Development of "System Dynamics-based" Flexible Strategy Game-card: Exploring Future Performance of the Indian Telecom Service Providers

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Abstract

India has emerged as one of the fastest growing telecom markets in the world and witnessed a telecommunication revolution in the last two decades. In the recent time, the Indian telecom industry is experiencing a major transformation with stagnating revenues, declining ARPU's, and stiff competition, which is overall impacting its performance. The present study seeks to explore the future growth perspectives for telecom service providers by identifying other revenue options and their impact on performance. The integration of system dynamics methodology with a recent developed performance management framework helps to bring the issue further in a case context by developing a system dynamics based performance management model portraying the impact of data based services on the performance with the help of many scenarios. STELLA 10.0 software package has been used for model and scenario developments. The study proves the integration of system dynamics methodology improves the holistic understanding of telecom operating system showcasing the integration of subscribers' view and data based services create the future of telecom service industry in this transforming business environment.

Keywords: Flexible strategy game-card, System Dynamics, Indian telecom service providers, Performance measurement and management

1. Introduction

"There is always room for improvement, you know-it's the biggest room in the house."

Louise Heath Leber

Every system changes/improves over time and the future behavior of the system can be created from within. This holds true for the field of performance measurement and management which has witnessed enormous developments in last two decades. Lot of transformations has been made in terms of incorporating integrative perspective of performance from merely looking from financial perspective. These developments suffered from some criticism highlighted in the literature, as the lack of cause-effect relationships, dynamic view of the performance, integration of customers' viewpoint related to performance etc. There are some recent developments related to performance management frameworks intending to overcome some of the major criticisms highlighted in the literature. *Flexible strategy game-card* is one of those developments that look the performance dominantly from two perspectives, i.e. enterprise perspective and customer perspective.

This is well received in the literature that the application of system dynamics (SD) methodology with balanced scorecard (BSC) which is one of the most popular frameworks, help to overcome some of the criticisms and help to use it in dynamic business environment. Thus, it can be stated that the integration of SD methodology with performance management frameworks/systems lead to better understand the dynamics of strategic interventions and performance results. This provides the motivation to carry out the present study which seeks to explore the linkages of flexible strategy game-card and system dynamics methodology in the context of performance of the Indian telecom service industry which has experienced transformation in the last few years. So understanding the future performance of Indian telecom industry with the help of integration of SD and game-card sets the agenda of present study.

The present study seeks to integrate flexible strategy game-card and SD to achieve the following objectives:

RO1: To determine the strategic indicators related to dimensions of game-card to develop the dynamic structure for the Indian telecom service providers;

RO2: To mapping the stock and flow diagram to simulate and analyze the dynamics of performance in the future;

RO3: To find out and analyze the key policy parameters which create future performance of the enterprises and to suggest policy directions to enhance the performance of the Indian telecom service providers in a case context.

To achieve the above stated objectives, the study has been structured in the following way: After delineating the research background and objectives in section1, section 2 deals with literature review detailing the available research related to dynamics in performance management systems, description of flexible strategy game-card and brief about SD methodology. Section 3 highlights

the conceptual research framework by integrating game-card and SD. The main body of the paper describes in section 4 by detailing the model construction and testing. Section 5 brings out the discussion related to development of different scenarios which help to analysis different policy parameters related to future performance of telecom operator. The last section carries out discussions and contribution of the study.

The expected outcome of the study is development of a SD based performance management model for the Indian telecom service providers leading to analyzing effect of key policy parameters on future performance.

2. Literature Review

In order to integrate flexible strategy game-card and SD methodology and application in context of the Indian telecom service providers, it is imperative to detail out the existing literature on these issues. This section highlights the literature related to flexible strategy game-card, SD methodology and growth trends of the Indian telecom service industry.

BSC, one of the most dominantly used strategic performance management system highlighted by the practitioners, suffer the criticism of being static and lack of causality. The concept of causality which is not extensively explained and very often such causal relationships are assumed to be unidirectional in BSC (Norreklit, 2000). The other criticism highlighted is that it lacks dynamics and does not consider time-delays between cause and effects (Bianchi and Montemaggiore, 2008). The last one decade showed enormous interest related to explore dynamics of BSC, some of the major studies are: Ritchie-Dunham (2002); Akkermans and van Oorschot (2005); Strohhecker (2007); Bianchi and Montemaggiore (2008); Capelo and Ferreira Dias (2009) and Barnabe(2011), who have conducted case studies and simulation based experiments for the development of "dynamic scorecard" taking into consideration feedback approach. These studies had explored that SD based scorecard comparing to traditional BSC specifically improve strategic architecture by using mapping tools, better representation of causal structure of the system, and helps in analysis of systematic structure in terms of relationships between structure and behavior (Barnabe, 2011). Thus, it is well established fact that the integration of SD modeling and simulation techniques help to give better results with performance management systems/frameworks.

Flexible strategy game-card (Sushil, 2010), which is one of the evolving performance management frameworks, emphasizes two perspectives of performance, i.e. enterprise perspective and, customer perspective. The enterprise perspective covers all the major stakeholders, while customer perspective exclusively considers the customers' view point related to performance of enterprise. Enterprise perspective deals with situation–actor-process-performance related parameters, thus covering the external environment as well as internal environment. The strategic indicators related to external and internal situations, actors, processes are dealt under this perspective. Financial and non-financial indicators are considered related to performance. The customer perspective deals the performance of the enterprise from customer's perspective which is linked to value in offerings and relationships to the customers. The structural overview of Flexible strategy game-card has been demonstrated in Figure 1.

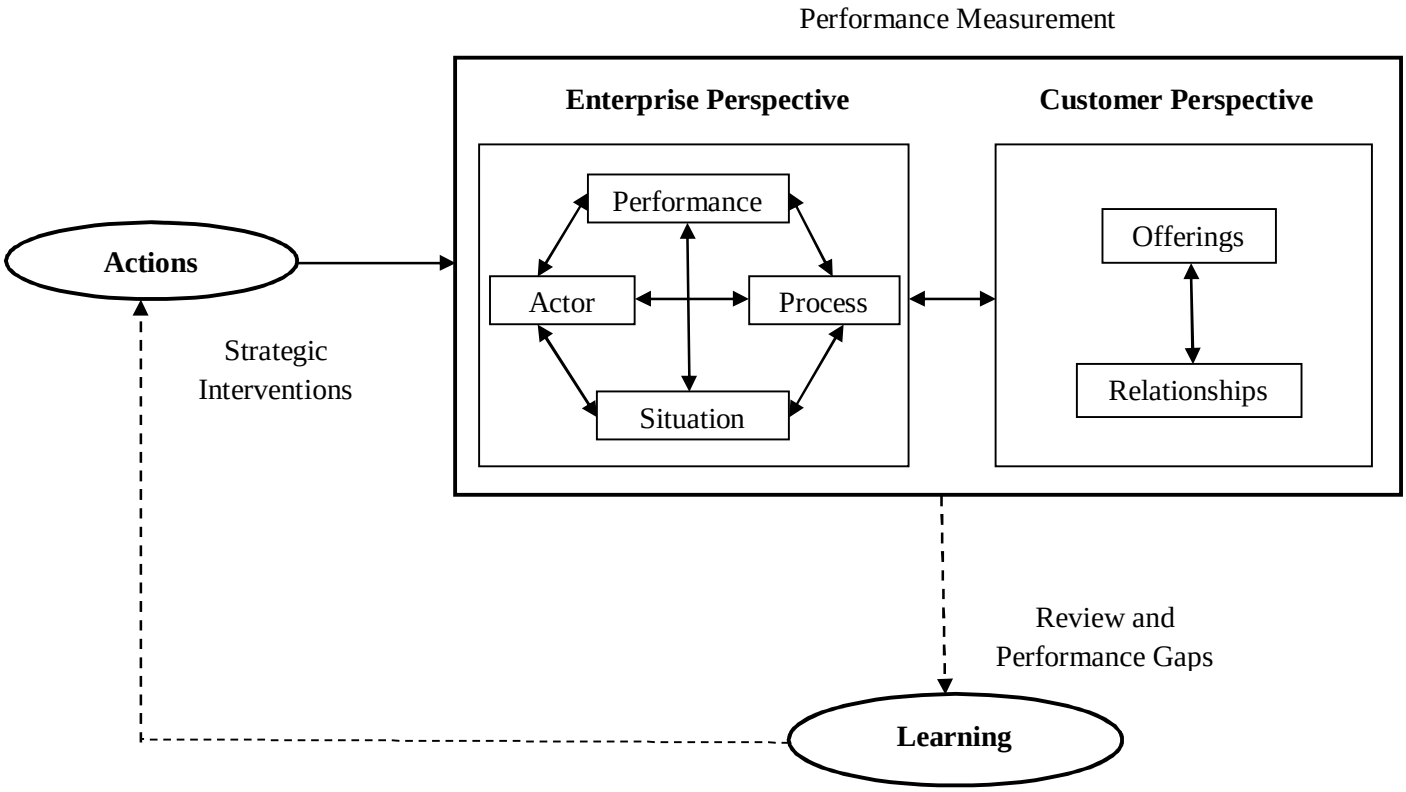

Figure 1: Flexible Strategy Game-card (Adopted from: Sushil, 2010)

This framework supports the full cycle of strategy development, execution, strategic interventions, and corrective actions, thus supporting the LAP (Learning-Action-Performance) framework, and this provides it an edge to existing performance management frameworks. The LAP framework provides the dynamism to this framework via considering the causal thinking and feedback loop learning. This framework has a strong theoretical background supported by strategic management theories, as stakeholder theory, contingency theory, dynamic capabilities view and resource-based view (Yadav *et al.*, 2012).

Looking toward the literature related to SD, it is a well-established methodology for understanding the behavior of the system and it has been widely used in various fields. SD is a quantitative method which is based on the theory of feedback control and takes the computer simulation as a mean to study the complex systems (Su, 1988).). The unique characteristic of this methodology is that it helps to understand the complex systems by the way of developing causal loop diagrams and stock and flow diagrams. These elements help to study the behavior of the system. SD employs both qualitative and quantitative approach for understanding the system. The problem identification, definition, system conceptualization and development of stock and flow diagrams and causal loop diagrams are part of qualitative approach; while developing mathematical equations, simulation and sensitivity analysis and scenario building are the part of quantitative approach. Thus this methodology is more than just technical tool to develop models for mathematics, physics and engineering but can be explored to social sciences and management.

The modeling process proposed by Sterman (2010) provides a whole picture of development and implementation of model for real world problem which is exhibited in Figure 2, and it consists of following steps (This study follows these steps for model development):

i. Articulating the problem to be addressed;
ii. Formulating a dynamic hypothesis about the causes of the problem;
iii. Formulating a simulation model to test the dynamic hypothesis;
iv. Testing the model until satisfied that it is suitable for the purpose;
v. Designing and evaluating policies for improvement.

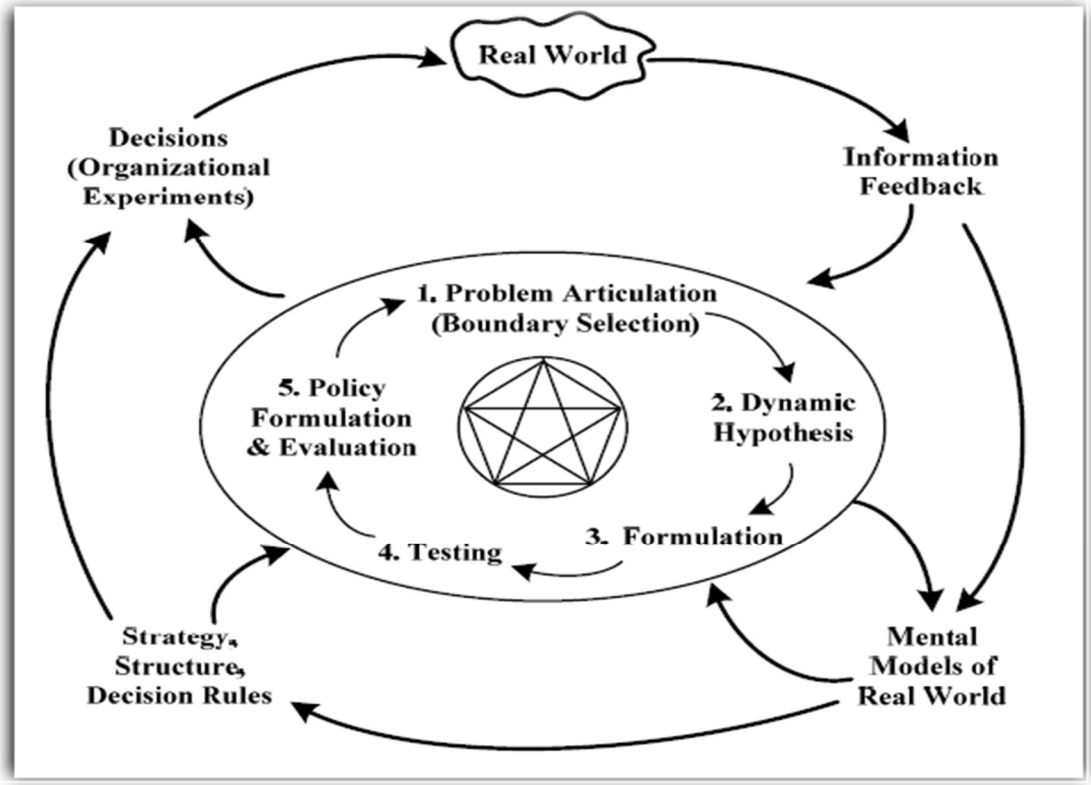

Figure 2: Modeling Process in System Dynamics (Source: Sterman, 2000)

The last part of literature review section seeks to characterize the performance of Indian telecom industry. Indian telecom industry, which is one of the performing industries since its inception has witnessed more than 965.52 million subscribers as on end of June, 2012 (TRAI report, 2012). The major growth trends of the industry can be summarized as follows:

- India is the second largest wireless network in the world after China.
- The overall tele-density has reached to 79.58 as on 30th June, 2012, where the rural tele-density has increased to 40.66.
- Total internet subscribers has reached to 23.01 million as of June, 2012.
- Growth revenues (GR) and adjusted growth revenues (AGR) for telecom industry for QE June-12 has reached to 52512.10 cr. and 35499.01 cr. respectively thus employing an increase of 6.64 per cent in GR.

The industry has shown a saturation in voice based services, as the Average Revenue per User (ARPU) has shown a declining trend, so the prospective growth and revenue sources are value added service (VAS), wireless and broadband services. With this reference, it witnesses the appropriateness of selection of the industry to investigate the research objectives.

3. Research Framework

On the basis of the two perspectives, and six dimensions of flexible strategy game-card, the key variables of the study has been identified through conducting semi-structured interviews with industry experts, academicians and telecom subscribers. SD methodology has been used to understand the behavior of system of telecom service providers and the simulation of the key decision parameters help to identify new strategic interventions and develop business plans for improved performance results. Figure 3 exhibits the conceptual framework of the research which has been followed to conduct the study.

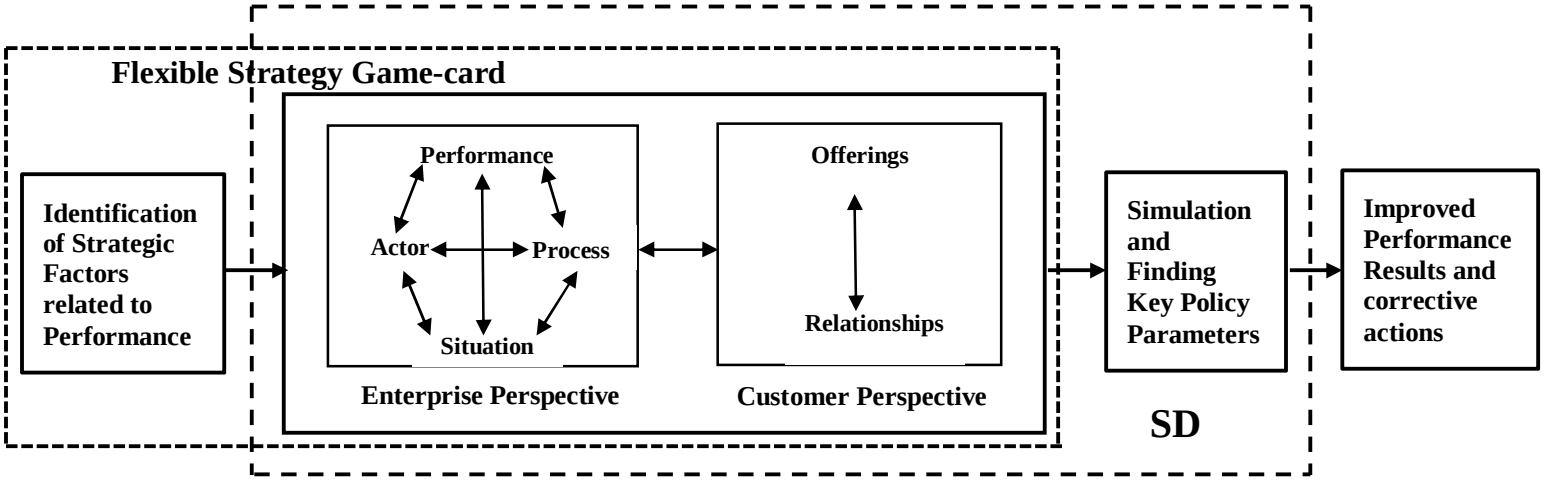

Figure 3: The Conceptual Framework of Research

The scope of the study is limited to the wireless and value added services provided by one of the telecom operators and its impact on the performance. As already mentioned that there is saturation in voice-based services and ARPU is declining, the impact of wireless, VAS and internet based services on the performance of telecom service providers are examined in the study.

The five steps given by Sterman (2010) for development of SD modeling has been followed in the study to develop SD based performance management model. STELLA 10.0 software package has been used for the development of the model and to run the simulation.

4. System Dynamics Model Construction and Testing

The main part of this paper is about the discussion of SD model construction and testing has been placed in this section. One of the Indian telecom service providers have been chosen as the case context to investigate the research issues and achieve research objectives. The case company is part of one of the biggest business group of India. The company aims to provide end-to-end telecommunications solutions for business and residential customers across the nation. It covers a full range communication services including, voice based services, connectivity based services, and location based services, and market to market based services. It is one of the largest mobile service operators in India and has a reach to many towns and villages of India with its 2G and 3G services. As there is stiff competition in the market, and revenues from voice service are declining, the scope of data based service is enormous contributing to revenues which is going to be examined through this performance management model which is developed in following steps.

For model development, five step process of Sterman (2010) has been followed, the discussion in details is as below:

Step I: Problem Definition, Variables and Scope

The objective statements of present study is clearly stated as development of system dynamics based performance management model exclusively looking the impact of data based services. The overall impact of key policy parameters and government policies has been attempted to figure out through the study.

As already mentioned, the present study has taken flexible strategy game-card as a theoretical basis, so the key variables which are strategic factors related to performance have been identified for two perspectives, i.e. enterprise perspective, and, subscriber perspective. Despite using the classical method of literature review for identification of factors, semi-structured interviews have been conducted with senior level management and telecom subscribers. They were asked to list performance related factors as per the game-card dimensions; these interviews have been analyzed using 'thematic content analysis, and themes from the qualitative data have been identified.

There is very limited understanding available related to customers' view point about the enterprise performance, here, it is very well taken care of by discussing and interviewing the telecom subscribers about their perception of strategic factors related to telecom operators performance, and thus, the strategic factors related to customer perspective have been captured (For detailed analysis of identification of strategic factors, see Yadav *et al.*, 2012). The strategic factors identified from this analysis are illustrated in Table 1.

Table 1: Key Dimensions and Variables

	Dimensions	Main Variables
Enterprise Perspective	**Situation**	PE1: Competition level PE2: Government policies
	Actor	PE3: Customer satisfaction PE4: Employee productivity
	Process	PE5: Business process efficiency
	Performance	PE6: Profitability PE7: Revenue growth PE8: ARPU PE9: No. of subscribers
Customer Perspective	**Value in offerings**	PC1: Quality of telecom services PC2: Call tariff PC3: VAS offerings
	Value in relationships	PC4: Brand image of operator PC5: Customer support services

Step II: Formulation of Dynamic Hypothesis

"The dynamic hypothesis is a preliminary sketch of the main interaction and feedback loops that could explain observed and anticipated behavior" (Morecroft, 2007). The dynamic hypothesis examined in the study are:

H1: The integration of subscribers' view point lead to future performance of telecom service provider.

H2: The application of data based services create the future performance of telecom service provider.

For examining these dynamic hypothesis, causal loop diagrams (CLD) have been developed both for enterprise factors and subscribers' factors through group discussions with company experts, industry experts, academicians as well as subscribers. As the emphasis of the study lies on discussing the transforming scenarios of telecom industry, changing trends of mobile usage for subscribers, and other revenue options for the industry were major discussion points. An integrated CLD showing the interaction of enterprise related factors and subscribers' related factors have been developed, which is exhibited in Figure 4. An innovation has been done in CLD by adding the interpretations of all the links of CLD and thus making it an 'interpretive CLD'.

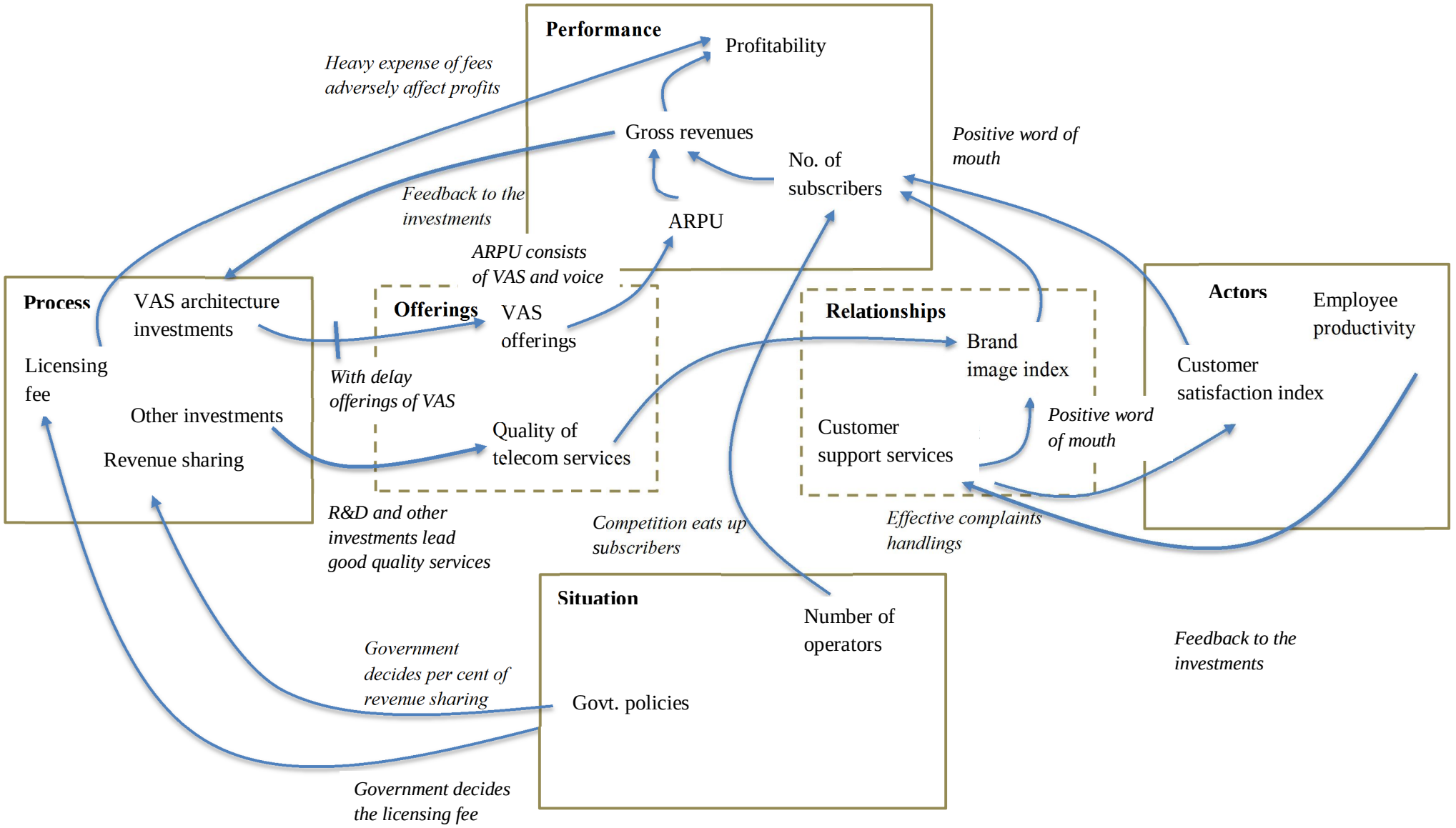

Figure 4: Interpretive Causal Loop Diagram (CLD) integrating Enterprise and Subscribers' Perspectives

Integrated CLD portrays that subscribers' related factors give feedback to actors as well as performance. Government policies give a guideline about the per cent of sharing of revenues between the government and the company, and the licensing fee. So, these are exogenous factors for telecom operator and it has to realign its' strategies to cope up these factors. As already stated, there are many sources of revenues of company which are coming from voice based services, data-based services and some other services. For providing ample number of value based services, the company is making investments in VAS architecture, there will be a delay in the investments and the VAS offerings, which is exhibited by a straight line cutting the loop. There are other investments as, R&D investments, infrastructure investments, tower investments, which will help to enhance the services.

The subscribers' related factors, as high brand image index leads to positive word of mouth and will attract more subscribers, customer support services lead to increase customer satisfaction index and employee productivity and thus integration of subscribers' view point give feedback to lagging indicators of performance.

The lagging indicators of performance, as gross revenues, number of subscribers, ARPU and profitability (return on total assets) are driven through competition (number of operators), brand image of operator, VAS offerings, and customer satisfaction index of the company. There is some per cent of ARPU coming from VAS and some per cent of ARPU is coming from voice-based services.

The polarity of the relationships have not been specified in the CLD, as there are some relationships where specifying polarity found difficult. Some relationships have very clear polarity, as licensing fee will negatively affect profitability

Step III: Formulation of Model

For development of system dynamics based model, STELLA 10.0 software package has been used, where stock and flow diagram has been developed. The values of parameters have been collected from case company and focus group discussions have been conducted before developing the model. Some of the assumptions were drawn while developing the model are as follows:

- *The licensing fee and revenue sharing has been paid on the basis of gross revenue on yearly basis.*
- *The cost components of telecom operator has been kept constant.*
- *As the competition increases (in terms of number of operators), the subscribers of case company will reduce.*

Keeping these assumptions in mind, stock and flow diagram has been developed for examining the dynamics of investments, gross revenues, number of subscribers, and ARPU from voice and data services. Figure 5 exhibits stock and flow diagram of SD performance management model integrating all sub-systems.

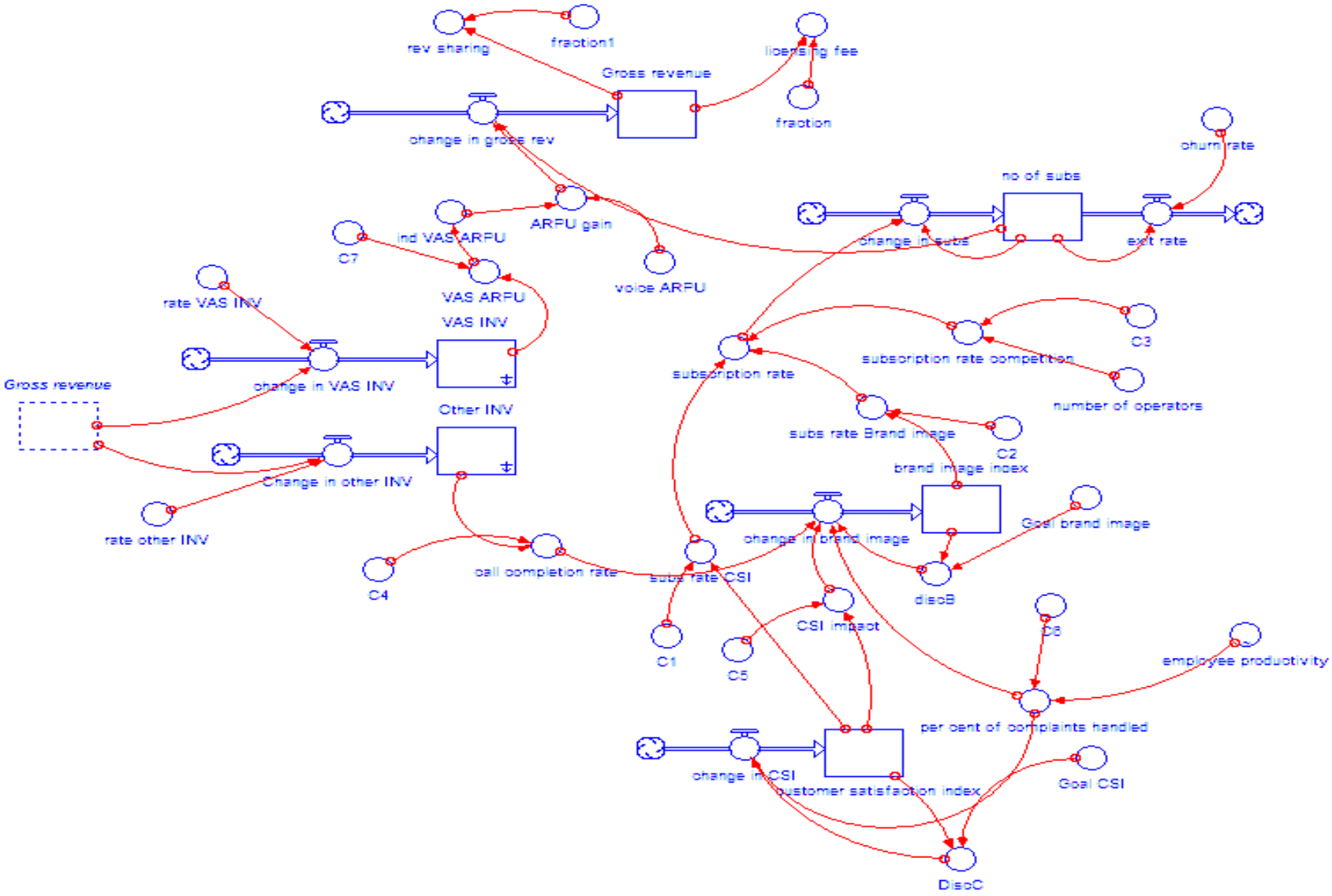

Figure 5: Stock and Flow Diagram of SD Performance Management Model

Looking at the dynamics of number of subscribers, which is getting influenced by brand image index, customer satisfaction index and exogenous factor competition. The company has a churn rate of 15 per cent for its subscribers. Brand image index has an influence from customer support services in terms of per cent of complaints handled, customer satisfaction index, and quality of telecom services in terms of call completion rate. Customer satisfaction index is measured through customer support services and per cent of VAS offered.

The other side of the model is showing the dynamics of different types of investments, VAS offerings, ARPU gain, and gross revenues. With a delay of one year, the investments in VAS architecture and infrastructure and R&D makes an impact on VAS offerings and quality of telecom services. ARPU gain for the operator is from two sources, one is from data services and other is from voice services. The operator is paying the licensing fee at 10 per cent of the gross revenues, and revenue sharing with the government is 8 per cent of gross revenues. As there are many intermediary processes have been compressed during the modeling, their combined effect has been captured in different correction factors (C1, C2, etc.).

Thus, the integrated dynamics of data based services, investments in VAS architecture, and feedback from subscribers' view point to the performance of telecom operator create a SD based performance management model looking towards the future prospective of performance in recent business environment.

Step IV Model Testing

It is imperative to conduct different tests for building confidence in SD models, and confidence accumulates gradually when model passes more tests and the correspondence between model and empirical reality can be identified. Here, the testing of model structure has been done with the help of following tests (Forrester and Senge, 1980):

a. *Structure-verification test:* This test encompasses the comparison of model directly with structure of the real system that the model represents (Forrester and Senge, 1980). For conducting this test on performance management model, the stock and flow diagram has been discussed with some of the experts from telecom service industry and case company. Although the model has suppressed the effects of some of the intermediary processes, yet it doesn't contradict with real life settings.

b. *Dimensional-consistency test:* This test entails the dimensional analysis of model's rate equations (Forrester and Senge, 1980). This is first and basis task for model testing to check whether the equations are dimensionally consistent. Here, all stocks are calculated on yearly basis and amount has been taken as '000 INR.

c. *Boundary adequacy test:* This test considers structural relationships necessary to satisfy the model's purpose. This test asks whether the model aggregation is appropriate and it includes all relevant structure. This test involves developing a convincing hypothesis relating proposed model structure to a particular issue addressed by a model (Forrester and Senge, 1980). Here, performance management model hypothesizes to examine the impact of interaction of subscribers' view point and investment in VAS architecture on future

performance of case company. The model includes all those stocks and auxiliaries capturing the impact of these issues.

Step V Simulation and Analysis

As the main purpose of the study is to visualize the impact of different government policies and the future performance perspective for Indian telecom operator in the case context, the simulation has been run for the model and dynamics of different stock variables have been captured. The base year has been taken as 2010 and simulation has been run for next 10 years. The stocks chosen for analyzing the model are all lagging indicators of performance, as gross revenue, number of subscribers, customer satisfaction index and subscriber's related factors, as brand image index. Figure 6 shows the integrative dynamics of all these stocks for the case context.

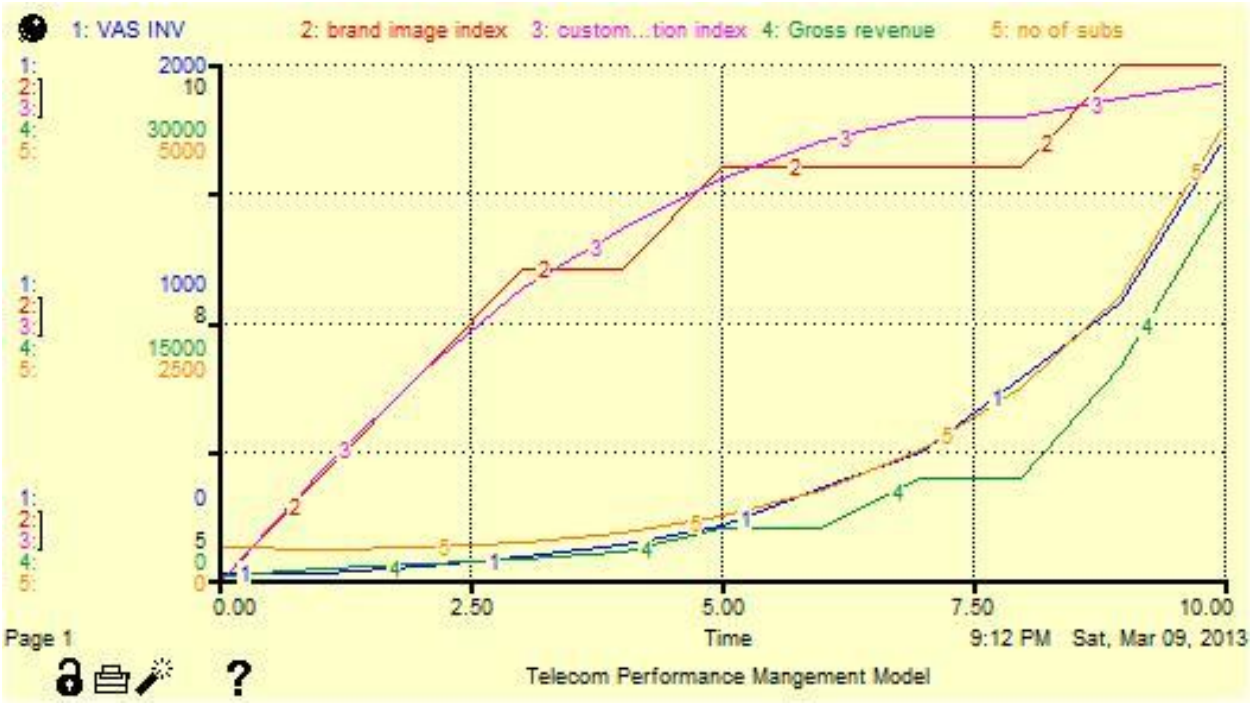

Figure 6: Dynamics of Lagging Indicators related to Performance

The graph clearly highlights that there is exponential growth in subscribers' numbers due to an increase in brand image index and customer satisfaction index. The behavior proves that by setting a positive brand image of operator and providing quality services, there is positive word of mouth from the existing subscribers which influence to more potential subscribers. Brand image index and customer satisfaction index are showing goal seeking behavior and moving toward reaching a goal of 10. Gross revenue, which is showing dramatic growth post 2015, which is prompting more investments in VAS architecture.

As the STELLA graph shows the integrative dynamics on a multi-scale, the exclusive dynamics of each stock is difficult to understand here. Separate graphs for all the lagging indicators and subscribers' related factors have been drawn which are demonstrated in Figures 7 to 11.

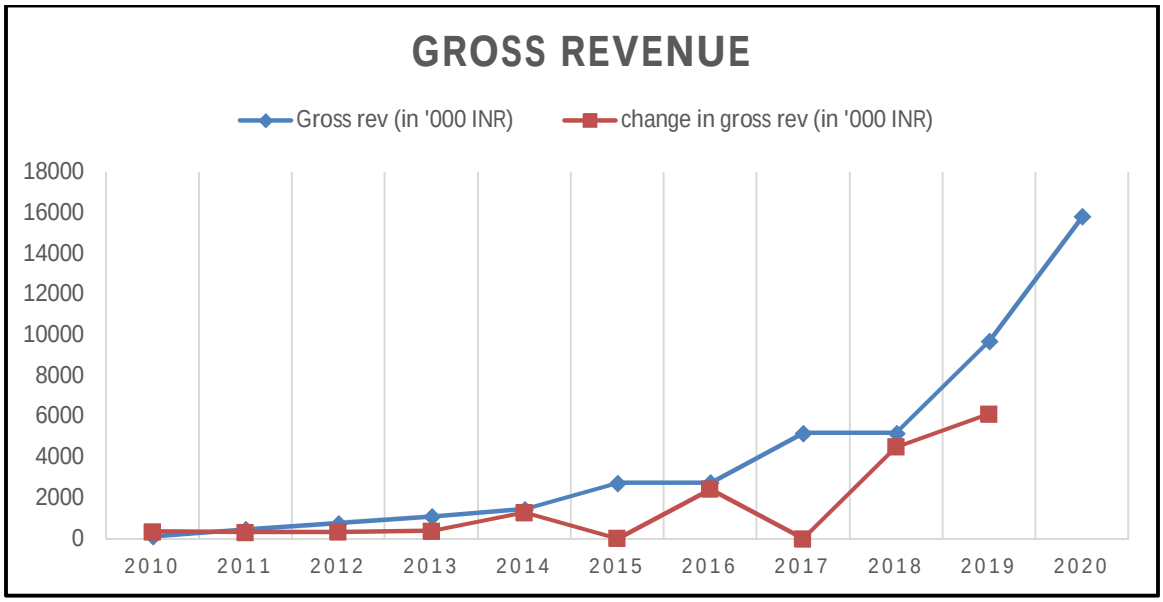

Figure 7: Dynamic Behavior of Gross Revenue

Gross revenue which is shown as a function of ARPU gain and number of subscribers has shown a dramatic growth post 2015. This implies that more investments in VAS architecture helps to fetch more revenues to the company, as the ARPU from voice services are declining, this revenue option widens services horizon and scope for revenues for telecom industry. Figure 7 explicitly captures the dynamics of changes in gross revenue and simulated values of gross revenue till year 2020.

Figure 8 helps to support dynamic hypothesis *H1* by showcasing the impact of subscribers' related strategic factors. Subscription rate, which is a function of competition, brand image index and customer satisfaction index. The subscribers' dynamics holds the assumption of negative impact of competition on the subscribers' numbers. Here, the impact of competition is balanced by brand image of operator, quality of services and customer support services, and the dynamics shows an exponential growth in number of subscribers.

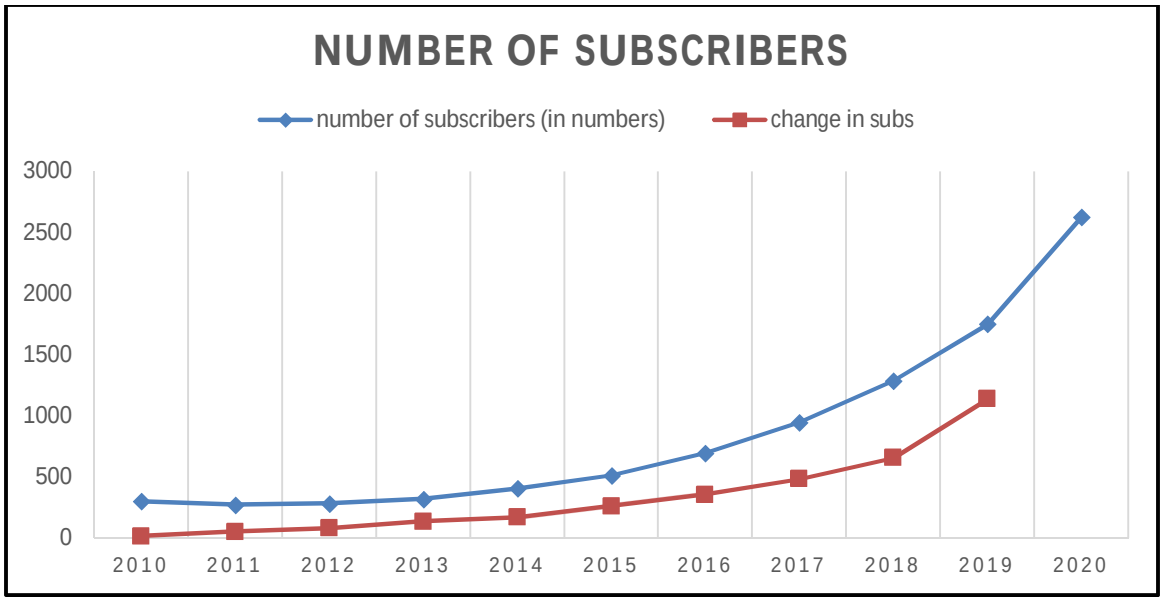

Figure 8: Dynamic Behavior of Number of Subscribers

Brand image index which has been measured on 1-10 scale, shows the impact of quality of services, customer support services and customer satisfaction. The model shows brand image index as a goal seeking behavior which is aspiring the goal of 10. The dynamics of brand image index and customer satisfaction index also support dynamic hypothesis *H1* by capturing the impact of quality and prompt services to subscribers' view point toward operators' performance. Figures 9 and 10 exhibit dynamics of brand image index and customer satisfaction index respectively.

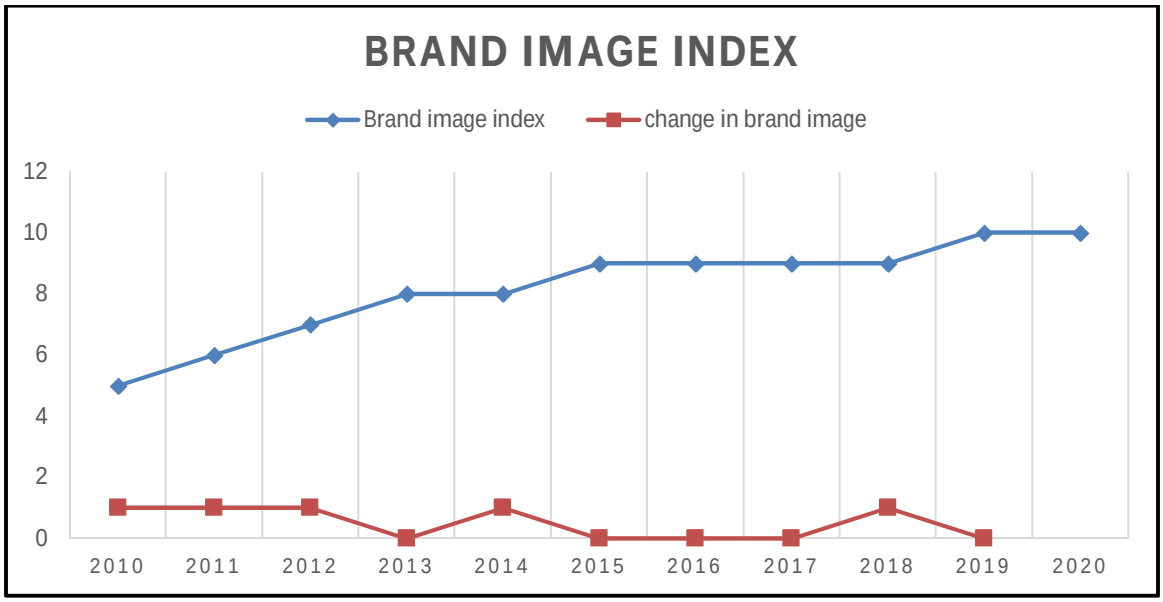

Figure 9: Dynamic Behavior of Brand Image Index

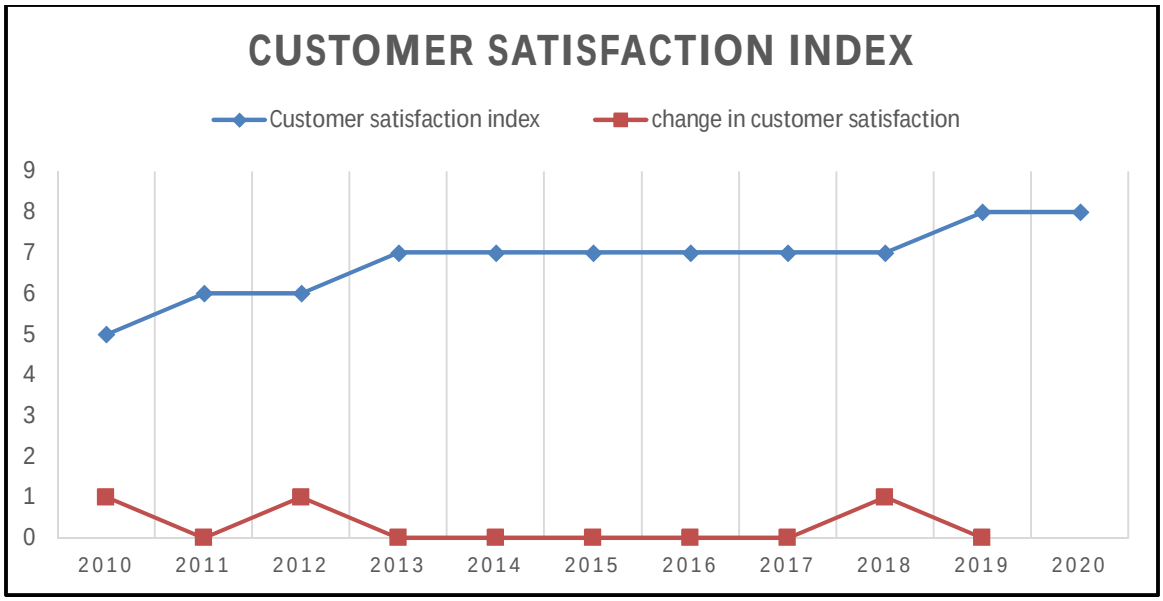

Figure 10: Dynamic Behavior of Customer Satisfaction Index

To examine the dynamic hypothesis *H2*, dynamics of VAS investments has been analyzed. As Figure 11 showcases, with an incremental growth in initial years till 2014, it has shown an exponential growth in post 2015, with some delay it shows the impact on VAS offerings and ARPU gain from VAS. The increments in VAS architecture investments give a positive feedback to ARPU gain, and ultimately achieving high gross revenue, thus supporting dynamic hypothesis *H2* in the case context.

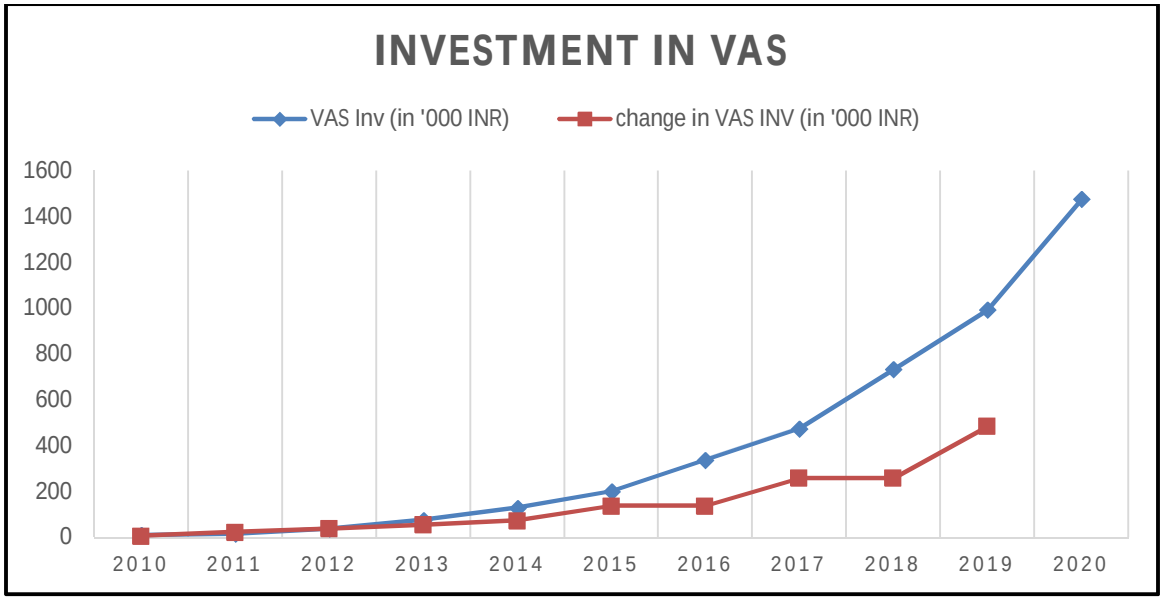

Figure 11: Dynamic Behavior of Investments in VAS

5. Scenario Building

To achieve research objective 3 (RO3), policy parameters affecting and creating the future performance of case company have been identified and their impact have been analyzed. A brief description of those analysis has been demonstrated in this section with the help of some scenarios developed here.

- *Scenario one: Policy about New Entrants*
  Indian telecom service industry is facing stiff competition. Recently some governmental regulations as, MNP (Mobile number portability) helped to attract subscribers of competitors, but the churn rate of subscribers has also increased. The policy related to new entrants will bring more players in the market and thus increase the competition and will decrease number of subscribers for case company.

- *Scenario two: Investments in VAS Architecture*
  Indian telecom industry is facing the problem of stagnated ARPU because of low and competitive tariffs. The only other option to increase ARPU is through data based services and VAS offerings. The more investments in VAS architecture will widen up the service portfolio for telecom companies, and will help to increase MoU (Minute of Usage) and data downloading.

6. Discussions and Conclusion

The behavior of existing system helps to create the future of that system. This has been studied and analyzed in the present study. The Indian telecom industry which is experiencing tremendous changes, the future performance can be created by studying the Indian telecom company at its present. Thus, a performance management model integrating system dynamics methodology helps to investigate the issue of concern. The advantage of using system dynamics methodology experienced by authors, as interpretive CLDs' and stock and flow diagram helps to understand and investigate the problem effectively.

With the help of modeling the performance management system, and running and analyzing the simulation, it gives better understanding about the major concern and drivers for creating future performance. The exponential growth observed in gross revenue and subscriber numbers is due to special consideration of subscribers' related factors, giving quality and prompt services and building a positive brand image. The SD based performance management model suggests strategic interventions in terms of developing new strategies or making corrective actions in existing one, as investment in training of customer care executives lead to effective complaints handling thus, increase the customer satisfaction and brand image. The investments in R&D and infrastructure help to build effective service platform and can help to provide better network connectivity and good voice quality calls and services, and help to enhance quality of telecom services.

The present study makes contribution to the strategic dimensions of telecom industry exclusively in Indian context by suggesting some of the scenarios and their likely impacts of future performance. Although the study is limited to a case context, yet this can be considered by other telecom operators, as most of the Indian telecom operators are working on almost same service

platform. The integration of SD methodology and flexible strategy game-card provide a mechanism to develop a performance management system for any enterprise of interest, and thus can see the likely future of their performance without any risk. The interpretation of the links of CLD gives better understanding at the time of development of stock and flow diagram.

Some of the limitations related to present study can be listed as, many processes effecting the lagging indicators and services for subscribers have been suppressed and combined effect has been presented here, which impact the clarity of the model. If all the processes would have been incorporated here, the model would become as complex as the real world. The correction factors have been determined with the help of experts' discussion, but there are some statistical techniques (Eg, regression) which can be used to calculate these parameters, which gives more statistical rigor and build confidence in the model. The retrospective validation of the model could not be performed due to lack of availability of data related to some factors.

The model can be further validated by using the data of some other telecom service operators, which can be considered as the future scope of the present study. Sub-systems of performance management systems can be modeled separately, and it helps to avoid the complexity of SD based performance management system. As, strategic decision making is a dynamic process, the model can be run for one year and then the impact of policy parameter can be studied, necessary changes could be incorporated and then it can run further, thus it brings dynamics in decision making and ultimately helps to achieve targeted performance results.

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