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Telecom Data Integration and Analytics – Proposed Model to Enhance Customer Experience

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Abstract— **Huge amounts of data in the order of Petabytes are stored every day by telecommunication service providers. The Communication Service Providers(CSPs) save operational data, customer data, financial data and constituency data. But these data lie in different segments and are often difficult or impossible to integrate due to various problems like the data size, file formats or the speed at which the data flows in. The huge amount of data itself is the problem in this industry, thereby making it difficult for analysis. Enhancing customer experience is the main goal of CSPs today as it will reduce customer churn and thereby improve their Return on Investments(RoI). The main objective of this paper is to propose a model which will integrate some of these data sources and thereby improve customer experience. Literature in this area is diversified, and very few studies have been conducted to enhance customer experience through analytics. The proposed model will be developed using Decision Trees and Logistic Regression. Structural Equation modeling will be deployed to develop a causal model. Data Visualization tools used for this telecommunication model can result in better business decision making.**

Keywords-- Telecom data; Data integration; Data analytics; Customer Experience; Visualization Tools

I. BACKGROUND OF THE PROBLEM

Information technology has grown to an extent where telecommunication companies have become part of our daily lives. For majority of the urban people, the day starts and ends with looking at the phone, either they may be texting, calling people or surfing the web. Looking at it from an information technology (IT) perspective, there is so much of data being generated. Data flows into these servers owned by the telecom companies at a rate which is beyond our imagination. Terabytes and petabytes of data are pouring into organizations every single day. Every call that we make creates a call detail record in their Call Detail Record (CDR) servers. For instance, Malaysia has about 4 major telecommunication companies and few smaller companies. For an example, one of the companies has about 100,000 active customers, and if on an average each customer makes 2 calls a day, then the server has been loaded with 200,000 call detail records. Just imagine the world population, the number of calls and the amount of data stored every day. This is also true for Internet Service providers and Application service providers like TM, Astro, Unifi and so on.

Data flows into their servers every day, every minute and possibly every second. Why these telecom companies have to store this huge amount of data? How can they use this data for their own benefit? The Business world always searches for data, conducts surveys to know their customers better and in order to design better products and plans. But, here we see is an industry which has so much of data and finding it hard to make meaning out of it. The growth of data in this industry can be seen from the Fig 1.

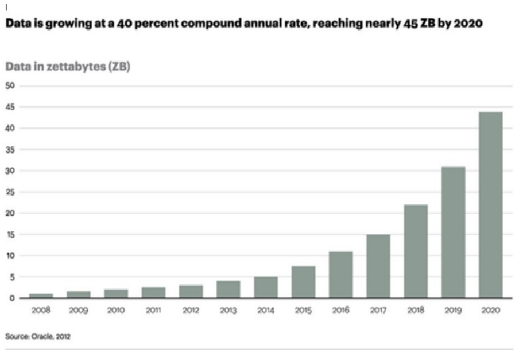

Figure-1: Estimated Data Growth – Prediction by Oracle, 2012

Businesses that can get a better handle on it can definitely outperform their competitors [18]. This is because the amount of data is so big. The data is big with Volume, velocity, variety, veracity [17, 18, and 26]. Handling these 4 and at near-real time is a challenge. Telecom data seems to have all these 4 characteristics which make it even more difficult.

Studying customer satisfaction levels will give us a picture of the factors that has led to the satisfaction in the past few weeks or months. If the study takes too long, it can be almost a year to obtain the results of a study. The world, people and preferences change fast, so we should have results instantly. If we know the factors that could affect this experience, then we can improve the experience through the huge amount of data we store in the telecom servers. The extent of the problem has been documented in Bain & Company's recent survey of the

customers of 362 companies, only 8% described their experience as superior, yet 80% surveyed believe that the experience they have provided is superior as shown in the below Fig 2 [1].

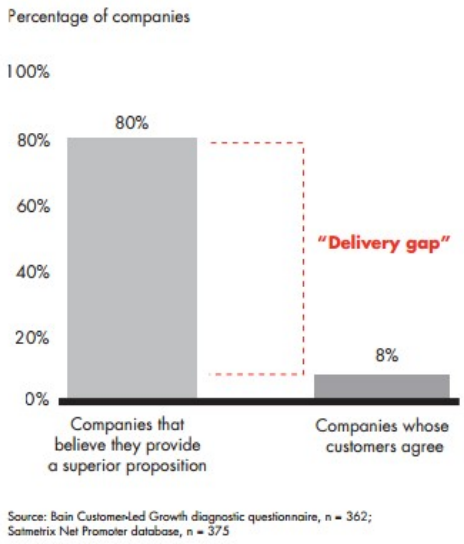

Figure-2: Illustration of the delivery gap

Consumers have a wide variety of choices today. In 2001, a study by Booz Allen Hamilton indicated that 17% of customer churn is attributed to network issues. Nearly a decade later, a similar study by Nokia Siemens Network found that 45% of smart phone users churned cited network quality as a factor.

Conducting business in the Internet economy will require managers to be informed about service quality as never before. Customer service problems will have disastrous effects – people will quickly find a new provider that offers a comparable product or service [20]. Jeff Bezos, president of Amazon.com, expressed it best when he said: "If you have an unhappy customer on the Internet, he doesn't go and tell six friends, he tells 6,000 friends"

A. Aim and Objectives of this Research

The aim of this work is proposing a model which will perform a confirmatory data analysis on the telecom operational data in order to enhance Customer experience, thereby reducing customer churn.

The Objectives of this work are:

1. To review the literature which ties up the three related but dijoint cohorts: Telecom data, analaytics and customer experiences.
2. To propose a methodology to develop the model
3. To identify suitable analytical methods to be used for analyzing the data

II. LITERATURE SURVEY

A. Customer Experience in the Telecom Sector

International Telecommunication Union [ITU- T 07] applies the following definition for Quality of Experience (QoE): "The overall acceptability of an application or service, as perceived subjectively by the end-user". Recent definitions of customer experience include that "The customer experience originates from a set of interactions between a customer and a product, a company, or part of its organization, which provoke a reaction. This experience is strictly personal and implies the customer's involvement at different levels (rational, emotional, sensorial, physical, and spiritual)" [13].

Customer experience has been gaining importance worldwide. Some famous companies have this phrase in their mission statements. Dell computer's mission statement is "To focus on delivering the best customer experience in the markets the firm serves", while Toyota's mission statement is "To sustain profitable growth by providing the best customer experience and dealer support". Additionally, a recent IBM report identifies customer experience as a key factor for companies to use in building loyalty to brands, channels and services [3].

Various research questions have been identified by researchers in this area such as Impact of the distinct drivers of Customer Experience, relation between Customer Experience and social environment, self-service technologies, branding [6]. From a phenomenological perspective, customer experience is about more than behavior, and has been seen as a wide range of activities and states of being, including aesthetics, symbolic meanings, variety seeking, hedonism, daydreaming, creativity, emotions and artistic endeavors, collectively categorized as the "experiential perspectives of consumption" [19].

As summarized by Kilkki in 2008, there are many available models which describe about human needs, factors affecting happiness and about human behavior [25]. Maslow's needs of hierarchy include physical, security, love, respect and self-actualization. These are the fundamental needs all human has [29]. Richard Layard has done studies and said there are much more things which bring happiness compared to money alone [27]. The theory developed by Kahneman and Tversky explained how the real-world outcome can affect human feelings and behavior [22, 34]. Marc Hassenzahl has developed a reference model on user experiences by laying the fundamental assumptions about user experiences and recommending action plans for improving it [16].

Telecommunication service providers can give more services than the basic call and data service. The other services include games, icons, ringtones, messages, web browsing, SMS (short message service) coupons, and electronic transaction. They can bring five values to consumers: time-critical needs and arrangement, spontaneous needs and decisions, entertainment needs, efficiency needs and ambitions, and mobility-related needs [2].

Based on the survey of 22052 users of wireless phone in the United States in 2008, the Wireless Phone Users' Satisfaction Index of United States of America indicated that important dimensions of service quality included customer satisfaction, billing, brand image; call quality, cost of service and options for service plans. This is published in the Customer Satisfaction Index (2009). Customer satisfaction arises out of multiple positive customer experiences. But none of these studies include customer experience as it is perceived as something difficult to measure.

A qualitative (focus groups) and quantitative (consumer surveys) research study about consumer satisfaction was undertaken by Australian Communications and Media Authority, ACMA (2008). The study reported highest levels of dissatisfaction with mobile phone services (35 per cent), citing problems such as drop-outs, poor call quality and interference. All these network problems give a negative user experience to the customer and hence the customer dissatisfaction. So, we should focus on setting the network right in order to make a customer happy.

Accenture (2008) carried out survey of 4189 consumers in Australia, Brazil, Canada, China, France, Germany, India, United States, and United Kingdom. More than 67% respondents confirmed poor customer services as the core reason for leaving the operators. The survey also found the rising expectations of customers in mature and growing markets. Poor customer services leads to unhappy customer experiences. Hence, customer services are one important aspect of customer experiences.

Employees play a leading role in telecommunication service. The role of frontline staff becomes extremely important in making the interaction with customer pleasing. The staffs need to know the importance of their role in service delivery. Management should ensure that human resources dimensions are addressed to optimize the service delivery by staff [24]. Simply stating, happy employees can create happy experiences for the customer who in turn can influence the profit.

B. Customer Churn or Attrition

Customer attrition is an important issue for any company and is easiest to define in subscription based businesses, and partly for that reason, churn modelling is most popular in these businesses. Long-distance companies, Mobile phone service providers, Insurance companies, Cable companies (Pay-Tv), financial service companies, Internet service providers, newspapers, magazines, and some retailers all share subscription model where customers have a formal, contractual relationship which must be explicitly ended [23]. It is estimated that the average churn rate for the mobile telecommunications is 2.2% per month. i.e., about 27% of given carrier's subscriber are lost each year [40]. This makes it essential to develop an effective churn reduction method. Wei & Chiu used the call pattern changes and contractual data and developed a data mining based churn prediction technique that identifies potential churners at the contract level. In their study they used the decision tree approach as the basis for the development of their technique for mobile telecommunication company in Taiwan [39].

C. Problems and challenges in telecom operational data

The data in the telecom industry come from four main data sources. Block level marketing and financial information, customer internal data, demographic data and customer contact records [21]. Customer internal data consists of information like market channel, plan type, bill agency, customer segmentation, ownership of the company's other products, dispute, late fee charges, discount, promotion, toll free services, rewards redemption and so on. Here the examples of customer usage variables are:

- Weekly average call counts
- Percentage change of minutes
- Share of domestic and international revenue

In a late 2010 study, MIT/IBM researchers have found the main obstacle to adopt analytics in their organizations was a lack of understanding on how to use them to improve business. Reference [4] states that the big challenges in this industry are

1. To Integrate the data sources
2. To Create adhoc reports for business users
3. Availability of advanced analytics capabilities

Data is collected in silos by different departments. Usage transactions, network performance data, cell site data, device info. Despite this treasure trove of info, they do not have real-time end-to-end view of their subscribers becoz of data in different departments and no integration. There is a need for solutions that can combine customer usage and subscription data with insights into the network, cost, customermood and customer preference data to trigger specific actions, which help enhance customer experience. Service providers must bring this data together, normalize and correlate all data sources, which poses a serious challenge.

Batch ETL (Extract Transform Load), good for analyzing historical trends or linking disparate data sources based upon pre-defined questions. This is called data federation. This approach involves pulling metrics from different data sources for the purpose of understanding how all the metrics are related (in a correlation sense) to each other [12].

D. Knowledge Discovery in Telecommunications

Communications ecosystem covers a huge area from technical issues to business models and human behaviour. Due to this extreme diversity various societies need to discuss with each other, each of them using their own language. Engineers talk about network performance and quality of service, business people talk about average revenue per user and customer churn while behavioural scientists talk about happiness and experiences as demonstrated in Fig 3 [25].

But all these things are not mutually exclusive; they are dependent on each other. If the network performance and

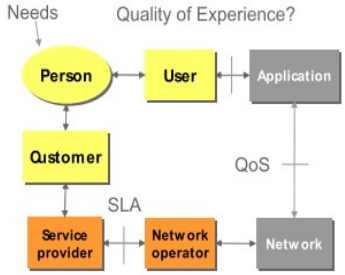

Figure-3: Communication Ecosystem Model. Source: [25]

quality of service is good, then customers are happy because they have a good experience, this will in turn increase average revenue per user and prevent customer churn. From this paper, it is also clear the network performance and quality of the service are two main factors in deciding the happiness quotient. Several studies have been done on service quality, churn detection and prevention, but the quality of Customer Experience (QoCE) remains under explored.

Today, telecommunication market all over the world is facing a severe loss of revenue due to fierce competition and loss of potential customers. To keep the competitive advantages and acquire as many customers as possible, most operators invest a huge amount of revenue to expand their business in the very beginning [7]. According to telecom market, the process of subscribers (either prepaid or post-paid) switching from one service provider is called customer churn [41].

Reference [9] includes the following as Knowledge discovery in telecommunications

- Call detail record analysis—Telecommunication companies accumulate detailed call records. By identifying customer segments with similar use patterns, the companies can develop attractive pricing and feature promotions.

- Customer loyalty—Some customers repeatedly switch providers, or "churn",to take advantage of attractive incentives by competing companies. The companies can use data mining to identify the characteristics of customers who are likely to remain loyal once they switch, thus enabling the companies to target their spending on customers who will produce the most profit

E. Methods of Knowledge Discovery

Knowledge Discovery in Databases (KDD) is defined as the "nontrivial process of identifying valid, novel, potentially useful and ultimately understandable patterns in data" [10]. Data mining is also called as KDD. In this process, there are four subtasks involved. They are: classification, clustering, regression and association rule learning [8]. Moreover, depending on the domain of application, data mining techniques are divided into two major categories: i) Verification oriented (the system verifies the user's hypothesis) and ii) Discovery oriented (the system finds new rules and patterns autonomously) [15]. Application of predictive statistical models such as Logistic Regression/ Cox Proportional Hazards model, Lifetime value (LTV) modelling, Up-Sell models, Market basket analysis, Logistic regression, Exploratory Data Analysis are used in KDD [37].

Qian, Peiji, and Quanfu employed Partial Least Square (PLS) to analyze the data. PLS is a powerful structural equation model (SEM) analysis tool. PLS path modeling can estimate very complex models with many latent and manifest variables [31]. Ren, Zheng, and Wu presented a clustering method based on genetic algorithm for telecommunication customer subdivision. First, the features of telecommunication customers (such as the calling behaviour and consuming behaviour) are extracted. Then, the similarities between the multidimensional feature vectors of telecommunication customers are computed and mapped [32].

Junxiang uses parametric regression models using maximum likelihood (ML) and a semi-parametric regression analysis using partial likelihood estimation (PLE) for predicting customer churn [21]. Wang & Lo developed Structural Equation models with PLS Graph. There are 2 types of estimation techniques for an SEM. The first type is the maximum likelihood (ML) based covariance structure analysis method and the PLS based variance analysis method [38]. Gursoy and Simsek's study determines the reasons why the telecom company loses its customers. Logistic Regression and Decision Trees are two important techniques that are applied [14]. Umayaparvathi and Iyakutti created predictive models based on the CDR database using Decision Trees and Neural Networks [35].

III. NEED FOR THIS RESEARCH

A. Research Questions

From the above problem statements and the vast literature the following research questions were identified for this research:

- What are the challenges in using telecom data?
- How to measure Customer Experience effectively?
- Which operational metrics have high impact on customer satisfaction?
- Can we use operational data to relate with the customer experiences?
- Will data visualization help to understand the whole scenario better?

B. Theoretical Framework

A negative experience which can lead to customer churn is not known to the company unless the customer reaches out to the call center to report it. Lack of timely insight and delayed response time translate into lost revenue [36].

Usually customer experience is measured by touchpoint surveys, or surveys by 3rd parties like JD Power and Nielsen which provide broad directional feedback. But they do not include customer behavioral data, online feedbacks, social

media data etc. Moreover there is a treasure trove of information embedded in interaction records such as emails, call recordings and chat transcripts which can provide rich insights into customer experience. An inability to tap into these sources of customer feedback leads to flawed assessment of the current state of customer experience [28].

According to researches done, references to experiences are still very rare when compared to quality of service. In the whole IEEE database, one paper has mentioned "quality of user experience" in 2004 by Chu, whereas no paper so far has mentioned the term "quality of customer experience" in abstract. Regardless of the scarcity of Quality of Experience (QoE) in the IEEE database, we may still argue that quality of experience is now the new 'magical word', as De Marez et al. have expressed it in a paper in 2007 with 66 references [25].

It is indeed a magical word, the trend of the future, but research data on this area have been very negligible. So, this research will be very vital in this field and all the others where customers can churn easily. It has been discussed on how to identify the voice of the customer. First use a qualitative discovery oriented methods like in-depth customer interviews to study what is the experience of the customer. Later use a survey to develop a statistically significant fact base to validate customer needs [37]. This analysis states how to translate the customer needs into an irresistible product or service as in Fig 4.

Despite a handful of research to unearth service quality, the quest for excellence in service delivery is continued and researchers recommend further studies that highlight different cultural contexts [11]. It is true that service quality has some features which are universal in nature [33]. However, customer expectations and perceptions are cultural phenomenon [5].

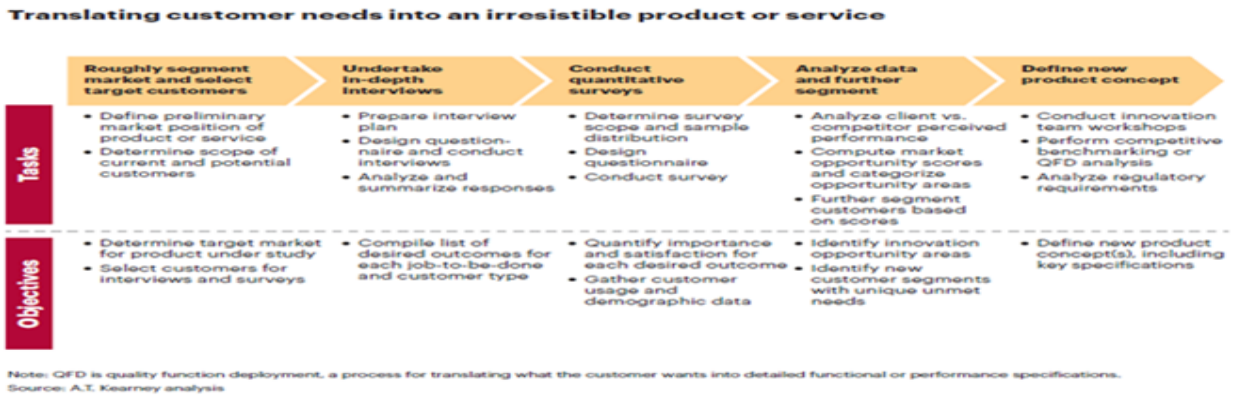

Figure-4: Model for Translating Customer needs into an irresistable product or service

IV. METHODOLOGY

After reviewing the above problems and literatures in these fields of study, the following method is proposed to develop a model:

i. Establishment of theoretical foundation for the research work through a considerable review of literatures to find out what is already done in the field.

ii. Apply qualitative research techniques to identify the factors which affect customer experience in the area of telecommunication services. Interviews will be scheduled with expertise in the Industry and telecommunication business.

iii. Apply quantitative techniques to prioritize the factors which have high impact on the services. The quantitative data will be obtained through a close-ended questionnaire using a 4-point Likert Scale.

iv. Operational Data Acquisition will be from a telecom firm in Malaysia. Data will be cleaned and prepared for further analysis using Clustering techniques and Customer segmentation. Derived variables will be formed and calculated from the raw data obtained

v. Develop a Data Analysis Model based on Decision Trees and Logistic Regression. Structural Equational Modelling will also be deployed using PLS Method. Test the model with the test data set.

vi. Display the results using a Visualization Software for Telecommunication Data.

vii. Benchmarking with other systems in the domain.

V. CONCLUSION

The underlying aim of this proposed research work is to improve business profit and reduce customer churn in the telecommunication industry. This work will help the industry to note those factors which help in making the customer happy. Then, they can invest their potential and resources in that arena. The telecom companies can use this research after completion, for their service roll out planning in order to identify which areas need focus. Investment can be done to maintain or improve those operational metrics which have high impact on customer experience.

This research work focused at addressing the following: Review of existing literature in the field of telecommunication services, proposing a model to confirm the factors using operational data and identifying suitable statistical techniques suited for this kind of data.

Customer Experience data that will be collected using Interviews and Questionnaires will be of importance to the vendors and telecom service providers. This proposed model based on decision tree method and Structural Equation modelling using PLS can be useful to the telecom industry to understand their customer better. The resulting model will be accurate and therefore can be used for understanding the customer's experience in the telecommunication industry using the operational data.

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