Supply Chain and Operational Performance in India’s Telecom Sector

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ABSTRACT
Telecom sector plays an important role in infrastructure development of a country and its economy. The study is set out to review supply chain operations and operational performance of organisations in Indian telecom industry. Major constituents of the sector are connected with intricate matrix and engagements are governed by multiple contracts and governing guidelines, making supply chain of the telecom sector unique in itself. Study has sought to assess and to find out the way supply chain performance impact organisation’s operational performance. This study has reviewed major constituents of telecom sector supply chain and engagement matrix among these players. Study has attempted to review impact of supply chain operations on operational performance parameters of project performance, financial performance, sales and marketing performance and customer satisfaction.

Keywords: India, Telecom sector, supply chain, operational performance

1. India’s Telecom Sector: A Brief Historical Perspective and Growth Profile
The governing part acquired by telecommunications in the world-wide business scenario has resulted into development of telecom services as instrumental in economy of any country. The telecommunication sector is a significant component of social and economic development of any nation. Growth of telecom in India is distinctive in itself with meagre 5.07 million subscriptions in 1991, when economy got liberated, it has developed to be the world’s second largest network with a subscriptions of one billion in 2015. (Telecom Regulatory Authority of India, 2010) (Telecom Regulatory Authority of India, 2015) Out of total telecom subscriber base of 1009.31 million subscribers, 98 per cent that is 983.21 million subscribers 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. (Telecom Regulatory Authority of India, 2015) With the introduction of upgraded technologies like third generation (3G) and fourth generation (4G / LTE), the data consumption is likely to multiply manifold. The total number of mobile subscriptions in India is expected to increase to approximately 1.4 billion by 2020, covering almost the entire population. 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. (Telecom Regulatory Authority of India, 2015)

Telecom sector plays a crucial role in infrastructure development of a country and its economy through multiple factors such as direct and indirect contribution to GDP, employment to native citizens, foreign direct investment, and through growth of associated sectors such as information technology or enabled services, banking, education, medical, travel, and engineering. (Arora & Bedi, 2016) 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) Sectors like retail, e-commerce and other services sector are heavily dependent on stabilised telecom sector.
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. 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) The sector observed a minimal drop in the number of subscribers during the year 2012-13. (Telecom Regulatory Authority of India, 2013) The drop in wireless connections is mainly due to deactivation of quiet connections. Wireline subscribers are only two per cent of total subscribers and the base of wire-line subscribers is continuously dropping. 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, showing a growth of 5.69 per cent over the previous year. (Telecom Regulatory Authority of India, 2014)

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. 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) 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.

2. Some Contemporary Challenges

Telecom industry is going through changing times where in multiple technical, regulatory, ecological, market and financial challenges are being encountered due to the same on one side revenue is under stress and on another side cost is on mounting side because of requisite transformation of network to cater to upgraded technologies. Major challenges which are being faced by the telecom industry can be categorised in following categories as below:
3.1 Technical Challenges
Due to adaptation of new technologies to cater to data explosion leading to growth in services, higher data speed, and obsolescence of old technologies, networks need to be re-engineered. With spectrum becoming a costly and scarce resource, every operator had to review their design of network so that they can leverage opportunities to deliver better quality at low cost.

3.2 Regulatory Challenges
With sudden growth in this evolving industry blemished by series of scams, regulator is forced to enforce stringent regulatory norms compelling stake holder to have a cautious approach. Regulatory guidelines are being imposed by almost all government and non-government bodies starting from municipal corporations, social associations to Honourable Supreme court of India making it challenging to operate in environment.

3.3 Environmental Challenges
Operators who all started their operations in 2004-05, are upgrading their network technologically to milk existing available spectrum which will result into huge amount of electronic scrap getting generated. Moreover, every year millions of mobile phones are getting scrapped as mobile phone has got an average life of less than two year. This shall certainly leave an impact on environment if not disposed properly. Due to non-availability of structured sector for disposal of electronic goods this, appear as major challenge to environment in times to come.

3.4 Market Challenges
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. On another side growth rate of subscribers has shown a downward trend. 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.

3.5 Financial Challenges
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 3-1) (Chiehyu & Ninan, 2010)

**Figure 3-1 Global Cell Phone Package Comparisons**

![Figure 3-1 Global Cell Phone Package Comparisons](image-url)
Recent downsizing of most telecom companies signify continued financial headwinds 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$27 billion, a meagre 2.3 per cent of the estimated global telecom revenues of Rupees 1.16 trillion. The industry’s total debt was up 200 per cent from Rupees 827 billion (~ US$ 14 billion) in 2008-09 to Rupees 2500 billion (~ US$ 42 billion) in 2012-13. (COAI, Internet reading, Company reports). Bharti Airtel the biggest operator in country alone was having debt of US $ 10.67 billion at the close of financial year 2014-15 (Business Standard, 2015) and estimated to be having debt of approximately US $ 12 billion at the end of second quarter of financial year 2015-16. Additional costs coming from above mentioned challenges is also adding 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 (Approx. US $ 58 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 3-2 Mounting Debts in Telecom Industry

In Rupees billion

<table>
<thead>
<tr>
<th>Year</th>
<th>Telecom Industry Debt (Rs. Bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-09</td>
<td>827.26</td>
</tr>
<tr>
<td>2009-10</td>
<td>1237.75</td>
</tr>
<tr>
<td>2010-11</td>
<td>1599.55</td>
</tr>
<tr>
<td>2011-12</td>
<td>1857.2</td>
</tr>
<tr>
<td>2012-13</td>
<td>2500</td>
</tr>
<tr>
<td>2014-15</td>
<td>3500</td>
</tr>
</tbody>
</table>

Source: COAI, Company Reports, PWC

Owing to all above challenges industry need to go ahead with project with good return of capital and balance with low return of capital had to wait. These multiple challenges being faced by the telecom sector are pushing for higher costs. 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. Motivation to this study comes from the challenges faced by the telecom Industry.
Supply chain management as a conception as well as Indian telecom industry has progressed in the last 15-20 years. Because of impulsive evolution in the industry and stress being on returns, sales modelling, network growth and expansion across various technologies, supply chain management persisted as an associate function and industry could not benefit from advancement in functions of supply chain management which other industries such as automobile industries did. For management of risk in telecom sector, supply chain has to play a major role in synchronising the processes to boost organisational performances. Organisations need to minimise the cost wastage generated in the process by initiating critical thinking on components of process.

4. Supply Chain of the Sector and Its Challenges
Supply chain management can be 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, synchronizing supply with demand and measuring performance globally. Supply chain management has its inception from the areas of operations management, logistics, procurement, and information technology, and strives for an integrated approach. Organisations increasingly find that they must rely on effective supply chains, networks or business relationships to compete in the global market and networked economy. In Peter Drucker's (1998) new management paradigms this concept of business relationships extends beyond traditional enterprise boundaries and seeks to organise entire business processes throughout a value chain of multiple companies. (Drucker Peter F, 1954) In recent decade globalisation, outsourcing, and information technology have enabled many organisations to successfully operate collaborative supply networks in which each specialised business partner focuses on only a few key strategic activities. (Scott, 1993)

This inter-organisational supply network can be acknowledged as a new form of organisation. However, with the complicated interactions among the players, the network structure fits neither "market" nor "hierarchy" categories. (Walter, 1990)

The supply chain of telecom equipment originates with sourcing of components like semiconductor chips and software. Components sourced from these suppliers are assimilated into equipment manufactured and supplied by equipment vendors which are deployed by telecom service providers. The service providers deploy these equipment to construct networks and offer telecom services for voice and data usage to the subscribers. While deploying these equipment, telecom service providers take the services of installation, infrastructure and logistics service providers. Telecom service providers charge subscribers for the used services with the help of software which are being provided by billing software providers. Other than the deployment of new networks, telecom services take services of operation and maintenance of deployed equipment and network from equipment, infrastructure and logistics service providers in the course of operation. Due to introduction of new technologies and obsolescence, service providers have to redesign and reconfigure their network which will give rise to enormous volume of electronic waste. These electronic waste is required to be disposed in ecological manner through recyclers.

All these constituents of telecom supply chain are connected with each other with their complex contracts and their ways of working. Service providers in 22 telecom circles deliver services through several technologies starting from incumbent technologies of 2nd generation GSM (Global system for Mobile communications) (2G) and CDMA (Code Division Multiple Access) to current prevailing technologies of 3rd generation GSM (3G), WCDMA (Wideband Code Division Multiple Access) and 4th generation Long Term Evolution (LTE). Telecom sector in India and supply chain management as a concept started almost same time that is around twenty years back. To start with country was not having any much of technical insights into aspects of telecom networks which pit dependence on overseas players for built up and maintenance of telecom networks. Strong partnerships emerged between global suppliers and Indian telecom service providers with opening of this sector to private sectors. In these partnerships, global equipment suppliers were given contracts for equipment supplies as well as helped in designing and managing operations of networks of telecom service providers. This gave rise to import of most of the equipment from overseas.
4.1 Supply Chain Constituents of the Sector

To summarise, telecommunications industry is enabled by a complex supply chain that includes:

a. **Telecom Network Operators**: Major telecom operators are Aircel, Airtel, Idea, Vodafone, Videocon, Loop, Spice, Reliance Communications, HFCL, Tata Tele, Telewings, Bharat Sanchar Nigam Limited (BSNL), Mahanagar Telecom Nigam Limited (MTNL) and Sistema Shyam Telecom. India's biggest carriers such as Bharti Airtel, Vodafone and Idea Cellular are associated with each other through Cellular Operators Association of India (COAI) and dual technology operators such as Reliance Communications and Tata Teleservices, and pure CDMA players like Sistema Shyam Teleservices are presented by the Association of Unified Telecom Service Providers of India (Auspi).

b. **Equipment Suppliers**: Telecom equipment market is commanded by European and Chinese suppliers such as Ericsson, Nokia Siemens, Huawei, and ZTE. Most of these companies have managed services contracts with network operators where they design and maintain networks for telecom service providers on end to end basis. These companies get support from their governments. On the other hand telecom operators because of their business cases do not insist on Indian products due to price issue and non-availability of such product which is designed and developed in India and can replace quality of foreign made products. However, still there are limited Indian companies such as ITI, Bharat Electronics Limited (BEL), Shyam Telecom, Tejas Network, Coral Telecom, Realtime System, and Zen had set up their production unit in India and are producing few numbers with limited value addition.

c. **Component Suppliers**: Supply chain of components is crowded with offshore suppliers such as Free-scale, ST Electronics, Intel, Flextronics, Harris Stratex, Marconi, and Volex which provides to world-wide telecom and electronics customers. Other than these suppliers few global suppliers with manufacturing facilities in India are CommScope, Jabil, ADC Krone, Delta, Sterlite, Amphenol and Agilent. However, due to recent promotion of make in India campaign more and more global manufacturers are interested in manufacturing in India to avoid increased duty impact on their products. Indian suppliers who have products of 100 percent Indian origin are very few in numbers, but there are few who are in low value addition cases manufactures as per imported technologies these are such as Shilpi cables, Surabhi Telecom. Most of these suppliers supplies their components and sub-assemblies to equipment vendors but in some cases based on individual business cases telecom service providers buys subassemblies like antennas system directly from these subassembly suppliers.

d. **Telecom and Logistics Service Providers**: Telecom equipment installation, operations and maintenance services for equipment are being done by telecom gear providers who engage their service partners to provide these services. Similarly, tower infrastructure providers construct, operate and maintain telecom towers either directly or through multiple service providers.

e. **Infrastructure Providers**: Major tower service providers who are contributing to development of telecom sector in India are Indus Towers, Bharti Infratel Limited, Reliance Infratel Limited, Viom Networks and GTL Infrastructure Limited. Other than these, 5 main tower companies who own approx. 300K towers, players like Essar Telecom, American Tower Corp, Tower Vision, Aster Infrastructure, India Telecom Infra Limited, KEC International, Independent Mobile Infrastructure put together own approx. 15000 towers. In addition, state owned companies BSNL and MTNL build and maintain their own towers and their current count is approximately 95000+ towers.

f. **Recyclers**: With more and more electronic equipment getting scrapped due to renovation of the network to cater to modernisation requirement owing to technology change and higher capacity requirement, role of recyclers who can dispose this electronic scrap in ecological manner, is growing bigger in the sector. According to a report by the United Nations, by
2020, the e-waste generated by computers will rise by 500 percent in India alone and up to 18 times from the 2007 mark for discarded mobile phones. Another alarming fact is that around 60% of the e-waste generated in India is contributed by 65 major cities and continues to grow at a rapid rate. (Clean e-India, 2014) However, most of scrap is presently being handled by unstructured players who are not too much sensitive towards environmental issues. Few structured players are M/S Tess Emm, M/S Clean e-India and M/S Karma Recyclers.

g. **Regulator:** Indian telecom sector has developed a long way in the last 20 years and this development has been possible because of reforms and liberalization in Indian economy and regulations. The regulatory and policy changes of the government has played a key role in this extraordinary progression during the last 15 years. The key regulatory bodies of the telecom industry operates under ministry of communications are Department of Telecom for formulating developmental policies for the accelerated growth of the telecommunication services, WPC Wing for frequency and spectrum management, including licensing and caters for the needs of all wireless users in the country, Telecom Engineering Centre (TEC) for formulating specification of common standards with regards to telecom network equipment, services and interoperability, issuing interface approvals and providing technical support to DOT, TRAI and TDSAT. Centre for development of Telematics (C-DoT) is a research and development unit under the Department of Telecom. The DoT has the public sector undertakings under its fold which are Bharat Sanchar Nigam Limited (BSNL), Mahanagar Telephone Nigam Limited (MTNL), Indian Telephone Industries (ITI) and Telecommunications Consultants India Limited (TCIL). In 2004 The Department of Telecom created 4 vigilance telecom monitoring cells (VTM) to monitor and control illegal and clandestine telecom operations in the country. These VTM cells were later rechristened as Telecom Enforcement Resource and Monitoring Cells (TERM) in 2008. The Telecom Commission is responsible for policy formulation, licensing, wireless spectrum management, administrative monitoring of PSUs, research and development and standardization.

TRAI was set up in 1997 by the government of India as an independent regulator of the business of telecommunications in the country. TRAI is mandated to provide an effective regulatory framework and adequate safeguards to ensure fair competition and protection of consumer interests. TDSAT was set up in May 2000 by the government of India to adjudicate over disputes that arise in the telecommunication sector. TDSAT was established with the view to protect the interest of the consumers and service providers of the telecommunication sector and also to encourage and ensure the growth of the telecommunication sector.

h. **Software Providers:** Software for running telecom equipment supplied by telecom equipment suppliers are being supplied by these equipment suppliers only. With emergence of new technologies more and more telecom products are software controller where in one hardware can cater to multiple technologies by altering software versions. Hence these software providers are going to play major role in progress of the sector. Other than software providers for telecom equipment there are other software providers such as Tech Mahindra, TCS, IBM, Microsoft, Oracle, Wipro, and Infosys, in value chain who deliver basic telecom software along with charging solutions.

### 4.2 Supply Chain Challenges of the Sector

It is expected that Indian telecom sector had 6.6 per cent of the worldwide requirement for telecom equipment in 2014-15. (Gupta, 2014) Major forex outflow is expected for procuring hardware, software and technology for telecom equipment and its parts excluding mobile phones. Most of these equipments are getting imported from China and Europe. As per Telecom Systems Design and Manufacturing Association (TSDMA), less than three percent of total telecom equipment demand is designed and manufactured in India. Even if one adds the share of foreign companies manufacturing in India then too share of Indian manufactured
goods reaches to 12 per cent. Value addition in India is restricted to only to assembly, integration and packaging resulting into major forex outflow in form of cost of design, component procurement and the intellectual property to the country of design or technology owner. It is apprehended now that deficiency of internal manufacturing is presenting a stern challenge to India for realisation of benefits from growth of the sector. The manufacturing segment is dominated by foreign firms and Indian companies occupy only a small space in the total domestic manufacturing base. Though there is a sizeable demand for telecom equipment which is also growing, supply is largely met through imports from China and Europe. (Chattopadhyay, 2013) Multiple studies from Telecom regulatory authority of India (TRAI) in 2010 and 2011 identified this as a problem area and could identify that that indigenisation of telecom equipment attracted the least significance and liberal import regime did not exhort any push to constituents of the sector for considering designing and manufacturing products in India.(Telecom Regulatory Authority of India, 2010) (Telecom Regulatory Authority of India, 2011) Studies established that designing and manufacturing equipment is an crucial activity in further development of the Indian telecom sector and therefore, same must be exhilarated. Moreover, other than economic reasons, the security deliberations also pushes for having indigenous design and manufacturing. Department of telecom shared multiple consultation papers and strategic plans for swelling the share of Indian products but still foremost share of enormous telecom equipment demand is being met through imports or being produced by global suppliers. Thereby, resulting in drainage of foreign exchange out of shores of the country, resulting in non realisation of significant benefits from Indian market to country’s own economy.

Supply chain management operations poses challenges for operations in matured economies such as that of US and challenges further increase for developing economies like India. Strategies of global companies which are successful in their home country had to be altered to major extent to achieve success in developing economies. Challenges of developing economies such as under developed infra-structure for transportation, power and water poses touch working environment for these organisation. (Swaminathan, 2006) In order to cater to these challenges organisation has to outsource few operations to specialist of these environment. While choosing such a supplier or service provider to outsource any activity, organisation has to review and evaluate these service providers on multiple considerations and these considerations occasionally overlay and make the process mystifying. Study from Mohanty and Dabade carried forward four major elements from 15 variables for vendor selection of Indian telecommunication service provider as perceived by the procurement authorities of Indian telecommunication service providers (Mohanty & Dabade, 2013)

From Infrastructure providers perspective, preserving infrastructure towers offers a strong challenge due to various factors like fuel consumption for power generation, stringent rules of radiations from towers, power usage, and theft of equipment from site, land lord and owner issues, terrorist activities, guidelines on green telecom, clearance from municipal, government, community and environmental bodies.

5. Supply Chain and Operational Performance
Organisational performance relates to the degree to which organisation is able to meet its performance objectives related to market performance as well as its financial performance. No standardized definition has been arrived about organisational performance by researchers however, results from study carried out by Ou et al suggest that results of positive benefits reaped from a successful SCM implementation show that SCM improves operational performance which yields greater customer satisfaction and financial performance. Higher financial performance is also attributable to better customer value resulting from the achievement of better customer satisfaction. (Ou, et al., 2010)

The study from Hsu et al tested the proposition that supply chain management practices mediate the relationship between operations capability and firm performance. Operations capability is defined in terms of a firm's new product design and development, total quality management and just-in-time capabilities. Results suggested the existence of a direct relationship between operations capability and
Few researchers have used marketing performance indicators such as product quality and new product development. The study had shown that quality management (QM) practices are significantly correlated with the supplier participation strategy and this influences tangible business results, and customer satisfaction levels. The data also showed that QM practices are significantly correlated with the supplier selection strategy. (Lin, et al., 2005)

Lia Suhong et al in their study concluded that effective supply chain management (SCM) has become a potentially valuable way of securing competitive advantage and improving organizational performance since competition is no longer between organisations, but among supply chains. This research conceptualised and developed five dimensions of supply chain practice such as strategic supplier partnership, customer relationship, level of information sharing, quality of information sharing, and postponement and tested the relationships between supply chain practices, competitive advantage, and organisational performance. The results indicated that higher levels of supply chain practice can lead to enhanced competitive advantage and improved organisational performance. (Lia, et al., 2006) Marketing performance relates to the organisation’s ability to increase sales and increase market share giving edge over the competition. Financial performance relates to organisation’s profitability and return on investment as compared to its competition. Supply chain’s main goals are to provide right product at right time at right cost with right quality and at right location, which contributes to both marketing and financial performance by improving productivity of resources, reducing inventories hence, it helps in improving profits and increases market share. Supply chain management can be considered as an effective tool which can help to reduce cost to company without impacting its revenues hence, supply chain leads to enhanced organisational performance. Therefore, it is necessary that supply chain of telecom sector is analysed and studied to improve organisational performance.

In order to study the impact of supply chain management to organisation performance there is a need to create a structured approach for reviewing objectives of supply chain management. Measurement information can be used to set objectives, analyse and resolve problems, and define and amend processes. Internal measurement of an organisation gives greater insight into performance. These internal assessments can be done through tools such as SWOT analysis, market research, strategic planning, SMART goals, company reviews and consulting. However, most of the organisations concentrate on financial performance while measuring organisational performance. To measure organisational performance, standalone financial performance is not a true reflection of organisational performance as most of the time organisation concentrates on passing financial risks to their suppliers or customer to improve financial performance on short term basis. Most of the organisations chase financial results without understanding what really creates and sustains results. From an organisational perspective people (employee’s and customers), products and processes are measured in terms of productivity, profitability and satisfaction. The measure of satisfaction has only risen to the top of performance metrics because there is a direct correlation to productivity and profitability which are extensions of financial performance. (Deragon, 2013)

In order to enhance edge in competitiveness, organisation are adopting a strategy to stick to their core competencies and outsource non-core competencies. Competitive advantage in organisation performace is getting enhanced by coordinating functions across supply chain partners. (Mentzer, 2007) Council of Supply Chain Management Professionals (CSCMP) in India and A.T. Kearney highlighted seven supply chain best practices or themes that successful organizations across India are using to gain competitiveness in their organisational performance: (Kearney, 2013)

**5.1 Collaborate to Integrate the Value Chain Virtually**

Collaboration can be at executed across functions or across value chain or even beyond the value chain as well. In order for success of any collaboration it need to work on win-win approach with complementary objectives with long term milestone clearly maked and tracked for progress for collaboratring organisations.

**5.2 Replace One-Size-Fits-All with a Tailored Approach**

With a good mix up of organisaitons from veterans to new start up operations, never before diversity is prevailing in India. Hence approach to deal with veterans may not fit with the start
up organisation so in supply chain approach will have to be customised to appreciate and working with diverse set of organisations.

5.3 Plan More Frequently and across Multiple Horizons
With fast changing technological, demographical, political and economic environment is pushing supply chain to its extreme. Executives of successful supply chain need to see the big picture while also focusing on the details. This can be achieved with frequent and multi-horizon planning sessions: weekly reviews for short-term planning, and regular reviews for long-term planning.

5.4 Implement Pull Replenishment across the Value Chain
In order to reduce costs and services, supply chain organisations in country are following pull replenishment strategies across their entire value chains from customers to vendors in place of push replenishment strategies from vendors to suppliers. With this pull strategy customer ensures that they don’t carry unjustified inventories in their warehouse.

5.5 Actively Manage Complexity
More and more organisations in country are adopting supply chain strategies such as value analysis, activity based costing or business process reengineering to optimise the process so that non value adding activity or processes can be get rid off and value addition activity or process can be maximised.

5.6 Let Business Needs Drive Technology and Automation Choices
In order to overcome challenges owing to environment changes it is becoming must to adapt to technological advancements and go for automation to meet the business requirements judiciously. A fine balance needs to be build up between incorporation of technology and human touch so that competitive advantage can be secured.

5.7 Reconfigure the Supply Chain Organisation to Include Business Management Capabilities
With change in challenges due to change in environment and business conditions expectations from supply chain are ever changing. These expectations call for renewing the skill and capabilities of supply chain professionals considering the business management capabilities and needs of the organisations.

Organisations across industries who follow these practices or strategies, to overcome challenges for fast pacing environmental changes can gain competitiveness over other organisations.

6. Impact of Supply Chain Inefficiencies on Operational Performance in India’s Telecom Sector
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, et al., 2008) Bowersox et al. incorporate performance metrics such as customer satisfaction, delivery speed, delivery dependability, and delivery flexibility. (Bowersox, et al., 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, et al., 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.

6.1 Objectives and hypotheses of the study
With the aforementioned back ground this study tries to find out the impact of supply chain on operational performance of organisation in the telecom sector in India. The study took into consideration of various constituents of operational performance of organisation such as project performance, financial performance in terms of cost and revenue, customer satisfaction and sales /
marketing performance. Considering present understanding of supply chain in telecom sector and past studies, objectives of this specified research are:

a. To review impact of supply chain performance on operational performance of organisation in telecom supply chain
b. To suggest ways to enhance effectiveness of these supply chain operations

To operationalise above objectives following null hypothesis is set for testing:

H1: There is no significant impact of supply chain operations on operational performance of an organisation.

6.2 Methodology

Not much information is available from secondary sources to prove the impact of supply chain management on operational performance in telecom sector’s set up in India. The study builds upon the information collected from the primary sources and it uses secondary information wherever available. Responses are collected from senior executives working in leading telecom service providers and equipment vendors. Respondents are associated with all major telecom network providers and equipment vendors in their supply chain, project deployment, planning and sales function hence, representing a sizeable portion of the sector’s value chain. Questionnaire was circulated through web based survey tool and responses were collected from web based notifications and through email notifications. 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 study takes into consideration telecom professionals who had been associated with network service providers, telecom equipment manufacturers, component vendors, tower companies, logistics service providers and software service providers. The primary data has been collected through questionnaire prepared through web portal surveymonkey.com and responses were administered through sharing of web link with respondents and through E-mail invitations via web portal. Responses were validated by telephonic queries. In order to understand impact between supply chain operations and operational performance of organisation in line with hypothesis, respondents feedback is sought for analysing the response on operational performance subcategories like marketing performance, financial performance in terms of revenue and cost, project performance, and customer satisfaction.

The observation /data thus collected are subjected to Chi-square test to check relatedness between these operational performance sub-factors and supply chain management. Further on During Kruskal-Wallis test and paired Mann-Whitney test was conducted to review response variations among three categories of respondents which are veterans, mid-experience and young. Conclusions were drawn based on weighted average score obtained for all sub-factors of performance.

6.3 Inefficiencies in the Supply Chain of the Industry

One of the foremost inefficiency prevailing in the sector is that most of equipment are getting outsourced either from overseas or what so ever is getting manufactured in India a having very low value addition. Though central government had come up with multiple guidelines and recommendations over past few years to promote manufacturing in India but real benefit to economy can be seen only when the products will be designed and manufactured in India because until then even for Indian manufactured items most of foreign exchange will be flowing. In case efforts are put in for designing network equipment of current technologies of 2G, 3G or LTE then, by the time product will be designed and developed in India, global technology will change and Indian designed product will become outdated. Considering this, a concentrated effort need to be put in by public and private sector including technical research institutions so that development efforts are directed towards future technologies like 5G for network equipment and 4G and 5G for end user equipment which are expected to be launched in the next couple of years. Moreover, this process of reviewing the manufacturing scenario has to be dynamic because environment is not sacrosanct and challenges keep on changing on daily basis. Study concluded that opportunity exists for Indian suppliers and technical institutions to develop Indian product which can fulfil the need of future technologies and country’s outflow of foreign exchange can be curtailed. (Arora & Bedi, 2015)

Few other inefficiencies inbuilt it that, fast changing environment of the industry coupled with unclear regulatory scenario, lack of adequate tools or methods for forecasting often contributes to
deviation in forecast accuracies. At present no such product package or software exists which can capture dynamics of market during start up or execution of a service and convert it to forecasts for supplier. (Arora & Bedi, 2015)

6.4 Sources of Inefficiencies

Sources of these inefficiencies can be due to global scenario, current regulatory environment in the country, contract with equipment manufacturers and internal ways of working of the organisation which are customised as per different origins of the organisations resulting into non-standardised ways of working. Non-availability of Indian products, quality of Indian products, lucrative financial deals offered by incumbent manufacturers, lead time, price advantage, international commitment / obligations, aggressive business scenario, ease of installation, after sale service and warranty policies, and regulatory scenario contributed to non-consideration of business case by Indian supplier for manufacturing Indian products.

6.5 Dimensions and Magnitude of Impact on Operational Performance: Some Empirical Results

In order to review impact of supply chain operations on operational performance of organisation of the sector in line with hypothesis that there is no significant impact between supply chain operations and operational performance of organisation, operation performance is reviewed and analysed in six sub-factors of performance and respondents view point was sought on impact from supply chain on three point scale namely to a minor extent, impact but not to a major extent, and to a major extent. These six sub factors are customer satisfaction, sales / marketing performance, financial performance, revenue, cost to organisation and project performance. Chi-square test was conducted to check relatedness between these operational performance sub-factors and supply chain management. Higher value of chi-square and lower p-value (Table 6-1) signifies that all these sub-factors are related to operational performance of organisation and supply chain of telecom sector and there is significant impact between supply chain operations and operational performance of organisation.

Table 6-1 Chi-Square Test for Operational Performance

<table>
<thead>
<tr>
<th>Impact of Supply Chain</th>
<th>Customer Satisfaction</th>
<th>Sales / Marketing Performance</th>
<th>Financial Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed N</td>
<td>Expected N</td>
<td>Residual</td>
</tr>
<tr>
<td>To a minor extent</td>
<td>5</td>
<td>23.3</td>
<td>-18.3</td>
</tr>
<tr>
<td>Impacts, but not to a major extent</td>
<td>9</td>
<td>23.3</td>
<td>-14.3</td>
</tr>
<tr>
<td>To a major Extent</td>
<td>56</td>
<td>23.3</td>
<td>32.7</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact of Supply Chain</th>
<th>Revenue of Organisation</th>
<th>Cost to Project / Organisation</th>
<th>Project Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed N</td>
<td>Expected N</td>
<td>Residual</td>
</tr>
<tr>
<td>To a minor extent</td>
<td>6</td>
<td>23.3</td>
<td>-17.3</td>
</tr>
<tr>
<td>Impacts, but not to a major extent</td>
<td>13</td>
<td>23.3</td>
<td>-10.3</td>
</tr>
<tr>
<td>To a major Extent</td>
<td>51</td>
<td>23.3</td>
<td>27.7</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

Chi-Square: 68.943\(^a\), 9.800\(^b\), 38.514\(^c\), 50.257\(^d\), 57.029\(^e\), 82.314\(^f\)

df: 2, 2, 2, 2, 2, 2
Asymp. Sig: .000, .007, .000, .000, .000, .000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.3.
During Kruskal-Wallis test, calculated value of the Kruskal-Wallis test (H) is higher than the critical chi-square value (Table 6-2) for two sub factors namely, customer satisfaction and sales / marketing performance, that means statistically three categories of respondents do not have same distribution of the response for these two sub-factors. For balance four sub-factors such as financial performance, revenue, cost and project performance three categories of respondents have same distribution. Paired Mann-Whitney test (Table 6-3), between veteran and young, shows significance factor greater than 0.05 for three sub factors namely, customer satisfaction, sales / marketing performance and revenue of organisation that means there is no major difference in ranking of categories of respondents for these three sub-factors. Mann-Whitney test gives significance factor less than 0.05 for three sub-factors that means there is difference in ranking of respondents for financial performance (q0029_03), cost to project (q0029_05) and project performance (q0029_06). But considering the majority of veterans and alignment of final results study is concluded on the basis of majority viewpoint.

<table>
<thead>
<tr>
<th>Customer satisfaction</th>
<th>Sales / Marketing performance</th>
<th>Financial performance</th>
<th>Revenue of organisation</th>
<th>Cost to project / organisation</th>
<th>Project performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>280</td>
<td>416</td>
<td>9.701</td>
<td>3.037</td>
<td>8.147</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig</td>
<td>.169</td>
<td>.12</td>
<td>.008</td>
<td>.219</td>
<td>.017</td>
</tr>
</tbody>
</table>

Similarly, Alscal test results (Figure 6-1) show that mid experience team is the one who had responded differently to these three variables to a major extent and veterans and young one had responded slightly different. But considering the extent of experience of majority (58% - 43 out of 74) that is veterans whose Alscal test results is aligned with that of complete population, results are populated based on majority and experience.
Figure 6-1 ALSCAL Test Result for Operational Performance

Euclidean distance model

Mean Value

Veteran / Mid / Young: Veteran

Mean Value

Veteran / Mid / Young: Mid experience 7-15 years
Respondents rated these factors of operational performance on the measurement of impact due to supply chain on three point scale. This three point scale is having variables as impact to a major extent, impact but not to major extent and to a minor extent. Further on, for ranking these significant factors of performance, each factor rank was assigned a rank score and weighted score became the basis of ranking of reasons. Similar ranking is obtained from frequency table. Respondents rated these based on their experience in the telecom sector and consolidated rating is reviewed with weighted average score of each factor. Empirics for these factors and weighted average score achieved due to these ranking are tabulated in Table 6-4 and Table 6-5 below respectively.

**Table 6-4 Empirics for Operational Performance Parameters**

<table>
<thead>
<tr>
<th>Factors of Operational Performance</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer satisfaction</td>
<td>70</td>
<td>2.73</td>
<td>0.59</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Sales / Marketing performance</td>
<td>70</td>
<td>2.26</td>
<td>0.72</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Financial performance</td>
<td>70</td>
<td>2.60</td>
<td>0.60</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Revenue of organisation</td>
<td>70</td>
<td>2.64</td>
<td>0.64</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Cost to project / organisation</td>
<td>70</td>
<td>2.71</td>
<td>0.51</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Project performance</td>
<td>70</td>
<td>2.80</td>
<td>0.50</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Veteran / Mid / Young</td>
<td>74</td>
<td>1.53</td>
<td>0.71</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

**Source:** Computed from survey data
These sub-factors of supply chain as responded from respondents are further detailed below:

a. **Project Performance**

Project performance relates to the fact that how much supply chain impacts deliverable of any project; these can be in terms of ultimate final closure timelines of project, quality of products or work performed, cost or any other deliverable of projects. Project performance can be characterised by characteristics such as timely delivery of project, project budget adherence, quality of outputs, organisation process approaches on staggered deliveries meeting project schedule and communication strategy so that relevant information is available to relevant stake holders to take calls on risk analysis, cost optimisation. In order to understand effectiveness of supply chain practices on project performance, respondents’ view point is sought in questionnaire to what extent project performance is getting impacted from these practices. 84 per cent of respondents submit that supply chain of telecom sector impacts the project performance to a major extent. Overall project performance gets a weighted average score of 2.80 and come out number one sub factor getting impacted by supply chain of telecom sector.

Any delay in supply of equipment, tools or logistics services, will delay the project end closure date hence impacting delivery timelines. In order to push for recovering the project timelines, organisations push suppliers, service providers or deliverable entities within its own organisation to crash the project by pumping in additional resources which results either in cost overrun due to ramp up of additional resources or results in poor quality of deliverables from project as new resources hired for short term may not meet quality parameter most of the time as there is no adequate time for training and competence building. Hence supply chain impacts project performance in all three indicators of project performance that is time, cost and quality.

b. **Customer Satisfaction**

Customer satisfaction relates to the fact that how much customer is satisfied with supply chain practices which can be in terms of delivery time, quality of product, cost of product, serviceability of product and softer aspects of supply chain. An organisation having great orientation in customer service has a clear lead over the competition. Organisation which exceeds the customer satisfaction expectations then it can also expect the customer retention and also affect word of mouth publicity. In order to understand how companies in telecom sector feel that customer satisfaction is getting impacted by supply chain practices and up to what extent respondents’ view point was sought for the same. 80 per cent of respondents submit that supply chain of telecom sector impacts the customer satisfaction to a major extent. Overall customer satisfaction gets a weighted average score of 2.73 and come out number two sub factor getting impacted by supply chain of telecom sector.

Meeting these customer expectations results in a satisfied customer but in present globally competitive scenario merely customer satisfaction is not sufficient. Supply chain needs to work on customer delight and need to offer products and supply chain services to differentiate the same from competitions and to gain inclination with customers by enhancing the value provided to them. Hence for all supply chain services being offered to customer, analysing these constituents from customer satisfaction perspective will aid to a long term sustainable path for value addition in this sector.
c. Cost to Project / Organisation
Supply chain’s cost to organisation can be in terms of material cost from suppliers, service cost for supply chain executives, cost of logistics service such as warehousing and transportation, and cost of consequential damages due to supply chain operations. Optimised cost structure of projects helps any organisation to improve upon financial performance of the organisation. An optimised supply chain operation shall help in bringing down cost for these activities and ultimately cost to project. In order to understand how companies in telecom sector feel that cost to project is getting impacted by supply chain practices and up to what extent respondents’ feedback was sought for the same. 74 per cent of respondents submit that supply chain of telecom sector impacts the cost to project / organisation to a major extent. Overall cost to project / organisation get a weighted average score of 2.71 and come out number three sub factor getting impacted by supply chain of telecom sector.

Impact on cost performance can be in terms of delivery cost, cost of product development, inventory carrying cost, packaging cost, batch size, physical distance between customer and supplier, taxes of state, out of stock scenario impacting cost due to non-realisation of available inventory, premium freight payment, cost of reworks, cost of inaccurate forecasts, product selling costs, cost due to warranty expiration due to failure in supply chain operations, logistics transactions correctness, and cost due to fluctuations in exchange rate. Consequential damages to organisation performance due to supply chain performance can be in terms of loss in revenue, loss in market share, brand value damage, lost opportunity to win over competition and goodwill lost relates to revenue directly. Similarly consequential damages impacting cost to organisation can be increased due to rework cost, loss of anticipated cost saving, increased scrap cost, premium freight payment, and higher inventories contribute to cost to organisation directly. All these costs contribute to financial performance organisations in terms of cost constituents as any variability in cost of material, services staff, warehouse space or any other service straight away impact its cost performance.

d. Revenue of Organisation
Revenue of organisation can be in terms of product supplies or services rendered. Revenue to organisation can be maximised by recognising revenue faster through improvement in product availability, escalating sales with reliable performance indicators, by having agile set up to handle demand fluctuations, retaining customer with continuous engagement with customer for problem solving and alignment of operations of individual functions with business operations. In order to understand how supply chain operations help to improve revenue of organisation of telecom sector respondents’ feedback was sought for the same. 73 per cent of respondents submit that supply chain of telecom sector impacts the revenue of any organisation to a major extent. Overall revenue of organisation get a weighted average score of 2.64 and come out number four sub factor getting impacted by supply chain of telecom sector.

e. Financial Performance Organisation
The financial performance of any organisation can be inferred from the financial results, which may be understood from its financial statements of profit and loss account and balance sheet. Factors such as return on investment (ROI), return on sales, profit margin, and contribution indicate the financial results of any organisation. In order to understand how supply chain operations help to improve financial performance of organisation of telecom sector respondents’ view point was sought for the same. 66 per cent of respondents submit that supply chain of telecom sector impacts the financial performance of any organisation to a major extent and another 29 per cent mentions that it impacts financial performance but not to major extent. Real impact on financial performance needs to be monitored by organisation at project level by establishing linkages of supply chain constituents with organisation performance.

f. Sales and Marketing Performance
Sales and marketing performance is likely to get impacted by supply chain of organisation because it helps to demonstrate delivery capability of any organisation and impacts sales growth, market share, overall competitive position, and overall product quality. The marketing efficiency of any organisation can be observed from the trends in its turnover and market share. Organisation having challenges in timely delivery of right product at right cost with right quality can get impacted by its sales and
marketing performance due to efficiency of supply chain in delivering goods. The factors for marketing performance are sales growth, market share, overall competitive position, and overall product quality. 41 per cent of respondents submit that supply chain of telecom sector impacts the sales and marketing performance to a major extent and another 43 per cent mention that it impact sales and marketing performance but not to major extent. In case organisation are not able to deliver the goods timely to customer due to inefficiencies in its supply chain, sales and marketing performance shall be impacted due to these inefficiencies of supply chain in delivering goods.

Based on percentage score obtained for respondents feedback as detailed above, it is clear that majority of respondents submit that supply chain impact these parameters of operations to major extent such as 84 per cent for project performance, 80 per cent for customer satisfaction, 74 per cent for project cost and revenue, and 66 per cent overall financial performance. Based on above findings of significant impact of supply chain operations on six parameters of operational performance hypothesis is rejected as hence it is found that that there is significant impact between supply chain operations and operational performance of organisation. So in order to improve the operational performance in terms of these sub-factors of operational performance, it is must that supply chain operations needs to be worked upon in respective organisations to improve the competitiveness of organisational performance.

7. Conclusion and the Way Forward
The study was set out to review supply chain operations and organisational performance in telecom industry and aimed to review various factors of supply chain impacting performance on organisation level in telecom sector. The study sought to evaluate its hypotheses that there is significant impact between supply chain operations and operational performance of organisation in telecom sector of India. Majority of respondents agree that supply chain operations impact operational performance of organisation in terms of performance parameters of project performance, financial performance, sales and marketing performance and customer satisfaction. As a result of the study it is found that supply chain operations impact these performance parameters to major extent hence the null hypothesis is rejected. Ratios to which these supply chain parameters impact factors of operational performance may vary across organisation in sector. With development of linkage matrix it is possible for organisation to clearly establish impact on operational performance from supply chain of organisation and define their goals / strategy for supply chain operations to optimise performance and its alignment with business strategy.

The telecom sector in India will continue to add considerably to the development of the economy. With the surge of new technologies, inclination has moved from speech based services to data based services and same is driving the development of mobile communication to new horizons. While the assessments of influence of development of telecom on a nation’s economy may differ from multiple studies being a fast dynamic sector but all studies zeroed on the element that telecom sector is the important infrastructure sector having substantial influence on supplementary sectors and driving the economic growth through ripple effect. To grow into a potent strength in the international telecom universe, country necessities to construct responsive and trim processes to build globally competitive supply chain across the telecom sector. As processes in value chain acquires alterations for betterment and become proficient, an exceptional influence on the telecom sector and the Indian economy would be obvious.

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