

The Impact of the Introduction of Code Division Multiple Access Technology on the Telecommunication Industry in Sri Lanka

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Abstract

In this study, the impact of introduction of CDMA Technology in the Sri Lankan telecommunication industry has been investigated.

For this purpose, a field survey and a series of interviews were conducted with senior personnel of the three fixed line operators and the personnel from Telecommunication Regulation Commission of Sri Lanka. Based on the conceptualization model adopted the study took a four dimensional approach, covering Customer Benefits, Operator Advantages, Technological Advancement and the Regulatory Framework. Accordingly, the related elements in those dimensions were operationalized. A comprehensive questionnaire was utilized in the field survey carried out to gather information of the perception of the customers and structured interviews were carried out with the senior industry experts to obtain their perspective of the other three dimensions of the study.

Based on the findings of the study a marginal overall improvement in relation to the benefits received by the end user is seen. Further, the findings strongly show that CDMA has brought many benefits to the operators and also it has been an advanced technology to Sri Lanka at the larger picture. In relation to the regulatory aspect of the whole process, there is further room for the improvement in order to have a smooth operation of new technological ka in future.

Keywords: Telecommunication, Technology, CDMA, Development, Regulation, Technological Advancement, Service Provider, Infrastructure, End User.

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Introduction

In an emerging global economy, the ability of the Telecommunication sector to provide an internationally competitive network for transferring information has significant implications for trade and economic growth. In view of recent large worldwide investments in the telecommunication infrastructure, quantifying the impact of telecommunication in economic growth has received much attention. The world is now going through a communication revolution. This revolution, which is the third of this nature, is a result of the convergence of communication satellites, computers and digitization. Digitization converts all information text, sound and pictures into a binary code that can promptly travel through a global network of computers linked by telephones, fiber optics and satellites.. The first two communication revolutions were the evolution of writing and the invention of printing. Sri Lanka has to face the third revolution head on to compete in the global material economy.

Telecommunication was naturally not seen as an area contributing towards the growth prospects and requirements of the Sri Lankan economy in early 1990's. Later a contradictory and strong growth was seen in the expressed demand for telecommunication services. As per the Central Bank(1997), there was a growth of 39% from 1994 to 1996. This was driven by the convergence of the Telecommunication and Information Technology fields, resulting in a new area/sector called Information Communication Technology (ICT). This paved the way for high economic and business growth caused by liberalisation of the economy and the large number of people working overseas either or living overseas who desired greater contactability with their families and friends.

With the CDMA Technology introduction to the Sri Lankan fixed telephone market in year 2005, ending a long needed requirement from all the three fixed line operators, the above parameters started to change significantly. At the end of the year 2005, both Suntel and Lanka Bell the pioneers in introducing the CDMA Technology in their networks, had almost doubled their number of fixed telephone lines. To be more specific, according to the Telecommunication Regulatory Commission of Sri Lanka (TRCSL 2007), they have doubled their respective existing number of lines as early as first quarter of the year 2006 and has reached a growth of 23% in 2006(1st half only) compared to 14% in 2005. By the end of 2006, there was nearly 50% growth of the whole fixed line customer base, because of the introduction of CDMA Technology.

With many changes happening in the field of telecommunication, both globally and locally, life of people of this world is becoming more and more complex today. In the Sri Lankan context, it has been almost one decade since the first wireless in the local loop (WLL) operator commenced provision of telephony services in December 1996 and almost as long as mid 1997, since State Telecom, SLT was privatized. During this period, the Sri Lankan fixed phone sector has undergone a severe transformation drastically. After long waiting licensing issues, in 2005 TRCSL granted permission for all the three fixed line operators to use or rather, introduce the CDMA Technology in Sri Lanka.

With this technological changes over the years, the government and the regulator had to face numerous problems with regard to the developments in the sector, which required new policy decisions along with complex legal and regulatory approaches. Accordingly, the three stakeholders, namely the government, the regulators and the operators had to adopt strong and aggressive market oriented strategies and competitive moves. Several anti-competitive moves taken by some of the operators had to be dealt even with legal proceedings. These developments raised several questions. Especially those questions were in relation to the nature of the stiff competition arisen after the introduction of the CDMA technology within the industry, the regulatory framework, the role of the government, the degree of achievement of objectives behind the new technology introduction etc.

Research Question

The problem focussed in this research is how impactful is the introduction. of the CDMA Technology to Sri Lankan Telecommunication Industry. This study attempts to achieve several objectives. Among them, the major objective behind the whole study is to, assess and analyze the overall impact of the introduction of the CDMA technology on the telecommunication industry in Sri Lanka. The above main objective of the study will be achieved by assessing and analyzing the following;

- Benefits received by the end users as a result of the Introduction of CDMA Technology to the telecommunication industry in Sri Lanka.
- Benefits obtained by the telecommunication service providers, as a result of the introduction of the CDMA Technology to the Sri Lankan telecommunication industry.

- Technological advancement, that has taken place with the introduction of the CDMA Technology to the Sri Lankan telecommunication industry.
- Conduciveness of the established regulatory framework in relation to the introduction of the CDMA technology in Sri Lanka to its telecommunication industry.

Research Design

This study was a four dimensional study. The study focused on customer, operator, regulator and technology. The overall intention is to examine the impact of introduction of the CDMA technology to the telecommunication industry of Sri Lanka. To supplement the above, the researcher carried out a sample field survey to gather quantitative information about the customer. In addition, qualitative information was gathered from key resource personnel in Sri Lanka. These data were gathered using both the questionnaire and the interview methods. The research was an exploratory study and therefore only examined relationships between variables and was not extended to establish causal relationships. The data gathered dealt with perceptions of the respondents in relation to selected issues. A scientific approach was utilized in carrying out research. The study took the form of an exploratory research under the Field Method.

Conceptualisation and Operationalisation

For telecommunication industries around the world to thrive and develop, there are some obvious pre-requisites, which need to be fulfilled. As a result of the technological innovations, the constant process of the introduction of new technologies results the different players in the telecommunication market to influence the degree of competition and the efficiency of the outcome.

With the introduction of the CDMA technology to the telecommunication industry of Sri Lanka, it is of great importance to the operators, regulators, customers and finally the government who take strategic decisions, to know how impactful the introduction of CDMA is. In this research, the term "telecommunication industry in Sri Lanka" is used to represent the fixed/phone telecommunication industry and the term "CDMA technology" represents the "CDMA-2000 1xRTT technology". "CDMA-2000 1xRTT" is a

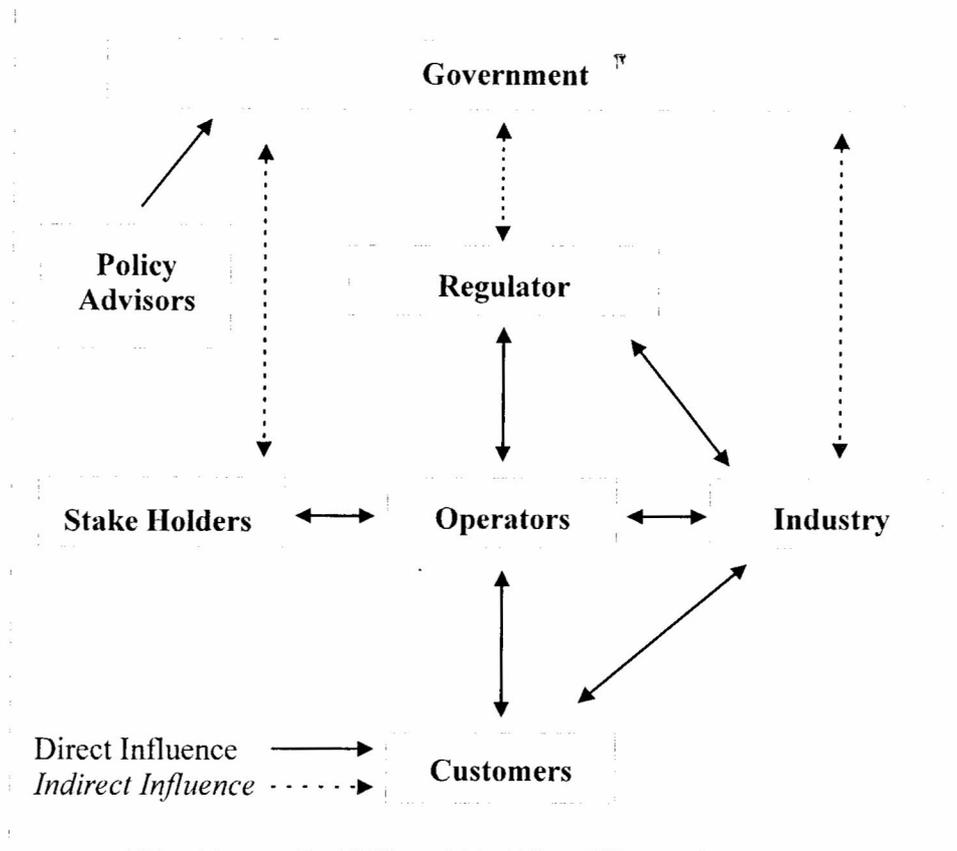
3G wireless technology based on the CDMA platform. At the beginning of the research in 2006, 4th quarter, Sri Lanka had only three fixed line/phone operators in the market namely, Sri Lanka Telecom Ltd, Suntel Ltd and Lanka Bell (Pvt) Ltd. However, at the beginning of the 3rd quarter of year 2007, the fourth fixed line/phone operator, Dialog Broadband Networks had started its operations for CDMA implementation, on a limited scale. Since, we had already started the analysis of the gathered data by that time and of the small-scale start by the fourth CDMA service operator, this research was conducted based on the first three fixed line/phone operators only. In case of the fourth, operator, if it is also considered and included in the research, which is having a very small customer base in their CDMA network at that time, there should not have been much difference of the findings as the perception of the new customers and the views of the operators would be seen in similar nature. Because of that, there is no possibility to have a deviation in the opinion with regard to the fourth CDMA operator. Accordingly, the major factors and the required association between them, with respect to the intended study were examined. In this research these relationships are conceptualized and brings them onto a single platform. It then examines and operationalizes the factors into dimensions and elements, which act as indicators of performance within this study.

The Overall Conceptual Framework

The convergent nature of telecommunication makes it a unique industry in many respects (See Figure 1, An Efficient Healthy Industrial Model in the annexure).

Within the global trend of market liberalization, resulting new technology introduction, regulation plays an important role. Some of the key factors that form the dynamics of a telecom industry resulting a new technology introduction are easily identifiable. In conceptualization, it requires establishing the interrelationships between various operators, and their customers and the related regulators in the industry. Figure 1 represents the interrelationship between several of these factors.

Figure 1: An Efficient Healthy Industrial Model



Source: Adopted based on Melody, 1997

Conceptualization Model and Operationalization

The Classical Economic theory proposes that increased competition leads to lowering prices, with the ultimate form being Perfect Competition where marginal revenues equal marginal costs.

Technological innovation and the new technology introduction cause the operators to move ahead in the markets, which they have already capitalized,

and in potential markets more efficiently and productively. Marketing theory refers to concepts like Segmentation and Product Differentiation where firms increasingly resort to non-price forms of gaining competitive advantage.

In addition, the consumers having derived many benefits from new technologies from a number of operators to choose from. The broader concept of the introduction of the new technology within an industry, especially within telecommunication, consists of several dimensions. This level of abstraction could be further broken down into several elements within each dimension. The elements in turn would each have specific measurements, which would be used. This is shown in the diagram given in Figure 2 (See Figure 2, Conceptualization Model in the annexure).

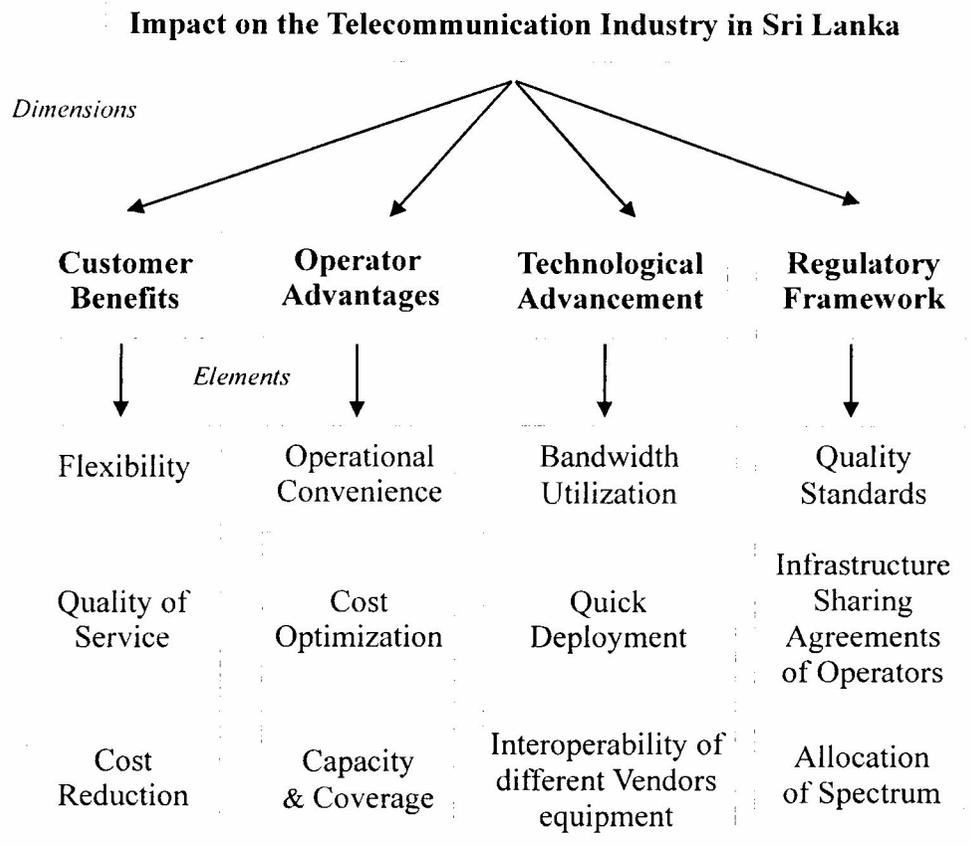
In customers point of view what is important for them is the derived benefits out of the product or service they buy or spent for. Anticipation of an increase of benefits is an integral part of introducing new technologies. The underlying assumption is that new technologies will bring added benefits at a lower cost. Customer benefits could be seen in a number of aspects. However, the focus is on a few important primary indicators, such as the quality of service, flexibility and the cost reduction in relation to the CDMA end user.

In a telecommunication industry for operators, to give consumers an adequate choice from the various operators need to have obtained better technologies. While acquiring these better profitable, new technologies, such as CDMA technology, operators get many advantages. Among them, operational convenience, cost optimization and capacity and coverage are the most significant ones in relation to the operators.

When analyzing the various technologies related to telecommunication in last decade or so, one can see many technologies have been introduced. Some have yielded many results and good things, and some have failed. This advancement of technology has improved the quality of living standards of the human beings significantly as well. Because of the telecommunication technological advancement, virtually anyone can talk to anyone, from anywhere, in no time as talking face to face. In this aspect there are some elements need to be discussed. In the study, the major elements considered are, Bandwidth utilization, Quick deployment and Interoperability of different vendors equipment.

Figure 2: Conceptualization Model

Variable



Source: Developed by the researcher.

An established regulatory framework is essential, which has to be both independent from the influence of the government and the operators, and competent enough to face whatever the challenges they face with respect to telecommunication. The regulator's task is to implement government policy, ensure performance accountability by the players in the market towards economic and social policy objectives, dispute resolution, monitoring change and advising the government. Since the operators, once separated from direct

government influence may focus too narrowly on economic objectives; the regulatory agency can ensure recognition of social and policy objectives as well.

In attempting to achieve efficient telecom structural reforms, perhaps the most fundamental underlying issue is effective separation of the basic functions of Policymaking, Regulation and Operator Management (Melody, 1997).

Further elaborating along these lines, Melody outlines the fundamental conditions required for establishing an institutional structure, which clearly defines these three distinct and separate roles. Some of the important areas under regulation, considered in the study are Quality Standards, Infrastructure sharing agreements between operators and Allocation of spectrum among operators.

Methodology of the Study

The scientific implementation of the research is mentioned here. The main aim of it is to describe the methodology and rationale behind the different elements of the research. This includes the methods utilized to collect data, the sampling framework and finally the methods used to process and analyze the gathered data, leading into the logical conclusions drawn at the end of the research.

Data Collection

Data gathering methodology adopted for this study was of a non-experimental method. Field methods were used in collecting primary data while the library method was used for secondary data gathering. The sample field survey method, which is both a scientific and orderly form of analysis, was preferred for primary data collection in the study. In primary data collection, the sample field survey was very much suited for collecting information from CDMA users. A self-constructed, structured questionnaire was used to collect information. This was done through field visiting and getting the questionnaire filled by the researcher himself based on the responses obtained from people to get the information exactly how they really perceive.

Primary Data

Primary data were gathered from two groups of stakeholders, the first being the Users of telecommunication services and secondly from a mix of the Providers of services and the Regulator. To extract data from the first group, a structured questionnaire filled in the field was used and for extraction of information from the second group, Non-scheduled, Structured Interviews were conducted.

The Primary data gathered from the users of telecommunication services, included classification data of, their type of usage, their service provider, time being in the network, etc. It also dealt with their perceptions about the service quality, flexibility and cost, which had taken place within the telecommunication industry after the introduction of CDMA technology.

Secondary Data

The secondary data were of two types. The first consisted of specific secondary data related to the Sri Lankan telecommunication industry including data from the TRCSL and the Central Bank regarding the number of telecommunication users, total demand etc. The second type of secondary data related to international trends and research submissions on global telecommunication reforms, new technology introductions, CDMA technology deployments, market developments, regulatory issues, government policy perspectives coupled with the ITU's most recent projections on telecommunication evolution and development.

Secondary data were extremely valuable for the research. The two main areas within this related to the Sri Lankan market and to the International arena. The data on the Sri Lankan market were gathered from several statutory documents such as the Telecommunications Act, the Telecommunications Policy, the License of the Operators, the Government MOU with NTT, TRCSL reports, the Central Bank reports, articles published in numerous magazines, technical journals. Internet web sites were also used along with material presented at conferences etc..

Data Processing

Based on the filled questionnaires in the field, each was double checked for completeness, consistency after which the data was transferred to the spreadsheets. All coding and classification was done manually. Answers to questions were coded differently. In Part One (General Information), the users were classified either as R for Residential or B for Business users. In the

designed questionnaire, in the second, third and fourth sections, all the questions were numerically classified orderly, using the Likert scale corresponding to the, numerical values used to indicate the responses. The Table 1, represents the classification of responses that has being utilized in Section 2, Section 3 and Section 4 of the questionnaire (See table 1, The Classification of Responses of the Questionnaire in the annexure).

With the aid of the above numerical values, central tendency measurements were calculated for each related question. Based on the average or the mean values obtained on the response received for the related questions, the results were classified shown in the Table 2 (See Table 2, Average/Mean Value Classification in the annexure).

This explains as depicted in table 2, which represents the responses gathered for the Section 2. Similar calculations are done for Section 3 and Section 4 of the questionnaire as well.

Table 1; Classification of Responses of the Questionnaire

Rating	Numeric Value
Much Worse than before	1
Worse than before	2
No Change	3
Better than before	4
Much better than before	5

Table 2: Average/Mean Value Classification

Average/Mean Value	Classification
Between 3.5 and 5.0	Has Improved after CDMA Introduction
Between 2.5 and 3.49	Noticeable Change Not Observed
Between 1.0 and 2.49	Degraded after CDMA Introduction

Presentation and Analysis of Data

The analysis is based on the primary data gathered. It gathers and does the analysis based on the responses provided. Based on those responses conclusions are drawn with relation to the main objectives of the study. Therefore, as for the major areas arising from the review of literature, the conceptual framework and Operationalization of the study and the methodology used are been presented. Furthermore, the characteristics of the respondents and their telephone ownership classifications are described. The analysis determines the characteristics of customer perception on flexibility, the perceived quality of service by the customer and the cost reduction incurred for the customer, with the Introduction of CDMA Technology on the telecommunication industry in Sri Lanka. Further to the above analysis, the qualitative aspect, which was discovered in the study through the interviews with senior personnel in the industry is also presented, analyzed, and discussed with related to different areas.

The Questionnaire used to get information from the customer, has four main sections. They are the section one, which gathers general information, section two in order to gather information on customer perception on flexibility, the section three to cover the perceived quality of service by the customer and the section four to asses the benefit of cost reduction incurred for the customer, with the Introduction of CDMA Technology on the telecommunication industry in Sri Lanka.

General Information

In the sample survey exercise, altogether fifty-three completed samples were gathered for the analysis. Among those 79% were residential users and the balance 21% were business users. Almost all of those business users were Small Scale. Entrepreneurs (SSEs). Among them the following were the categorization as per the below table 3 (See Table 3, Classification of the Respondents in the annexure).

In the survey, it was found that both the means and mode of ownership duration of CDMA Phones of Lanka Bell was high. Suntel closely follows second. In addition, SLT being introduced CDMA lately in early 2006, having the lower values relatively as in the Table 4 (See Table 4, Ownership Duration of CDMA Phones in the annexure).

As shown in Figure 3 (See Figure 3, Money Spend on Telephone Monthly Bills in the annexure) thirty percent of the respondents are having monthly telephone bills of Rs. 1000-2000. Among the respondents, only 8% are having T/P bills of less than Rs.500. In addition, more than 70% of the respondents are having average monthly bills more than Rs. 1000. This shows that most of the respondents are using the phone very often. Among the respondents, the usage of the CDMA phone for voice, fax & data is depicted as in the Table 5 (See Table 5, Usage of CDMA Phones in the annexure). With the survey results, it is found that, almost all are using CDMA phones for the primary purpose of voice communication. Further, it was found that almost 53% are using the phone for Internet Data access as well.

Table 3: Classification of the Respondents

Type of Business	Numbers	Percentage
Pharmacy & Drug Stores	2	18
Fuel Station	1	9
Import Dealer	1	9
Grocery Stores	4	36
Communication Bureaus	3	27

Source: Sample Survey 2007

Table 4: Ownership Duration of CDMA Phones

Measure Type	SLT	Suntel	Lanka Bell
Mean (Months)	6-12	12-18	6- 12
Mode (Months)	12-18	18-24	>24

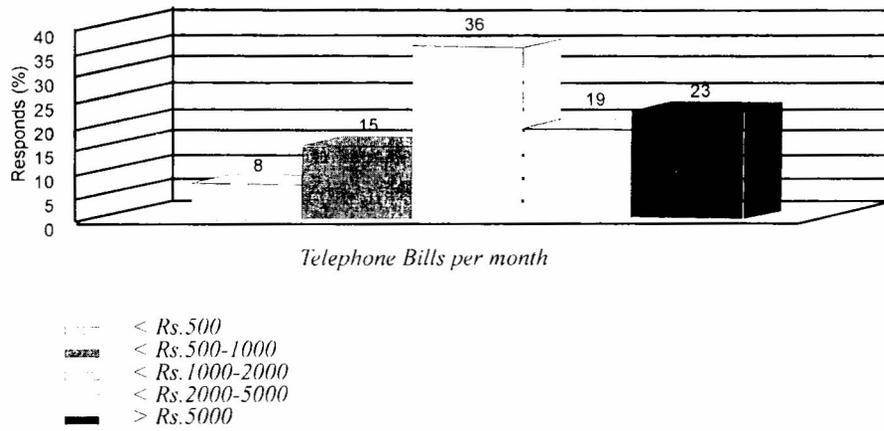
Source: Sample Survey 2007

Table 5: Usage of CDMA Phones

Usage Type	Respondents	Percentage
Voice	53	100
Fax	7	13
Data	28	53

Source: Sample Survey 2007

Figure 3: Money Spend on Telephone Monthly Bills



Source: Sample Survey 2007

Customer Perception on Flexibility

In order to analyze whether the introduction of CDMA technology has increased the level of flexibility of using a telephone, the individual ratings are analyzed as well. The Table 6 (See Table 6, Classification of Ratings for Flexibility Arisen with CDMA Telephones in the annexure) shows the classification of flexibility aspect by the users.

The results clearly indicate that 84.9% of all the respondents could be classified as those who perceive that there has been an improvement in relation to the flexibility associated with a telephone after the introduction of CDMA technology to the telecommunication industry of Sri Lanka. In addition, the remaining 15.1% perceive that, there is no improvement with regard to the flexibility associated with a telephone, after the introduction of CDMA technology.

Table 6: Classification of Ratings for Flexibility Arisen with CDMA Telephones

	Mean/Average Ratings Obtained		
	Degraded after CDMA Introduction	Noticeable Change Not Observed	Has Improved after CDMA Introduction
Frequency	1	7	45
Percentage	1.9	13.2	84.9

Source : Sample Survey, 2007

Perceived Quality of Service by the Customer

In further analyzing the introduction of CDMA technology to the Sri Lankan telecommunication industry has increased the quality of service perceived by the telephone users in the country, the individual ratings need to be analyzed. The Table 7 (See Table 7, Classification of Ratings for Quality of Service Perceived by Users in the annexure) shows the classification of quality of service perceived by the telephone users.

The above results indicate that 54.7% of all respondents could be classified as those who perceive that there has been an improvement in relation to the quality of service of using a telephone, after the introduction of CDMA technology to the telecommunication industry of Sri Lanka. At the same time 45.3% of all the respondents say that the introduction of CDMA technology has not increased the quality of service of a telephone.

Table 7: Classification of Ratings for Quality of Service Perceived by Users

	Mean/Average Ratings Obtained		
	Degraded after CDMA Introduction	Noticeable Change Not Observed	Has Improved after CDMA Introduction
Frequency	3	21	29
Percentage	5.7	39.6	54.7

Source : Sample Survey, 2007

Cost Reduction for the Customer

In order to ascertain whether the introduction of CDMA technology has led cost reduction for the customer, the individual ratings are analyzed as well. The Table 8 (See Table 8, Classification of Ratings for Cost Reductions for the Customer in the annexure) shows the classification of cost reduction that has occurred for the customer.

The results indicate that 52.8% of all respondents could be classified as those who perceive that there has been a considerable cost reduction associated with a CDMA telephone, after the introduction of the new technology to Sri Lanka.. Therefore, there is no evidence to confirm that the introduction of CDMA technology has offered telecommunication services that are more economical to the consumers.

Information based on the Interviews

Interviews were conducted to gather primary data from the three fixed line operators and a regulator. Here also the analysis is done based on the responses provided by the senior personnel from the operators as well as the regulator. Based on those responses conclusions are drawn with relation to the main objectives of the study. With this, qualitative aspect, which was discovered in the study through the interviews with senior managers, is highly considered in the researcher's recommendation as well.

Interviews with the Operators

The interviews were carried out with two senior personnel from each of the three operators namely, Sri Lanka Telecom Limited, Suntel Limited and Lanka Bell Pvt. Most of the time both the representatives of each of the operators had the same view on all the matters which was discussed during the interviews. Very rarely, there was a difference of the opinion of the two interviewees. Most of the time they had the same information in different perspectives.

In the interviews conducted with senior personnel from-Suntel Limited and Lanka Bell Pvt. Limited yielded similar responses and differed from the response received from the senior personnel from the Sri Lanka Telecom Limited.

In conclusion, of the interviews, the overall impact of CDMA technology to the Sri Lankan telecommunication industry was discussed. There, Suntel believe that though the coverage is fully achieved throughout the nation, still there are accessibility issues. Therefore, need for a better payphone network, communication bureaus and common internet cafes, sort of things should be deployed extensively in the rural areas, which could be easily done with the deployment of CDMA technology. Lanka Bell believes, by providing many end user or customer benefits, rural area coverage, less customer end equipment cost, and higher coverage with less cost which cannot be matched by the popular GSM technology has benefited the industry at large. In SLT's point of view, they think there is a boom in the industry with the introduction of CDMA technology and a better competition has resulted customer having many choices suitable for their income.

Interviews with the Regulator

Similar to the interviews conducted with the senior managers of the three operators, the regulators, and TRCSL's senior personnel were interviewed. They were requested to comment on some facts with related to the introduction of CDMA technology to Sri Lanka. Initially they were asked on the following aspects; about any possible regulatory barriers for the development of CDMA technology in Sri Lanka, if the objectives behind CDMA technology achieved, is the regulator influencing enough the operators for timely implementation and also whether the regulator take proactive action to do so and any example for such case. In the view of the regulator, they were in the strong point that there are no regulatory barriers for CDMA technology operation among the three operators. With regard to the concern over whether they have achieved the objectives behind the introduction of CDMA technology, they were in the opinion that partly they have achieved the objectives.

Finally, in the interviews with the TRCSL senior personnel, the overall impact of the CDMA technology to the industry, whether the development in the telecommunication industry is adequate in the last few years, whether the policy decisions of TRCSL have affected the development of the industry and finally whether TRCSL has had learning experience for future introductions similar to CDMA technology, based on the experience gained from CDMA introduction process, were further discussed. TRCSL had a positive view of the outcome of the CDMA introduction. They are in the opinion that it has yielded better results. As per them, the waiting lists have been reduced to almost zero, which is a huge achievement.

Conclusions

The analysis revealed that with the introduction of the new technology, the CDMA, a significant progress in the industry is achieved. With the ability to obtain, new connections, the waiting time had reduced completely. Starting from long waiting years, now it has come down virtually to zero waiting time. All the operators were found to be very much interested in expanding their network throughout the country to cater to needs of the masses. They have acquired a good perception of network quality and reliability of the users. However, there is further room for improvement in some specific features associated with the voice service.

The first aspect of the main objective was to assess the benefits received by the end users after the introduction of the CDMA Technology on the telecommunication industry in Sri Lanka. With the outcome of the sample survey and by reviewing numerous secondary data sources, it was clear that the customers have been benefited largely in the process of the CDMA introduction. In respect of pricing it was evident that there had been a strong reduction of the initial cost on purchasing a telephone with the introduction of the CDMA technology and with the fierce competition among the operators. The cost of obtaining a telephone has come down from fifteen to twenty thousand rupees to couple of thousand rupees. Contrary to that fact, in many instances, consumers have indicated of the unchanged or not reduced call charges is a bothering factor for them at large. This is despite the introduction of the cost effective technology and which in turn had introduced a fierce competition among the operators. This was contrary according to Izaguirre (1999), but supported by a few others such as Dnes (1995). Both the operators and the regulator cited the ongoing tariff rebalancing process, which resulted in increases in local call charges (i.e. charges for calls made within the same secondary exchange area) and national call charges(i.e. charges for calls made

between different secondary exchange areas), as the reason for these phenomena. Price levels are yet to be cost based. Anyhow as per the forecasting provided by the operators, they have started working out an interesting tariff plan to suit all kinds of users in their networks.

Statistical tests revealed that the Business users were less affected by high call charges as the operators offered them, discounts or special tariff plans. Business users also received several added benefits such as subsidies, free equipment etc., as operators competed against each other for the business and large customers. Monthly charges had also decreased with the CDMA technology, despite higher call charges. This is due to the fact that the CDMA telephone is a device that requires no in-depth professional expertise for installation. Because of that, the operators need not to send service personnel to install these telephones. Because of this reason, they can afford to have less monthly rentals for the CDMA users. Anyway still, there are certain areas as seen by the customers that need to be further developed and expanded. However, similar to the experiences of many other countries (Petrazzini, 1996, and Wellinius, 1997), where the competition, resulted with the technology innovations had led to a stronger network growth. The empirical findings, clearly indicated, that the introduction of the CDMA technology had resulted in stronger and steady growth, network roll out and development in the telecommunication industry in Sri Lanka.

The second aspect of the main objective of the research, which was to assess the benefits obtained by the telecommunication service providers, with the introduction of the CDMA Technology to the Sri Lankan telecommunication industry, was achieved as well. The findings confirmed that many benefits are obtained by the telecommunication service providers, as a result of the introduction of the CDMA Technology to the Sri Lankan telecommunication industry.

All the three operators were very much positive in the outcome of the CDMA technology deployment. As per their opinion, this is the best technology presently available for a country like Sri Lanka and they are of the view that they have taken a correct decision at the appropriate time by investing a huge amount of money on the new technology. In addition, all the operators, to the benefit of the rural community had done considerable expansion. Nevertheless, even after completing more than two years of CDMA operation there are no coverage or fringe coverage to rural areas in Sri Lanka. This is one important thing that the regulator the TRCSL has to intervene further for the betterment of the industry. The operators felt that technology neutral license conditions (i.e. providing local and international voice and data service, wireless and wireline services, and mobile services etc.) and also unified

licensing concept where the operator can operate, mobile as well as fixed telephone services, would benefit network roll out and also could offer bundled services to the consumer cost effectively. The lack of focus on the Universal Service Obligation (USO) was seen as a major weakness. It was not clear enough whether the USO was really in practice or not. The two privately owned operators also pointed out that, the lack of consistent and clearer policies and weak regulation as factors affecting investors confidence.

The study examined the service provision and service orientation within the industry. Evidence presented in the data analysis section, proved that the introduction of the CDMA technology had resulted in improved overall service levels provided by the operators as perceived by their customers. Similar conclusions had emerged in several global markets as well. As stated by Milne *et al* (1998) and Boylaud and Giuseppe (2000), the operators too confirmed the importance of increased focus on service in order to maintain competitive advantage and retain customers. The degree of innovation and direct service provision were both found to have improved after the introduction of the CDMA technology, during the past few years. The regulator had also taken several contributory steps in this regard.

However, the study found no perceived improvement in areas such as bill payment facilities provided for bill payments in near by regional centres etc. For example, the bill payments of most of the operators are still centred in major towns and alliances for bill payments are with major state banks only. Nevertheless, the operators were having the opinion that with the CDMA technology they have opened up a new platform for pre paid services, where the users have to buy their calling cards before they use the service. This in turn reduces the requirement of paying monthly bills all the time. However, still all the operators are having a majority of post-paid customers. In overall considering of the second aspect of the main objective of the study, it was clear that operators were pressurized to improve their performance, service levels and pricing because of the new technology introduction and resulted competition among the operators.

With the third aspect of the main objective of the study being, to assess the technological advancement that occurred with the introduction of the CDMA technology, the study revealed that the operators as well as the regulator have accepted that in par with the global trend in telecommunication development, Sri Lanka in the Asian context got down the best suitable technology at the appropriate time. After experiencing many barriers from the previous standard and non-standard, proprietary systems, all the operators were of the strong opinion that they have gone for the best with the CDMA. In addition, they have proved that their selection was correct, with increased figures of capacity, coverage, penetration, income, etc.

In relation to the fourth aspect of the main objective of the study, which was to assess the conduciveness of the established Regulatory Framework in relation to the Introduction of the CDMA technology in Sri Lanka, there was no clear perception among the operators that the Regulator had a positive influence on the development of the fixed phone industry in Sri Lanka. This is contradictory to the fact that the role of the regulator was universally seen as crucial to the successful implementation of technology and in turn the competition among the operators offering various choices for customers. The neutrality and independence of the regulator were questioned by some operators and seen as a barrier to market development by other operators. The telecommunication policy seemed to have been well thought through, at the point of defining, but fallen along the wayside when it came to implementation. The regulatory perspective was that, significant growth and development had taken place in the telecommunication industry, and this was a reflection of the successful, facilitation of new licenses for new technologies and letting new investment to, invest in Sri Lanka and of sound regulation within the industry.

The overall impact of introducing the CDMA technology on the telecommunication industry in Sri Lanka was seen as a beneficial one in many respects by this study. The customers, operators and even the regulatory personnel also shared this view.

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