	7	8	9	10
14		1	2	3	4	5	6	7	8	9	10
15		1	2	3	4	5	6	7	8	9	10

8. On a scale of 1-10, please indicate the opinion of your organization on the extent (likelihood) to which *can* lead mobile subscribers to churn. (even if this is not currently happening in your organization)



1	Poor network quality	1	2	3	4	5	6	7	8	9	10
2	High call rates / Expensive services	1	2	3	4	5	6	7	8	9	10
3	Poor call centre customer service	1	2	3	4	5	6	7	8	9	10
4	Poor service centre customer service	1	2	3	4	5	6	7	8	9	10
5	Operator's products not available on the market	1	2	3	4	5	6	7	8	9	10

6	Operator's lack of latest technology trends	1	2	3	4	5	6	7	8	9	10
7	Operator's location of offices not convenient	1	2	3	4	5	6	7	8	9	10
8	Billing errors	1	2	3	4	5	6	7	8	9	10
9	Competition offering better promotions	1	2	3	4	5	6	7	8	9	10
	Others (Please write below);										
10		1	2	3	4	5	6	7	8	9	10
11		1	2	3	4	5	6	7	8	9	10
12		1	2	3	4	5	6	7	8	9	10
13		1	2	3	4	5	6	7	8	9	10
14		1	2	3	4	5	6	7	8	9	10
15		1	2	3	4	5	6	7	8	9	10

9. How did the sim registration exercise affect the following in your organization;

- Market share drop/increase (%): _____
- Active subscribers drop/increase (numbers / %): _____
- Churn rate drop/increase (%): _____
- % Mobile subscribers with more than 1 sim card *on your network*:

Section III: Effects of Churn & Churn Management

1. Please rate how severe the following are as effects of mobile customer churn in your organization.



1	Loss of brand value	1	2	3	4	5	6	7	8	9	10
---	---------------------	---	---	---	---	---	---	---	---	---	----

2	Loss of market share	1	2	3	4	5	6	7	8	9	10
3	Loss of revenues	1	2	3	4	5	6	7	8	9	10
4	Increased activation, deactivation and provisioning costs	1	2	3	4	5	6	7	8	9	10
	Others (Please write below)										
5		1	2	3	4	5	6	7	8	9	10
6		1	2	3	4	5	6	7	8	9	10
7		1	2	3	4	5	6	7	8	9	10
8		1	2	3	4	5	6	7	8	9	10
9		1	2	3	4	5	6	7	8	9	10
10		1	2	3	4	5	6	7	8	9	10
11		1	2	3	4	5	6	7	8	9	10
12		1	2	3	4	5	6	7	8	9	10

2. What preventive measures do you take as an organization to manage competition?

- _____
- _____

3. In your organization, how does the revenue contribution of long-term customers compare with that of newly signed up customer?

4. In terms of revenue value addition, do you feel that a long-term customer who churns can be substituted by a new customer?

Yes Reason: _____

No Reason:

5. What measures does your organization take to manage churn?

6. What value addition have you identified to have helped lower your churn rates if any?

7. As an organization, what do you think you should do /plan to do/ would do (if you had the means) to bring churn rates to the barest minimum?

Section III: How dynamic and uncertain are factors that lead to customer churn?

1. For a particular time in future (near or far), how easy is it to predict what factors may lead to customer churn?

Easy  Difficult

10	9	8	7	6	5	4	3	2	1
----	---	---	---	---	---	---	---	---	---

2. From organizational experience, how would you rate the success of your company in making the correct predictions of what factors may lead to customer churn?

Always correct  Barely correct

10	9	8	7	6	5	4	3	2	1
----	---	---	---	---	---	---	---	---	---

3. What do you use to predict factors that may lead to customer churn?
(Tools & Strategies).

- _____
- _____
- _____

4. How does competition affect your organization's customer churn and retention?

5. What is your normal reaction when competition launches a promotion that seems to heighten churn rates in your organization?

END.

THANK YOU!

Appendix 6: Questionnaire used for ZICTA



THE UNIVERSITY OF ZAMBIA

QUESTIONNAIRE: WHAT FACTORS PROMPT MOBILE SUBSCRIBERS TO TERMINATE SERVICES WITH ONE SERVICE PROVIDER AND SIGN UP WITH ANOTHER ON THE ZAMBIAN MARKET?

Hello,

I am a student at the University of Zambia. Part of my schooling requires me to do research work. I am doing a research on mobile customer churn using a technology called system dynamics. Some of the input data I need for this model is data such as requested in this model.

The information requested from your organization will help with general data clarification at national level, and as a benchmark to the information that the mobile operators themselves will provide. This will help add quality to the result of this research work, considering the credibility of your organization in providing information related to the mobile telecommunication sector.

Kindly help add quality to this research work by providing answers to the 8 questions below. Your responses will remain highly confidential and will only be used for academic purposes.

INSTRUCTIONS:

Please tick or cross on the applicable choices provided, or write where indicated.

1. Kindly indicate the market share for the mobile operators for the listed years;

Year	AIRTEL	MTN	ZAMTEL
2010			
2011			
2012			
2013			
2014			
2015			

2. Kindly provide data for the measures in the table below;

Yr	Opening Number of Mobile Subs	Closing Number of Mobile Subs	ARPU (ZMK)	Market Share (%)	Churn Rate (%)	Geographical Coverage (%)
2010						
2011						

2012						
2013						
2014						
2015						

3. Kindly indicate the reported churn rates per operator in the table below;

YEAR	AIRTEL	MTN	ZAMTEL
2010			
2011			
2012			
2013			
2014			
2015			

8. On the mobile services segment, what is the average revenue per user (ARPU) of the mobile service providers?

YEAR	AIRTEL	MTN	ZAMTEL
2010			
2011			
2012			
2013			
2014			
2015			

9. What is the average revenue contribution of the mobile telecommunication sector for all 3 operators for the years listed below? (Remitted as fees to your organization as a regulator).

YEAR	REVENUE (ZMK)	% OF ANNUAL GOVERNMENT REVENUE
2010		
2011		
2012		
2013		
2014		
2015		

10. As a communications' regulatory authority, what measures have you put in place to control dual sim ownership of mobile subscribers for the same mobile service provider?

11. Is there a regulatory requirement that limits the number of sim cards that an individual mobile subscriber can register or own at once or cumulatively?

- Yes
 No

12. If you answered 'YES' to question 7, kindly quantify the maximum number of sim cards or mobile phone numbers a mobile subscriber can be allowed to register with an individual mobile service provider.

END!

THANK YOU

Appendix 7: Published Research Paper

A Study on Mobile Penetration Rate in a Multi-Simming Environment: The Case of Zambia

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Abstract: There are many ways of measuring mobile penetration rate. In Zambia, like many other countries, mobile penetration rate has been measured using the number of sim connections. This approach, as well as that which uses the number of

phones to measure mobile penetration rate does not give an accurate view of the actual mobile penetration rate. Measurements that determine mobile penetration rate based on number of sim connections might give false information indicating that there is saturation in the mobile telecommunications sector when in fact not. Understanding how number of phones, number of sim connections and number of actual mobile subscribers relate becomes very important. In this study, we use Microsoft excel to analyze and determine actual mobile subscriber penetration rate in Zambia. Data used in this study is based on a survey done on 700 mobile customers in six districts, surveys with the three Mobile Network Operators (MNOs) present in Zambia and the Zambia ICT Agency (ZICTA). Extrapolations were made on the results of the survey, with strict correlation made to fluctuations in population growth as estimated by the Central Statistical Office (CSO) to estimate the approximate actual mobile subscriber penetration rate for the years 2010 up to the year 2030. The results show that multiple sim ownership by mobile subscribers has a large influence on the actual mobile subscriber penetration rate. As of the year 2015, on average, every mobile subscriber in Zambia owned about more than two sim connections. Using our Mobile Penetration Rate Projection (MPRP) method, the actual mobile subscriber penetration rate is projected to be at 58% at end of the year 2030.

Keywords: *Mobile Penetration Rate, Sim Connections, Actual Mobile Subscribers, Zambia*

1. Introduction

Mobile telephony is a fast growing industry all over the world. By the year 2012, the adoption of mobile telephone service was at 76.6% in developed countries, while the global mobile phone adoption stood at over 60% [1, 2].

Most countries allow subscribers to own multiple sim connections with MNOs of their choice. Customers have multiple sim connections for many reasons, especially cutting down costs when making off-net calls [3]. Zambia in particular, allows mobile subscribers to own multiple sim connections. This is in order to ensure fair competition among the MNOs and as a measure towards consumer protection [4, 5, 6].

As of December 2015, there were three MNOs on the Zambian Telecommunication market namely Airtel Zambia, MTN Zambia and Zambia Telecommunication Limited

(ZAMTEL). ZAMTEL is a government owned mobile network operator while Airtel and MTN are owned by the private sector. Figure 1 shows the trend in market share for the three MNOs for the years 2010 up to 2015.

Prior to the year 2010, Airtel dominated the mobile telecommunications sector with a market share a little over 70% in 2009 [7]. MTN later picked on market share and took the market lead just after the year 2013 as shown in Figure 1. ZAMTEL has seen a slight rise in market share, but not aggressive enough to surpass that of Airtel and MTN, which both dominate between 80 to 90 percent of the mobile telecommunication market.

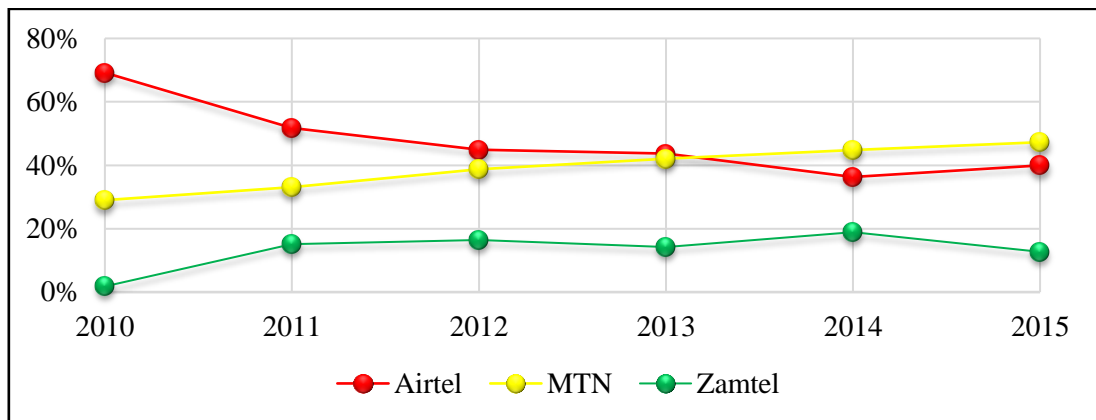


Figure 1: Market Share for MNOs. Source [ZICTA, Interview]

This paper has seven sections. Section 1 gives general information about the Zambian mobile telecommunication industry. It shows market share evolutions for the three MNOs present by end of year 2015. Section 2 discusses literature surrounding the concept of multi-simming and approaches taken in measuring mobile sim penetration rate. Section 3 discusses the MPRP model proposed to use in determining mobile penetration rate in cases where subscribers can own multiple sim connections. It also discusses some of the advantages that this model has, compared to the widely adopted model recommended by GSMA. Section 4 describes the methodology used in this study in detail, with the study approach, sampling technique and data analysis carried out outlined. The results are outlined and discussed in section 5. Section 5 also shows that subscribers do not own multiple sim connections only across but also within MNOs. Further, section 5 shows step by step calculations for the actual mobile penetration rate using the proposed MPRP model. Section 6 summarizes the findings and gives a

conclusion while section 7 points out some of the areas on which future works can be done for this study.

2. Literature Review

Today, there are many ways of measuring mobile penetration rate. Some approaches measure the number of mobile phones, others measure the number of sim connections that are active or mobile connections, while others measure the number of actual subscribers compared to the population in an area under consideration. Most of the reports that are common on the internet today measure mobile penetration by a count of mobile phones and sim connections. For example, in 2014, there was an estimated 7 billion mobile sim connections globally [2, 8], while the number of actual mobile subscribers was stated as 3.6 billion thereby placing the global average actual mobile subscriber penetration rate at 49.9% [1]. Doshi and Narwold [2] reported the global mobile cellular penetration rate to be at 96.2% in 2012 with 6.8 billion mobile subscriptions worldwide.

The dimension taken in measuring mobile penetration matters a lot. This is because the three approaches give different indications and may be advantageous or not depending on how one intends to use the data. Gillet states that dividing the population by the total number of sim connections would not be so accurate. The case of countries such as China, where there are more sim connections than the total population qualifies this statement [1]. The recommendation by the Global System for Mobile Communications Agency (GSMA), is to measure Mobile Penetration Rate (MPR) as in Equation 1 [1].

$$MPR = \frac{\text{Actual mobile subscribers in an area}}{\text{Total population in an area}} * 100 \quad (1)$$

MNOs in Zambia and many other regions measure their mobile subscriber base by counting the actual sim connections on their network [7, 8]. A survey done by ZICTA, which regulates mobile services in Zambia, the Central CSO and the Ministry of Transport and Communications determined that about 51% of people above 10 years of age are active users of mobile phones while about 64.5% of households in the country have access to a mobile phone.

Table 1: Ownership of Mobile Phones in Zambia. Source [9]

INDICATOR	RATIO
-----------	-------

Active users of mobile phones in Zambia	51%
Active users of mobile phones in urban areas	61.8%
Active users of mobile phones in rural areas	38.8%
Ownership of mobile phones among active users	83.8%
Ownership of mobile phones among active users in urban areas	89.2%
Ownership of mobile phones among active users in rural areas	77%

CSO estimated that there were about 10.1 million Zambian individuals above the age of 10 in 2015, who are subscribed to mobile services [9]. The 51% of individuals above the age of 10 translates into about 5.1 Million individuals with access to mobile phones. This report however, does not indicate the approximate number of mobile connections or actual mobile subscribers countrywide. An estimate of the available proportion of actual mobile subscribers was approximated to be at about 29% as of 2009 [10].

As in Table 2, ZICTA reported that as at the end of September 2015, there were 10.9 million mobile phone subscribers, representing a mobile penetration rate of about 70 percent countrywide [5, 10].

Table 2: Mobile Penetration Rate in Zambia. [5, 7]

Year	Mobile Subscribers	National Population	Mobile Penetration Rate
2010	5,237,066	13,092,666	40%
2011	8,500,700	13,493,174	63%
2012	10,595,145	13,583,519	78%
2013	10,352,060	14,580,366	71%
2014	10,099,792	15,074,317	67%
2015	10,925,107	15,473,905	70.6%

According to ZICTA, the mobile penetration rate in Zambia has evolved as shown in Table 2. This study aims at determining the mobile penetration rate on the Zambian market for the years 2010 up to 2030 by comparing the number of actual mobile subscribers to the total national population.

3. Proposed MPRP Model

According to a research done by Doshi and Narwold [2], the International Telecommunication Union (ITU) reported that the mobile penetration rate in developed countries was 128 percent for the year 2012. This typical scenario shows how much mobile penetration rate estimates can be distorted when the number of sim connections is used instead of actual mobile subscribers in measuring mobile penetration rate. Another example which shows distortion is found in a report [11] which stated that developed markets are growing slowly because the market was approaching saturation. While we do not entirely dispute this fact, it would be much more accurate if the report [11] also acknowledged the fact that multi-simming was inflating Figures, thus causing this saturation.

Research [1, 8, 11] shows that there will soon be as many mobile connections as people on the planet, a great milestone in itself for the telecommunications industry. This however does not mean that every person will be subscribed to mobile services because it is possible for a subscriber to own more than one sim connection. Considering this fact becomes cardinal, not only to prospective investors, but also to management in the telecommunications industry. Understanding proper determination of mobile penetration rates in environments where there is multiple sim connection ownership can help in determining the addressable market in a more accurate manner [4, 6, 9].

The GSMA method for measuring mobile penetration rate in Equation 1 [1], does not state explicitly how actual mobile subscribers in an area need to be determined in cases where individual customers can own multiple sim connections. This is inevitable because in most of the countries there are no regulations that ensure that mobile subscribers only have one sim connection [4, 6, 10]. Equation 1 becomes limited in cases where the number of sim connections becomes more than the total population. The result is that the mobile penetration rates will be over hundred percent, a highly impractical scenario.

To prevent such situations, the MPRP model proposed in this paper ascertains the actual number of subscribers of Equation 1, by taking average number of sim connections individual subscribers own into consideration. The key parameters shown in Equation 2 segments the total population in an area according to the number of sim connections owned.

$$\text{Actual mobile subscribers in an area} = \sum_{i=0}^M \frac{(P_i + P_N)}{i} \quad (2)$$

Where;

- a) P_i is the percent ratio of the total population of mobile subscribers that own i sim connections in a particular defined area.
- b) P_N is the total population of mobile subscribers in a particular defined area.
- c) i is the particular number of sim connections under consideration.
- d) M is the maximum possible number of sim connections that an individual mobile subscriber owns.

The upper limit for Equation 2 has been set to a maximum possible number an individual mobile subscriber can own, M in that in a multi-simming environment such as Zambia, there is no regulation that limits the number of sim connections that an individual mobile subscriber can own [3, 7].

Hence, the upper limit considers this fact and can become useful in a case where an individual subscriber happens to own an enormous number of sim connections.

It is key to note that the MPRP method proposed in Equation 2 represents the numerator of Equation 1. Equation 2 can be used to determine the actual number of mobile subscribers in an area by comparing the proportion of a population that is subscribed to mobile services to the proportion that owns a significant number of sim connections.

To derive our MPRP model, we substitute Equation 2 into Equation 1. This yields Equation 3 as our MPRP model, with all parameters as defined under Equations 1 and 2.

$$\text{MPRP} = \left(\frac{[\sum_{i=0}^M \frac{(P_i + P_N)}{i}]}{\text{Total population in an area}} * 100 \right) \quad (3)$$

The proposed MPRP method of Equation 3 has the following advantages over that proposed in Equation 1;

- 1) It is practical for usage in determining the actual mobile subscriber penetration rate in environments where mobile subscribers are allowed to have multiple sim connections.
- 2) It brings the possibility of duplicating actual subscribers to the barest minimum. This is because it factors in the actual sim connections owned at age group level, and compares it to the mobile sim connections to make an estimation of the actual mobile subscribers.
- 3) It gives a more accurate measure of Average Revenue Per User (ARPU) to mobile telecommunication business owners in determining as it considers the actual mobile subscribers and not sim connections.
- 4) It is a better method to use when determining mobile market saturation levels in that it can give a truer measure of a possibly greenfield market for exploitation.

The advantages of the model in Equation 3 are not limited to the ones mentioned in this paper, as it can be a better measure to use for making various strategic decisions.

4. Methodology

4.1 Research Approach and Design

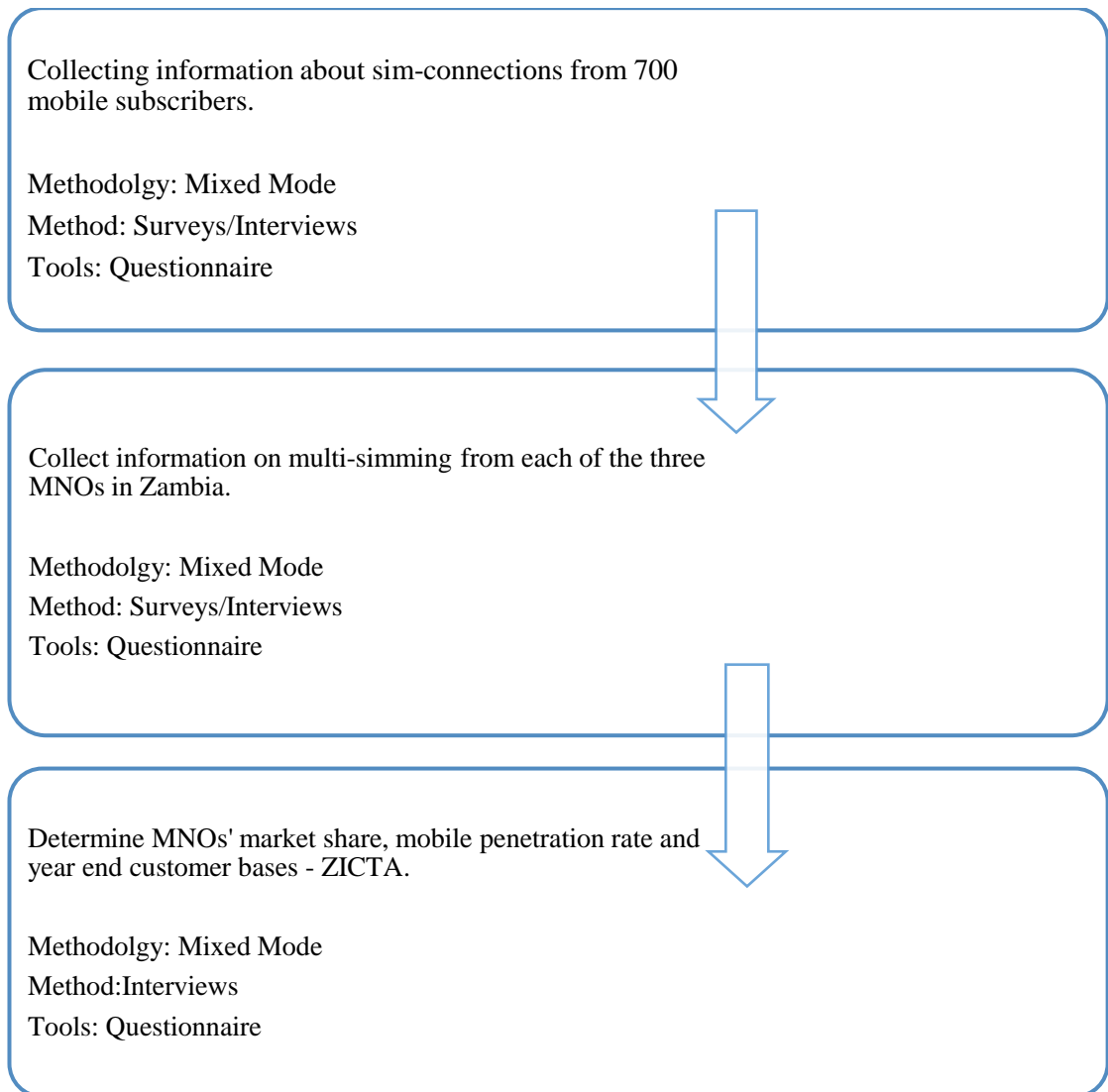


Figure 2: Methodology, Methods and Tools used in this Study

Figure 2 presents a summary of the approach and design taken for this research. Data on multi-simming from three perspectives namely that of mobile subscribers, that of MNOs and that of ZICTA and government agencies such as CSO was collected. The sources of this data are mobile subscribers, the three MNOs and ZICTA through surveys and interviews. Additional data was obtained from reports done by CSO.

4.2 Sampling Procedure

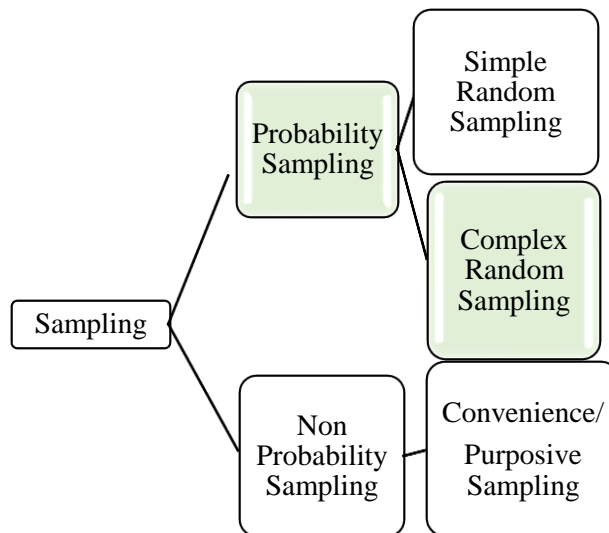
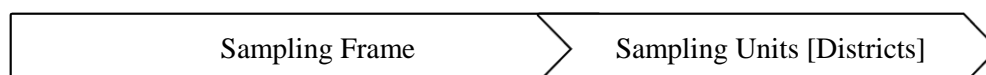


Figure 3: Sampling Technique used for this Study

Figure 3 summarizes the main types of sampling techniques and used in this study. In probability sampling, each sample has an equal chance of being selected to take part in the study. In non-probability or biased sampling, individual samples are not representative of a relevant population [12]. As Jonker and Pennink point out, a biased sample will therefore not be adequate in making logical conclusions about certain attributes of the entire population [12].

The population variations among the distinct districts of Zambia facilitated for the use of stratified sampling, which irons out such in-homogeneities so that samples within each sampling unit or strata have an equal opportunity of being represented [13]. As Table 3 shows, some of the districts had even just about one percent population in comparison to the others.

The samples were drawn from 6 districts in 3 different provinces of Zambia. From Lusaka province samples were drawn from Lusaka, Kafue, Chongwe and Luangwa districts. Mbala district was sampled from Northern Province while Chibombo district was sampled from Central province. Figure 4 represents these 6 districts as strata from the sampling frame, which constitutes the entire population of individuals subscribed to mobile services in Zambia.



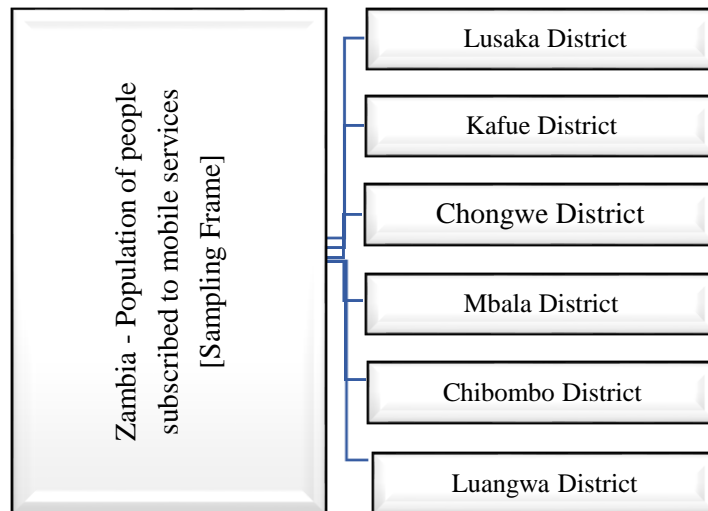


Figure 4: Sampling Frame and Units/Strata used in this Study

The sample size per stratum or district was determined using Equation 4 [14], which relates number of sampling units to the population

$$\text{Sample size per stratum} = n_i = n \cdot P_i = n \cdot \left(\frac{N_i}{N}\right) \quad (4)$$

Where;

- a) n is the sample size or total number of samples to be drawn from the sample space.
- b) n_i is the number of samples to be drawn from the i^{th} stratum.
- c) N_i is the population per i^{th} stratum, which in this case was calculated as 70% of the population per district as determined by ZICTA for the year 2015. The ZICTA office provided responses on a questionnaire provided to them.
- d) N is the total population in a sampling frame. The national population of Zambia was determined as 13092666 as shown in Table 2.
- e) P_i is the ratio of the total number of samples in the i^{th} stratum

Using Equation 4, the sample sizes shown in Table 3 were determined. N in Equation 4 was represented by the total population subscribed to mobile services in the sampling frame. N_i was represented by the population subscribed to mobile services per district or strata. The total number of samples desired to be drawn, n , was 700.

Table 3: Sample Sizes per Strata/District

District	Population	Mobile Subscribers (Ni)	Sample Size
Lusaka	1,715,032	1,205,667	458
Chongwe	181,816	127,817	34
Kafue	219,000	153,957	41
Luangwa	23,059	16,210	4
Mbala	192,636	135,423	57
Chibombo	290,556	204,261	38
Sampling Frame	2,622,099	1,843,336 [N]	700 [n]
Universe [Zambia]	13,092,666	9,164,866	

4.3 Data Analysis

The level of multi-simming per age groups and per district were determined by applying Equation 1 on the data collected from the surveys. The number of actual mobile subscribers was determined from the projections on actual populations done by CSO and a flat mobile connections penetration rate of 70% for all years as projected by ZICTA for the year 2015.

For the years 2010 up to 2014, the average annual mobile penetration growth rate was at about of 3.8% [5, 7]. This Figure was used to project the average sim connection and mobile penetration rates for the years 2015 to 2030.

5. Results and Discussion

5.1 Internal and External Multi-Simming

Results of this research indicate that it is possible for customers to have multiple sim connections with a particular MNO as well as belong to more than one MNO. In this paper, we refer to the earlier case as internal multi-simming and the later as external multi-simming respectively. Figure 5 illustrates internal multi-simming while Figure 6 shows external multi-simming.

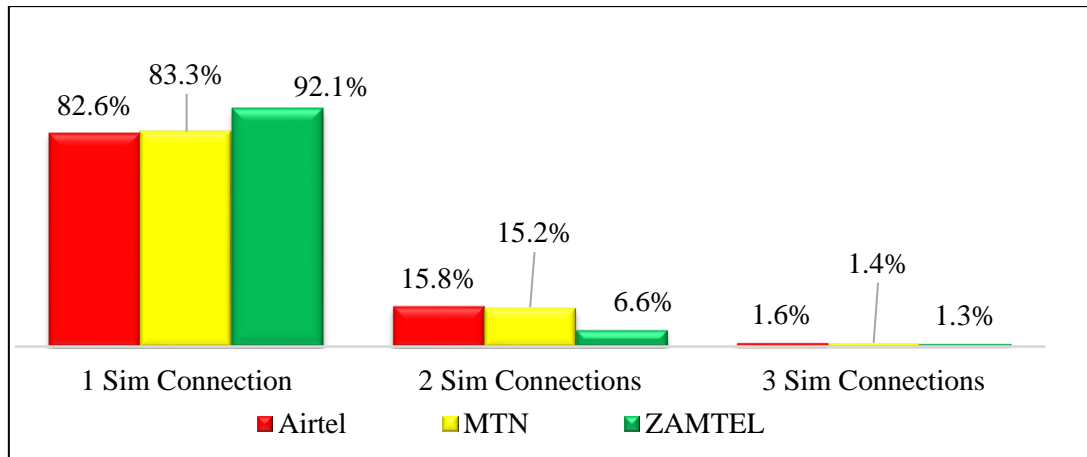


Figure 5: Internal Multi-Simming

Figure 5 shows cardinal information in terms of internal multi-simming. Multi-simming does not only happen across MNOs but also within MNOs. This is so because as confirmed by ZICTA, there is no restriction on the number of mobile sim connections that an individual can own per MNO. Multiple device ownership by individuals also heightens multi-simming within and across MNOs. The results show that 17.4% of subscribers on Airtel have more than 1 sim connection each, with 15.8% and 1.6% of the subscribers having 2 and 3 sim connections respectively. MTN has 16.6% of subscribers with more than 1 sim connection, with 15.2% and 1.4% of the subscribers having 2 and 3 sim connections respectively. ZAMTEL has the least internal multi-simming, with 7.9% of the mobile subscribers having more than 1 sim connection while 6.6% and 1.3% having 2 and 3 sim connections respectively.

The variations of Figure 5 can be explained in terms of the reasons that mobile subscribers indicated as prompting them to have multiple sim connections within MNOs. About 49% of the mobile subscribers indicated that they would use MTN for both voice and data services because it has better voice services quality, good network coverage and fast data browsing speeds. About 37% of subscribers indicated that they would use Airtel for both voice and data because it has good voice services quality, good network coverage, fast data browsing speeds as well as good and consistent promotions. About 14% of the population indicated that they would use ZAMTEL for both voice and data services because it is cheap, has fast data browsing speeds and good promotions.

The 700 mobile subscribers interviewed in this study had 1,402 sim connections. Analyzing these sim connections as separate from their owners, MTN has the highest proportion in terms of sim connections, followed by Airtel and lastly ZAMTEL with

1,172; 862 and 823 sim connections respectively. This result shows that subscribers may own multiple sim connections even within a particular MNO. The operators have many sim connections, but only 82.6%, 83.3% and 92.1% of the subscribers for Airtel, MTN and ZAMTEL respectively have only one sim connection.

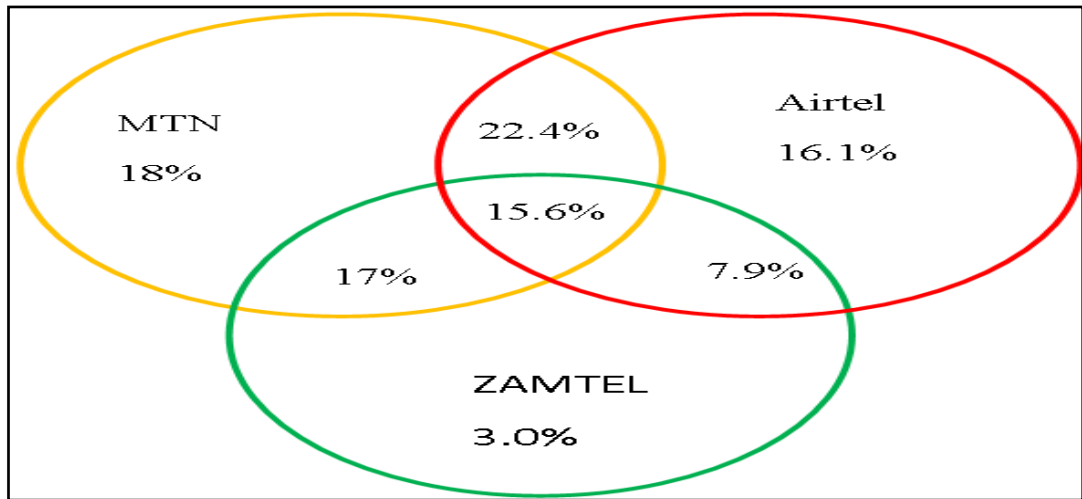


Figure 6: External Multi-Simming

The results in Figure 6 show that for the 700 subscribers interviewed in this survey, 18% were exclusively subscribed to MTN, 16.1% were exclusively subscribed to Airtel and 3% were exclusively subscribed to ZAMTEL. The rest of the subscribers were subscribed to services for either two or all three MNOs.

Figure 6 addresses external multiple sim ownership per individual subscriber across MNOs. This is in contrast to Figure 5, which analyses multiple sim ownership within MNOs. For example, if a particular subscriber owns 3 sim connections for MTN, 1 sim connection for Airtel and 2 sim connections. Under Figure 5, this subscriber will be part of the 1.4% that own 3 sim connections for MTN, part of the 82.6% of subscribers for Airtel that own 1 sim connection and part of the 6.6% of subscribers in ZAMTEL that own two sim connections. This however is a single subscriber, hence in Figure 6, this subscriber will be among the 15.6% of individuals that are subscribed to services for all three MNOs.

This information becomes very useful when determining the approximate number of actual subscribers at MNO and national levels. Figure 7 amplifies the results of Figures 5 and 6 by presenting average number of sim connections certain age groups own regardless of whether it is internal or external multi-simming. The results show that most of the

population aged between 36 and 55 have at least 2 sim connections each. Individuals below the age of 15 have an average of one sim connection each.

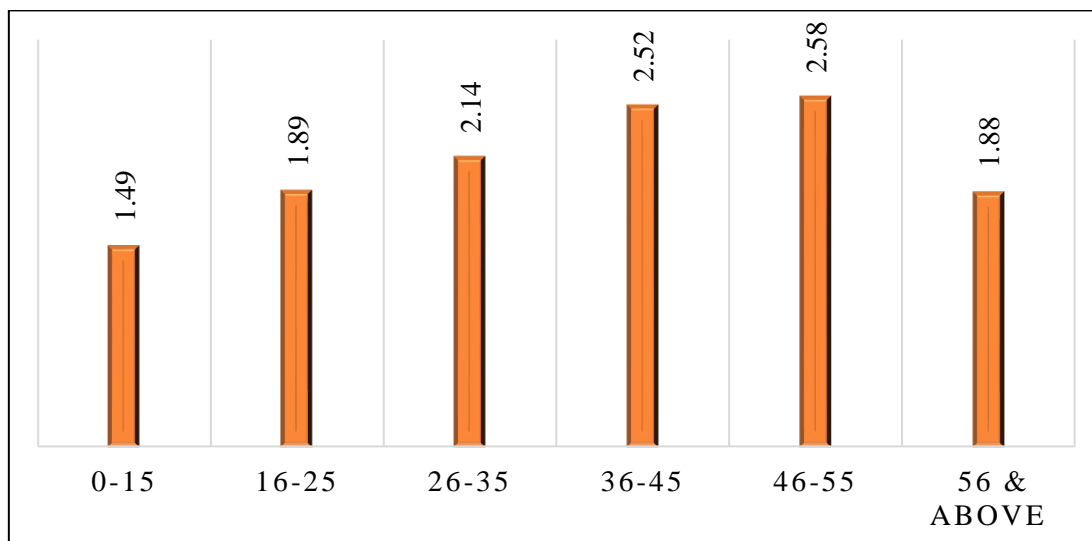


Figure 7: Actual Sim Connections Owned per Subscriber by Age Group

For the 700 samples done in the six districts with proportions as stated in Table 3, the average number of sim connections at district level was determined as shown in Table 4. In Luangwa district for example, all subscribed interviewed are multi-simming. The last row of Table 4 shows that in each district, there's a proportion of subscribers with at least 3 sim connections each.

Table 4: Average Number of Sim Connections at District Level

	Lusaka	Chongwe	Kafue	Chibombo	Mbala	Luangwa
Airtel	1.1	0.6	1.1	1.2	1.0	-
MTN	1.3	1.0	1.2	1.2	-	-
ZAMTEL	1.0	-	-	1.0	-	-
Airtel & MTN	2.2	2.3	2.2	2.2	2.6	2.0
Airtel & ZAMTEL	2.4	2.4	2.0	3.0	2.0	-
MTN & ZAMTEL	2.6	1.0	1.2	1.2	-	-
Airtel, MTN & ZAMTEL	3.6	3.5	4.0	3.5	3.7	3.5

There were many reasons given as to why subscribers own two or more sim connections; about 41% of mobile customers stated that the cost of mobile services in Zambia is high, hence, they own multiple sim connections to cut down on costs such as off net calls. Poor customer service, promotion seeking, poor network quality and lack of operator’s products on the market followed with 31%, 29%, 9% and 5% of the population feeling that these factors prompted them to have multiple sim connections.

The information of Figure 7 and Table 4 become very cardinal in determining the average actual mobile subscriber penetration rate in Zambia. Using projections on population growth at national level per age group or district, the predictions for approximate number of actual mobile subscribers can be made. This study uses approximated average annual population growth to extrapolate the average ratio of average actual mobile subscribers.

5.2 Mobile Penetration Rate Projections

5.2.1. Population Segmentation Using Average Number of Sim Connections Owned

To make the projections for mobile penetration rate up to the year 2030, there are four sets of data used for this exercise;

- i) The proportion of the population that is subscribed to mobile services per age group determined from results of the survey done on 700 subscribers as shown in Figure 8.
- ii) The average number of sim connections per age group determined during the survey as shown in Figure 7.
- iii) Projections of the national population by age group as projected by CSO.
- iv) The total number of mobile connections (or sim connections) as reported by ZICTA and the mobile network operators via surveys and publications as shown in Table 2.

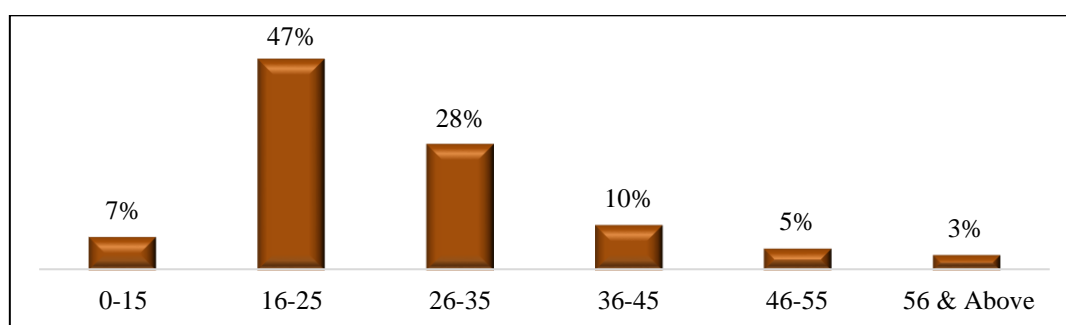


Figure 8: Proportion of the Population Subscribed to Mobile Services

Using Equation 2, the average number of actual mobile subscribers was determined as in section 5.2.3. The approximated actual mobile subscribers in the country are based on assumptions that the population growth is as of the 2010 census data in terms of proportion by age. The data used was done at age level by approximating the population that would subscribe to mobile services in each age group as presented in Figure 8.

The results of the survey were summed up and analyzed in terms of the average sim connections owned as shown in Figure 7. Section 5.2.2 shows as an example, how the total mobile sim connections were determined for the year 2015.

5.2.2 Determining Total Mobile Sim Connections

Mobile sim connections were determined using the method that ZICTA uses as in Equation 5, which is also called the ZICTA method in this paper [5].

Total mobile sim connections =

$$\text{National mobile sim connections penetration rate} * \text{National population} \quad (5)$$

Using National mobile sim connections penetration rate and National population from Table 2 for the year 2015;

$$\text{Total mobile sim connections} = 70.6\% * 15,473,905$$

$$\text{Total mobile sim connections} = 10,925,107.$$

5.2.3 Determining the Actual Number of Mobile Subscribers for Zambia

Using Equation 2 and data presented in Figure 7, the actual mobile subscribers were determined as demonstrated in the example below;

$$\text{Actual mobile subscribers} = \sum_{i=0}^M \frac{(P_i * P_N)}{i}$$

$$\begin{aligned} \text{Actual mobile subscribers} = & \frac{(P_{1.49} * P_N)}{1.49} + \frac{(P_{1.89} * P_N)}{1.89} + \frac{(P_{2.14} * P_N)}{2.14} + \frac{2.52 * P_N}{2.52} + \frac{(P_{2.58} * P_N)}{2.58} \\ & + \frac{(P_{1.88} * P_N)}{1.88} \end{aligned}$$

Using proportions of age as presented in Figure 8, Total national population as presented in Table 2 and the Total Mobile sim connections determined in 5.2.2, the number of actual mobile subscribers was determined as follows;

$$\begin{aligned} \text{Actual mobile subscribers} = & \frac{(7\%)*10,925,107}{1.49} + \frac{(47\%)*10,925,107}{1.89} + \frac{(28\%)*10,925,107}{2.14} + \\ & \frac{(10\%)*10,925,107}{2.52} + \frac{(5\%)*10,925,107}{2.58} + \frac{(3\%)*10,925,107}{1.88} \end{aligned}$$

Actual mobile subscribers = 5,428,087

5.2.4 Determining the Actual Mobile Subscriber Penetration Rate for the Years 2010 to 2030

Using the actual mobile subscribers determined in 5.2.3, the national population shown in Table 2 and Equation 3, the actual mobile subscriber penetration rate in Zambia was determined as described below;

$$\text{Actual mobile subscriber penetration rate} = \left(\frac{5,428,087}{15,473,905} * 100\% \right)$$

Actual mobile subscriber penetration rate = 35% for the year 2015.

Using the methods outlined in sections 5.2.1 up to 5.2.3, the actual mobile subscribers for the years 2010, 2015, 2020, 2025 and 2030 were determined as presented in Table 5.

Table 5: Actual Mobile Subscribers and Population Projections [15]

Year	Actual sim connections	Actual mobile subscribers	National Population
2010	5,446,991	2,706,311	13,092,666
2015	10,925,107	5,428,087	15,473,905
2020	15,354,478	7,628,798	17,885,423
2025	20,923,536	10,395,758	20,574,138
2030	27,713,216	13,769,178	23,576,214

The data presented in Table 5 was then used in Equation 1 to determine the mobile penetration rate as presented in Figure 9.

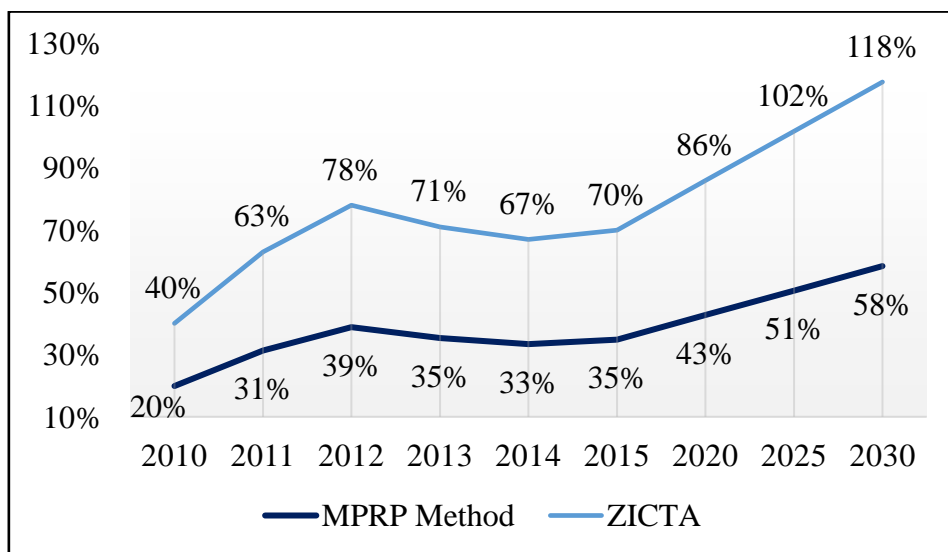


Figure 9: Projections of the Zambian Actual Mobile Subscriber Penetration Growth

The ZICTA sim connections penetration rates of 40%, 70.6%, 86%, 102% and 118% were used for the years 2010, 2015, 2020, 2025 and 2030 to determine actual sim connections of 5,237,066; 10,925,107; 15,354,478; 20,923,536 and 27,713,216 for these years respectively. ZICTA reports that in 2010, the mobile sim connection rate stood at 40% for Zambia. Results of the MPRP method have shown that the actual mobile subscriber penetration rate stood at 20%. Compared to 2012, the years 2013 and 2014 saw a drop in mobile penetration rate for both the MPRP and ZICTA methods. This was due to the sim registration exercise, which the MNOs embarked on as required by the regulator.

6. Conclusion

The MPRP method used in this study shows that the actual mobile subscriber penetration rate for the year 2010 was about 20% in Zambia. This rate has been determined using information on projected population growth from CSO and the approximate number of sim connections that subscribers have for different age groups.

From the findings of the study, on average, every mobile subscriber owns more than two sim connections. The age groups of 0 to 35 and above 56 years of age own two sim connections each, while the ages ranging from 36 to 55 own about three sim connections each. This implies that the actual mobile penetration rate would be about half or less of the mobile connections rate in a population.

The result of the MPRP method contrasts the projections made by ZICTA as shown in Figure 9, but makes sense analytically considering the fact that mobile subscribers on the Zambian mobile telecommunication market own about 2 sim connections each on average. The MPRP method uses actual mobile subscribers instead of sim connections as used by ZICTA.

The approximated number of actual subscribers is 5,428,087 as of the year 2015. Although the two leading mobile operators reported their mobile subscriber base around 5,200,000 and 5,400,000, about 43.7% of mobile subscribers use services for two MNOs while about 15.6% use services for all there MNOs. This implies that only 40.7% of the population subscribed to mobile service use one MNO exclusively. Hence, at national level, the actual mobile subscriber base would be lower than the average subscribers that the individual MNOs would be reporting.

The results presented in Figure 9 show that the actual subscriber mobile penetration rates are 20%, 35%, 43%, 51% and 58% for the years 2010, 2015, 2020, 2025 and 2030 respectively while the mobile sim connection rates determined and projected by ZICTA are 40%, 70.6%, 86%, 102% and 118% for the same years. The actual mobile subscriber penetration rates are expected to fluctuate in rhythm with changes in the national population projections done by CSO and changes in the mobile sim connections penetration rate as projected by ZICTA.

7. Limitations and Recommendations

This study estimates the mobile penetration rate with no regard to factors in the external environment. The assumption is that the mobile penetration rate only fluctuates in resonance with the population growth or decline of Zambia and few demographic parameters related to projections done by CSO up to the year 2030. The factors considered in this study do not address all factors that may have an impact on growth or decline of the mobile penetration rate. As Doshi and Narwold [2] show, mobile penetration rate fluctuates in rhythm with dynamics surrounding other demographic, economic, social and political factors in almost every region [2]. An extensive study, that considers how other social and economic parameters affect mobile penetration rate would be highly useful for mobile operators, current and prospective investors in the Zambian mobile telecommunications sectors, as well as ZICTA. The results in Figure 9 have two assumptions for the years from 2010 up to 2030; the first is that the ratio of mobile subscribers having two and three or more sim connections remains constant as presented in Figure 8. A study that factors in how variances in population growth would alter the patterns established in Figures 7 and 8 would add a lot of value.

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Note: The contents of publication in appendix 5 are as published in the web link stated below. However, the formatting has been altered to suit requirements of this dissertation.

Publisher: Scientific and Academic Publishing (SAP)

Journal Name: Macroeconomics and Microeconomics

Volume: 4, Issue: 2, Pages: 37-45

Date of Publication: 2nd April, 2016

Web link: <http://article.sapub.org/10.5923.j.m2economics.20160402.01.html>