Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 10, October -2018

TITLE- OPERATIONS RESEARCH AND TELECOMMUNICATIONS

[1]Divya Mutreja, [2]Gargi Modi, [3]Hryhthm Gupta, [4]Hardik Budhraja, [5]Harmilan Kaur

[1,2,3,4,5]*SYBBA, NMIMS, ASMOC, Mumbai Campus*

Abstract:- *Telecommunications is a wide area which includes transmission of signs, signals, messages, words, compositions and data of any nature through wired or remote systems. For conveyance of such administrations, most recent innovation is being utilized so that it spans to the goal at time. A considerable measure of research papers and articles have been utilized to talk about the utilization of Operations Research in this division. The motivation behind our examination is to utilize complex scientific models and an arrangement of strategies for arranging, booking and breaking down in light of man-made reasoning to manage troublesome and touchy issue of conveying this administration rapidly at the goal. This exploration paper discloses to us that Operations Research helps in the basic leadership for assembling cost structure investigation, specialized information examination, generation and income figure in this part. Brazil and Jio contextual investigation have been cited to give a down to earth perspective of how OR is connected, in actuality, complex issues. To face these issues, application of Operations Research becomes vital.*

Introduction:

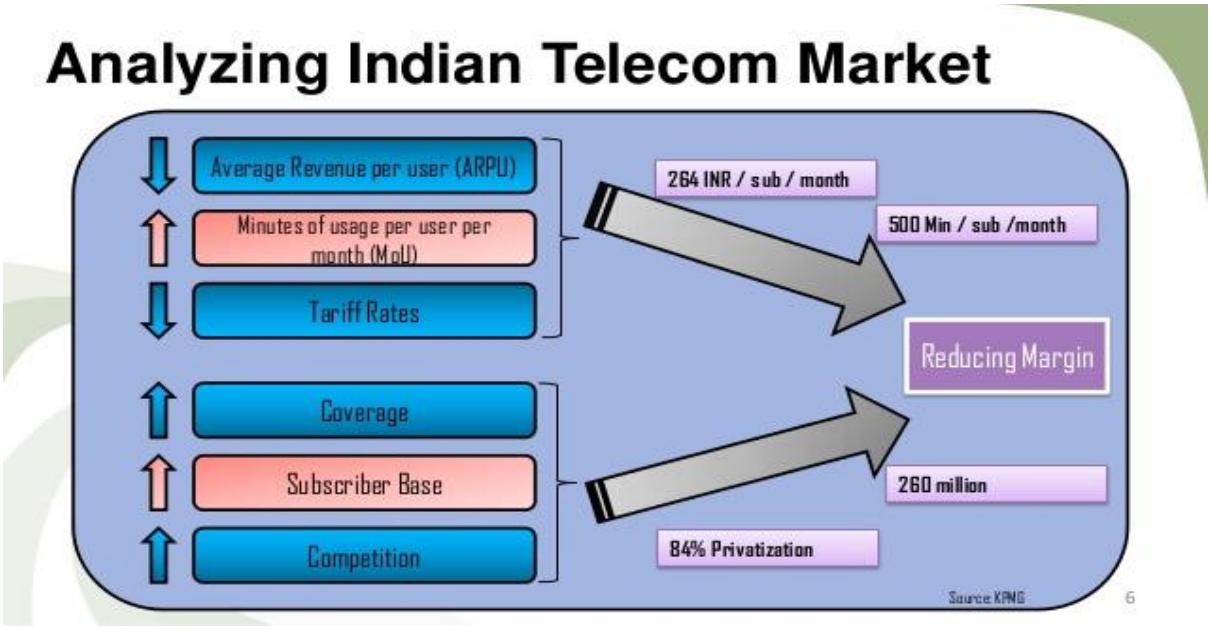
Operations Research (OR) arises providing a such of methods and equipment for thinking, analysing and solving, which leads to making decisions in a structured and focused way towards optimality and efficiency. these tools include the mathematical modelling, the optimisation theory, the graph theory, or the artificial intelligence methodologies amongst others.

OR analysis steps:

Understanding the system- The process of operation research analysis starts with understanding a real-life problem in which we use mathematical models to achieve optimality and further implement the prototype designed.

1. **Creating a Model**
2. **Shows Important Variables**
3. **Symbolises the Model**
4. **Finding optimality**
5. **Quantifying the Model**
6. **Using Mathematical Devices**
7. **Use of Computer**
8. **Interdisciplinary**
9. **Highest Efficiency**(Kimball, 2011)

The actual telecommunication system is composed of intricate networks that enables the communication of hundreds of thousands of customers within a city and of millions of customers around the world. The hierarchical organization of this network is a matter of fact and plays a major role for operations research and management science (OR/MS) models, in as much as optimized levels of customer concentration enables the substantial economies of scale of increasing transmission bandwidth.



Brief History-

A.K. Erlang was introduced to communication system issues by J. Jensen, chief engineer at the Copenhagen telephone company. in a 1917 paper Erlang projected a formula to model telephone traffic showing that incoming calls are often characterised by the Poisson distribution. Since then, Erlang's formula has been used to estimate the wants of lines in circuit switched telecommunication networks (that is, the standard PSTN, Public Switched telephone Network). continuing Erlang's work, E.C. Molina, as well as T.C. Fry, created vital contributions on telephone traffic theory, building a queuing model by means of birth-and-death processes. in addition, to the telephone traffic characterization, OR origins gave impulse to the telephony call routing potency. In fact, most of the routing algorithms that are accustomed to outline the operation routing tables were based on the shortest path or/and minimum spanning tree algorithms. Throughout the last decade of the past century, the boom experimented by the telecommunications industry led to the development of latest transmission standards, transmission media, switching modes, access protocols, etc. Since then the telecommunication industry continued growing and branching and increasing its technical complexness. Currently, there's a wide vary of analysis potentialities in telecommunications which can be classified in the kind of telecommunications network. For instance, wire-based telecommunication systems (including interurban networks, or urban networks among others), wireless and mobile communications, satellite- primarily based communication, etc.(Cortes, 2012).

For a telecom company we would be interested in answering questions such as:

i) How to be more cost-effective and ensure efficient service distribution?
ii) What is the effect of delay of any activity on the overall completion of project?
iii) How to reduce the time to perform certain activities in case of availability of additional funds?
iv) What is the probability of completion of project in time?

Overview

India is the world's 2nd-biggest telecommunications marketplace, with over 1.418 billion subscribers as of April 2018. throughout FY07-18. The country is now the world's 2nd largest telephone market and could have nearly one billion unique cellular subscribers by 2020. the upcoming country wide Telecom policy 2018 has envisaged attracting investments worth US$ 100 billion within the telecommunications region by 2022. There are a large number of telecom products manufacturing and carrier providing corporations in India which consist of Airtel, Spice communication, Idea cellular, Reliance communication, MTNL, Tata Docomo, Vodafone, Tata communication and so on.

It is expected that telecommunication market of India will experience further growth, because of increased non-voice revenues and high penetration in rural market. Telecom penetration reached 56.68 per cent in April 2018 in the nation's rural market. The emergence of an affluent middle class is triggering demand for the mobile and internet segments.(2018)

Telecommunication corporations were earlier owned by the government but later it became privatized. these days there are a large number of companies in India that offer efficient and reputed services to its clients through various transmission gadgets. The telecommunication sector in India is extensively renowned for its profitable markets inside the worldwide economic system. the rural sectors of the country are considered to encompass a large ability to enhance the growth of the communication sector in all viable ventures.

The government has taken steps to modify the communication sector with the introduction of TRAI or Telecom Regulatory Authority of India to adjust these private sector businesses. With the advent of numerous regulatory acts and guidelines, there has been a tremendous development in the communication sector of the country. Low costs for calls, elevated sale of cellular phone, reasonably-priced cellular phones with free sim cards and so on are some of the recent trends in the area of communication.(An Overview of Telecommunication Sector in India)

Strong policy aid from the government has been vital to the sector's development. foreign Direct investment (FDI) cap inside the telecom sector has been expanded to one hundred percent from seventy-four percent. additionally, government of India is soon going to come out with a brand-new countrywide Telecom policy 2018 in lieu of rapid technological advancement in the region over the last few years.

Literature review:

"Telecommunication Systems Management and Operations Research: A Successful Alliance"

This article is from the journal of the university of Seville, Spain (2012).

This article talks about the growing significance of operations research in telecommunication and it's far stated how the future of this is promising. the acute complexity that telecommunications problems generally display is extensive, and hence OR will find wide gaps to make successful contributions. cutting-edge telecommunication networks permit intercommunication among individuals, computers, systems, organisations, monetary operations, etc. throughout the world. Such networks transport massive quantities of data that may be for amusement, training, educational, or industrial activities assisting sensitive information in many occasions. with the intention to ensure this data reaches its destination quickly without any loss of data with ensuring that the capacity of the networks is used effectively we use complex mathematical models and algorithms primarily based on artificial intelligence techniques as relevant tools to deal with such tough and sensitive problems. in this Operations research (OR) arises offering a set of strategies and tools for thinking, analysing and solving, which leads to taking decisions in an established and targeted manner towards performance and optimality.

It is said that this rising research field pressured to generate a new specialized researcher. So, researchers from different scientific fields having acquired sufficient expertise of OR techniques were the pioneers in making substantial contributions to telecommunications making use of these OR techniques. in the course of time OR researchers and practitioners entered the sector and now the presence of OR people are a fact in the scientific literature.

"Global Operational Analytics Market Research Report 2018", by Comprehensive Market Study with Emphasis on Key Driver, Applications and Trends 2025

This report gives us information about the operation analytics market and applications of Operations research in Industries like Manufacturing, Telecommunication IT, Financial Industry.(K, 2018)

Operations research helps in the decision making for the following -:

- Manufacturing Cost Structure Analysis
- Technical Data and Manufacturing Plants Analysis
- Regional Operational Analytics Market Analysis
- Type Segment Market Analysis
- Application Segment Market Analysis
- Major Manufacturers Analysis
- Development Trend of Analysis
- Production and Revenue Forecast
- Marketing Type Analysis
- Operational Analytics Market Opportunities

- Affecting Factors
- Porters Five Forces Analysis
- Operational Analytics Market Challenges
- Distributors, Customers
- Upstream, Industry Chain and Downstream Customers Analysis

Case study of Brazil- In Brazil the telecommunications industry is dealing with a situation with an immoderate wide variety of telecom service companies, with an overvalued demand that marks a situation of hyper-competition. as a result, the briefness in activating a service overcomes all the different capabilities of that service provisioning, also putting apart an adequate planning of delivery of the goods that make up the client's network and this prioritization of delivery brings approximately some loss to the service provider's cash. in order to ensure there is a marker within the prioritization of clients' circuit provisioning that targets at the primary purpose of sales and the business: its profitability; application of the Linear Programming quantitative technique has been carried out in order to assist planning and control of consumer circuit delivery.

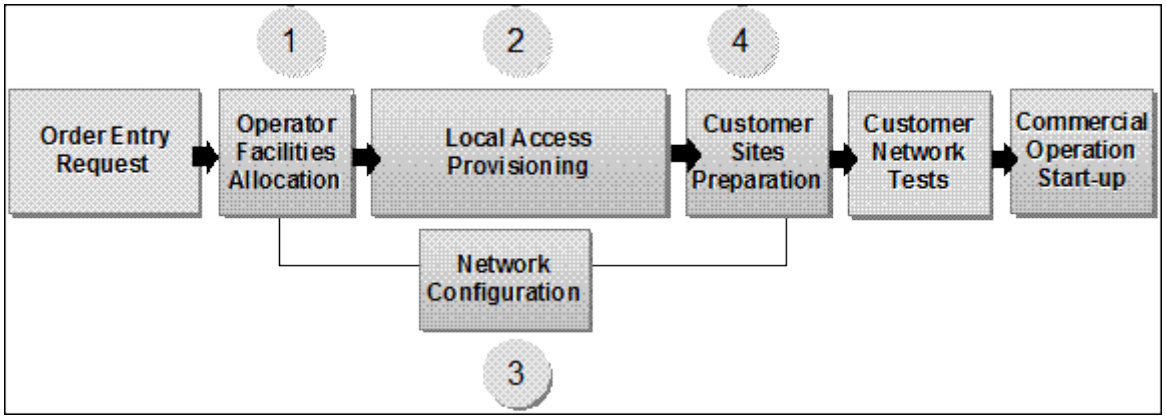


Fig. 2 – Simplified representation of the Customer Network Provisioning Process of a telecom operator in Brazil.

The operational research can assist the selection-making technique through the Linear Programming model. This model is appropriate for fixing such issues as, for instance, allocation of quick finances in order to acquire a positive intention. Linear Programming deals with unique mathematical problems by developing rules and relationships that aim at the distribution of constrained price range beneath the regulations imposed by either technological or realistic elements when an attribution selection needs to be made (ANDRADE, 1990).

One kind of hassle for which the Linear Programming presents a solution could be summarized as: to maximize or to minimize any structured variable that's a linear function of numerous impartial variables which might be subject to many regulations (CARLSON, 1988).Example: profit maximization, cost reduction, return on investment, sales,machine-hour, size of material inventories etc.

In order to solve problems through the proposed model, structuring of a general formulation is required.

The problems dealt with here refer to the optimization of resources of a given object function "Z", which is subject to system and/or environment restrictions. When the problem involves "n" decision-making variables and "m" restrictions, the model can be represented mathematically in the form of either maximization or minimization of the object function

MAXIMIZE Z = C 1X 1 + C 2X 2 + ... + C nX n

Subject to restrictions:

a 11X 1 + a 12X 2 + ... + a1nXn ≤ b1

a21X1 + a22X2 + ... + a2nXn ≤ b2

am1X1 + am2X2 + ... + amnXn ≤ bm

Being compulsory that:

X1, X2, ..., Xn ≥ 0 (note: non-negative figures)

The Hyper-competition Concept-Hyper-competition includes an environment marked with the aid of speedy and excessive competitive actions wherein competitive, innovative flexible competitors invade the market to build up advantages and break their opponents' position. Hyper-opposition takes place in a world of complicated dynamics, where players engage at global level, where competitive advantages are ephemeral and the life cycle of products is brief, unstable and, in many instances, unpredictable.And so, arises the need for organizational networks that aim to reduce uncertainties and dangers and to arrange affordable activities through the coordination and cooperation amongst organizations.(Augusta, 2014-2015)

Research Methodology:

We have done secondary research to collect the data which includes:

- Previously published research papers
- Articles
- Blogs
- Newspapers

No primary research has been done.

Tools used- Bar graphs used for analysis

Analysis and Findings

We have done analysis of strategies followed by Jio to disrupt the market and become one of the major players in the telecommunication sector.

A. Disruption by Reliance Jio in telecom sector

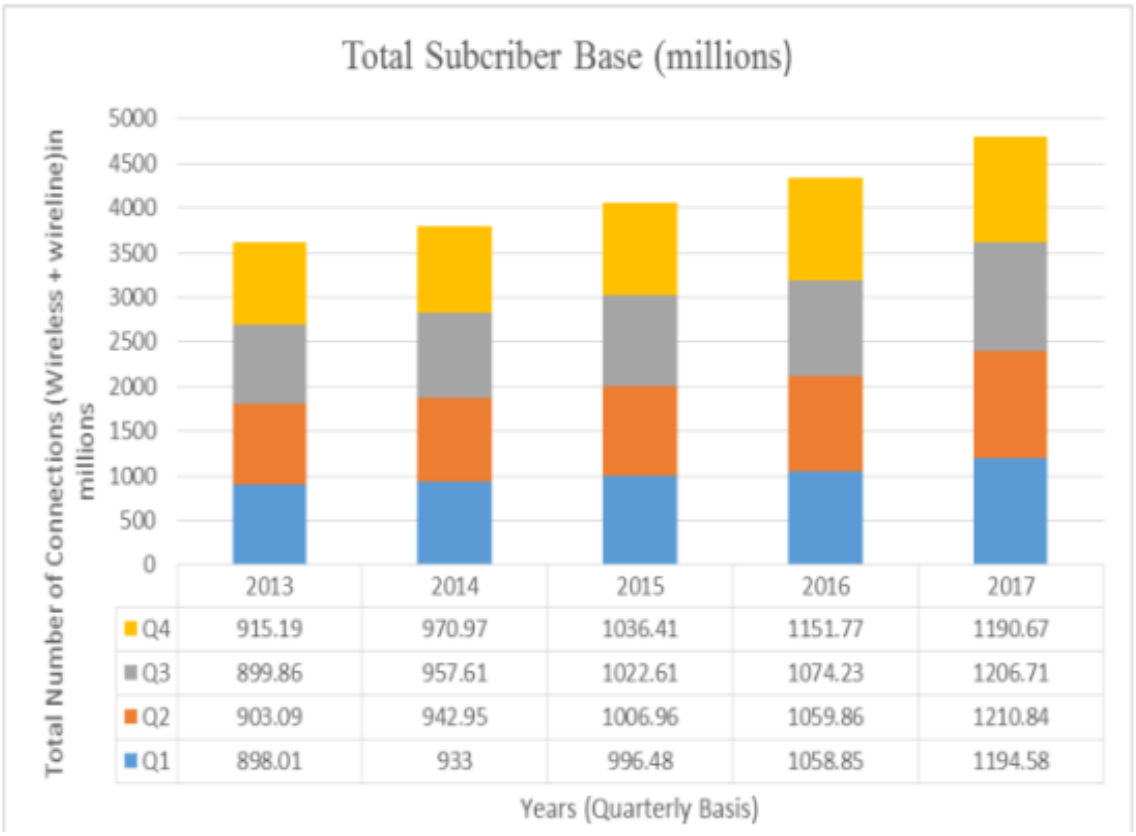
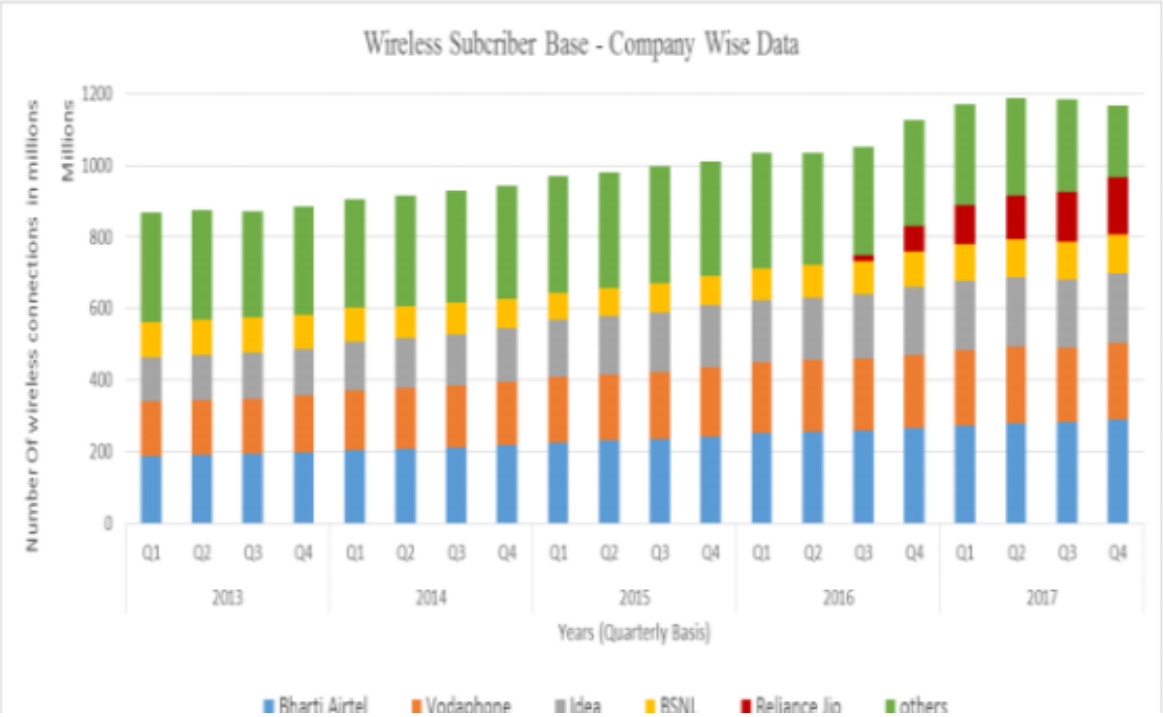


Fig. 1. Total Subscriber Base across India from 2013-17 (Source-TRAI)

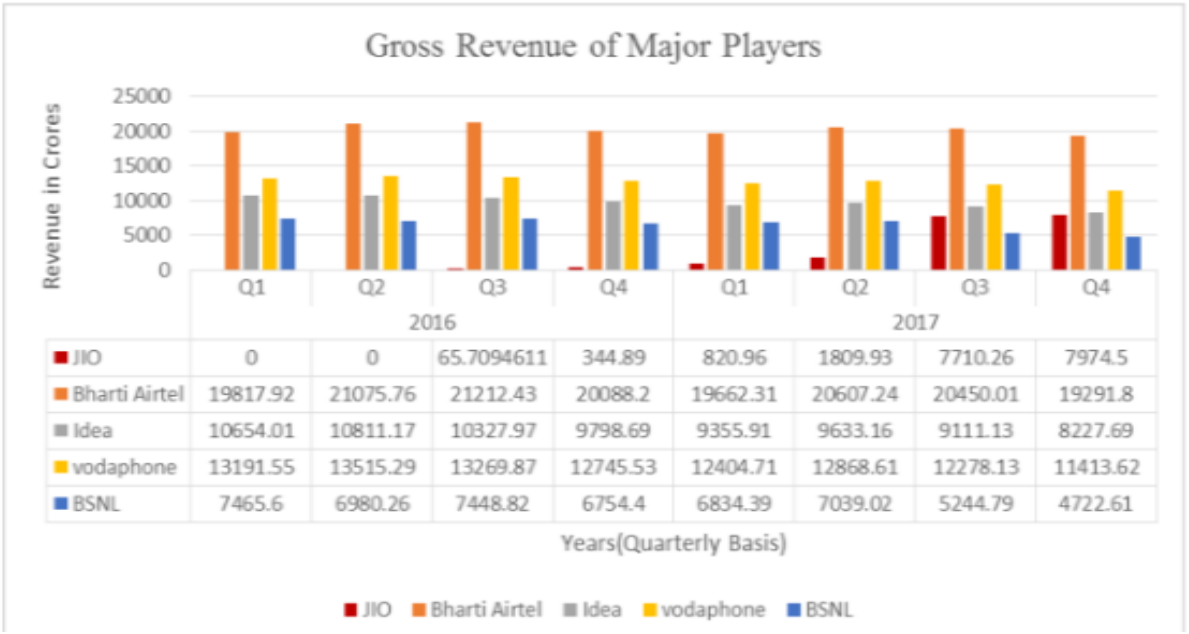
After the commercial launch of RJIO on September 5, 2016,with free services, we can see a tremendous growth of about77.7 million in total subscriber base in Quarter 4 in 2016. Allthe 12 service providers in India were eager to capture newcustomers and also to retain the existing customers after thelaunch of Reliance JIO.

Fig. 2. Wireless subscriber base-company wise data (Source-TRAI)



After the launch of RJIL, we can conclude that overallmarket share of all the playersin wireless subscriber haveincreased in 2017 compared to 2016. There was a reductionof wireless subscriber base for the players who werecategorized under others (Reliance, Tata, Aircel, MTNL,Telenor & Sistema).These players could not retain theirexisting customers due to many reasons. Some of theseplayers were not having a technology like 4G and VOLTE tocompete with Reliance JIO.

Fig. 3. Gross revenue of major players (Source-TRAI)



There was a huge reduction in revenue for major players likeBharati Airtel (1124.23 Crore), Idea (529.28 Crore),Vodaphone (524.54 Crore) and BSNL (694.42)in Q4, 2016soon after the introduction of Reliance JIO free services. Theoverall revenue of the major players in 2017 was much lesscompared to the revenue they obtained in 2016.

The operational strategy followed by Jio was focused mainly on the fiveperformance objectives such as speed, quality,cost, flexibility, and, dependability. The operational decisionswere made in three different areas such as

Capacity strategy:

- Construction of towers & laying fibre optic cables:Before the launch, RJIL have made variousagreements with Tower Vision, ATC and Viomnetworks for about erection of 61400 towers inIndia. Reliance Jio has laid in excess of 2.5 lakhkilometres of fibre-optic links, covering 18,000urban societies and further one lakh townships,with the fact of 100% covering of the country'spopulation by 2018. Fibre is the basic spine onwhich a telecom specialist organization cangivehigh-end services to consumers. To provide these high-end services Jio has used Assignment Problem to allocate how many towers should be allocated to which region of the country.

- Construction of international networks like BBGgateway: Reliance Jio was involved in shaping amulti-terabit capacity globalgrid and an 8,100kmcable system, BBG i.e. the Bay of Bengal Gateway.The Bay of Bengal Gatewayoffersstraightconnectivity to Middle East and South East Asia,there on to Africa, European and Far East Asiafrom end to end unified interconnection with currentcable systems. This isimportant because ithas the undersea cable landing facility in Chennaiwhich can provide a low latency route,high-speedand high capacity networklinking India to theglobe. Here, we see that Transportation Problem has been used effectively to cover large-distances with minimal cost and maximum profit. Also, giving assignment to BBG gateway could not have been possible without hard-core use of Assignment Problem.(R, 2017)

Limitations:

- The uncertainty about environment and system itself is considered as one of the most complex problem to deal with
- Another important issue is the gap that exists between theoretical studies and practical implementation and fusing the two is not a straightforward task, thus a lot of work needs to done in this direction.
- There is a lack of system integrators.
- Due to rise in competition in the telecommunication sector, operators need to differentiate themselves from their competitors. This has led to a boost in complexities of their service and network management operations to meet different customer expectations.
- The telecom companies face high costs in order to facilitate these operations and they look for operations support solutions to effectively deliver telecom services with reduced OPEX and CAPEX cost-this has led to the increasein the telecom operation management market.
- Relying on technology: The math required to analyse situations needs to be done by a computer. If technology fails or you lose records somehow, the operations of the company would be affected.(Reed)

Conclusion:

OR as the technological know-how of higher, presents a set of strategies and tools for questioning, analysing and fixing. This set of strategies results in taking decisions in a structured and targeted manner towards efficiency and optimality. In reality, the future of operational research in telecommunications is promising and since the telecommunications is constantly changing, the OR researchers will need to adapt quickly to the ongoing adjustments in the industry and cooperate more effectively with the technology aspects. OR researchers will have to make essential attempt to lessen the distance among real life and academic problems, being attentive to the remarks from practitioners and real-life successful studies due to the societal significance of telecommunications, reflected in its close to-ubiquitous penetration and use. communication plays a significant role in the fundamental operations of a society—from business to government to households. In reality, communication amongst people is the essence of what distinguishes an organization, community, or society from a collection of people. communication—from web browsing to cellular phone calling to instantaneous messaging—has become increasingly integrated into how we work, play, and live. Telecommunications permits participation and development. Telecommunications performs an increasingly essential role in permitting the participation and improvement of people in communities and countries deprived by geography. Telecommunications provides essential infrastructure for national security. From natural disaster restoration, to homeland security, to communication of vital intelligence, to continued military superiority, telecommunications play a pivotal role. when the issue is countering an adversary, it is important not only to maintain telecommunications functionality, but also to have a superior functionality. To ensure all this application of operations research in telecommunication is crucial.

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