1 INTRODUCTION

India today is the foremost focal point for global economies. According to Bertelsmann Foundation and the Centre for applied research, Munich, Germany Transformation Index (BTI) Rankings of 2014, India was ranked 26th and China 84th in terms of economic and political transformation. (Bertelsmann Stiftung, 2014) The dominant role acquired by telecommunications in the global business management and its effect on national economies has seen telecom service develop as a vital backbone and utility service for business and industry. It is now universally acknowledged that telecom sector is an important constituent of social and economic progress of a country and the growth of any economy essentially requires that its telecom network is fully developed. The Indian telecom sector contributed significantly to the growth of the Indian economy. Success story of telecom in India has got only few parallels in the world. With just about 5.07 million connections in 1991, when liberalisation started, it has grown to be the world’s second largest network with a subscriber base of 938 million in July 2014. (Telecom Regulatory Authority of India, 2010) (Telecom Regulatory Authority of India, 2014) The telecom subscriber’s base touched one billion by the mid of year 2015. (Telecom Regulatory Authority of India, 2015)

![Number of Subscribers in Million](image)

**Figure 1-1 Number of Wireless Subscribers**

(Source: COAI, TRAI Multiple reports)
The total number of mobile subscriptions in India is expected to increase to approximately 1.4 billion by 2020, covering almost the entire population. Out of total telecom subscriber base of 1009.31 million subscribers, 98 per cent that is 983.21 million subscribers (Figure 1-1) are mobile subscribers and only 2 per cent that is 26.10 million subscribers are on wire line technology. Out of these 983.21 million mobile subscribers, a healthy 90 per cent that is 885.50 subscribers are active subscribers. (Table 1-1) (Telecom Regulatory Authority of India, 2015) India grew the most in terms of mobile subscribers, with 26 million net additions in first quarter of 2015, followed by China (+8 million), Myanmar (+5 million), Indonesia (+4 million), and Japan (+4 million). (Ericsson, Sweden, June, 2015) As a result of the policy and regulatory initiatives over the years, the growth of subscribers connected to the Indian telecommunications network has seen a compound annual growth rate (CAGR) of 44.66 per cent over last five years. (Telecom Regulatory Authority of India, 2011) With the introduction of upgraded technologies like third generation (3G) and fourth generation (4G / LTE) in the near future, the data consumption is likely to multiply manifold. The prospects of continued aggressive growth and availability of a big pool of skilled manpower hold immense potential for the sector.

1.1 ROLE OF TELECOM SECTOR IN COUNTRY’S DEVELOPMENT

Telecom sector plays a crucial role in infrastructure development of a country and its economy. Over the last two decades the sector continues to be key growth sector for all leading economies. In present scenario moving without telecom is beyond imagination as this has become an integral part of day to day lifestyle. Following are key contributions from the sector towards the development of the country

### Table 1-1 Number of active wireless subscribers, 2009-15 (Source: COAI, TRAI Multiple reports)

<table>
<thead>
<tr>
<th>City/Circle</th>
<th>Dec-09</th>
<th>Dec-10</th>
<th>Dec-11</th>
<th>Dec-12</th>
<th>Nov-13</th>
<th>Dec-13</th>
<th>Jan-14</th>
<th>Jul-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>All India</td>
<td>379.8</td>
<td>543.0</td>
<td>639.6</td>
<td>657.2</td>
<td>688.0</td>
<td>693.9</td>
<td>703.4</td>
<td>885.5</td>
</tr>
</tbody>
</table>

The total number of mobile subscriptions in India is expected to increase to approximately 1.4 billion by 2020, covering almost the entire population. Out of total telecom subscriber base of 1009.31 million subscribers, 98 per cent that is 983.21 million subscribers (Figure 1-1) are mobile subscribers and only 2 per cent that is 26.10 million subscribers are on wire line technology. Out of these 983.21 million mobile subscribers, a healthy 90 per cent that is 885.50 subscribers are active subscribers. (Table 1-1) (Telecom Regulatory Authority of India, 2015) India grew the most in terms of mobile subscribers, with 26 million net additions in first quarter of 2015, followed by China (+8 million), Myanmar (+5 million), Indonesia (+4 million), and Japan (+4 million). (Ericsson, Sweden, June, 2015) As a result of the policy and regulatory initiatives over the years, the growth of subscribers connected to the Indian telecommunications network has seen a compound annual growth rate (CAGR) of 44.66 per cent over last five years. (Telecom Regulatory Authority of India, 2011) With the introduction of upgraded technologies like third generation (3G) and fourth generation (4G / LTE) in the near future, the data consumption is likely to multiply manifold. The prospects of continued aggressive growth and availability of a big pool of skilled manpower hold immense potential for the sector.

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Page | 2
a. GDP Contribution

The telecom services have been acknowledged world-over as an important instrument for socioeconomic growth of a country. The sector helps not only in the growth of any economy directly but also in terms of availability of good telecom infrastructure for other important sectors such as banking, education, medical, travel, and engineering. That way, it results in further growth of nation creating ripple effects. As per UNCTAD (United Nations Conference of Trade and Development), there is direct relation between mobile tele-density and growth in GDP per capita in developing country. (D & B Research, 2010) In India, steps taken by the government were correspondingly responded by the industry which led to far-reaching range of telecom network expansion throughout the country and consequent development of the economy. Share of the sector to India’s GDP continuously grew from one per cent in 1992-93 to three per cent in 2010 (FICCI, 2012) and with prevailing growth in data consumption and correspondingly revenue of the sector, trend is going on between 2 to 3 per cent of GDP.

![Figure 1-2 Direct Contribution to Global GDP from Mobile Ecosystem, 2013
(GSMA Intelligence, 2014)](image)

As per global trends as well, mobile ecosystem world over contributes one to two per cent of GDP directly (Figure 1-2) and approximately value for the same in year 2013 was that of US$ 870 billion. Approximate 77 per cent of contribution for
the same that is US$ 672 billion coming from mobile network operators followed by wireless handset devices manufacturers, distributors and retailers of mobile devices, mobile content and service application providers. Contribution to GDP is further higher to three to four per cent if one considers gross contribution that means contribution coming from increase in productivity and general economy upswing. As per GSMA intelligence, contribution to productivity increase and general economy was 1325 and US$ 174 billion respectively making total gross contribution from telecom sector to US$ 2367 billion for year 2013. (Figure 1-3) Further on it is estimated that gross contribution from mobile ecosystem to GDP is likely to increase to approximately five per cent of GDP by year 2020. (GSMA Intelligence, 2014)

![Figure 1-3 Total Mobile Contribution to GDP, 2013-20](image)

*Figure 1-3 Total Mobile Contribution to GDP, 2013-20
(GSMA Intelligence, 2014)*

b. Employment to Native Citizens

Being one of the key infrastructure sectors it involves employment to its citizens. With skilled expertise available in the field these resources become global resources as well and are considered assets for organisations globally. According to a KPMG report, the sector currently has about five million jobs and this number is expected to increase to 20 million. (KPMG and FICCI with Department of Telecom (DOT) and others, 2010) Moreover, this resource pool of country is catering to telecom operators across globe.
c. **Infrastructure Development of Country**

Telecom has evolved as a basic infrastructure like electricity, roads, water. Sector is connecting to each and every part of country like any other basic infrastructure. Technically at present second generation technology (2G) which caters to voice and text services mainly and data services on lesser speed, currently covers 95 per cent of country’s population that means 95 per cent of nationals can subscribe to 2G making it the technology with the broadest spread in India. Third generation (3G) services covers more than 35 per cent of the Indian population at the end of 2014, and is anticipated to spread to approximately 90 per cent by the end of 2020. Furthermore, about 40 per cent of the population will be covered by high speed data service of long term evolution (LTE-4G) by 2020. (Ericsson, Sweden, June, 2015)

d. **Foreign Direct Investment**

Foreign direct investment has been one of the major sources of foreign exchange in the growth of the Indian economy and therefore the need for higher FDI is felt across sectors in the Indian economy. Today telecom is the one of major sector attracting FDI inflows after services and computer software sector. In the telecom sector FDI up to 49 per cent is allowed under automatic route and beyond that up to 74 per cent is permitted through the Foreign Investment Promotion Board (FIPB), a government body. As per the current telecom services policy, the sector has 74 per cent of equity on basic cellular, unified access services, and other value-added services.

![Figure 1-4 Cumulative FDI in Telecom Sector since 2000](Telecom Regulatory Authority of India, 2015)
1.2 EVOLUTION OF INDIAN TELECOM INDUSTRY

Indian telecom industry, though being 165 year old, was under government ownership until 1984. Post 1984 private sector was allowed entry in telecom equipment manufacturing. Until 1990 the Government of India held a monopoly on all types of communication because being driven by pre independence Telegraph act of 1885.

Figure 1-5 Major Phases of Growth of Telecom Industry

(D & B Research, 2010)
Figure 1-6 Yearly Growth Story of Telecom Industry

(Ganesh, et al., 2011)
Post liberalisation era (1990-99) Indian telecom market is one of the most liberalised markets in the world with private participation in all segments. Growth in the sector was further spearheaded with announcement of new telecom policy (NTP 1994 and NTP 1999) and with formation of Telecom Regulatory Authority of India (TRAI-1997). Post 2000, Bharat Sanchar Nigam Limited was established and Videsh Sanchar Nigam Limited was privatised (2002). With launch of mobile telephony 2002 onwards there was no look back for this sector and growth was fuelled further with increase in limit of foreign direct investment (FDI) to 74 per cent in year 2005. (Arora & Bedi, 2015) Technically telecom sector in India initially started with wire line technologies but over a period of time wireless technologies surpassed wire line technologies and at present subscribers on wireless technologies represent 98 per cent of the industry. Hence, for current study focus is kept on wireless subscribers and associated organisations as it represents majority section of the sector. (Telecom Regulatory Authority of India, 2015)

1.3 PRESENT STATUS

Globalisation and progressive regulatory regime resulted into development of telecom sector and sector became an integral part of Indian economy’s infrastructure. The sector observed a minimal drop in the number of subscribers during the year 2012-13. (Telecom Regulatory Authority of India, 2013) At the end of the financial year 2014, the subscriber base was 898.02 million, out of which 867.80 million were wireless subscribers. The drop in wireless connections is mainly due to deactivation of quiet connections. During the year wireless subscriber base recorded a drop of 51.37 million while the overall tele-density dropped slightly to 73.32 from 78.66. The year also saw rise in rural tele-density to 41.02 from 39.22 while the urban tele-density diminished to 146.96 from 169.55. During the year, 47.82 million subscribers opted for porting requests to different service providers for availing Mobile Number Portability (MNP) facility. The overall subscriber base and tele-density are depicted in below table. As evident from above table, wireline subscribers are only two per cent of total subscribers hence through out this study concentration is given to wireless subscribers and related organisations as they represent 98 per cent of industry.
Table 1-2 Subscriber base and tele-density, July, 2015 (Telecom Regulatory Authority of India, 2015)

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Wireless</th>
<th>Wireline</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total subscribers (Millions)</td>
<td>983.21</td>
<td>26.1</td>
<td>1,009.31</td>
</tr>
<tr>
<td>Total net monthly addition (Millions)</td>
<td>2.40</td>
<td>-0.05</td>
<td>2.35</td>
</tr>
<tr>
<td>Monthly growth (per cent)</td>
<td>0.22%</td>
<td>-0.18%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Urban subscribers (Millions)</td>
<td>567.29</td>
<td>21.24</td>
<td>588.53</td>
</tr>
<tr>
<td>Urban subscribers net monthly addition (Millions)</td>
<td>4.34</td>
<td>-0.01</td>
<td>4.32</td>
</tr>
<tr>
<td>Monthly growth rate (%)</td>
<td>0.77%</td>
<td>-0.06%</td>
<td>0.74%</td>
</tr>
<tr>
<td>Rural subscribers (Millions)</td>
<td>415.92</td>
<td>4.86</td>
<td>420.78</td>
</tr>
<tr>
<td>Rural subscribers net monthly addition (Millions)</td>
<td>-1.93</td>
<td>-0.04</td>
<td>-1.97</td>
</tr>
<tr>
<td>Monthly growth rate (%)</td>
<td>-0.46%</td>
<td>-0.73%</td>
<td>-0.47%</td>
</tr>
<tr>
<td>Overall teledensity</td>
<td>78.02</td>
<td>2.07</td>
<td>80.09</td>
</tr>
<tr>
<td>Urban teledensity</td>
<td>145.13</td>
<td>5.43</td>
<td>150.56</td>
</tr>
<tr>
<td>Rural teledensity</td>
<td>47.84</td>
<td>0.56</td>
<td>48.40</td>
</tr>
<tr>
<td>Share of urban subscribers</td>
<td>57.70%</td>
<td>81.37%</td>
<td>58.31%</td>
</tr>
<tr>
<td>Share of rural subscribers</td>
<td>42.30%</td>
<td>18.63%</td>
<td>41.69%</td>
</tr>
</tbody>
</table>

The base of wire-line subscribers is continuously reducing and it was 26.1 million subscribers on 31 July, 2015 from 30.21 million on 31st March 2013 and 32.17 million subscribers on 31st March, 2012 recording a continuous decline. Out of the 26.1 million wire line subscribers, 21.24 million are urban wire line subscribers and the remaining 4.86 million are rural subscribers.

![Number of Subscriber in million](chart)

Figure 1-7 Wire-line Subscribers, 2009-15
(Source: Telecom Regulatory Authority of India, Multiple reports)
The tele-density at the end July 2015 reached to the mark of 80.09 as compared to 78.66 at the end of year 2012 recording a decrease from 2012 to 13 and then regaining. (Figure 1-8) The trend of teledensity since March 2008 is as shown below.

![Tele Density Growth](image)

**Figure 1-8 Tele-density Growth, 2008-15**
(Telecom Regulatory Authority of India, 2013) (Telecom Regulatory Authority of India, 2015)

The wire line internet subscriber base that means excluding internet access by wireless phone in the country as on 31st March 2013 stood at 21.61 million as compared to 19.51 million as on 31st March 2012 registering an annual growth rate of about 10.77 per cent. (Figure 1-9) The total broadband subscriber base has touched 15.05 million as on 31st March 2013 as compared to 13.81 million as on 31st March 2012 thereby recording a net addition of 1.24 million broadband subscribers during the financial year 2012-13 with growth of 8.98 per cent. The internet subscriber base involving that of narrowband (<256Kbps speed) and broadband (> 256Kbps speed) for last six years is depicted in the below figure. In 2013-14, the minimum download speed for the broadband services was increased from 256 kbps to 512 kbps and the wireless data services were also included in the revised definition of broadband service notified by the Government. The total broadband subscriber base of the country as on 31st March 2014 (as per the revised definition) was 60.87 million which further grew to 113.32 million on 31-July 2015. (Telecom Regulatory Authority of India, 2014) (Telecom Regulatory Authority of India, 2015). Out of these 113 million broadband subscribers 97 million broadband subscribers are mobile equipment that means around 86 per cent of subscribers.
In total, there were 283.29 million internet subscribers as on 31-Mar-2015 (Figure 1-10) who access internet by wireless phone which excludes BSNL, MTNL, Quadrant and Videocon due to non-reporting in TRAI database. In total there were 302.35 million internet subscribers who are using internet through wire line and wireless technology in March-2015. (Telecom Regulatory Authority of India, 2015) Here also wireless internet subscribers of 283 million contribute to 93 per cent of total internet subscribers hence wireless organisations demands concentration and focus in this study.

![Figure 1-9 Wire-line Internet Subscribers, 2008-15](Source: Telecom Regulatory Authority of India, Multiple Reports)

![Figure 1-10 Wireless Internet Subscribers, 2013-15](Source: Telecom Regulatory Authority of India, Multiple Reports)
As per TRAI data, total gross revenue of Indian telecom sector after adjustment of intra operator interconnection charges, increased from Rupees 2,075 billion in 2012-13 to Rupees 2,193 billion in 2013-14, (Figure 1-11) showing a growth of 5.69 per cent over the previous year. Revenue for corresponding period in 2011-12 was Rupees 1,859 billion and 2012-13 revenue of Rupees 2,075 billion recorded a growth of 8.68 per cent.

![Revenue in Rupees billion](image)

**Figure 1-11 Telecom Sector Revenue (YOY), 2006-2014**  
(Source: Telecom Regulatory Authority of India, Multiple reports)

Because of unprecedented growth in mobile telephony, the number of mobile subscribers grew at unbelievable growth rate from ten million in 2002 to 1002 million in 2015. The telephone density was a meagre 0.8 per cent in 1991 but now stands at a respectable 80 per cent with urban and rural tele-density of 151 per cent and 48 per cent respectively. (Telecom Regulatory Authority of India, 2011) (Telecom Regulatory Authority of India, 2015) The growth has so far breached several targets set by the government and continues unabated. The target of tele-density of seven per cent by 2005 and 15 per cent by the year 2010 set in New Telecom Policy 1999 was achieved in 2004 and 2007 respectively and the target of 600 million connections set by the planning commission for the end of eleventh five-year plan (2007-12) was achieved in February 2010.

As the growth continues, the number of connections crossed the one billion mark by the mid of 2015. More than 40 per cent of the current monthly addition over
18 million customers are in rural areas. This growth will not be only in terms traditional voice or broadband connections. With multiple research and design activities being made in machine to machine communication, cloud computing, tracking, and positioning, controlling devices and processes, smart meters, smart grids and smart cities the number of connected devices and human being together is going to exceed all estimates. This growth in the sector will predominantly be spearheaded by the growing affordability of handsets, dongles and services. Second generation (2G- Global System for Mobile Communication- GSM) subscriber base is estimated to be its highest in 2015 and with third generation (3G) services picking up now, 2G subscribers shall migrate to 3G. Third generation (3G-Wideband Code Division Multiplexing Access WCDMA/HSPA) subscriber base is anticipated to develop from over 120 million in 2014 to around 620 million by 2020, resulting into 45 per cent subscribers on 3G. Long term evolution (LTE) subscriber base is anticipated to be around 230 million by 2020 which will be approximate 17 per cent of the total subscriber base. Technically at present 2G technology currently covers 95 per cent of country’s population that means 95 per cent of nationals can subscribe to 2G making it the technology with the broadest spread in India. On another hand 3G covered more than 35 per cent of the Indian population by the end of 2014, and is anticipated to spread to approximately 90 per cent by the end of 2020. Furthermore, about 40 per cent of the population will be covered by LTE technology by 2020. (Ericsson, Sweden, June, 2015)

Demographically smart phone users in age group 50 years or above rose four times from a small number in 2013 to 2015. In the same tenure users in 31-40 years age group rose to three times. Smart phone subscribers users are spending more than three hours a day on their smart phones and 25 per cent of them check their phones over 100 times a day. Approximately 30 per cent of this time is spent on applications like chat, social media, and gaming. 65 per cent of mobile broadband smart phone subscribers in India give inclination to video streaming for downloading videos. Lower costs of smart phones are driving the overall uptake of mobile data services in India. The number of smart phone subscribers is anticipated to touch 750 million by 2020, which in 2014 stood at 130 million. With this upsurge in number of smart phone subscribers’ data usage is expected to grow approximately 18 times of current levels. This upsurge in
data is expected from applications such as video streaming, social networking, banking and financial transactions. (Ericsson, Sweden, June, 2015)

![Minimum Cost for Cell Phone Package](image)

**Figure 1-12 Global Cell Phone Package Comparisons**
(Chiehyu & Ninan, 2010)

India in 2013 had about 826 million connections against six billion connections all over the world which gives further scope for advancement. With the prevailing growth rate in India, we can assume that India will be having major share in non-telephony connections. According to GSMA the total number of connections in world will be about 15 billion by 2015 and 50 billion by 2020. TRAI assumed that India will have nearly eight to ten per cent or 1.2 billion connections by 2015 and five billion connections by the year 2020.

Also being lucrative industry, the Indian telecom Industry is facing intense competition and price war among approx. a dozen telecom service providers. The New America Foundation's Open Technology Initiative (OTI) completed a survey on the costs and types of mobile cell phone packages available to consumers around the world where in India emerged as the country with lowest tariff and complete cell phone package and it offers consistently lower prices than others. **(Figure 1-12)** (Chiehyu & Ninan, 2010)
1.4 CHALLENGES FACED BY THE TELECOM INDUSTRY

As evident from present status telecom industry is going through changing time where in on one side revenue is under constraint and on another side cost is on upward side because of requirement of modernisation of network to cater to new technologies. Major challenges which are being faced by the telecom industry are downward trend in subscriber growth, network re-engineering, ways to maximise return on capital, data explosion leading to growth in services, tough regulatory environment, and huge electronic waste generation. Subscriber growth rate is already down Though sector recovered from its worst ever phase in 2012-13 but subscribers’ growth trend is certainly going to reduce as soon as market is going to be mature further. With spectrum becoming a costly and scarce resource, every operator had to relook into their network design so that they can leverage opportunities to deliver better quality at low cost. In order to maximise return on capital, industry need to go ahead with project with good return of capital and balance with low return of capital had to wait. With influx of smart phones and new technologies surrounding data usage, data growth is clearly visible and expects a data explosion in next five years. Industry especially operators have to refocus their efforts on engaging customers through services and experience. With sudden growth in this evolving industry marred by multiple scams, regulator is forced to impose tough regulatory norms forcing stake holder to have a cautious approach. Operators who all started their operations in 2004-05, need to renew their network because there is need to upgrade technology to milk existing network which will result into huge amount of electronic scrap getting generated. This shall certainly leave an impact on environment if not disposed properly. All above challenges are discussed in details in Section 3.7.

Recent downsizing of most telecom companies signify continued headwinds being faced by the challenges in the Indian telecom market. Few MNCs like DoCoMo, Sistema even reduced their stakes in Indian venture. With huge investments required by operators towards renewal of network to cater to data services the consolidation process is expected to accelerate so that mounting debts in industry can be controlled. After reviewing challenges, it is quite clear that telecom industry is going through tough phase. Though industry hit the one billion subscription mark during mid 2015 but it
continues to be deeply constrained by the negative growth witnessed in 2012. At the end of the calendar year 2012, the Indian telecom industry closed with revenues of Rupees 1,487 billion or US$27 billion, a meagre 2.3 per cent of the estimated global telecom revenues of Rupees 1.16 trillion. The industry’s total debt was up 200 per cent from Rupees 827 billion in 2008-09 to Rupees 2500 billion in 2012-13. (Figure 1-13) (COAI, Internet reading, Company reports) Moreover, additional costs coming from above mentioned challenges will also add further debt to debt ridden industry and it is estimated that owing to recent spectrum auctions and cost coming from modernisation efforts debt for 2014-15 is Rupees 3500 billion. Industry is at risk to become a low profit business and with average revenue per unit (ARPU) under downward trend margins are stretched.

![Figure 1-13 Mounting Debts in Telecom Industry](Source: COAI, Company Reports, PWC)

The telecommunications sector will continue to contribute significantly to the growth of the Indian economy over the next few years. With the surge of third and fourth generation of technology, trend is moving from voice to data services which are accelerating the growth of mobile telephony to new heights. The growth in the spread of telecom infrastructure and provision of services is humungous and this rapid growth
resulted into some processes in supply chains which are modest as sector was prima facie revenue centric. There is a requirement that proactive steps must be taken to repair the situation and optimise these processes so that costs can be optimised. To overcome these challenges impacting costs, cost management is a key which industry has to adopt. Owing to these challenges, the very nature of telecom sector is having the threat of risk absorbed in it. Need is felt that it is high time that cost needs to be optimised to manage the risk getting generated through these challenges.

This study is concentrated on one such major process that means supply chain management. Supply chain management as a concept as well as Indian telecom industry has come into limelight over the last 15-20 years. Because of sudden growth in telecom industry and pressure being on revenues, sales modelling, network growth and expansion across multiple technologies, supply chain management function remained as a supporting function and industry could not enjoy the fruits of optimisation of supply chain management which other industries such as automobile industries easily did. For management of risk in telecom sector, supply chain has to play a major role in synchronising the processes to boost organisational performances.

The telecommunications supply chain begins with sourcing of components like semiconductor chips and software. These components are incorporated into equipment purchased by service providers. The service providers then use the equipment to build networks and provider service to the end users. The telecommunications industry is enabled by a complex supply chain that includes:

a. Service Provider / Network operators
b. Equipment suppliers such as like Ericsson, Nokia Siemens, Huawei, ZTE
c. Component suppliers (Mostly overseas suppliers of equipment suppliers)
d. Service providers for contract servicing, Logistics, warehousing
e. Infrastructure Providers
f. Recyclers

India is able to drive innovation when it comes to software services in the telecom space but the results are not encouraging when it comes to developing telecom equipment. To become an important player in the global telecom space India need to
create a synergetic telecom ecosystem and build globally competitive supply chain. Despite the growth in the number of subscribers, the ecosystem so far failed to adequately reap the benefits of efficient supply chain management. Since, supply chain management function is not able to pursue efficient functionality from passive to active, as a result, the domestic telecom equipment manufacturing segment is not able to meet the demand created by other segments of the telecom ecosystem forcing the telecom operators to import most of the equipment required for their network. In 2008-09 alone, as per Directorate General of Commercial Intelligence and Statistics (DGCIS) data, equipment worth Rupees 461.58 billion was imported by the Indian telecom operators. According to a KPMG report, the telecom equipment market in India is estimated to be Rupees 450 billion and growing at the rate 20-25 per cent per annum. (KPMG and FICCI with Department of Telecom (DOT) and others, 2010) With the right initiatives by all stakeholders the supply chain management can make rapid strides and can help to establish a value chain which can create a large value optimisation opportunity with the consequent benefits to the telecom industry and the country.

1.5 CONCEPT OF SUPPLY CHAIN MANAGEMENT

Supply chain management (SCM) is the management of the flow of goods and services. It includes the movement and storage of raw materials, work-in-process inventory, finished goods from point of origin to point of consumption, and reverse logistics from point of consumption to point of repair/replacement and return. It is network of interconnected or interlinked channels and node businesses for delivering products and services to end customers in a supply chain. Supply chain management has been defined as the design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronising supply with demand and measuring performance globally.

A supply chain is a set of organisations directly linked by one or more upstream and downstream flows of products, services, finances or information from a source to a customer. Supply chain management is the management of such a chain. Supply chain management employs software tools or modules which are used to execute supply chain
transactions, manage supplier relationships, and control associated business processes. Supply chain also includes the collection of goods for recycling after consumer use including third-party logistics or other gathering agencies as part of the raw material repartition process. It is a way of illustrating the new endgame strategy in line with organisations’ environmental strategy. Supply chain management is a cross-functional approach that includes following functions:

a. Managing the movement of raw materials into an organisation.
b. Certain aspects of the internal processing of materials into finished goods.
c. The movement of finished goods out of the organisation and toward the end consumer.

As organisations want to focus on core competencies, they reduce their ownership of raw materials sources and distribution channels. These functions are increasingly being outsourced to other firms that can perform the activities better or with more cost effectiveness. This study is an attempt to bring out relationship between supply chain management and performance of telecom industry and how it can help to improve the performance of industry.

Kulkarni, S. and Sharma, A. in their book *Supply Chain Management: Creating Better Linkages for Faster Business Turnaround* categorised supply chain as raw, ripe, internal, extended, self-monitored, outsourced, production oriented, financial oriented, market oriented, value chain (Kulkarni & Sharma, 2010). These type of supply chain as reviewed in literature is summarised in Section 2.3. In Indian telecom sector, mix of supply chains categories are visible such as outsourced, financial oriented and market oriented. We have seen some unique supply chain models getting developed where in supplier is paid for supplied equipment throughout life cycle of product that means payment for deliveries do not happen on supply but also during course of operations.

Historically six major movements can be witnessed in the development of supply chain management studies: creation, integration, and globalisation, specialisation phases one and two, and SCM 2.0. (Movahedi, Lavassani, & Kumar, 2009) The characteristics of creation phase (post 1980) of supply chain management include the necessity for significant changes, re-engineering, rationalising driven by cost reduction.
programs, and extensive consideration to Japanese management concepts. Integration phase of supply chain management studies emphasised the development of electronic data interchange (EDI) systems in the 1960s and advanced during 1990s by the initiation of enterprise resource planning (ERP) systems. The globalisation phase of supply chain management can be characterised by the attention to world-wide schemes of supplier relations and the growth of supply chains over countries’ boundaries and to other regions. During specialisation Phase- Outsourced Manufacturing and Distribution: In the 1990s, organisations emphasised on fundamental proficiencies and knowledge. Organisation restrained vertical assimilation, traded off operations which were not related to their proficiencies, and subcontracted those operations to organisations having expertise in those operations. Specific focus within the supply chain originated in the 1980s with the initiation of transportation brokerages, warehouse management, and carriers having no asset, and developed further than transportation and logistics to functions of forecasting, planning, relationship, implementation, and performance evaluation of supplies. Marketplace conditions command rapid alterations from sellers, manufacturers, traders, logistics sources, or customers in their capability as components of supply chain structures. With focus on globalisation and specific concentration areas, the web based supply chain management conceived to define changes within supply chains along with the development of processes, methods, and tools. The increasing desirability of collaborative and partnership approaches connected through world-wide web is highlighted by the growth of these approaches. All these six phases are as reviewed in literature are detailed in Section 2.4.

Supply chain management as a function has its reach starting from inception of any project and goes up to final conclusion of project. One can find traces of supply chain function in any aspect of the business of any organisation starting from strategic approach towards decisions like make or buy, defining inventory norms or operational challenges for day to day operations. Identified features of supply chain management function which are critical to success of any organisation’s supply chain policy are superior customer value, viewing it as single entity, inventory perspective, strategic orientation, outsourcing vs. in-sourcing approach, supply chain relationships, flexibility in supply chain approaches. These features are discussed in detail in Section
2.5. Success of any company in supply chain fields depends on meeting principle of five Rs that means supply chain success depends upon planning and facilitating (Kulkarni & Sharma, 2010)

a. movement of Right thing
b. at the Right time
c. at the Right place
d. at the Right cost
e. In the Right quantity

Key factors which every organisation need to possess so that supply chain of any organisation can be successful are Infrastructure flexibility, customer / stake holders’ co-operation, optimised network structure, identification / codification system, consideration of geographical constraints, process capability, logistics economics, and co-ordination among stake holders. These factors as reviewed in literature are detailed in Section 2.7.

Supply chain management assimilates processes or major business functions which occur through or across organisation. Supply chain activities such as purchasing, logistics, inventory management drives synchronisation of processes and activities with and across multiple functions such as marketing, sales, finance, planning, product design, manufacturing, information technology, and operations. Sales personnel have to understand the supply chain to commit the lead time of product to customer and if both functions are not interlinked then most of the time commitment to customer will not be met. Similarly marketing personnel need to understand supply chain cost, lead time of product to device product marketing strategy. Speed to market or reducing the cycle time to develop new products can be improved significantly through involving supply chain management in research and development functions. For manufacturing, supply chain strategy is different for make to stock or make to order. Production planning for make to stock products can’t be done till the time supply chain is not integrated with manufacturing team for raw materials. Information technology facilitates high degree of inter functions integration and co-ordination with in the firm hence an effective supply chain system. For Finance, supply chain activities affect profit and loss statements, balance sheets, and the cost of capital. Significant
opportunities exist in supply chain cost reduction, generation of better returns on invested capitals.

1.6 DESCRIPTION OF THE PRESENT STUDY

Indian telecom industry has got much importance in the Indian economy in present scenario. While the estimates of impact of growth of telecom on a country’s economy may vary from study to study but one cannot deny the fact that telecom is a critical infrastructure sector having significant impact on other sectors and the economic growth. On the basis of technical aspects telecom sector in India is bifurcated into two segments mainly on wire-line and wireless technology. As evident from records of multiple government bodies, wire-line subscribers are only two - three per cent of total subscribers hence throughout this study concentration is given to wireless subscribers and related organisations since they represent 97 per cent of industry. (Telecom Regulatory Authority of India, 2013) To become a force in the global telecom space, India needs to create an efficient supply chain system and build globally competitive supply chain across the telecom sector. As the supply chain gets altered and become more efficient, an all-round impact on the telecom sector and the Indian economy would be evident. However, there are multiple challenges faced by the telecom sector today pushing for higher costs. Motivation to this study comes from the challenges being faced by the telecom Industry which are detailed in Section 1.4.

To overcome these challenges impacting costs, cost management is a key which industry has to adopt. Owing to these challenges the very nature of telecom sector is facing the threat of risk imbibed in it. Need is felt that it is high time that cost needs to be optimised to manage the risk getting generated through these challenges. New cost pressures shall mean a change in mind-set and the ability to think outside the box. Organisations need to minimise the cost wastage getting generated in the process by initiating critical thinking on components of process. This study brings out one such component of telecom industry which can help to improve the performance of industry which is supply chain management and its various sub functions. Supply chain management’s main role is to integrate processes or major business functions which run through or across organisation. For management of risk in telecom sector, supply
chain has to play a major role in synchronising processes to boost organisational performances. Supply chain performance impacts the organisation’s performance as it relates to its ability to deliver goods and services in the precise quantities and at the precise times required by customers. (Green Jr, Whitten, & Inman, 2008) Bowersox et al. incorporate performance metrics such as customer satisfaction, delivery speed, delivery dependability, and delivery flexibility. (Bowersox, Closs, Stank, & Keller, 2000) Marketing performance reflects the organisation’s ability to increase sales and expand market share as compared to its competition. (Green & Inman, 2005) Financial performance reflects an organisation’s profitability and return on investment as compared to its competition. (Claycomb, Germain, & Droge, 1999) (Green, et al., 2004) Therefore, it is necessary that supply chain of telecom sector is analysed and studied to improve organisational performance. Also both telecom industry and supply chain management function has grown at fast pace in India in last 15-20 years, a need is felt to measure relationship between these. Also not much study had been done on supply chain management of telecom industry so it becomes important to study this relationship. Therefore, the overall purpose of the study is to review “Supply Chain Operations and Organisational Performance” in telecom industry.

1.7 OBJECTIVES AND HYPOTHESES OF THE STUDY

This study is descriptive research work and aims to verify various factors of supply chain impacting performance on organisation level in telecom sector. It further aims to verify and validate key functions of supply chain of telecom operator. Considering present understanding of supply chain in telecom sector and past studies, objectives of this specified research are:

a. To examine the current supply chain dynamics of Indian telecom industry and to identify key factors of telecom industry’s supply chain competitiveness
b. To assess the existent parameters on which the supply chain performance is measured
c. To identify bottlenecks of supply chain performance and to find out the way they impact organisational performance
d. To suggest ways to enhance effectiveness of these supply chain operations
To operationalise above objectives following hypotheses are set for testing:

H1: There is significant impact of supply chain operations on operational performance of an organisation.
H2: Supply chain management has more impact on cost rather than revenue of company.

1.8 METHODOLOGY

Not much information is available from secondary sources to prove the impact of supply chain management on organisational performance in telecom sector’s set up in India. There is a general impression held by the industry that supply chain management activity is a support activity required to meet the revenue targets. There is another view equally prevalent among the people in industry that technical knowhow for the product is not must for supply chain professional. The study builds upon the information collected from the primary sources and it will use secondary information wherever available. The primary data is collected from the structured questionnaires.

Initially, a list of major players in telecom sector is made and flow of information and material flow among these players is analysed. Further on, the study try to identify the linkages among various stake holders of telecom sector and try to analyse supply chain operations. Some warehouses are in a bad shape and are generating more wastage. Some other warehouses are just a ‘going concern’; with little or no prospect at present to thrive in the future. Yet, some other warehouses are thriving and handling the goods carefully and contributing to profits. Since, the economic conditions of industry is undergoing a challenging situation where in operators are constrained to increase the mobile tariffs but ever changing scenario such as increasing equipment price, higher spectrum prices, wages, inflation are pushing cost on upwards side hence, this impact of wastage getting generated shall be analysed.

At the third stage, primary data received through questionnaire is analysed. Questionnaire is circulated to supply chain professionals and internal or external customers of the supply chain management function such as from project and operations team. The observation/data thus collected are subjected to suitable statistical analysis to draw conclusions and relevant statistical techniques are used wherever
applicable. Detailed methodology for study is shared in Section 4.1. The limitation of the present study is that it may suffer from lack of representation because of following factors:

a. Presence of indirect factors such as outsourcing impacting supply chain  
b. Reliability of data provided by the respondents  
c. The study is restricted to a particular sample size else the study scope would have been extremely wide. However, efforts have been made to ensure that sample chosen represents industry in its true sense.

1.9 ORGANISATION OF THE THESIS

The telecom industry development has been one of the most remarkable development stories in Indian history. In last 20 years from a nascent stage this industry has been indistinguishably interweaved with practically every characteristic of an individual’s life. Universality of telecom has had a deep influence on human lives and organisations. This study brings out multiple facets of supply chain in telecom sector and their impact on organisational performance of the sector. Study is organised in six chapters which are discussed in below paragraphs:

Chapter-1 Introduction, explains role of telecom sector in country’s development, its evolution, current status, and challenges being faced by the telecom industry. Further on study touch-bases on concept of supply chain management, its types, historical developments, features, importance, and critical success factors relationships. Further section introduces present study, its objectives, hypotheses and framework of present research work.

Chapter 2 explains business process integration through supply chain processes, partnerships and collaboration approach in the supply chain, performance measurement, sustainability and social responsibility in supply chains from the reviewed literature. Further on it reviews data on Indian telecom sector through multiple studies carried by Department of Telecom (DOT), research carried out by private sector organisation and industry association like FICCI, pre budget economic surveys, and supply chain scenario of the sector.
Chapter 3 contains eight sections explaining profile of telecom industry’s dynamics, its challenges and supply chain dynamics of industry. It elaborates spread of telecom sector in India, relationship matrix of multiple constituents in supply chain of the sector, key players, regulatory framework of the sector in country, and telecom equipment manufacturing scenario. Further on study explains major governing factors in telecom sector, challenges being faced by the telecom sector and ecosystem challenges prevailing in the country.

Chapter 4 supply chain bottlenecks and their impact on competitiveness, contains fifteen sections and presents empirical analysis for the study. First section explains the research methodology followed in the research work with respect to sampling plan and its criteria, size and profile of the sample, data collection tools and its analysis and interpretation. Next fourteen sections present the summary of finding of the research work based on respondents’ feedback for surveys and analysis of the data from survey. These sections address the various dimensions of telecom’s supply chain in line with objectives of study and test hypotheses as per below details:

a. Ranking of important constituents of telecom supply chain  
b. Awareness of purchase structure by various verticals of organisation  
c. Business model of ordering and frequency of ordering  
d. Empirical assessment of forecasting constraints  
e. Empirical assessment of manufacturing and import scenario  
f. Challenges to indigenisation of telecom network equipment  
g. Review of transportation scenario  
h. Supply chain impact on revenue or cost  
i. Supply chain processes and cost of consequential damages  
j. Inventory aging scenario  
k. Enterprise Resource Planning (ERP) package usage  
l. Material demand cycle  
m. Warehousing operations  
n. Operational performance of organisation
Chapter 5 contains implications for supply chain management and telecom sector from findings of research work and tabulates prevailing challenges in the sector. Based on study major constituents of supply chain management are listed and challenges to forecasting and indigenisation of telecom networks are discussed in detail.

Chapter 6 summarise and concludes the findings and details out implications of these findings. Further on study recommends strategic policy initiatives which can be taken by research institutions, telecom service providers, software developers and government to improve upon the scenario. Finally study concludes with recommendation for future research which can be taken up by building up base over present study.

Telecom sector contributes to development of country through direct and indirect contribution to GDP, employment, infrastructure development, foreign direct investment and growth of other sectors such as IT and ITES. Historically sector had grown in last 20 years in India and had become an instrument for ample opportunities of growth of the country. However sector is facing challenges for growth sustenance hence cost of the sector needs to be optimised and this study is an effort in that direction so that supply chain of the sector can be reviewed and worked upon accordingly.