Mobile Telephony in India

Towards a Sustainable Innovation Economy

Broadband India Forum
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THOUGHT ARBITRAGE
Bridging the thought divide

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About This Report

This research is jointly conducted by Indian Institute of Management, Calcutta, Broadband India Forum (BIF) with Thought Arbitrage Research Institute (TARI) as the lead author as an effort towards understanding the challenges facing the mobile telephony sector especially the mobile manufacturing segment in relation to intellectual property and its effect on costs, outflows and price from a macro, producers, consumer and other stakeholders' perspective.

Project Partners

Thought Arbitrage Research Institute (www.tari.co.in) is a not for profit organisation set up under Section 25 of the Indian Companies Act, 1956 to bridge the gap between policy initiatives and common perception through evidence based research and comprehensive data based reasoning. TARI is privately funded, independent and non-partisan Indian think-tank and works with government, industry, civil society and other stakeholders on corporate governance, sustainability, economics and public policy.

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Foreword

The importance of mobile telephony in the Government of India's economic growth plans and in creating social equity is underscored by recent policy initiatives such as Make in India that have laid a strong emphasis on mobile manufacturing in the country.

This report is BIF's contribution to the debate on improving the state of domestic mobile industry. The report offers new insights into how we can achieve sustainable growth in the sector, which faces an influx of some foreign manufacturers. The domestic mobile phone economy faces the challenge of low innovation marked by marginal R&D spending. There is also the fear of intellectual property violations putting future innovation at risk.

The report takes a balanced approach to looking into the pertinent issues facing mobile telephony sector in India. I thank the industry experts who have given their perspectives and helped in analysing the factors involved in development of this sector.

My special thanks to Thought Arbitrage Research Institute and Indian Institute of Management, Calcutta for bringing out this study, which we feel will substantially add value to debates around the growth of domestic mobile telephony economy and ways to make it innovative and sustainable.

T. V. Ramachandran
President, Broadband India Forum

Preface

Mobile telephony is one of India's fine success stories of the post-liberalisation era. Unlike some other industries which were in a similar development path but could not leverage the potential the market offered, mobile telephony paved way for the emergence of a strong domestic industry. The phenomenal growth of the mobile telephony industry has been marked by a period of sustained technological innovation.

The development of the sector was backed by the exponential growth of telecom technologies. The growth of mobile generation technologies, namely, 2G, 3G and 4G—have made mobiles cheaper and of greater value. Mobile telephony in India offers a world of economic opportunities. The report draws a linkage with the economic potential of the mobile telephony sector. The mobile manufacturing segment, which is heavily import dependent, faces the problem of marginal innovation by domestic manufacturers. The fast spread of the market share of Chinese phones makes matter worse for the domestic phone industry, especially in the smartphone segment, where the Chinese mobile brands are increasingly dominant.

Technology comes at the heart of the mobile phone industry. Its potential can be fully realised only when we invest in the technologies ourselves. Respecting the Intellectual Property Rights is essential to sustained innovation. The increase in the number of litigations on use of essential technologies in mobile phones builds an environment of uncertainty around technology availability and utilisation.

At the heart of the debate lies the question of royalty payment on use of patents considered essential to a mobile technology, commonly Standard Essential Patents (SEPs), by mobile manufacturers/ resellers. It is necessary that policy prerogatives are based on evidence-based analysis and takes account of the market realities. The report takes a look at these issues based on available evidences.

Domestic mobile manufacturing industry faces the problem of a lack of innovation focus, as seen in terms of its poor investment in R&D over the years. The vulnerability comes from a rapid advent of Chinese mobile phone manufacturers. This threat can be dealt with through technology upgradation. Given the poor state of innovation of the domestic mobile manufacturers, reliance on globally recognised technologies cannot be done without. The mobile telephony sector has the right inputs to propel itself into a high growth trajectory– a young and aspirational population, growing demand for goods and services, a vibrant democracy ensuring rounded development. It is important that we take initiate positive steps to make India a global force in the mobile manufacturing segment.

We hope that this study will result in a fruitful dialogue among different stakeholders.

Kaushik Dutta
Director, Thought Arbitrage Research Institute

Contents

Abbreviations

3GPP
3rd Generation Partnership Project

BRICS
Brazil, Russia, India, China and South Africa

CAGR
Compound Annual Growth Rate

C-DOT
Center for Development of Telematics

DEITY
Department of Electronics and Information Technology

DIPP
Department of Industrial Policy & Promotion

EDGE
Enhanced Data GSM Environment

FRAND
Fair, reasonable and non-discriminatory

FTTF
Fast Track Task Force

GDP
Gross Domestic Product

GPRS
General Packet Radio Service

GSM
Global System for Mobile Communications

ICT
Information and Communication Technology

IoT
Internet of Things

ITI
Indian Telephone Industries

LTE
Long-Term Evolution

IPO
Indian Patent Office

MOSPI
Ministry of Statistics and Programme Implementation

MVA
Manufacturing Value Added

NSSO
National Sample Survey Organisation

OEM
Original Equipment Manufacturing

ODM
Original Design Manufacturing

SDP
State Domestic Product

SEP
Standard Essential Patent

SMS
Short Message Service

TRAI
Telecom Regulatory Authority of India

TSDSI
Telecommunications Standards Development Society, India

UMTS
Universal Mobile Telecommunications System

WCDMA
Wideband Code Division Multiple Access

Executive Summary

Mobile Telephony: An Economic Growth Accelerator

Mobile telephony in the contemporary structure of the world order consists of the wheels on which an economy continues to run and accelerate. It is the backbone of the digital infrastructure—connecting and binding people in the country and beyond its borders.

India is witness to a telecom revolution which began after the economic liberalisation of the early 90s, a sector which continues to contribute to the country's economic prosperity. The volumes of mobile handsets in India have grown much faster (14.1%) in the last five years as compared to the global growth of 4.1%. As a result, India's share in the global market has increased from 11.6% in 2011 to 14% in 2015.[1]

The importance of mobile telephony in the Government's economic growth plans and in creating social equity can be underscored by recent policy initiatives such as Make in India that has laid a strong emphasis on mobile manufacturing in the country.

The study looks at the sector from the prism of these policy goals to assess whether the Make in India initiative in this sector is a success. Towards this, we analyse the economic and social potential of the mobile manufacturing sector and assess its preparedness to support Make in India.

Mobile Telephony's Contribution to India's Economic Prosperity

The total direct economic contribution of the mobile telephony to the Indian economy is estimated to be ₹2,520 billion, which is about 1.75% of the Indian GDP for the year 2015.[2] Linkage with a host of other industries leads to indirect and induced effects on the economy, which we measure by using the 'Input-Output (I-O) Analysis' methodology developed by Nobel laureate, economist Wassily Leontief. As per our analysis, the output multiplier results are:

Input-Output (I-O) Analysis	Mobile and Tele-communication equipment
Output Multiplier	2.82
Value-added Multiplier	5.89
Employment Multiplier	4.08

Source: MOSPI, NSSO Input-Output Tables, TARI Calculations

The mobile telephony industry currently contributes a total of 6.5% of India's GDP including direct, indirect and induced effects—contribution amounting to more than 9,000 billion.[3] The mobile telephony industry is expected to grow faster than the economy as a whole and contribute to 8.2% of India's GDP and is expected to create employment for an additional 4.77 million people till 2022.[4] That is more than double the existing employment in the sector.

Out of this, the manufacturing sector (including mobile handset and telecommunication equipment manufacturing) is expected to provide employment to 2.3 million people, that is, nearly half of the expected additional employment, in the next five years under the impetus of the Make in India programme. Mobile phones with a manufacturing value added (MVA) of 18.3% and corresponding value addition multiplier effect of 5.89 implies that the total value addition to the economy due to increase in demand for mobiles will be significant. Hence, mobile phones require greater attention under "Make in India" to increase the contribution of the manufacturing sector to the GDP.

[1] Manufacturing/ Assembly of Mobile Phones, Electronics and Hardware, Government of Gujarat, https://vibrantgujarat.com/writereaddata/images/pdf/project-profiles/Mobile-Phones.pdf
[2] The Mobile Economy: India 2016', GSMA
[3] The Mobile Economy: India 2016', GSMA
[4] DIPP (2016). Telecommunications Sector, Achievement Report. Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, 24th November 2016; Skill Plan of Department of Telecommunications, Available at: http://www.dot.gov.in/sites/default/files/Skill%20Plan%20of%20Department%20of%20Telecom.pdf

Innovations and Growth of Mobile Telephony

Innovation and development of technology has helped make giant strides in the field of mobile phones. The growth of the mobile telephony industry has followed the path of the evolutionary standards—2G, 3G and 4G. The improvements in mobile telephony standards from 2G in the early 1990s through the current 4G have been more than incremental, with each generation providing dramatic performance improvements in transmission capacity, service quality, congestion management, cell handover and signal quality.

Mobile technology standards have acted as technology enablers to make mobile phones interoperable. Standards are necessary not only to reap economies of scale and scope, but also to reduce transaction costs and to prevent a duplication of efforts. By freezing a given technology, standards are supposed to provide stability for industry.[5] This provides assurance to the manufacturers on the quality of their product that further drives demand.

Development of standards is a long-drawn-out process involving a significant amount of time and effort from various stakeholders. The standards development process for 2G, 3G and 4G required the participation of hundreds of companies from all over the world. The 4G (Long-Term Evolution LTE) standard releases took more than nine years involving 320 companies from 43 countries, and more than 1 million-person[6] hours and still counting.

The number of mobile subscribers has grown exponentially with the emergence of new mobile telephony standards. In particular, 2G and 3G mobile technology standards have changed the way people communicate. India has benefited from the evolution of these standards over the last two decades. NITI Aayog, the Government of India's policy think tank[7], attributed India's growth in mobile handset manufacturing to the adoption of these global standards.

Standardisation and Gains for Smartphone Economy

There exist two competing claims on standardisation gains. While popular opinion is consistent on the benefits of standardisation in terms of technology upgradation, there exists a belief that it is prone to abuse. At the core of this claim lies a theory which suggests that patent rights holders charge royalty disproportionate to their investments. On the contrary, innovators say that mobile manufacturers routinely ignore royalty claims by the innovators and do not pay the legitimate royalty sum.

Between these competing claims, there is the consumer point of view. Like in any market, consumers look for three things while making a purchase decision: quality, affordability and utility.

Smartphone economy has gained significantly from standardisation of mobile technologies which can be understood from three key factors:

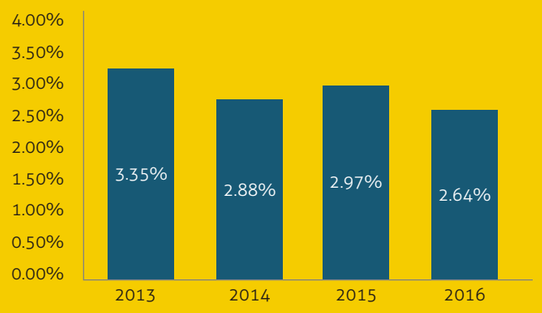
- **Reduction in average selling price of a smartphone:** Different market estimates are consistent in their conclusion that the average selling price of a smartphone in India has come down in the last six years.
- **Higher growth in smartphone sales:** Smartphone shipments in India have grown at 61% between 2014 and 2016, as compared to 20% growth globally.[8]
- **Smartphone market competition:** The mobile manufacturing market is an intensely competitive sector. It has witnessed the emergence of Chinese firms in the last five years, which have captured a significant pie of the market.

Royalty Yield – Too Little or Too High

Mobile technology innovators, who are also the Standard-Essential Patent (SEP) owners, have often held the view that they do not make sufficient economic gains for their investments in research and development (R&D). On the contrary, mobile manufacturers state that the royalty claims on use of licensed technologies is too high. The study estimated the royalty yield by analysing the IPR revenues (earnings from IPRs in their annual report/filings) of 10 global companies, which includes major mobile technology innovators and licensors as a percentage of the mobile sales in the global settings.

[5] Standards, innovation, and latecomer economic development: Conceptual issues and policy challenges Ernst, Dieter, Lee, Heejin, Kwak, Jooyoung, http://dx.doi.org/10.1016/j.telpol.2014.09.009
[6] The Boston Consulting Group: *The Mobile Revolution, How Mobile Technologies Drive a Trillion-Dollar Impact* (January 2015).
[7] Make in India Strategy for Electronic Products, NITI Aayog, Government of India, May 2016.
[8] Indian Cellular Association

Royalty Yield As % Global Smartphone Sale value



Source: Company Financials, GfK, TARI Analysis

The royalty yield of the 10 selected companies is in the range of 3.35% to 2.64% and shows a declining trend between years 2013 and 2016 suggesting that the royalty revenue of license holders has remained stagnant but smartphone sales in volume and value have increased over the years.

R&D expenditure of the mobile license holders is in the range of 10.3% and 35.8% of their total revenue with a median of 21.9%, which is among the highest when compared with other industries.

Cost and Sustainability of Mobile Innovation

Standardisation and innovation have been the cornerstones of the sustained growth momentum of the mobile telephony in the last three decades. With 5G and concepts of Internet of Things (IoT) and smart cities on the anvil, the need for sustained industry effort is required.

Royalty gives innovators a fair share for the efforts they put into the development of a standard. A critical question often raised is that the holders of SEPs earn too high a patent royalty at the cost of mobile manufacturers, thus making mobile phone manufacturing an unsustainable business. This report analysed the financial position of seven key Indian mobile manufacturers to assess different business aspects.

Innovation and Royalty Payment
Out of seven domestic mobile manufacturers considered for our analysis, only two companies reported some expenditure on research and development (R&D). R&D cost (as a percentage of revenue) is virtually non-existent for six companies, and only one company has reported R&D cost with maximum value of 0.1% of mobile revenues in 2016.

Only three companies have reported royalty payment which, as a percentage of mobile sales revenue, stands in the range of 0.03% to 2.2% (2014-2016). The highest value is not more than 1.3% for any company in 2016.

Most Indian companies have not reported royalty payments for the years under review.

Profitability and Discretionary Expenditure

- Median gross and operating margins for domestic entities have marginally come down between 2014 and 2016; however, they still reflect a healthy status.
- Gross margin for these seven mobile manufacturing companies during the years between 2014 and 2016 is in the range of 13.5% and 27.3%.
- Operating margin for these seven mobile manufacturing companies during the years between 2014 and 2016 is in the range of 11.5% and 24.7%.
- During the financial years 2014-2016, median advertisement and promotional expenditure domestic (as percentage of their total revenue) by mobile manufacturing companies ranges between 3.0% and 3.8%.
- The Indian companies have a significant discretionary spend for advertisement and sales promotion accounting for about 3.3% of their revenues which includes endorsements by celebrities, cricket and sports, tournaments and other high cost spends.

Do domestic companies have the ability to pay royalty?
Standardisation does not appear to have negatively impacted the average Indian mobile manufacturer. On the demand side, standardisation has made smartphones more popular, primarily because of their falling average selling prices. The average Indian buyer of a smartphone, which is fast transcending towards higher specification smartphones, is likely to drive demand. Indian mobile manufacturers have maintained a healthy gross margin in the last three years. Contrary to the belief that the mobile industry is not financially healthy, evidence suggests that a majority of Indian mobile manufacturers/re-sellers are doing well financially. Mobile manufacturers' claims that they do not have the ability to pay because of market conditions do not appear to be true, especially when their discretionary spending has consistently increased.

Innovation, IPR and Make in India

Mobile telephony in India is anticipated to increase swiftly in the coming years. The growth drivers inter alia include scope for increased consumer base as unique mobile subscription is only about 47% of the population; changing consumer preferencewith rising incomes, consumers are willing to spend more on mobile phones and replacement cycles of phones are getting shorter.

The mobile telephony growth in the country, however, has largely been driven and is currently dependent upon imports. The share of mobile and other telecommunications equipment in the country's total import basket is continually increasing and currently stands at 26.4%. The share of Chinese products in this basket is continually rising and its share has increased from 64.3% in 2012-13 to 69.4% in 2016-17.

The manufacturing value added (MVA) by Indian manufacturers, either OEMs or ODMs, is relatively small due to high dependence on imported components and completely built up phones. Considering increase in mobile penetration from current levels and large dependency on imports, mobile and telecommunications equipment is crucial under the Government of India's Make in India initiative.

A Fast Track Task Force (FTTF) has been formed to 'catalyze and re-establish' significant growth in mobile handsets and the component manufacturing ecosystem in India. It is expected to promote large-scale manufacturing/assembling activity to achieve production of 500 million mobile handsets by 2019. India has already achieved the benchmark of 100 million units, which is a step towards achieving the target and establishing India as a manufacturing hub.

NITI Aayog points out that OEMs or ODMs or component/accessories suppliers are still in infancy in India and most of it is confined to last mile assembly indicating that the industry remains in the early stages of development. The domestic mobile manufacturers are largely reliant upon the innovations and standards set up by the international players and organisations.

By investing in research and development, India can increase innovations and also develop standards in mobile telephony. The Government of India on 12th May 2016 has adopted National IPR Policy 2016 which aims to make Indians recognize their own IPs, as also respect others' IPs.

The Indian mobile phone industry has some distance to cover with respect to establishing an innovation framework and contributing to the global standardisation process. But before we reach that stage, we need to have a business-friendly ecosystem. The incentives and policies of the Government under the Make in India initiative will enable establishing such eco-system in the country. This will allow us to reap the benefits of standards and at the same time help the country to reduce cash outflow due to large imports.

There is no unanimity in the views expressed by agencies and courts over what is reasonable when it comes to determining royalty rates on SEPs. There has been a tendency among courts to fall back on comparable rates to determine what would be a "reasonable rate". There is limited guidance on how a free market determines licensing rates on SEPs. It is widely acknowledged that it is common industry practice to use the end-used device as a royalty base. However, there should be no room for abuse. A decision on what is a "reasonable royalty" should be market determined and in case of a dispute, judicially considered.

1.

Mobile Telephony: An Engine of Growth of Indian Economy

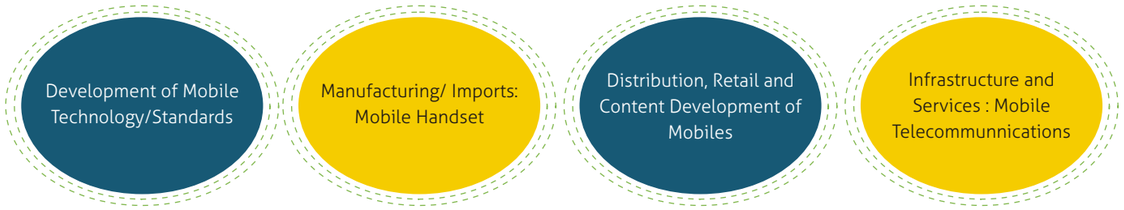
Since the first mobile call in 1995, the mobile telephony sector in India has come a long way. This section looks at the contribution of mobile telephony to the country's economy and examines its causal relationship with the country's economic prosperity.

> Mobile telephony is the backbone of the digital infrastructure—connecting and binding people in the country and beyond its orders.

Mobile Telephony: An Economic Growth Accelerator

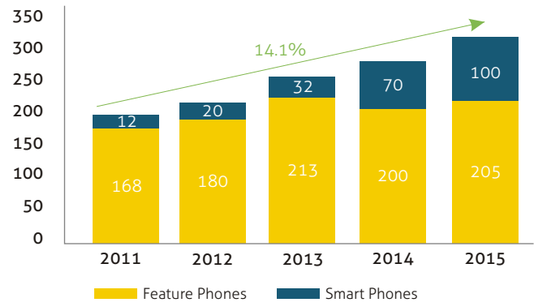
Mobile telephony in the contemporary structure of the world order consists of the wheels on which an economy continues to run and accelerate. It is the backbone of the digital infrastructure—connecting and binding people in the country and beyond its orders. Mobile telephony is also highly innovative where fast innovations take place that continually change the manner and mechanism of communication whether people use their mobile handset as a standalone phone or as an integrated smart device.

The mobile telephony ecosystem has four important players that drive the underlying equations of change:



The Indian mobile handset market is a bright spot in the global mobile handset market, where volumes of mobile handsets have grown much faster (14.1%) in the last five years as compared to the global average of 4.1%. As a result, India's share in the global handset market has increased from 11.6% in 2011 to 14% in 2015.[9]

Growth of Mobile Phones (No's in Million)

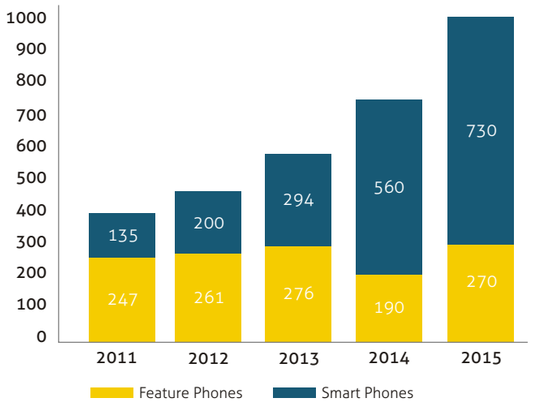


Source: Speeding ahead on the telecom and digital economy highway, EY 2015[10]

[9]Manufacturing/ Assembly of Mobile Phones, Electronics and Hardware, Government of Gujarat, https://vibrantgujarat.com/writereaddata/images/pdf/project-profiles/Mobile-Phones.pdf
[10]Manufacturing/ Assembly of Mobile Phones, Electronics and Hardware, Government of Gujrat, https://vibrantgujarat.com/writereaddata/images/pdf/project-profiles/Mobile-Phones.pdf

However, due to the low per capita income and economic inequalities, the Indian mobile market is predominantly occupied by the feature phones, which have around 68% share in number terms. Smartphones are gaining popularity and growing at a very fast rate as incomes are rising and also due to the cost of these phones coming down rapidly. In 2016, India overtook the United States to become the second largest global smartphone market in terms of users having a base of 275 million.[11]

Growth of Mobile Phone Market (₹ Billion)

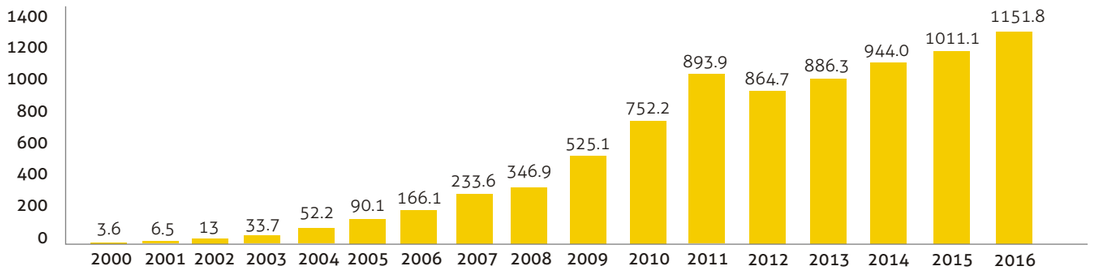


Source: Speeding ahead on the telecom and digital economy highway, EY 2015[12]

Mobile telephony in India has a fairy tale story that started in the late 90s. The industry witnessed an exponential growth over the years. In India, there are more than 1 billion mobile subscribers with mobile tele-density[13] being around 90 at the end of December 2016. The urban tele-density is 170.15 and rural tele-density is 53.27.[14]

> In 2016, India overtook the United States to become the second largest global smartphone market.

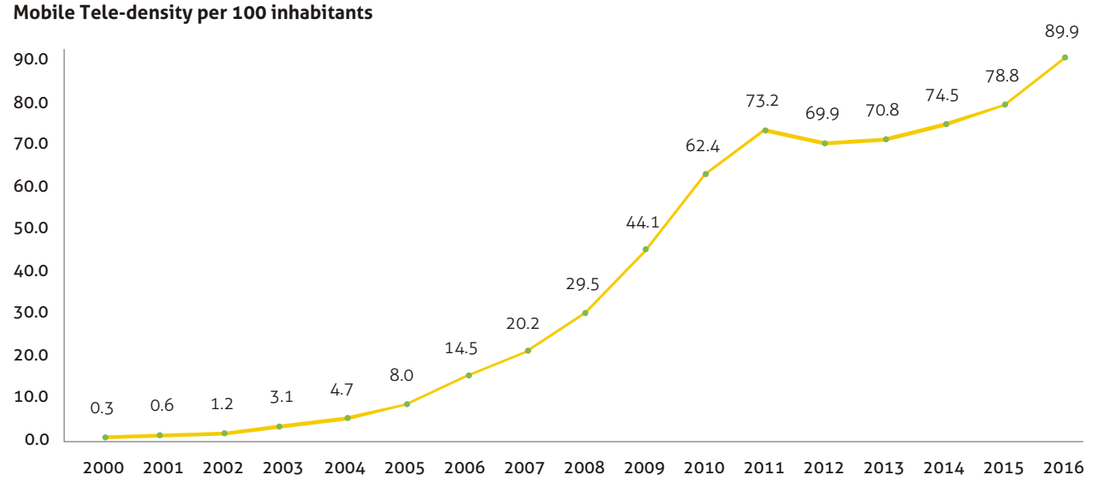
Mobile Subscriptions (in Million)



Source: Telecom Regulatory Authority of India (TRAI), Department of Telecommunications

[11]IIM B and Counterpoint Research (2016). Maximizing Local Value Addition in Indian Mobile Manufacturing: A Practical Approach. IIM B- WP 528, November 2016; The Mobile Economy: India 2016', GSMA
[12]Manufacturing/ Assembly of Mobile Phones, Electronics and Hardware, Government of Gujrat, https://vibrantgujarat.com/writereaddata/images/pdf/project-profiles/Mobile-Phones.pdf
[13]Tele-density is the number of telephone connections for every hundred individuals living within an area.
[14]The Indian Telecom Services Performance Indicators October December, 2016, TRAI; http://www.trai.gov.in/sites/default/files/Indicator_Reports_Dec_16_07042017.pdf

Mobile Tele-density per 100 inhabitants



Source: Telecom Regulatory Authority of India (TRAI), Department of Telecommunications

The growth of mobile telephony has favorably impacted the lives of ordinary citizens across India by placing in their hands the power of immediate communication, which was earlier denied to them due to low outreach of the fixed-line phones.

Many studies co-relate the proliferation of mobile services in a country to increased economic activity, creation of employment and rise in the income levels of both individuals and companies. These studies empirically establish that mobile penetration increases economic output. As per a World Bank study, for low and middle-income economies, 10% increase in mobile penetration can lead to additional GDP growth of 0.81%.[15]

A detailed India-specific study conducted by ICRIER, a Government of India accredited think tank, points to an even stronger relationship between State Domestic Product (SDP) and mobile tele-density. According to the study, higher mobile tele-density leads to faster growth of states, with the growth rate being 1.2 percentage points greater for every 10% increase in the mobile tele-density. Another key finding of the study was that if there was a gap among penetrations in various states, the states with lower penetration would suffer lower growth rates.[16]

India had a unique penetration[17] rate of about 47% at end of 2015 which is below the regional average of Asia-Pacific of 62% at the end of 2015.[18] This underscores the need for greater subscriber penetration rate, which will increase inter-connection between people.

The unique mobile subscriber base was around 615 million at the end of 2015, and it is expected to add another 330 million unique mobile subscribers by 2020, leading unique penetration to the level of 68% with mobile tele-density of 101%. This is because of improved affordability of mobile services, decrease in mobile phone prices and better network coverage.[19]

A greater unique subscriber penetration rate will increase the economic activity and productivity of the country. The increasing penetration of mobile broadband, particularly 4G services, is reducing the digital divide and will bring greater connectivity and efficiency of the individuals, companies and government, propelling the economic growth of the country.

Contribution of Mobile Telephony to Indian Economy

The total direct economic contribution of the mobile telephony to Indian economy is estimated to be ₹2,570 billion, which is about 1.8% of the Indian GDP for the year 2015.[20]

[15]Kim, Y., Kelly, T. & Raja, S. (2010). Building broadband: Strategies and policies for the developing world. Global Information and Communication Technologies (GICT) Department, World Bank. January 2010.
[16]Kathuria, R. & Jaju, M.K (2011). India: The impact of Internet.
[17]Unique penetration = unique subscription
[18]The Mobile Economy Asia-Pacific 2017, GSMA; The Mobile Economy: India 2016', GSMA
[19]The Mobile Economy: India 2015', GSMA
[20]The Mobile Economy: India 2016', GSMA

Direct Contribution of Mobile Telephony to Indian Economy

Mobile Ecosystem	Contribution to GDP (₹ Billion)	Contribution to GDP (%)
Mobile Handset Manufacturers	170	0.12
Mobile Distributors, Retailers and Content developers	780	0.54
Mobile Infrastructure and Services	1570	1.09

Source: MOSPI, ASI & GSMA Report 2016

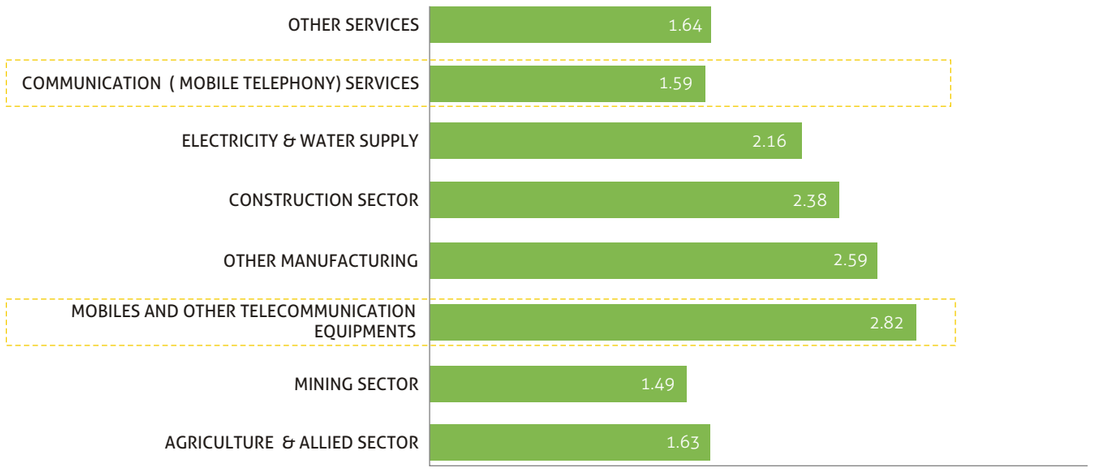
The total economic contribution of the industry due to its linkages to other industries is significantly larger causing a high multiplier effect on the economy due to its direct, indirect and induced effects on other sectors of the economy.

Multiplier effect, a scientific and widely used method involving the **"Input-Output Table"** established by Leontief, has been used based on the input-output tables of NSSO, Ministry of Statistics and Programme Implementation (MOSPI), Government of India.

The estimated output multiplier of the mobile and telecommunication communication equipment is 2.82, which implies that an increase of ₹1 in the final demand in the communication equipment will lead to an increase in the overall output of the economy by about 2.82 times. The output multiplier effect of communication services is 1.59, which is lower than mobile and other communication equipment that drives higher economic activities than the end of chain of consumption of services.

(Refer Annexure – I for detailed methodology on multiplier estimation)

Output Multipler Effect (per 1₹)



Source: MOSPI, NSSO Input-Output Tables, TARI Calculations

With an increased demand, employment and income rise, which leads to rise in spending power and hence, consumption culminating into demand for other related segments, say consumer goods. The industry has a multiplier effect on other business, generating sales and economic value added for other sectors and industries.

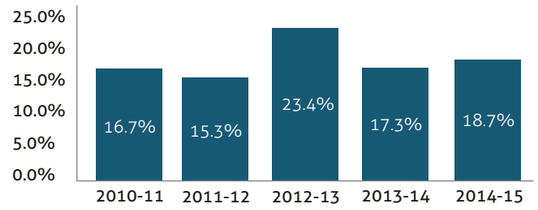
Mobile telephony also has a significant efficiency and productivity impact on individuals, industry and services sectors and Government. Widespread adoption of the mobiles particularly through smartphones with mobile broadband in the areas ranging from digital financial inclusion, e-commerce, mobile banking, e-governance, agriculture, and healthcare and educational services is bringing radical changes in outreach and improvement of services.

The mobile telephony industry is responsible for a total of 6.5% of India's GDP, a contribution that amounts to more than ₹9,000 billion. The figure accounts for both direct and indirect economic activity generated by the entire mobile industry ecosystem.[21]

Faster economic growth rests on high productivity activities and value addition in the manufacturing process is a key factor to drive such productivity.[22] Manufacturing value added (MVA) is the net output of a sector and is calculated by adding all output and subtracting intermediate input from it, but without deducting depreciation of fabricated assets. It reflects the value additions that an industry makes. A higher value addition to output ratio indicates: high final usage of the industry's product and higher investment flows to the industry.

The average MVA in the mobile telecommunication equipment including mobile phones for the last five years is 18.3%, which is higher than the average for the manufacturing industry, which has a MVA of 14%.[23] The MVA of industry in recent years has increased and can further be enhanced with the Government's focus on "Make in India".

Manufacturing Value Added

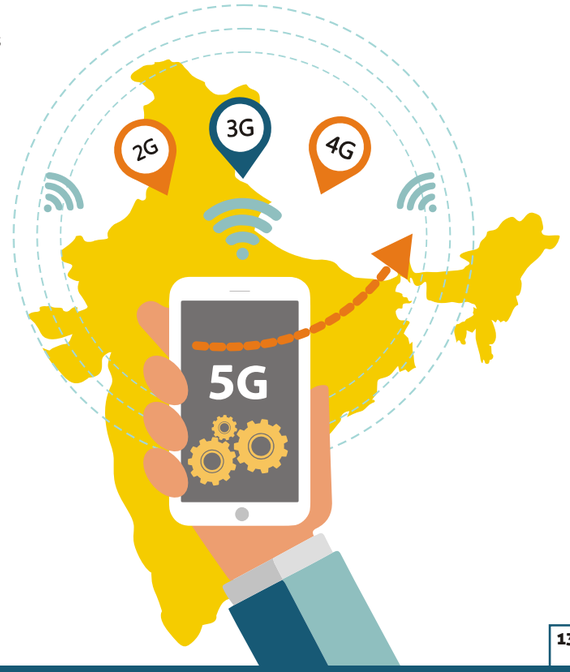


Source: Annual Survey of Industry, MOSPI

Value addition/income generation is a productivity metric that measures the relative contribution of a sector. It accounts for the amount of goods and services that have been produced, less the cost of all inputs and raw materials that are directly attributable to that production.

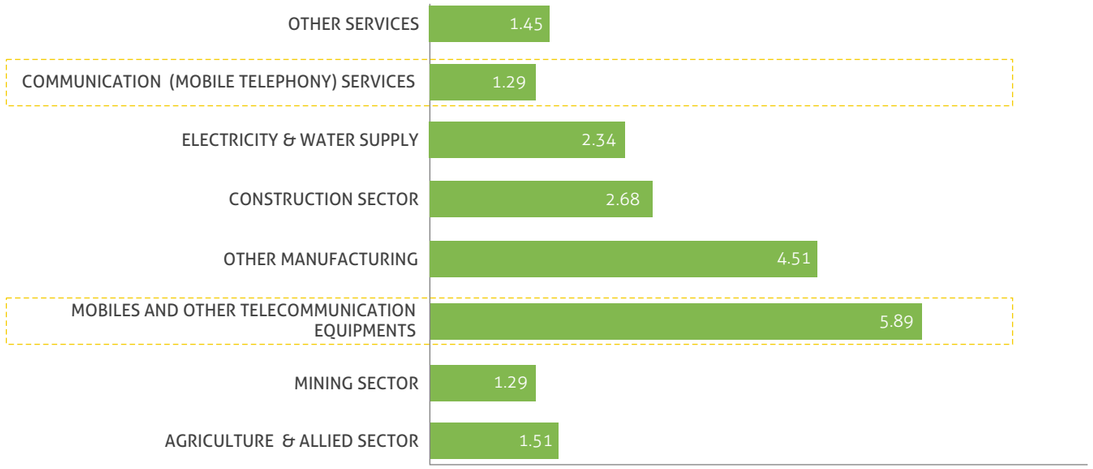
The estimated value-added multiplier of the mobile and other communication equipment is 5.89, which means that value added to the economy because of a ₹1 rise in demand from the industry is almost 5.89 times the value added in the industry itself.

The growth of the mobile handset market will have a direct impact on the increase in mobile communication services. The value multiplier effect of the communication services is estimated to be 1.29.



[21]The Mobile Economy: India 2016', GSMA
[22]Make in India. (2015). TARI and ASSOCHAM
[23]Annual Survey of Industries, MOSPI

Value Added Multipler Effect (Per 1₹)



Source: MOSPI, NSSO Input-Output Tables, TARI Calculations

Mobile phones have a MVA of 18.3% and corresponding multiplier effect of 5.89, which is the highest in comparison to other sectors of the economy. This implies that the total value addition to the economy due to the increase in demand for mobiles will be significant. Hence, mobile phones require greater attention under "Make in India" to increase the contribution of the manufacturing sector to the GDP.

Contribution to Employment

The entire mobile telephony industry in 2016-17 is estimated to employ over 4 million people with greater than 3 million people involved in the distribution, retail, content and services sector. According to a Skill Plan report of the Department of Telecommunications, the mobile telephony industry is expected to employ an additional 4.77 million people in the next five years.

Employment in the Mobile Telephony Industry (in Million)

Sectors	2016-17	2021-22	Requirement
Mobile Handset Manufacturing	0.20	1.70	1.50
Telecom Equipment Manufacturer	0.58	1.38	0.80
Distribution, Retail and Content Development	1.65	2.80	1.14
Infrastructure and Service Provider	1.57	2.90	1.33
Total	**4.00**	**8.78**	**4.77**

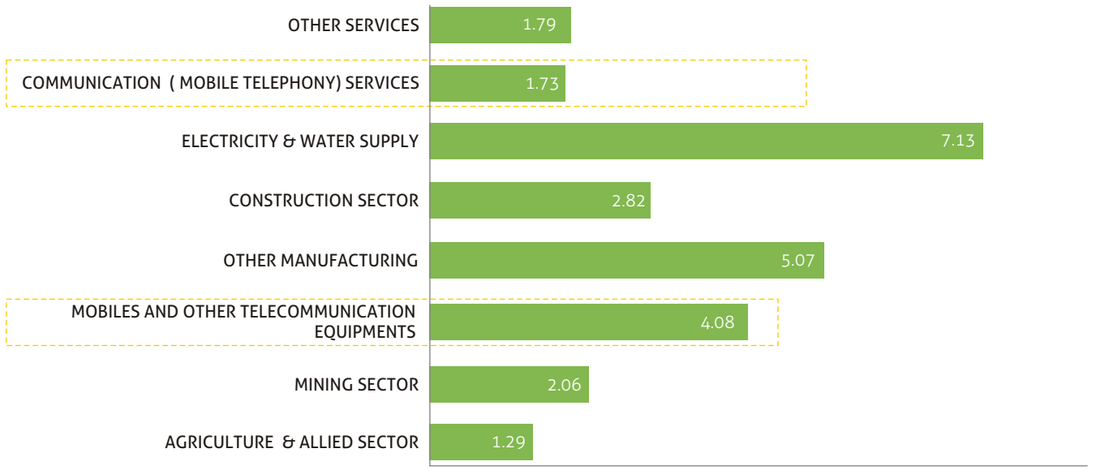
Source: : Skill Plan of Department of Telecommunications[24]

[24]Skill Plan of Department of Telecommunications, Available at: http://www.dot.gov.in/sites/default/files/Skill%20Plan%20of%20Department%20of%20Telecom.pdf

Under the impetus of the "Make in India" programme, the mobile handset and telecom equipment manufacturing industry in the country has attained significant attention, attracting a number of domestic and international businesses to start manufacturing facilities. Mobile handsets and the manufacture of their accessories are expected to create 1.5 million jobs in the country in the next five years.

An employment multiplier is one of the measures used to determine the impact a particular industry will have upon a municipality when it arrives or withdraws. In its simplest terms, the employment multiplier measures the amount of direct, indirect and induced jobs created in an area.

Employment Multipler (Per 1₹)



Source: MOSPI, NSSO Input-Output Tables, TARI Calculations

The estimated employment multiplier of the mobile phone industry based on this methodology[25] is 4.08 which implies that total employment generated in the economy because of a rise of ₹1 in demand of the industry is roughly 4.08 times the employment created within the industry.

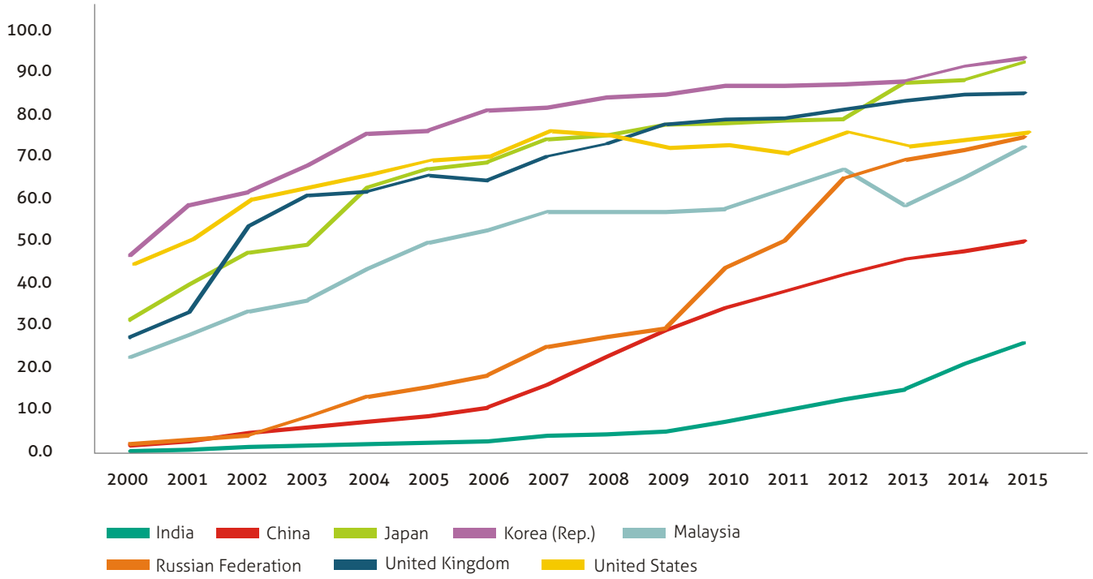
The mobile telephony industry is expected to grow faster than the economy as whole and contribute to 8.2% of India's GDP and create employment for an additional 4.77 million people.[26] Out of this, the manufacturing sector (including mobile handset and telecommunication equipment manufacturing) is expected to contribute employment for 2.3 million people, that is, nearly half of the expected additional employment, in the next five years under the impetus of the Make in India programme.

[25]Refer Annexure -1 for detailed methodology
[26]DIPP (2016). Telecommunications Sector, Achievement Report. Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, 24th November 2016; Skill Plan of Department of Telecommunications, Available at: http://www.dot.gov.in/sites/default/files/Skill%20Plan%20of%20Department%20of%20Telecom.pdf

Mobile Telephony: Enabler of Digital Infrastructure

According to the Global Competitiveness Report 2014-2015; India ranks low among the 12 pillars in technological readiness Index (121st) and is one of the world's least digitally connected countries, adversely affecting its ability to be globally competitive.[27]

Internet Penetration within Population (%)



Source: World Bank Database

India has an internet penetration rate of 27%, which is very low in comparison to its global peers, and only about 15% of the population has regular internet connectivity.[28] Mobile broadband in India remains the privilege of a few, with only 5.5 subscriptions for every 100 people. Compared to the BRICS countries and the USA, India's internet penetration still hovers at a low level. Kucera and Roncolato[29] concluded that "advanced services and IT in particular can be a leading complement to manufacturing and to other sectors in the process of economic development."

[27]Global Competitiveness report 2014-15, World Economic Forum (WEF).
[28]World Bank database & Global Competitiveness report 2014-15, World Economic Forum (WEF).
[29]Roncolato, L.; Kucera, D. 2013. "Structural drivers of productivity and employment growth: a decomposition analysis for 81 countries", in Cambridge Journal of Economics, doi: 10.1093/cje/bet044

The Indian government has recognized the potential of digital technologies to address some of the socio-economic challenges in the country with the launch of its Digital India initiative. The Government looks to empower every citizen of the country by making broadband a utility and providing them internet access.

International Telecommunications Union 2016 report on ICT development index points out that more than 40% of the population of India still does not own a mobile phone. There is lack of mobile ownership seen in the lower income category, among those who are not educated and those living in rural areas. Lack of adequate alternative (fixed) infrastructure has resulted in the decline of fixed line telephone subscribers in India, and now only two people in a hundred have a landline.[30]

Increasing the mobile penetration to the untapped population is essential for the success of the Digital India initiative.

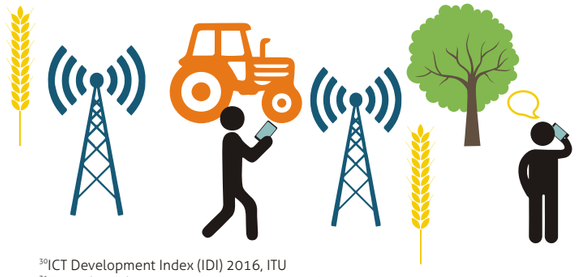
Decline in mobile broadband data prices and increasing availability of affordable smartphones will further increase the penetration of the internet to all citizens of the country. Higher speed mobile broadband through adoption of 4G technology will enable a smartphone user to have feature-rich content and value-added services.[31]

Mobile telephony has helped the Government in the financial inclusion and increased digital transactions. It has enabled the Government to identify the people, digitally connect with the people and reduced the leaks in implementing the programmes.

Mobile Phones as Interface for Financial Inclusion

Phase	Project	Functionality	Result
Identity	Aadhaar Card	Single digital identification and eKYC	1.15 billion cards generated resulting in weeding of duplicate accounts
Banking	Jan Dhan Yojana	Bank accounts linked with Aadhaar Card	Savings of ₹495.6 crore from direct benefit transfer (DBT)[32]
Mobile Services	Universal Payments Interface (UPI)	Mobile application of instant money transfer between bank account through phone number	49 banks, 9.16 million transactions, ₹27.65 billion value
	Bharat Interface for Money (BHIM)	Government App for UPI for payment using mobile number	14.54 million app downloads, 44 banks, 3.97 million volume, 13.07 billion value

Source: National Payments Corporation of India, ICICI Securities



The benefits from digital inclusion will increase with greater penetration of mobiles and usage of internet over mobiles. The GSMA report on India points out that by 2020, over 670 million of the population will be using mobile broadband on their phones and out of this about 280 million will have 4G services.[33]

[30]ICT Development Index (IDI) 2016, ITU
[31]GSMA (2016), The Mobile Economy India 2016.
[32]Remittances & DBT- Starting step towards rural financial inclusion', June 5-June 9, 2017, ICICI Securities
[33]GSMA (2016), The Mobile Economy India 2016

> Mobile applications can enable a very large section of the population to access services in the areas of agriculture, healthcare and education, which otherwise would not have been accessible to them.

Mobile telephony is the critical enabler and support for the Government in developing the digital infrastructure in the country, increasing the outreach of its services and programmes and effectively implementing them.

Mobile Telephony as Social Equity Accelerator

Greater penetration of mobile telephony in India will bring many socio-economic benefits. Mobile applications can enable a very large section of the population to access services in the areas of agriculture, healthcare and education, which otherwise would not have been accessible to them.

In agriculture, mobile applications can be used for improving crop yields and for greater information to get access to new markets. Smartphones with mobile broadband can be used as tools for increasing the outreach of educational services, fulfilling the objective of education for all. Another important area of usage includes the government services for citizens through e-platform on mobiles, where it can enable increase in outreach and dissemination of information on social schemes and empower citizens to protect rights that can result in reduced instances of corruption.[34]

Mobile Telephony in the Healthcare Sector

The Ministry of Health and Family Welfare (MoHFW) has launched four mobile health (mHealth) initiatives, three of which are **Kilkari, Mobile Academy and mCessation**. These initiatives were launched as a part of Government's Digital India Programme. The core of all these services is the use of mobile phone technology in order to strengthen these citizen-centric health services with an aim to prioritise public health by using India's expanding mobile phone penetration.

Kilkari initiative is an audio-based mobile service that delivers weekly messages to families about pregnancy, family planning, childbirth, nutrition and maternal and child care. These 72 audio messages will start from the second trimester of pregnancy and go on until the child is one year old. This service has been launched in Jharkhand, Odisha, Uttar Pradesh, Uttarakhand and the high priority districts of Madhya Pradesh and Rajasthan in the first phase.

Mobile Academy is a service which helps ASHAs in refreshing and reinforcing their existing knowledge of maternal and child behaviours. This is an anytime, anywhere audio course that can train hundreds of ASHAs simultaneously. ASHAs can access the 240-minute course via a **toll-free number, 1800-3010-1704**. This service has been launched in Jharkhand, Madhya Pradesh, Rajasthan and Uttarakhand in the first phase.

The **mCessation** programme is a service that aims to reach out to every person who is willing to quit tobacco. Any tobacco user can register by giving **a missed call on 011-22901701** or by registering on **http://www.nhp.gov.in/quit-tobacco** for e-registration. Thereafter, a two-way SMS process will begin.

[34] GSMA (2013). The Mobile Economy India 2013

Mobile Phones – Driving Startup India Programme

Entrepreneurship will play a crucial role in shaping India's future employment generation as the scope for the creation of new jobs in big industries is becoming limited due to technological improvement in the production process. Recent experiences in Indian economy also show that small and tiny enterprises are generating higher levels of employment. Herein lies the importance of a startup revolution, which has the potential to alter successfully the challenges to livelihood in the country, along with a structural change and balance in the business environment.[35]

> Startup India mobile app, an initiative of the Government of India, serves as a single e-platform for startups for interacting with government and regulatory institutions for business needs, and for information exchange among various stakeholders.

With the intention to build a strong eco-system for nurturing innovation and startups in the country, the Hon'ble Prime Minister launched Startup India Action Plan on January 16, 2016, in New Delhi. The Government, through this initiative, aims to empower startups to grow through innovation and design and to accelerate the spread of the startup movement.[36]

The Government of India under its ambitious Startup India initiative provides benefits such as self-certification for regulatory compliances, Startup India hubs for handholding of the startups and assisting the startups with specific focus on obtaining finance, feasibility testing, business structure advisory, marketing skills, technology commercialization and management evaluation along with providing incentives and benefits on tax and patents.

The Government of India, for the success of the Startup India initiative, and to provide on-the-go accessibility, introduced the Startup India mobile app to serve as a single e-platform for startups for interacting with government and regulatory institutions for business needs, and for information exchange among various stakeholders.[37]

Startup India Mobile App

The Startup India mobile app provides the following services to stakeholders:

- registering startups with relevant agencies of the government, by back-end integration with Ministry of Corporate Affairs and Registrar of Firms for smoother information exchange and processing of registration application
- tracking status of application, and anytime downloading of the registration certificate
- filing for compliances, and obtaining information on various clearances/approvals/registrations required
- collaborating with various ecosystem partners and stakeholders through the national platform provided by the app
- applying for various government schemes announced and undertaken by Startup India

[35] START-UP INDIA: Making India Stand Up (2016). ASSOCHAM and TARI
[36] http://startupindia.gov.in/status.php
[37] START-UP INDIA: Making India Stand Up (2016). ASSOCHAM and TARI

Mobile Telephony Enabling 'Make in India' Programme

The Make in India initiative was launched by the Prime Minister in September 2014 as part of a wider set of nation-building initiatives with the objective of transforming India into a global design and manufacturing hub.[38]

The Department of Industrial Policy & Promotion (DIPP) leveraged technology for the Make in India programme to build brand new infrastructure through mobiles that packed a wide array of information into a simple, sleek menu which had contents like key facts and figures, policies and initiatives of the Make in India programme and specific details about 25 sectors selected under the programme.[39]

Digital connectivity and infrastructure have a significant and sizable impact on all manufacturing industries. Mobile telephony encompassed technological changes and innovated itself not only to enhance the reliability and reduce the cost of communication but also to give new directions for enhancing productivity in other industries.

Empirical studies have shown that improvement in telecommunication services increases the productivity of the manufacturing sector. A World Bank study finds that a one-standard-deviation change in the telecommunications liberalization index corresponds to a 7.2% increase in productivity for domestic firms.[40] Another study finds that information and communication technology (ICT) has a positive and statistically significant impact on all manufacturing industries, in particular, Transport Equipment and Textiles, which show the highest sensitivity to ICT limitations (with an elasticity of 0.16 and 0.12 respectively).[41]

Mobile telephony, therefore, can be a significant enabler for the success of the Make in India programme for increasing its outreach and creating trust among the various stakeholders. It can be leveraged in a wide range of ICT applications such as intelligent transportation systems, mobile payments and digital signatures; e-government will improve ease of doing business and productivity of manufacturing firms.[42] This will improve India's ranking in the global competitiveness index and in making the country a global manufacturing hub as envisaged under the initiative.

[38]http://www.makeinindia.com/about
[39]*Ibid*
[40]Jens Matthias Arnold, Beata Javorcik, Molly Lipscomb, and Aaditya Mattoo. 2012. Services Reform and Manufacturing Performance: Evidence from India. World Bank, Policy Research Working Paper 5948
[41]Arup Mitra Chandan Sharma Marie-Ange Véganzonès Varoudakis. 2011.Total Factor Productivity and Technical Efficiency of Indian Manufacturing: The Role of Infrastructure and Information & Communication Technology
[42]Stephen Ezell and Robert Atkinson. 2014. The Indian Economy at a Crossroads. The Information Technology & Innovation Foundation (ITIF).

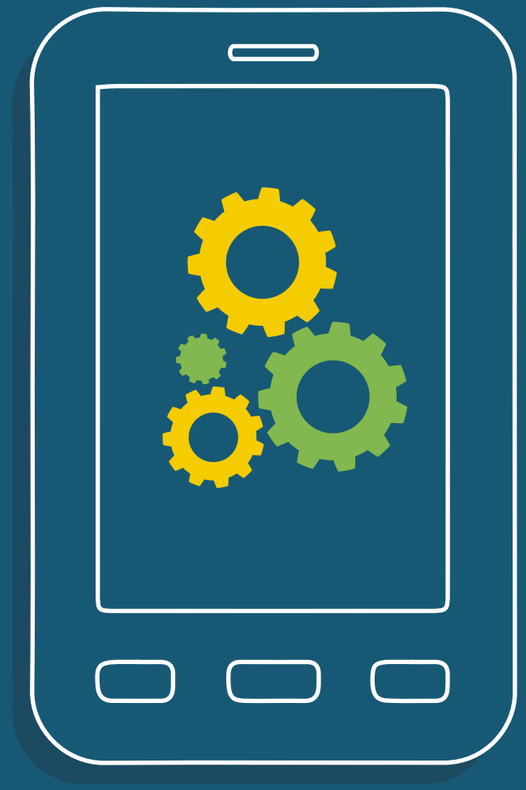
Key Highlights

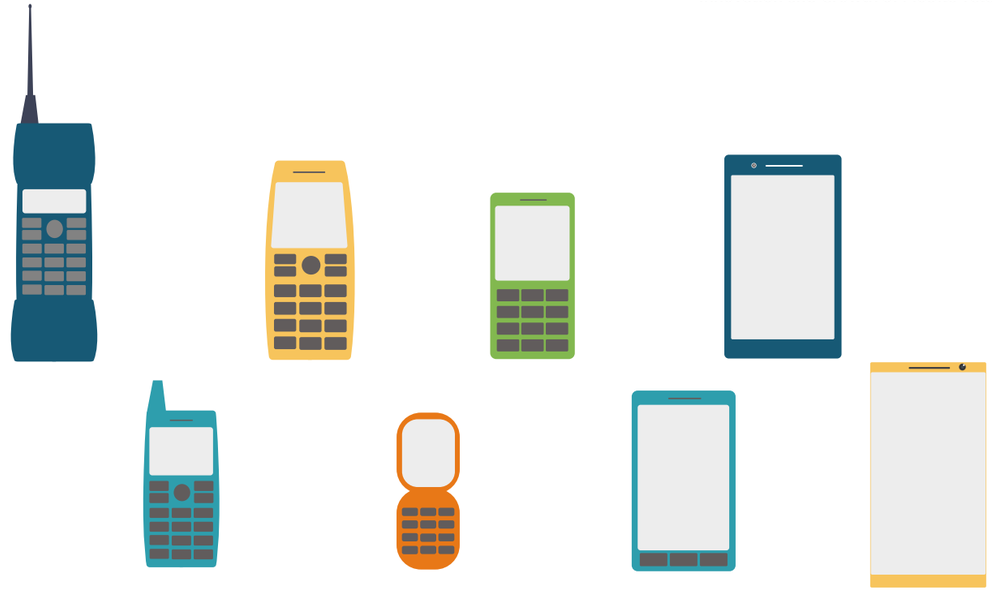
- The Indian mobile handset market has grown much faster (14.1%) in the last five years compared to the global average of 4.1% occupying 14% global market share.
- The Indian mobile market is predominantly occupied by the feature phones having around 68% share; however, smartphones are gaining popularity as India now occupies the second position in the global smartphone market.
- The total direct economic contribution of the mobile telephony to the Indian economy is estimated to be ₹2,570 billion, which is about 1.8% of the Indian GDP.
- The mobile telephony industry, accounting for both direct and indirect economic activity, is responsible for a total of 6.5% of India's GDP, a contribution that amounts to more than the ₹9,000 billion.
- Unique subscriber penetration rate, which is currently at 47%, will increase India's economic activity and the productivity of the country as about 330 million new subscribers are expected to be added by 2020.
- Mobile phones with MVA of 18.3% and corresponding multiplier effect of 5.89, which is highest in comparison to other sectors of economy, implies that the total value addition to the economy due to increase in demand of mobiles is significant.
- Mobile telephony in India provides employment to about 4 million people. The mobile handset and telecommunication equipment manufacturers that currently employ about 0.78 million people are expected to generate employment for another 2.3 million people in the next five years under the impetus of the Make in India programme.
- The mobile telephony industry is expected to grow faster than the economy as a whole and contribute to 8.2% of India's GDP and to create employment for an additional 4.77 million people.
- In absence of alternative (fixed line) infrastructure in the country, mobile technology has a central role in the realisation of the Digital India initiative by providing internet access and making broadband a utility for every citizen of the country.
- Increased penetration of mobile technology in India will bring with it many socio-economic benefits in the fields of agriculture, healthcare, financial inclusion and education.
- The Startup India initiative mobile app serves as the single e-platform for startups for interacting with government and regulatory institutions for business needs and information exchange.
- Mobile telephony can be a significant enabler for the success of the Make in India programme for leveraging a wide range of ICT applications to improve ease of doing business as well as the productivity of manufacturing firms to improve the country's ranking on the global competitiveness index and make India a global manufacturing hub.

2.

Innovation and Growth of Mobile Telephony

The evolution of the mobile phone has followed the path of evolution. The section examines the innovation growth path, the value of standards as an innovation tool, and the challenges underlying its future growth.





Mobile Revolution in India

The first mobile call in India was recorded in 1995, eleven years after the world got to see a mobile phone. Since then, the growth has been exponential. The telecom revolution, which closely followed India's economic liberalisation, truly represents the aspiration of its people.

In 1991, India had 5 million telephone subscribers. At the end of July 2007, this number increased to 233 million and as of July 2015, it touched 1006.96 million subscribers. The share of mobile penetration in this period surpassed the landline subscribers significantly. The total number of telephone subscribers between 2000 and 2011 grew at a Compound Annual Growth Rate (CAGR) of 35%, compared to 9% and 22% in the 1980s and 1990s decades respectively.[43] The growth of the 2000s was led by mobile subscribers. The increase in tele-density has mainly been driven by the increase in mobile phones.[44]

This period also saw the transition of the mobile phone from a simple analogue phone to a smartphone. In the words of the Supreme Court of India, smartphones have become a "miraculous device" for the consumer which cater to almost all necessary and day-to-day telecom needs, serving the purpose of a computer.[45]

The mobile revolution in India has been one of the success stories of post-liberalised India. What led to this transition? The transition ran concurrent with the evolution of mobile technology, in the form of standards, helping make technology affordable, consistent and commercially viable to adopt.

NITI Aayog[46] attributed the country's growth in mobile handset manufacturing to the adoption of these global standards. One of the beneficial effects of standards, according to NITI Aayog, is the phenomenal expansion of the mobile phones in the last decade, and the country's ability to produce handsets at sufficiently low costs.

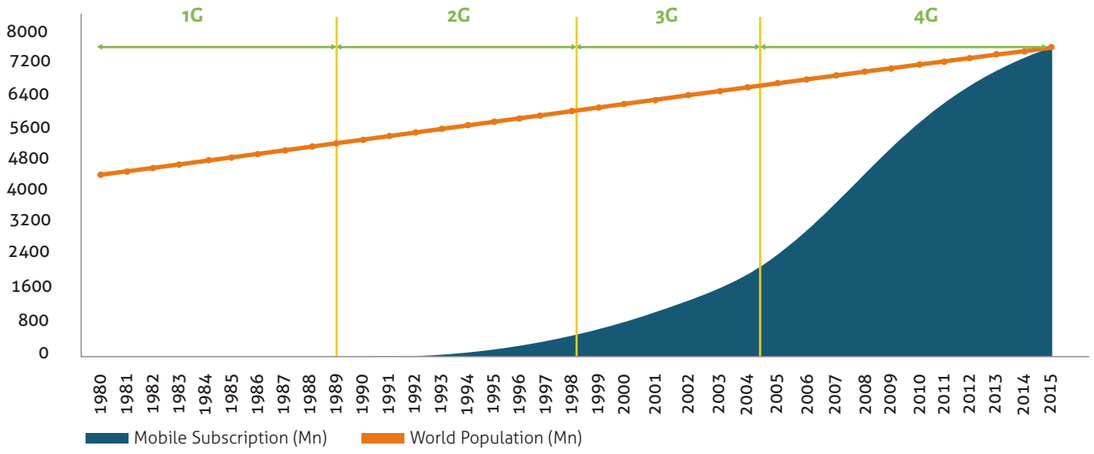
Innovation and Growth of Mobile Telephony

Mobile phones have come a long way in the short span of 33 years since they were first launched. The first mobile phone, the Motorola DynaTAC 8000X, cost almost $4,000 and weighed over a kilogram, with a battery life of 20 minutes.[47] Since that time, mobiles have evolved significantly. A mobile phone today is affordable and is technologically capable of doing complex functions.

The mobile device industry during the late 1990s was spurred by an explosion of demand for wireless telecommunications across much of the Western world. First in Europe and then North America, penetration rates exploded as consumers were attracted to the convenience and productivity benefits of access to mobile networks.

[43]Telecom Sector in India: A Decadal Profile; Telecom Regulatory Authority of India, 2012.
[44]Ibid.
[45]Centre for Public Interest Litigation vs Union of India & Ors.; Supreme Court of India, [W.P (C) No. 382 of 2014] Order dt. Apr-8, 2016.
[46]Make in India Strategy for Electronic Products, NITI Aayog, Government of India, May 2016.
[47]Dialling for development: How mobile phones are transforming the lives of millions, WIPO Magazine (September 2010). Available at http://www.wipo.int/wipo_magazine/en/ 2010/05/article_0002.html

Growth and Penetration of Mobile Telephony



Source: World Bank Database, TARI Analysis

Innovation and development of technology has helped make giant strides in the field of mobile phones. The growth of the mobile telephony industry has followed the path of the revolutionary standards—2G, 3G and 4G. The number of mobile subscribers has grown exponentially with the emergence of new mobile telephony standards, particularly 2G and 3G, which changed the way people communicate.

The pace at which technologies are replaced by a new standard represents their dynamic nature; 2G phones have become near obsolete and industry trends reflect that 3G phones are rapidly making way for 4G-enabled mobile phones.

To deliver to the demands of the market, the mobile standards have been continuously developed and the latest technological solutions are made accessible so that handset manufacturers can improve the performance of their products. Customers, both mobile network operators (MNOs) and end users themselves, are more than willing to pay for enhanced functionality, usability and reliability.

Transitioning Technologies and Improved Performance

Telecommunications is a technology-intensive industry whose development has been a result of technology adaptation. In an industry such as ICT, both the availability of technology and the industry's ability to adopt it are the drivers. The improvements in mobile telephony standards from 2G in the early 1990s through the current 4G have been much more than incremental, with each generation providing dramatic performance improvements in transmission capacity, service quality, congestion management, cell handover, and signal quality.[48]

For instance, the 2G technology that enabled digital phone calls and messaging was a significant leap forward from 1G which allowed analogue phone calls. Again, the transition from 2G to 3G added data connectivity to allow mobile internet on mobile. Then, with 3.5G, there was a giant leap in terms of consumer experience that occurred as a result of continued investments in R&D and development of standards. This led to enhanced functionality of mobile broadband networks, which enabled smartphones, leading to an enhanced mobile internet experience and the app-centric interface. With transition from 3.5G to 4G, users had access to considerably faster data speeds and lower latency rates.[49]

[48]Teece, David J., *Profiting from Innovation in the Digital Economy: Standards, Complementary Assets, and Business Models in the Wireless World,* Tusher Center for the Management of Intellectual Capital, Working Paper Series No. 16 (August 23, 2016).
[49]Understanding 5G: Perspectives on future technological advancements in mobile, GSMA Intelligence (December 2014).

Evolution of technology generation in terms of services and performance[50]

Generation	Primary Services	Key Differentiator	Weaknesses (addressed by subsequent generation)
1G	Analogue phone calls	Mobility	Poor spectral efficiency, major security issues
2G	Digital phone calls and messaging	Secure, mass adoption	Limited data rates – difficult to support demand for internet/email
3G	Phone calls, messaging, data, mobile email	Better internet experience	Real performance failed to match hype, failure of WAP for internet access
3.5G	Phone calls, messaging, broadband data, web-browsing	Broadband internet, applications	Tied to legacy, mobile specific architecture and protocols
4G	All IP services (including voice, messaging), video streaming	Faster broadband internet, lower latency	–

Source: GSMA Intelligence

We are now on the cusp of 5G and Internet of Things (IoT), which describes the coordination of multiple machines, devices and applications connected to the internet by multiple networks.

Innovations, Standards and Products

Standards are the lifeblood of innovation in the global knowledge economy. In mobile telecommunication, interoperability is key and technology acts as a key enabler towards ensuring that standards are interoperable. Mobile technology standards acted as technology enablers to make mobile phones interoperable. Standards are necessary not only to reap economies of scale and scope, but also to reduce transaction costs and to prevent a duplication of efforts. By freezing a given technology, standards are supposed to provide stability for industry.[51] This provides assurance to the manufacturers on the quality of their product, and further drives demand.

There is no universal definition of standards. In general, a technical standard is a series of published documents which sets out technical specifications, guidelines or rules for common and repeated use in order to ensure performance, quality, safety and interoperability of products. In the Information and Communication Technology (ICT) space, standards allow networks, systems, products, and devices to seamlessly connect in order to exchange and use information. Standard development is the process of determining a common set of characteristics for a good or service.[52]

Standards create significant economic and other benefits for consumers. Without standards, it would not be possible to make calls or browse the Internet on a smartphone. It assures consumers of the performance, quality, safety and interoperability of their purchases.[53] Dynamic benefits from standards partly derive from economies of scale and lower average costs. This draws on 'strategic trade theory' literature (e.g. Krugman and Obstfeld, 1988).[54] It also allows companies to increase production because of the certainty that standards offer, and access to technology at a low cost, giving them a competitive edge in the market. Essentially, standards facilitate

[50]GSMA Intelligence [Understanding 5G: Perspectives on future technological advancements in mobile], December 2014].
[51]Standards, innovation, and latecomer economic development: Conceptual issues and policy challenges Ernst, Dieter, Lee, Heejin, Kwak, Jooyoung, http://dx.doi.org/10.1016/j.telpol.2014.09.009
[52]"Standard Setting": OECD Policy Roundtables (2010): DAF/COMP (2010) 33
[53]WTO, *World Trade Report* 2005 (n 4) 35-51.
[54]Krugman, P.R., Obstfeld, M. (1988): 'International Economics: Theory and Policy', Scott, Foresman and Co., Illinois

the adoption of a technology, achieving economies of scale. Innovation and development of new mobile telephony standards provides this potential. This is evident from the recent trends in mobile telephony in India:

- The value of a smartphone is largely contingent upon the features it offers, thus feature-heavy phones are more in demand
- Consumers are willing to make a future investment in a 4G phone to be "future ready"[55] — driving up demand for such phones

Dynamics of Standardisation

Standardisation, *in-principle*, is a voluntary activity and hence can follow different paths. Based on their method of creation, standards can be categorised into three: proprietary standards, open standards, and consortium standards.[56] Proprietary standards are set by a single firm which does not seek or allow input from others, and retains control over the specifications and often sets the rules by which others can participate, if at all.

In contrast, open standards are set by standard development organisations that have rules about open participation in the process, follow a consensus-based procedure for decision making, and openly make available the standards specifications and often the rules about eventual patents covering their standards.[57]

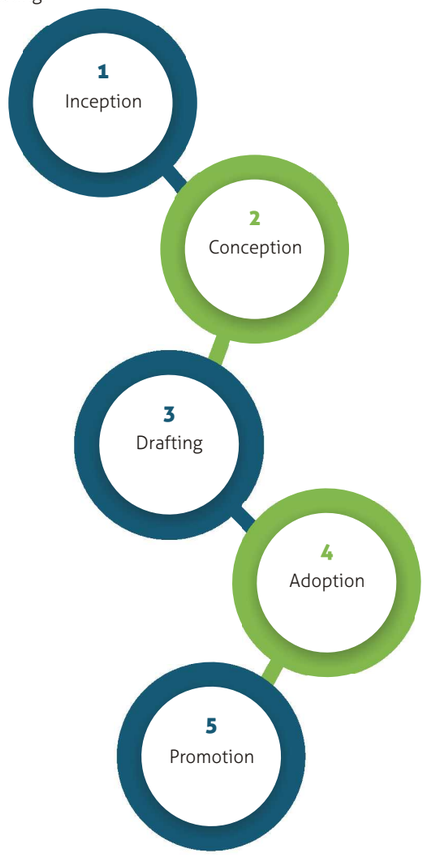
The so-called consortia standards lie somewhere between proprietary and open standards and, for instance, could allow open access to interested participants. This category is built on the belief that a smaller group of like-minded organisations can more quickly achieve an outcome that is satisfactory for everyone.[58]

The Process of Open Standards

Standards development is a voluntary, collaborative, or "collegial" effort between technology developers, implementers and users.[59] A standard is developed over time. Following its initial development, there are usually amendments, corrections and revisions to rectify omissions and add features based on experiences gained.

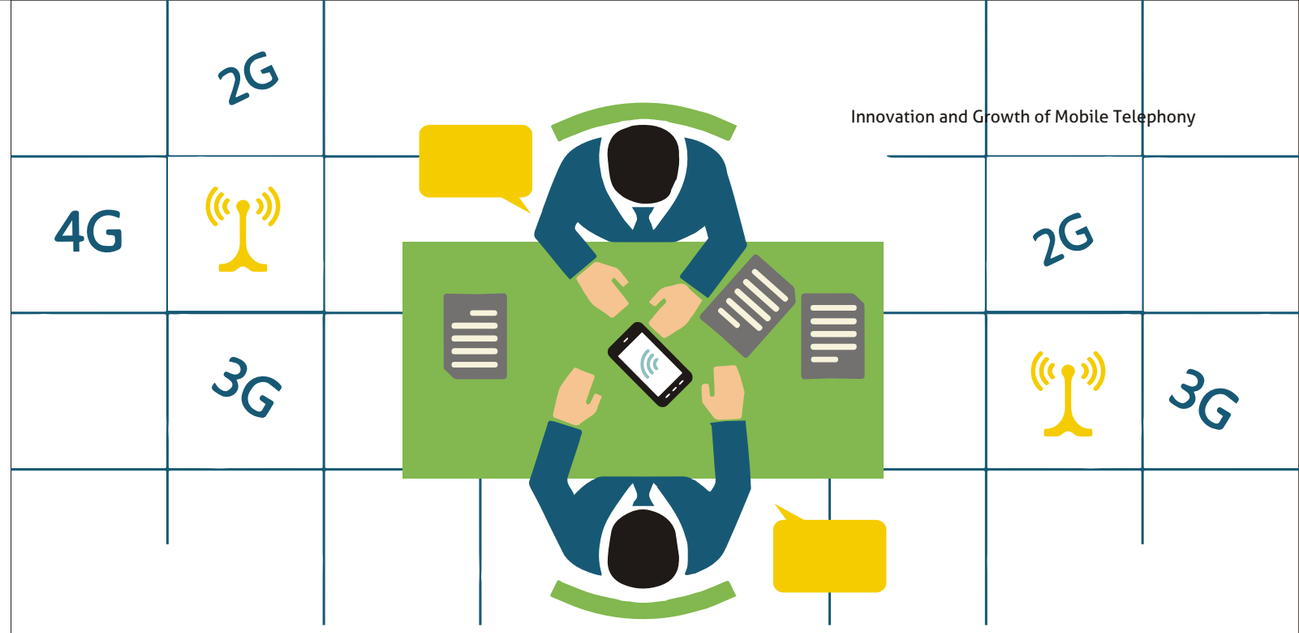
There may be major new additions to a standard to raise performance and open new applications. Over the period from 1992 to 2002, GSM standards had more than five major revisions and introduced new technologies such as Short Message Service (SMS), Multimedia Messaging Service (MMS), General Packet Radio Service (GPRS), and Enhanced Data GSM Environment (EDGE). The revisions significantly advanced Global System for Mobile Communications (GSM) capability. The Universal Mobile Telecommunication System (UMTS) standard has so far appeared in 12 versions, the latest of which has taken it from 3G UMTS to 4G LTE (Long-Term Evolution), partly by evolution, partly revolution.

The standards development process has five stages. The main focus for standards generation is the drafting phase. Drafting takes place in stages of management, specification validation and testing.



Source: European Telecommunications Standards Institute (ETSI)

[55]IDC Research Press Release, New Delhi, 8-May-2017. Available at http://www.idc.com/getdoc.jsp?containerId=prAP42527117&pageType=PRINTFRIENDLY
[56]The Role of Standards in A Digital Economy, GSR 2013 Background Paper. Pub. By International Telecommunication Union (ITU).
[57]Ibid.
[58]Ibid.
[59]David J. Teece, Peter Grindley, Edward Sherry, Keith Mallinson, *'Maintaining Ecosystem Innovation by Rewarding Technology Developers: FRAND, Ex Ante Rates and Inherent Value'*, Tusher Center for the Management of Intellectual Capital, University of California, Berkeley (W.P. Series 21), 24-April-2017.



Standards development is a long-drawn-out process involving a significant amount of time and effort from various stakeholders. The standards development process for 2G, 3G and 4G required participation from hundreds of companies all over the world, as follows:

- **2G – Global System for Mobile (GSM) –** This effort entailed 15 years spent on 2G-related standard releases, with more than 200 companies and 13 countries involved, and took approximately 866,000-person hours.[60]
- **3G – Wideband Code Division Multiple Access (WCDMA) –** This endeavor involved 11 years spent on 3G-related standard releases, with more than 300 companies and 39 countries involved, and took approximately 950,000-person hours.[61]
- **4G – Long-Term Evolution (LTE) –** This required more than nine years spent on 4G-related standard releases, with 320 companies and 43 countries involved, and took more than 1 million-person hours (and counting).[62]

Between 1999 and 2012, there were 989 meetings for the various working groups at the 3rd Generation Partnership Project (3GPP)—the primary standards-setting body for 3G and 4G technology standards, which unites the major telecommunications standards bodies of the world. As per another research, nearly three million-man hours were spent on meeting-time, a proxy for the amount of R&D activity associated with the standards.[63] In addition to this, substantial work is done in back offices to support these activities.

Standardisation and Gains for Smartphone Economy

Mobile phones, especially smartphones, rely on standards in order to be interoperable. On the demand side, standardised technologies enable consumers to interact with devices made by different manufacturers.[64] India's success in the area of low-cost mobile phone economy is attributed to the benefits of standardisation.[65] Yet, there are views which feel mobile manufacturers have much to fear, to the extent that their continuance may be under threat.[66] This argument is driven from fears of abusive practices by holders of these technologies due to exorbitant royalty claims made of them.

This school of thought suggests that the innovators, often through abusive means, charge royalty disproportionate to their investments. The basis of such an assertion is that higher claims of royalty would put downward pressure on the financial position of mobile manufacturers and could also render the business of mobile manufacturing unviable.[67] Against such claims of exorbitant royalty lies another claim by certain market observers that mobile manufacturers routinely ignore royalty claims by the innovators, resulting in licensors losing their ability to make a fair return on their investments in SEP technologies.[68]

Between these competing claims, there is a consumer point of view which, like in any market, would look for three things

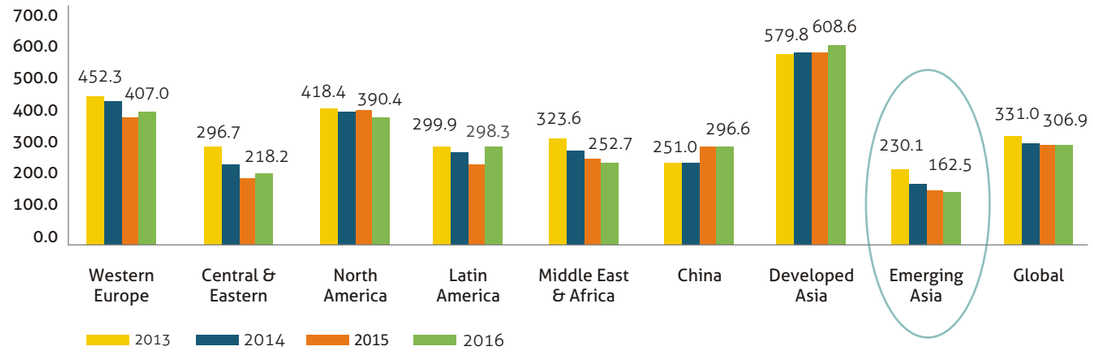
[60]The Boston Consulting Group: *The Mobile Revolution, How Mobile Technologies Drive a Trillion-Dollar Impact* (January 2015)
[61]*Ibid*
[62]*Ibid*
[63]Gupta, K., "The process and data behind standard setting in wireless communications", June 2013.
[64]Galetovic, Alexander and Gupta, Kirti, Royalty Stacking and Standard Essential Patents: Theory and Evidence from the World Mobile Wireless Industry (February 2017). At SSRN: https://ssrn.com/abstract=2790347
[65]Make in India Strategy for Electronic Products, NITI Aayog, Government of India, May 2016.
[66]In *Re. Intex Technologies (India) Limited v. Telefonaktiebolaget LM Ericsson (Publ)*, Case No. 76/2013, Competition Commission of India, Dt. of Order. 16 January, 2014.
[67]In *Re. Intex Technologies (India) Limited v. Telefonaktiebolaget LM Ericsson (Publ)*, Case No. 76/2013, Competition Commission of India, Dt. of Order. 16 January, 2014.
[68]Mallinson on Patent Holdup and Holdout: for IP Finance 16th August 2016. Available at http://www.wiseharbor.com/pdfs/Mallinson%20on%20Holdup%20and%20Holdout%20for%20IP%20Finance%2016%20Aug%202016.pdf

while making a purchase decision: quality, affordability and utility. Increasingly, the trends in the demand for smartphones in India are driven by a phone's features and specifications, which are gaining an uptick from the young population. According to IDC's Smartphone PULSE (Indian smartphone end consumer research study), released in May 2017, the latest features and specifications remain the priorities for two out of five offline buyers.[69] Smartphone demand from Tier 2 and 3 cities is outgrowing demand from Tier 1 cities as urban markets have begun to saturate.[70]

> The trends in the demand for smartphones in India are driven by a phone's features and specifications, which are gaining an uptick from the young population.

We take the period 2013-2016, and analyse how the smartphone economy has responded. An average smartphone buyer is necessarily conscious of three factors, as discussed below:

Average Selling Price of Smartphones (US $ per Unit)



Source: GfK

Average Selling Price of a Smartphone

With respect to the number of handsets sold and the average selling price, we looked through data relating to smartphones.[71]

- Average selling price of smartphones came down from US$ 230.1 in 2013 to US$ 162.5 in 2016, in the Emerging Asia region which includes India. During the same period, a smartphone's average price globally came down from US$ 331 to US$ 306.9.
- According to GSMA,[72] the average selling price of smartphones in India has almost halved since 2011, to less than ₹15,000 in 2015.
- Average selling prices of smartphones have come down over the recent years. As per a 2016-report by IIM Bangalore and Counterpoint,[73] the average price of a smartphone in 2016 was ₹9,903 as against ₹13,221 in 2011.

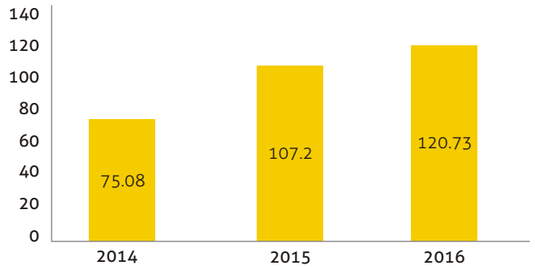
Reduced average selling price is an indicator that the market is maturing and the beneficial impact of mobile technology standards cannot be ignored towards this development.

[69]IDC Research Press Release, New Delhi, 8-May-2017. Available at http://www.idc.com/getdoc.jsp?containerId=prAP42527117&pageType=PRINTFRIENDLY
[70]Ibid.
[71]Agencies such as Gartner, GfK and IDC publish data on smartphone shipments and Average Selling Price.
[72]The Mobile Economy India 2015
[73]IIM B and Counterpoint Research (2016). Maximizing Local Value Addition in Indian Mobile Manufacturing: A Practical Approach. IIM B- WP 528, November 2016.

Growth in Smartphone Sales

The smartphone market in India has shown robust growth between 2014 and 2016. Smartphone shipments in India have grown at 61% between 2014 and 2016, as compared to 20% growth globally.[74]

Smartphone shipments in India (million units)



Source: Gartner

The Indian mobile market is predominantly occupied by the feature phones having around 68% share by volume. Smartphones are gaining popularity and growing at a very fast rate.[75] In 2016, India, with 275 million smartphone subscribers, outpaced the United States to become the second largest smartphone subscriber base in the world.[76]

One of the major drivers for this rise in demand for smartphones in the country is the rapid expansion and promotion of the 4G network footprint by telecom operators. The customers across city tiers are willing to be future ready by choosing more 4G than 3G devices, with more than 80% of the smartphones being 4G compatible across all city tiers.[77]

Number of Smartphone Manufacturing Companies

The mobile manufacturing market is intensely competitive. The mobile telephony sector has witnessed the emergence of Chinese firms in the last five years, which have captured a significant market share. Still, domestic manufacturing firms have a significant hold on the market. This is because of the Make in India initiative of the government, which has provided a push for growth. Thirty-eight mobile manufacturing units have been set up since September 2015, which has ramped up the manufacturing of mobile phone units in 2015-16 by 90%.[78]

Royalty Yield - Too Little or Too High?

Ask SEP holders, and they will say they earn too little for their efforts to innovate. Conversely, every mobile manufacturer will claim royalty claims on licensed technologies are too high. The section looks to follow existing studies, to estimate royalty yield[79] based on royalty earnings by major SEP holders to understand whether exorbitant royalties are being charged on account of standards.

We have made an attempt to estimate the royalty yield by analysing the IPR revenues of those companies which have made significant contributions to developing mobile telephony standards as a percentage of the mobile sales in the global settings.

We have relied upon a similar methodology as used by Haber et al., as represented below:

Royalty Yield = sum total of patent royalty payments earned by licensors/total value of smartphone sales

Unlike Haber et al.,[80] we have not done an exhaustive search of SEP licensors and patent pools, but have selected only companies whose royalty earnings are reported with reasonable clarity in their annual filings, leaving us little or no room for discretion.

In addition, we have restricted our analysis to smartphones. We have relied upon confirmed public data on global sales data of smartphones, both in number and values, from GfK. The royalty yield analysis of Haber et al. suggests that smartphones account for about 97% of the total mobile sales.[81] Moreover, smartphones use more standardised mobile technologies as compared to feature phones.

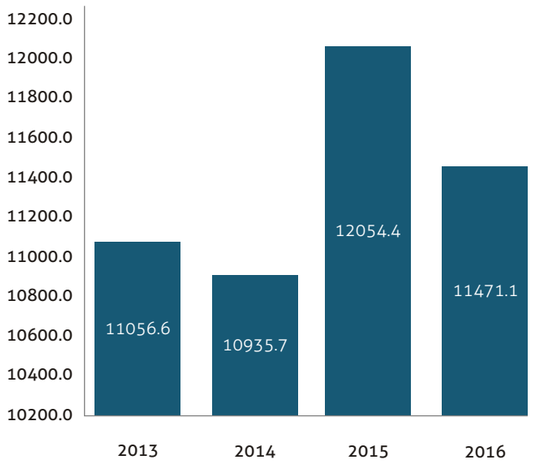
[74]Indian Cellular Association
[75]IIM B and Counterpoint Research (2016). Maximizing Local Value Addition in Indian Mobile Manufacturing: A Practical Approach. IIM B- WP 528, November 2016.
[76]Telecommunications Sector: Achievements Report (Make in India), DIPP (24 November 2016).
[77]IDC Research Press Release, New Delhi, 8-May-2017. Available at http://www.idc.com/getdoc.jsp?containerId=prAP42527117&pageType=PRINTFRIENDLY
[78]The Mobile Economy, India 2016 [As referenced in *Telecommunications Sector: Achievements Report* (Make in India), DIPP (24 November 2016).
[79]The term "Royalty Yield" is a term, used by researchers, Keith Mallinson, "Cumulative Mobile-SEP Royalty Payments No More than Around 5 percent of Mobile Handset Revenues" (IP Finance, August 2015); Alexander Galetovic, Stephen H. Haber, Lew Zaretzki, "A New Dataset on Mobile Phone Patent License Royalties" (Hoover Institution Working Group on IP, Innovation and Prosperity, Stanford University, September 2016)
[80]Alexander Galetovic, Stephen H. Haber, Lew Zaretzki, "A New Dataset on Mobile Phone Patent License Royalties", Working Paper Series No. 16011, Hoover Institution Working Group on IP, Innovation, and Prosperity, Stanford University (September 25, 2016). Available at www.hooverip2.org
[81]Ibid

Estimation of Royalty Revenue

In our analysis, we have covered 11 companies which hold patents in mobile technology standards and report their earnings from IPRs in their annual report/filings.[82] For all companies except Samsung, we have taken their reported IP earnings/royalty revenue. Wherever the reported IPR earnings of the company are not in US$, we have applied the appropriate currency conversion rate to arrive at US$.

Samsung is not entirely into the mobile telephony business and has three segments, namely, Consumer Electronics (CE), Information Technology & Mobile Communications (IM), and memory and Device Solutions (DS). The company does not report royalty revenue under IPR heading but shows it under heading "Services and Other Sales". We have taken the entire earnings given this head as IPR revenue of Samsung. However, we have kept Samsung separate from the main analysis, and reported it separately to reduce any biasness and discrepancy. We believe that our calculation is based on a reasonable approach to determine its royalty revenue from SEP licensing.

Total Royalty Revenue of Major SEP Holders (in US $ Million)



Source: Annual Filings of Companies, TARI Analysis

In consideration of the royalty revenue of licensors, we have reduced our analysis to 10 companies in view of certain data limitation and as we do not present our analysis with approximations and assumption. We could have easily included the following companies; however, we have excluded them from our analysis for the following reasons:

- Emerging players in the mobile phone SEP licensing arena such as Huawei and ZTE do not report their royalty numbers, and hence have been left out
- A similar lack of consistent reporting of royalty revenue by companies such as Microsoft has led us to omit them from our research purview
- Licensing gains by patent pools involve the application of significant assumptions.

The total royalty revenue of the 10 license holders analysed varies between $11 billion and $12 billion. One point that is easily implied from the royalty revenue of these selective license holders is that even though the benefits of standardisation have led to the growth of mobile telephony, and particularly smartphones in the recent years, it has not benefited the companies which have contributed towards development of these mobile telephony standards.

Estimation of Global Mobile Sales Value

In our analysis, as mentioned before, we have relied on public data. IDC, Gartner and GfK reported data on mobile shipments and value in their report. Haber and others in their analysis used data from all these to derive royalty yield value. However, we were unable to verify the data from IDC and Gartner from the publicly available sources.

Therefore, for the purpose of analysis of global mobile sales and their value, we have used data reported by GfK that is available from public sources.[83] However, as previously mentioned, GfK reports only smartphones sales, which it largely captures from different countries and regions point of sales data. We have collated data from various GfK reports to present the smartphone units sold and their values.[84]

[82]Qualcomm, Ericsson, Inter-Digital, Nokia, Alcatel-Lucent, Samsung, Tessera Technologies, Rambus, Unwired Planet, Parker Vision, VirnetX
[83]GfK data utilised for the analysis is based on end-demand consumer purchases rather than manufacturer shipments.
[84]http://www.gfk.com/insights/press-release/global-smartphone-demand-peaks-alongside-a-leap-in-average-sales-price-in-2q17/
http://www.gfk.com/insights/press-release/global-smartphone-sales-exceed-12b-units-in-2014/
http://www.gfk.com/en-gb/insights/press-release/strongest-q3-smartphone-sales-on-record-driven-by-demand-in-china-mea-and-emerging-apac-1/
http://www.gfk.com/insights/press-release/emerging-markets-power-smartphone-sales/

Total Smartphone Units Sold (In Million)

Regions	2013	2014	2015	2016
Western Europe	115.4	127.9	135.4	131.2
Central & Eastern Europe	50.9	69.3	71.5	77.9
North America	139.1	177.2	190.1	198.5
Latin America	68.7	108.5	106.5	106.6
Middle East & Africa	99.8	135.8	162.1	167.8
China	359	392.8	385.3	450.1
Developed Asia	68.3	65.1	73.4	74.1
Emerging Asia	96.9	148.6	201.8	211.7
Global	**998.1**	**1225.2**	**1326.1**	**1417.9**

Source: GfK, TARI Analysis

China and Emerging Asia (including India) contribute to about half of the global smartphone sales volume. However, their contribution in smartphone sales value is only about 39% in 2016 as the average selling price of smartphones is less than in the regions. This is particularly true for Emerging Asian countries, where consumers are still largely using feature phones and gradually moving to low-end smartphones for better usage and applications.

> China and Emerging Asia (including India) contribute to about half of the global smartphone sales volume.

Total Smartphone Sales Value (In US $ Billion)

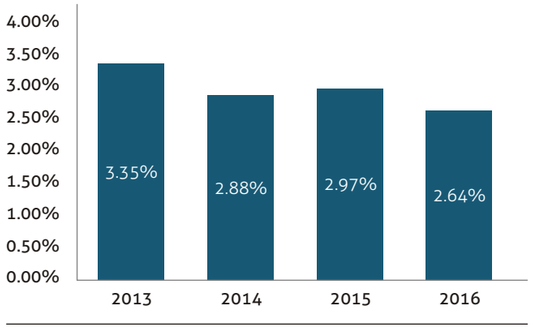
Regions	2013	2014	2015	2016
Western Europe	52.2	55.8	52.9	53.4
Central & Eastern Europe	15.1	17.1	14.5	17
North America	58.2	72	77.7	77.5
Latin America	20.6	30.6	26.3	31.8
Middle East & Africa	32.3	39.4	42.4	42.4
China	90.1	99	116.2	133.5
Developed Asia	39.6	38.1	43	45.1
Emerging Asia	22.3	28.2	33	34.4
Global	**330.4**	**380.2**	**406.0**	**435.1**

Source: GfK, TARI Analysis

Royalty Yield of Global License Holders

Based on the adopted methodology as mentioned before, we have estimated the royalty yield of the 10 selected IPR holders of mobile technology standards as percentage of global smartphone sales value. The graph below shows the aggregate royalty yield of the nine companies as percentage of global smartphone sales value:

Royalty Yield as % Global Smartphone Sale Value



Source: Company Financials, GfK, TARI Analysis

Our analysis:

- The royalty yield of the 10 selected companies is in the range of 3.35-2.64% and shows a gradual declining trend;
- When Samsung revenues are considered, the royalty yield increases to 4.33% in 2013, 3.48% in 2014, 3.35% in 2015 and 2.87% in 2016;
- In our overall analysis, the royalty revenue of license holders has remained more or less stagnant but smartphone sales numbers and values have increased over the years;
- Every year, mobile technology license holders and standard developers invest around 16-18% of their revenues towards new innovations for growth of mobile telephony globally.

Licensors Cost towards R&D

We examined the seven licensors covered in our analysis[85] who report R&D expenditure to analyse how much effort is behind coming up with new innovations that will lead the development of future mobile technologies and standards.

R&D Spending by Licensors as a % of Revenue

Year	2013	2014	2015	2016
Total Revenue (US$ Million)	80,661.0	73,325.9	72,351.4	50,066.6
R&D Expenditure (US$ Million)	13,491.3	13,193.5	12,703.8	9,067.1
R&D Expenditure (% of Total Revenue)	16.73%	17.99%	17.56%	18.11%
Median R&D Expenditure (% of Total Revenue)	18.3%	17.4%	16.7%	21.9%

Source: Company Annual Filings/Reports, TARI Analysis

We find that the total R&D/Revenue spending by licensors is fairly robust and is increasing gradually. The R&D expenditure of the license holders is in the range between 10.3% and 35.8% of their total revenue with median of 21.9%. The R&D expenditure of mobile technology companies is among the highest in comparison with other industries.

Continuous innovation and developments by the industry have enabled the mobile telephony market to grow exponentially in the last three decades. Standards, which have defined the innovation path in the mobile telephony market, are the result of large-scale investments made by the industry, both in R&D and in manpower.

[85]Includes Qualcomm, Ericsson, InterDigital, Nokia (Nokia Technologies), Alcatel-Lucent (Nokia), Tessera Technologies and Rambus

Key Highlights

- The mobile revolution in India has been one of the success stories of post-liberalised India, which can be attributed to the adoption of global mobile standards
- The number of mobile subscribers has grown exponentially with emergence of new mobile telephony standards, particularly 2G and 3G, that changed the way people communicate
- The improvements in mobile telephony standards from 2G in the early 1990s through the current 4G have been more than incremental, with each generation providing dramatic performance improvements in transmission capacity, service quality, congestion management, cell handover, and signal quality
- Mobile technology standards acted as enablers to make mobile phones interoperable and reap benefits of economies of scale and scope and also led to reduction of transaction costs and prevention of duplication of efforts
- Standards development is a voluntary, collaborative, or "collegial" effort between technology developers, implementers and users, which is a long-drawn-out process involving significant amounts of time and efforts from various stakeholders
- 4G standards required more than nine years involving 320 companies and 43 countries involved, and took more than 1 million-person hours and still counting
- The smartphone economy has gained significantly from the standardisation of mobile technologies which can be understood from three key factors : reduction in average prices of smartphones, growth of smartphone sales and increased competition among smartphone manufacturing companies
- The royalty yield of the 10 selected companies is in the range of 2.64% to 3.35% and showing a declining trend between years 2013 and 2016, suggesting that royalty revenue of license holders has remained more or less stagnant but smartphone sales numbers and values have increased over the years
- The R&D expenditure of the mobile license holders is in the range between 10.3% and 35.8% of their total revenue with a median of 21.9%, which is among the highest when compared with other industries.

3.

Cost of Mobile Innovation

Standards provide the necessary technology inputs for the telecom environment to function. In our previous analysis, we have examined the process of standardisation, the time and effort invested into developing standards (together, input costs), and the benefits of the adoption of standards to the mobile manufacturers, and the consumers at large. In the royalty debate, it is necessary to understand and test essential public policy questions: Do beneficiaries of the technology innovation have the ability to pay for the benefits they gain of the innovation? This section aims at getting answers to this question.

India and the Innovation Debate

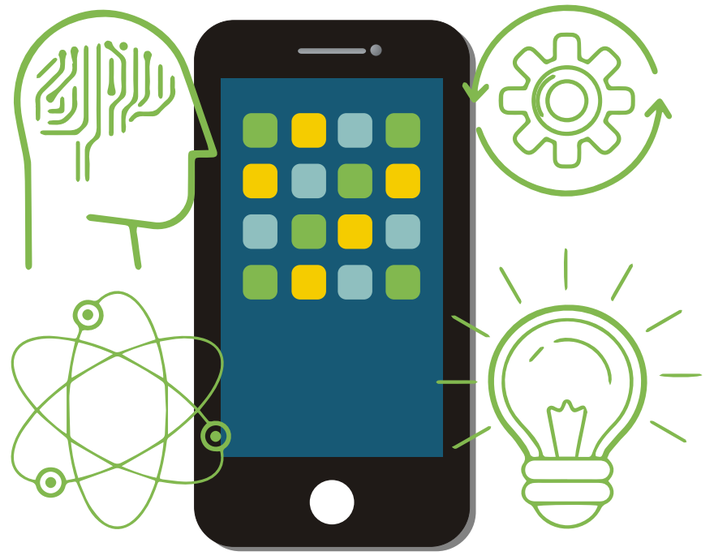
India, together with Russia, China, Brazil and South Africa (BRICS), has been marked as an "emerging market" with distinctive features. Economic development at over 7% in India over the past decade has resulted in high income inequity, market diversity and high price elasticity of demand. The economic disparity has led to the creation of a market space which is underserved or cannot be properly served by products from developed economies. Alongside the population which is rich and can afford to consume premium products, the Indian market remains diverse in spatial and social terms, leaving a much larger cohort of mid-level consumers underserved and underexplored by premium brands. It is this aspirational India, which in its purchasing decisions ranks affordability over branded luxury that holds the potential for change.

While disruptive technologies may be considered as "innovations that result in worse product performance, at least in the near term, but are generally cheaper, simpler, smaller, and frequently, more convenient to use",[86] they could be the appropriate means and playing field for new entrants to serve and expand the lower tiers of the market overlooked by the incumbents. China's uneven development in both spatial and social terms, particularly grassroots demand in the lower tiers of the market, for instance, helped in the promotion of indigenous innovations. With the approach to bottom of the pyramid and good-enough innovation, local firms in China such as the Shanzhai handsets that used to dominate the Chinese market, and in other emerging markets, have been able to set up their own playing field by taking advantage of specific and underserved local demands.[87]

In this context we have to take lessons from China, where local manufacturers have invested in technological and intellectual upgradation to be able to produce products to cater the markets that are underserved by major global players from the developed world. In order to be effective, Indian companies need to invest in research, product development and manufacturing excellence, so that the Make in India programme is effectively served.

Sustaining the Mobile Innovation

Standardisation and innovation, as pointed out in the preceding section, are the cornerstones of sustaining the growth momentum of the past decades. With the development of 5G standards and the concepts such as Internet of Things (IoT) and smart cities on the anvil, sustained industry efforts are required.



[86]Professor Clayton Christensen of Harvard Business School, in the book The Innovator's Dilemma
[87]Chen, Shin-Horng, Pei-Chang Wen and Chih-Yen Tai. (2013) 'Shanzhai Handsets and China's Bottom of the Pyramid Innovation', in Phil Cooke, Glen Searle and Kevin O'Connor (eds.)

The cost of innovation in standards development, as highlighted earlier, necessarily involves the question of royalty. Royalty needs to give innovators a fair share for the efforts they have put into the development of a standard. In the ICT industry, royalty demands by innovators, particularly in the case of a Standard Essential Patent, are subject to several market conditions, and correspond to the economic realities of each market, which has limitation on how much people can afford to pay.

The argument raised by mobile manufacturers worldwide and in India is that patent holders could exercise an inequitable dominance in respect of sparing these technology standards, embedded in the forms of chipsets that are integral to a mobile phone. The proponents of this argument claim that the holders of SEPs earn too high patent royalties, at the cost of the mobile manufacturers, thus making mobile phone manufacturing an unsustainable business.

In the last section, we examined the royalty yield for licensors of SEPs and found that the royalty revenue for a significant group of licensors, put together, is below 5% over the last four financial years.

Manufacturers in India claim that the royalty demands made by licensors have been heavy and could potentially make their business run out of profits, i.e. make the business unviable to operate.

Contemporary Developments in India

Recent years have witnessed activity in respect of royalty claims made in courts by patent holders against mobile manufacturers in India. At the heart of these claims lies the question of royalty payment for the use of mobile technologies. We enumerated some of the competing claims made by both sides—the mobile manufacturers and the patent rights holders—before courts and other forums.

The cases we reference in the following paragraphs have not been finally disposed, and hence, may not be commented upon otherwise to the extent of looking at economic evidence to test some of these claims. In their objections before the courts and regulatory agencies, the manufacturers have claimed that the royalty demanded by SEP holders is excessive and would make their business unviable if they were to pay it. On the other hand, the SEP holders view royalty as a fair share for the investments they have made to develop the standards.

In the ongoing debate, the manufacturers say that the royalty claims made on them are exorbitant and are a burden on them. In this respect, some of their arguments against such abusive behaviour by the holders of such rights include[88]—(1) arbitrary imposition of royalty on the basis of the sale price of the phone instead of on the basis of the value of technology/chipset used in the phone;[89] (2) royalty rates that are "excessive and discriminatory"—a practice that could likely render the business unviable;[90] (3) unreasonably high royalties demanded by the rights holder by way of a certain percentage value of the handset as opposed to the cost of the actual patent technology used.[91]

We now enumerate a few of the contentions of a SEP holder, as forming part of court records. In a pending suit, it was claimed that royalty is demanded on the following considerations: (1) royalty base in the sale price earned by the supplier from its customer; (2) a percentage of the said sale price is demanded as a royalty depending upon the technology used; (3) percentages are determined on the basis of the contribution of patented technology to the standard and its contributed value for the end user in the end product; (4) percentage/royalty is also dependent upon the amount (number) of essential patents held compared to others who have contributed to the standard; (5) percentage is then confirmed or revised based on what the market has found reasonable in licensing negotiations, as evidenced by the numerous signed license agreements with the licensor.[92]

Data Analysis Methodology

With competing claims being offered, we considered only Indian mobile manufacturers, and analysed the financial position of seven of the key players because of two reasons: first, these companies are required to pay royalty in India unlike global phone makers/re-sellers in whose case the royalty is paid would show in the books of the global parent; and second, Indian companies are mandated under the company law to report their financial accounts which can be accessed electronically. So we assume that if Indian companies have paid royalty, it would show up in their financial accounts, electronically accessed from the website of Ministry of Corporate Affairs, Government of India.

[88] The enumeration of issues are not exhaustive and is only aimed at developing an understanding of their respective claims.
[89] Case No. 50 of 2013 [Micromax Informatics Limited V. Telefonaktiebolaget LM Ericsson (Publ.)], Matter before the Competition Commission of India
[90] Case No. 76 of 2013 [Intex Technologies (India) Limited V. Telefonaktiebolaget LM Ericsson (Publ.)], Matter before the Competition Commission of India
[91] Case No. 04 of 2015 [Best IT World (India) Pvt. Ltd. (iBall) v. Telefonaktiebolaget LM Ericsson (Publ.), Matter before the Competition Commission of India
[92] Telefonaktiebolaget LM Ericsson (Publ.) v Intex Technologies (India) Limited, I.A. No. 6735/2014 in CS(OS) No.1045/ 2014, Delhi High Court

Mobile Manufacturing and Patent Landscape in India

Innovation is key to the sustenance of the mobile telephony world. The pace at which mobile phone technologies have been developed demands the active support and involvement of all stakeholders in the mobile value chain. Mobile manufacturers have an essential role to play on this front. How innovative are they? The number of domestic mobile manufacturers and their growth in the past decade leaves no room for doubt about their keeping pace with time. To survive and sustain in this rapidly growing mobile telephony market, innovation is key.

Patents are a proxy of testing how innovative a company is. A recent study[93] looked through quantitative patent filing data from Indian Patent Office (IPO) records, to consider the patents published between 2000 and 2015, relevant to the mobile devices. According to this study, of the approximately 23,500 patents that were identified, a total of only 18 patent applications, but not issued patents, were held by three of the Indian firms studied (Spice Digital, HCL, and Videocon).

The chart below mentions the top 11 assignees of Indian patents in telecommunications between 2000 and 2015.

The same study also provided a breakdown of the technology category of the patents, as per which the single greatest number of patents (including both applications and issued patents) were for communications (12,857). There were 3,407 patents covering operational blocks and 3,068 patents covering software-related features such as the operating system, message display, searching, file management, and ringtone management.[95]

Why do Indian firms hold so few Indian patents in a market full of domestic competitors? —was a question the authors raised in the study. The paper considers three possible reasons: (1)

Assignee	Country	Total Published Indian Applications and Issued Patents
Qualcomm	United States	5,954
Ericsson	Sweden	1,843
Samsung	South Korea	1,827
Nokia (Many Nokia patents are now held by Vringo)	Finland	1,744
Microsoft	United States	1,557
Philips	Netherlands	1,460
Sony	Japan	1,235
Alcatel-Lucent	France	971
Motorola	United States	842
LG	South Korea	791
RIM/Blackberry	Canada	558

Source: Adopted from Patents and Mobile Devices in India: An Empirical Survey[94]

[93] Jorge L. Contreras and Rohini Lakshane, "Patents and Mobile Devices in India: An Empirical Survey", Vanderbilt Journal of Transnational Law, Vol. 50. (January 2017).
[94] Jorge L. Contreras and Rohini Lakshane, "Patents and Mobile Devices in India: An Empirical Survey", Vanderbilt Journal of Transnational Law, Vol. 50. (January 2017).
[95] Ibid.

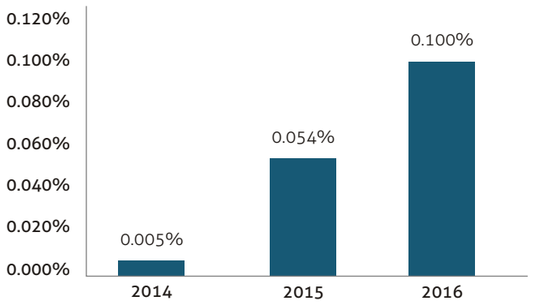
Indian firms are not innovative; (2) absence of a patenting culture; (3) cost factor.

Innovation, if seen as a proxy of patents filed, is non-existent for Indian mobile manufacturing firms. We further test this assertion with our analysis of the financial position of Indian mobile manufacturing companies, in terms of their R&D (research and development) costs incurred.

How Much Effort Does the Industry Put into Research and Innovation?

Out of seven domestic mobile manufacturers considered for our analysis, only two companies had reported some expenditure on research and development (R&D). However, considering that reported R&D expenditure is very negligible for one company, the graph below shows R&D expenditure for only one company. The other five mobile manufacturing companies considered in our analysis have not reported any spend on R&D.

R&D Cost as Percentage of Revenue



Source: MCA database and company filings

From the above discussion, it appears

- R&D cost (as a percentage of revenue) is below marginal, virtually non-existent
- The R&D spends may not be sufficient to support on their own the innovation that the mobile telephony sector demands, unless substantially increased.

We then go to test a point raised by authors Jorge Contreras and Rohini Lakshane[96] with respect to their perspective of why Indian mobile manufacturers have no patents filed between 2000 and 2015. The authors point out that:

"Cost may play a role in the unwillingness of Indian firms to pursue patent protection in the telecommunication sector. Indian vendors dominate the low end of the mobile device market. They procure low-cost hardware from China and Taiwan, load it with open source and locally-developed apps, and then sell it on the domestic Indian market at prices ranging from $100 down to the extreme low of Ringing Bells' $4 price point. At these rock bottom prices, profit margins are likely to be thin to non-existent, perhaps making the additional cost of filing patent applications uneconomical."[97]

At this stage, it is important to test this aspect of mobile phone production in India—do domestic mobile manufacturers earn enough? We looked through the gross and operating margins of mobile phone manufacturers in India and find that they have maintained a healthy margin.

Considering that domestic manufacturing companies are doing well in terms of their gross margins, the "thin profit margins" argument cannot be a plausible reason for such firms to not be investing in R&D. This in a business environment where the consumer preference in the market is steadily moving towards Chinese mobile phones, which are better in terms of their performance and invest heavily in newer technologies.

Innovation and Royalty

There is an ongoing debate, worldwide and in India, about how much royalty domestic manufacturers pay. Many of these domestic manufacturers are engaged in legal cases in Delhi High Court and the Competition Commission of India.

Royalty Payment as Percentage of Mobile Sales Revenues

Year	Royalty Payment (%)
2014	1 company, 2.2%
2015	2 companies, 0.052%-1.2%
2016	3 companies, 0.03%-1.3%

Source: MCA database and company filings

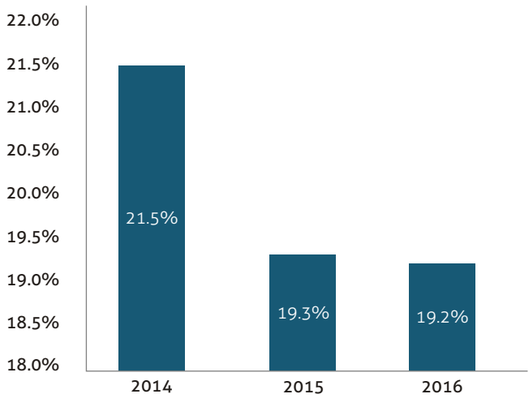
For our analysis,[98] we have considered seven domestic mobile manufacturers as they are the only entities that are supposed to report as per the requirements of the Companies Act. As per our analysis, only three companies have reported royalty payment (as a percentage of their mobile sales revenue) and the highest value is not more 1.3% for a company in 2016. Most Indian companies have not reported a royalty payment for the years under review, including an entity which was required under a court order to pay certain royalty amount. Based on the aforesaid analysis:

- Indian mobile manufacturing firms have nil to marginal investment in R&D
- No domestic mobile company has any patent issued in India (2000-2015)
- Royalty payment as a percentage of mobile sales revenue stands in the range of 0.03% to 2.2% (2014-2016)
- Most of the domestic mobile companies do not pay a royalty

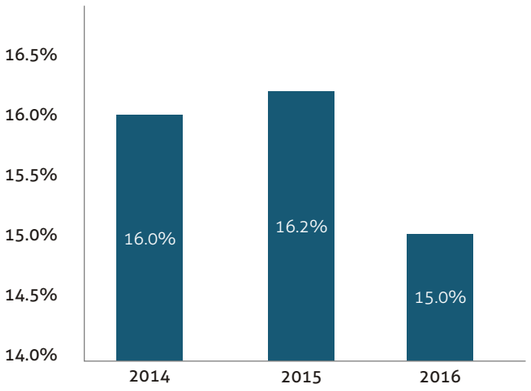
Are Companies Profitable?

One of the arguments of the mobile manufacturers is that they do not earn sufficient profits, and hence, a royalty payment would make business unviable. We tested this claim against a financial analysis of their margins. For this, we considered seven key domestic mobile manufacturers and did a financial analysis on them to report the median gross margin[99] and operating margin[100] over the period from 2014 to 2016 in the graphs shown below.

Median Gross Margin as percentage of Total Revenue



Median Operating Margin as Percentage of Total Revenue



Source: MCA database and company filings

The analysis shows:

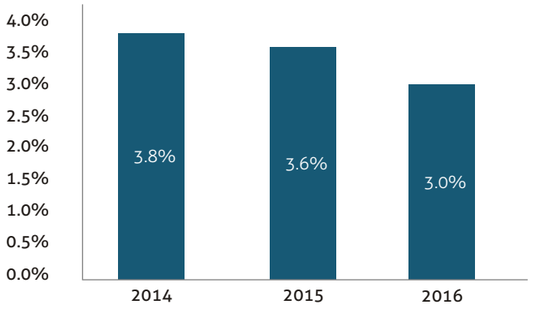
- Median gross and operating margins for domestic entities have come down marginally between 2014 and 2016; however, they still maintain a healthy margin.
- Gross margin for these seven mobile manufacturing companies during the years between 2014 and 2016 is in the range of 13.5-27.3%.
- Operating margin for these seven mobile manufacturing companies during the years between 2014 and 2016 is in the range of 11.5-24.7%.
- Gross margins are significant at levels of nearly 20% for domestic companies, which gives them sufficient headroom for other operating expenses and overheads for turning in a contribution.
- Hence, the margins can absorb reasonable amounts of royalties without adversely affecting the sales price to the consumer. The selling margins of distributors and retailers are outside of the above calculations, as Indian GAAP (generally accepted accounting principles) requires turnover to be disclosed as the net of selling discounts.

[96]Jorge L. Contreras and Rohini Lakshane, "Patents and Mobile Devices in India: An Empirical Survey", Vanderbilt Journal of Transnational Law, Vol. 50. (January 2017).
[97]Ibid.
[98]We have only considered the Indian company financials.
[99]Gross Margin calculated as Total Revenue minus Total Purchases– Changes in Stocks over Total Revenue
[100]Operating margin calculated as Total Revenue minus Total Expenses plus finance and other cost over Total Revenue

Discretionary Spending

What is the level of discretionary spending by mobile manufacturing companies in India? For our analysis, we have considered advertisement and promotion expenditure, as reported in their financial statements (profit and loss accounts).

Median Adversting and Promotional Expense as Percentage of Total Revenue



Source: MCA database and company filings

The chart above shows that

- During the financial years 2014-2016, median advertisement and promotional domestic expenditure (as percentage of their total revenue) by mobile manufacturing companies ranges between 3.0% and 3.8%.
- The Indian companies have a significant discretionary spend on account of advertisement and sales promotion, which accounts for about 3.3% of their revenues. This includes endorsement of celebrities, cricket and sports, tournaments and other high cost spend, which is discretionary and optional.

Do Companies Have an Ability to Pay Royalty?

The profitability of mobile manufacturing companies has been debated for long. Our analysis provides us reason to believe that

- Innovation cannot be an option for companies in the ICT industry including mobile phones, and the consequence of not investing in research and innovation is to be bound to those who hold the patents and licenses. In the medium- to long-term, lack of innovation will hurt the consumers as manufacturing will be shifted out of India or be set in India by other overseas companies who have innovated both technology and processes.

- Indian companies have low capital asset intensity and outlay, which shows their overall investments in manufacturing facilities. This along with the low expenditure on research tilts the base of manufacturing of handphones to outside India, mainly China. This phenomenon is also manifested through extremely high imports by Indian companies, which makes the manufacturers and consumers dependent on overseas companies for sustenance of one of the most important growth drivers of the Indian economy.

These factors make Indian manufacturing extremely fragile. Most of the manufacturing value is created outside India making it a fragile business model, which will be significantly affected when the Chinese manufacturers set up facilities to manufacture in India. The lack of innovation and research becomes even more evident as no alternative models of economies of scale or patented technologies have been developed that create effective global competition and self-reliance.

Standardisation does not appear to have negatively impacted the average Indian mobile manufacturer. On the demand side, standardisation has created a mass market leading to economies of scale that has made smartphones more popular, primarily because of their falling average selling prices. The average Indian buyer of a smartphone, which is fast transcending towards higher specification smartphones, is likely to drive demand. Indian mobile manufacturers have maintained a healthy gross margin in the last three years. Contrary to the belief that the mobile industry is not financially healthy, evidence suggests that a majority of Indian mobile manufacturers/re-sellers are doing well. Mobile manufacturers' claims that they do not have the ability to pay because of market conditions do not appear to be true, especially when their discretionary spending has consistently increased.

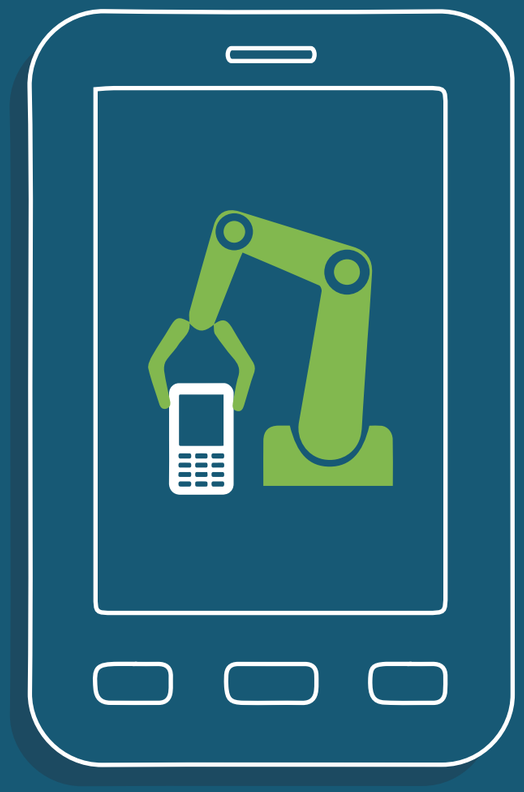
Key Highlights

- Cost of innovation involves the question of royalty that gives innovators a fair share for the efforts they have put into the development of a standard
- Innovation is key to the sustenance of the mobile telephony world but research shows that India is on weak footing on this front. Out of the approximately 23,500 patents that were identified between 2000 and 2015, only 18 patent applications, but not issued patents, were held by three of the Indian firms
- R&D expenditure (as a percentage of total revenue) on seven domestic mobile manufacturing companies is almost non-existent and the maximum extent of expenditure reported by one of the companies is 0.1% in 2016
- Royalty payment as a percentage of mobile sales revenue stands in the range of 0.03% to 2.2% (2014-2016) and the majority of companies do not report any royalty payments
- Median gross and operating margins for domestic entities have marginally come down between 2014 and 2016; however, they still maintain a healthy margin
- Gross margin for seven mobile manufacturing companies during the years between 2014 and 2016 is in the range between 13.5% and 27.3%, while operating margin ranges between 11.5% and 24.7%
- Median advertisement and promotional expenditure domestic (as % of their total revenue) by mobile manufacturing companies ranges between 3.0% and 3.8%
- Indian manufacturing is extremely fragile and most of the manufacturing value is created outside of India making it a fragile business model, which will be significantly affected when the Chinese manufacturers set up facilities

4.

Innovation, IPR and Make in India

This section discusses the future of mobile telephony in India, the current status of mobile manufacturing in the country, the Make in India programme as an accelerator for mobile manufacturing, and why innovation and IPR are perquisites for establishing an ecosystem for mobile manufacturing in the country.



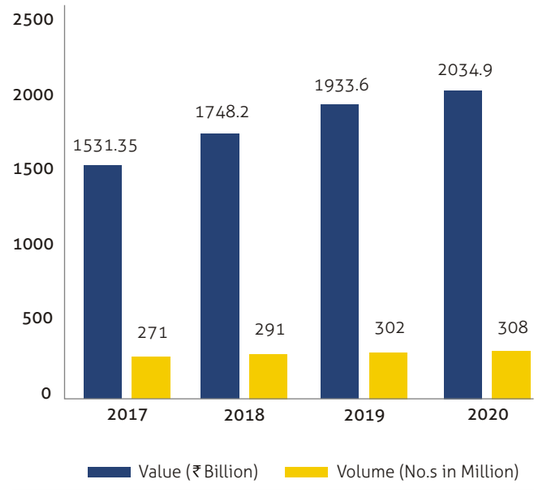
> The development of high speed 4G infrastructure and large-scale roll out of affordable mobile internet services is driving the demand for 4G enabled smartphones exponentially.

Growth of Mobile Phones in India: Future Prospects

Mobile telephony in India is anticipated to increase swiftly in the coming years. The growth drivers inter alia include the scope for increasing the consumer base as unique mobile subscription is only about 47% of the population; changing consumer preferences with rising income of the population as consumers are willing to spend more on the mobile phones and replacement cycles of phones are getting shorter.[101]

The smartphone share is increasing as the average selling prices of the smartphones are declining over the years, making them affordable for the mass market. The development of high speed 4G infrastructure and large-scale roll out of affordable mobile internet services is driving the demand for 4G enabled smartphones exponentially. It is expected that users of 4G services will increase substantially as the number of 4G connections are estimated to increase exponentially to levels of 280 million in 2020 from a paltry 3 million in 2015.[102]

Projected Growth of Mobile Handset Market



Source: IDC

[101] The Indian Mobile Economy 2015, GSMA; The Indian Mobile Economy 2016, GSMA.
[102] The Indian Mobile Economy 2016, GSMA.

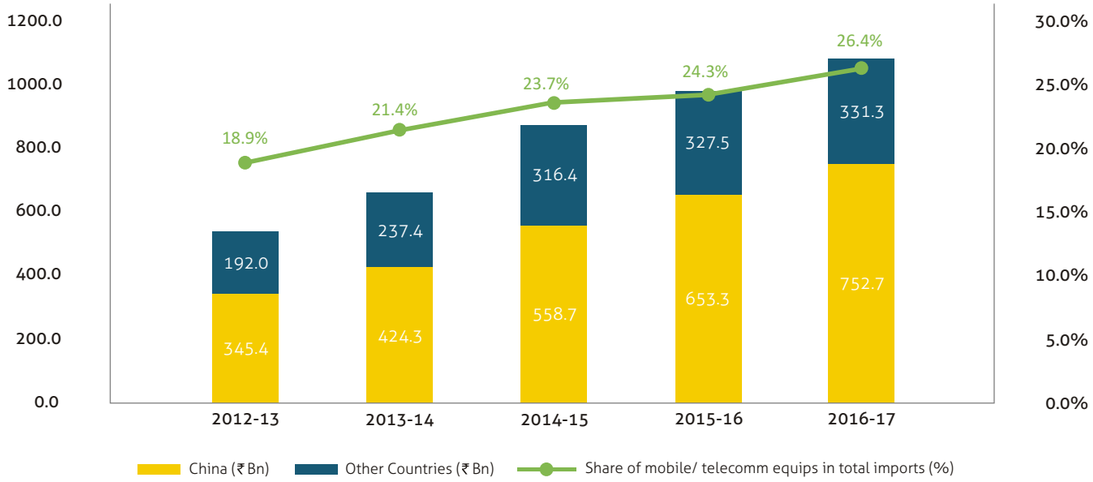
Mobile Handset Market in India: Current Status

The mobile telephony growth in the country, however, has largely been driven and is currently dependent upon the imports of complete mobile handsets or components or devices required for the mobile telephony. The share of mobile and other telecommunications equipment in the country's total import basket is continually increasing and currently stands at 26.4%, which is second only to oil imports.[103]

The share of Chinese products in the mobile and telecommunications equipment imports is continually rising and this share has increased from 64.3% in 2012-13 to 69.4% in 2016-17.

> The share of mobile and other telecommunications equipment in the country's total import basket is continually increasing and currently stands at 26.4%.

Mobile and Telecommunication Equipment Imports



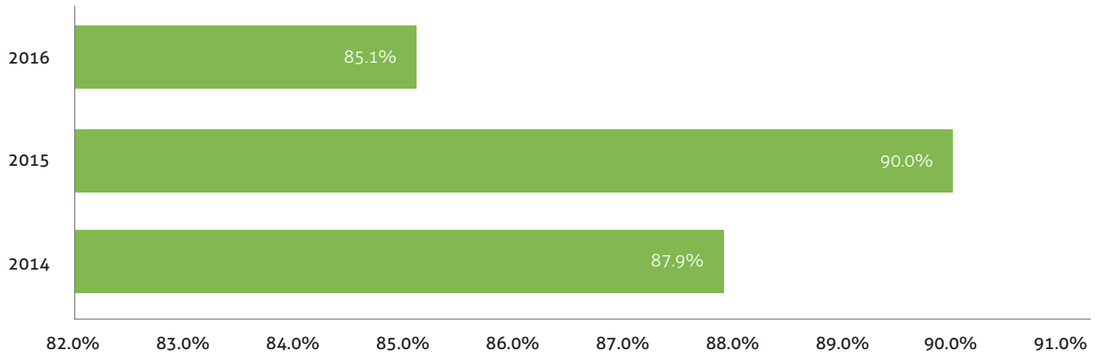
Source: DGFT database, Ministry of Commerce

Our analysis of the seven domestic mobile companies also highlights that median import dependency of these companies is not less than 85%. The imports reported by these companies (as percentage of their total purchases) range between 75% and 95% reflecting their high reliance on either fully built devices or parts/components of the devices that, in turn, have patented technologies embedded in them.

The manufacturing value added by the Indian manufacturers, either Original Equipment Manufacturers (OEMs) or Original Design Manufacturers (ODMs) is relatively small due to high dependence on imported components and completely built up phones.

[103]DGFT database, Ministry of Commerce

Imports of Domestic Mobile Manufacturers (% of Total Purchases)

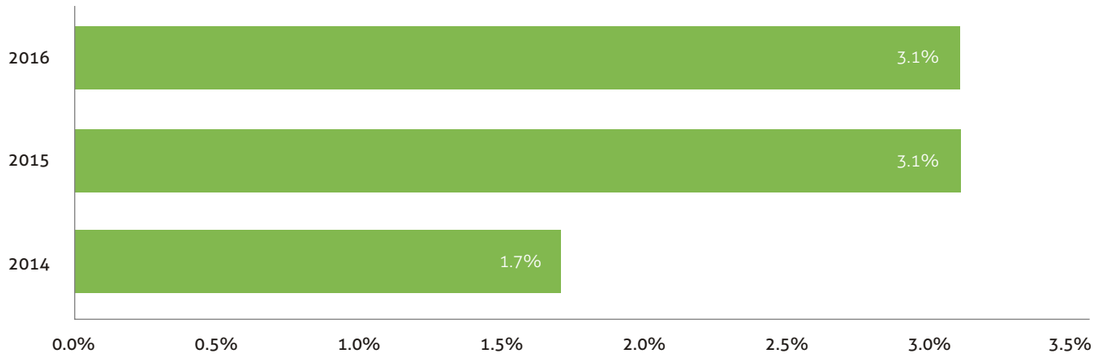


Source: Annual Reports, Ministry of Corporate Affairs, TARI estimations

The median net fixed assets as percentage of the total assets of these seven domestic mobile manufacturers also suggests that the companies have not invested significantly in the establishing of manufacturing facilities and assets in this highly innovative and IPR driven industry. Imports fulfill most of the demand and purchases by the companies.

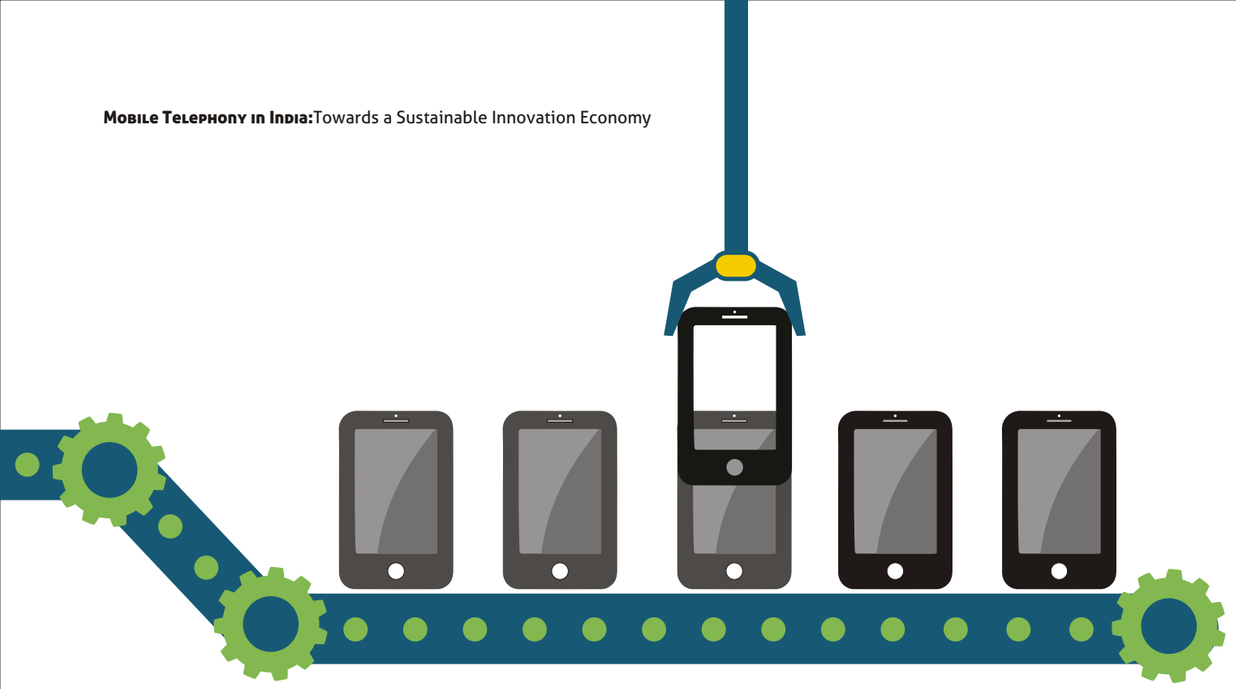
In the view of scope of increase in mobile penetration from current levels and large dependency on imports, it is projected that telecommunications equipment imports in the near future may be more than oil imports.[104] Therefore, mobile and telecommunications equipment is crucial under the Government of India's Make in India initiative.

Net Fixed Assets (% of Total Assets)



Source: Annual Reports, Ministry of Corporate Affairs, TARI estimations

[104]Report on Telecom Sector Roadmap for Innovation 2010-2020: http://www.cdot.in/tsic.pdf, last accessed April 22, 2016.



Make in India: Mobile Handset Manufacturing

Through the Make in India initiative, the Government intends to attract a large investment for manufacturing of telecommunication equipment domestically. Between October 2014 and September 2015, the Indian government received ₹6,887.13 crore as FDI inflows in telecommunications, which is 3.30% of the total FDI inflows into the country.[105]

Under Make in India, 38 new mobile manufacturing units with a capacity of over 20 million units per month have been set up since September 2015 generating 38,300 employment opportunities.[106]

The Department of Electronics and Information Technology (DEITY) has also formed a Fast Track Task Force (FTTF) to 'catalyse and re-establish' significant growth in mobile handsets and in the component manufacturing ecosystem in India. It is expected to promote large-scale manufacturing/assembling activity to achieve production of 500 million mobile handsets by 2019. India has already achieved the benchmark of 100 million units, which is a step towards achieving the target and establishing India as a manufacturing hub.[107]

The FTTP, in order to promote depth in manufacturing mobile handsets domestically, has prepared a phased manufacturing plan (PMP) roadmap keeping in view the state of the design/manufacturing ecosystem in the country, where through the appropriate fiscal and financial incentives, indigenous manufacturing of the mobile handsets and various sub-assemblies that go into manufacturing mobiles handsets will be promoted over a period with the aim to increase value addition within the country and reduce import dependency.[108]

NITI Aayog points to the fact that OEMs or ODMs or component/accessories suppliers are still in their infancy in India and most of the OEM is confined to last mile assembly indicating that the industry remains in the early stages of development. The domestic mobile manufacturers largely rely on the innovations and standards developed by the international players and organisations.[109]

Chinese Mobile Manufacturers in India: A Case in Point

The Chinese mobile phone makers have captured a significant share of the Indian market. According to IDC India, China-based vendors have contributed to more than half of the Indian smartphone market in CY Q1 2017.[110]

As of now, as Chinese phones are completely imported, the cost of innovation accrues at the point of manufacture of the phone. As an increasing number of Chinese firms have evinced their interest in manufacturing phones under Make in India, they shall also be eligible to pay royalty in India.

[105] 'Make in India' Programme: Government's Reply to the Lok Sabha, Starred Question No. 18, 30th November, 2015.
[106] Telecommunications Sector: Achievements Report, Make in India, Department of Industrial Policy and Promotion (DIPP), November 24, 2016.
[107] Skill Plan of Department of Telecommunications, http://www.dot.gov.in/sites/default/files/2016_10_27%20SDP-Skill_0.pdf
[108] Ministry of Electronics and Information Technology, Notification 4(8)/ 2016-IPHW, Phased Manufacturing Programme (PMP) to promote indigenous manufacturing of Cellular Mobile Handsets, its sub-assemblies and parts/ sub-parts/ inputs of the sub-assemblies
[109] NITI Aayog (2016). Make in India Strategy for Electronic Products. Niti Aayog, Government of India, May 2016
[110] China-based Vendors Now Contribute More Than Half of Indian Smartphone Market in CY Q1 2017: IDC India. Available at http://www.idc.com/getdoc.jsp?containerId=prAP42557317

Chinese Mobile Manufacturers' Participation Under Make in India

Vivo	Vivo entered India in December 2014. In April 2015, Vivo opened its first company-owned exclusive brand store Hyderabad. Vivo plans to set up a manufacturing plant in India over the next few years.
Xiaomi	Xiaomi had earlier announced that it would establish a R&D unit in Bangalore, which will be the first venture out of its home country. With the establishment of a manufacturing plant in India, the company will be able to meet the high demand of the market.
Gionee	Chinese smartphone maker Gionee will set up a manufacturing plant in India that could serve as a hub supplying the company's Android handsets to multiple markets in the region.
OPPO	OPPO, Chinese smartphone manufacturer, entered the Indian market in January 2014. OPPO will set up a handset manufacturing unit in India where it will make smartphones for Indian and overseas markets. It will focus on setting up a state-of-the art facility to manufacture world-class smartphones for the Indian audience as well as key markets overseas.
ASUS	ASUS plans to set up a manufacturing unit in India. ASUS is in the process of hiring a consultancy firm to evaluate the prospects of manufacturing in India. The company will also look at setting up a research and development lab in India.

Source: Make in India[111]

With the Chinese companies willing to manufacture their products in India, the Indian companies must be willing to step up their innovation efforts if they want to remain competitive.

Recently, in a case before the Delhi High Court, responding to certain royalty claims, the Indian subsidiaries of two Chinese entities stated their willingness to pay royalty of a certain sum on the price of their mobile phones.[112] The arrangement could provide guidance on the manner the royalty debate in India is likely to emerge in the future.

Innovation and IPR: A Prerequisite for Developing a Resilient Local Mobile Manufacturing Ecosystem

Investment in R&D is an important indicator for assessing the quality of the innovation ecosystem of a country. In a country where the innovation ecosystem is good, the R&D investment will be higher. The R&D expenditure in India was 0.9% of the GDP in the mid-1980s. Even after the introduction of economic reforms and modification of intellectual property rights regimes in the country, the share has not increased. China, which had the same level of R&D investment in the 1980s, and which had a poor record in IP protection, increased it to more than 2% of the GDP by 2013.[113]

Gross R&D Expenditure (% of GDP)

South Korea	4.15
Japan	3.47
Sweden	3.30
Germany	2.85
United States	2.73
China	2.08
Brazil	1.21
Malaysia	1.07
India	0.81

Source: Science and Engineering Indicators 2016, United States

[111] 'Make in India' Programme: Government's Reply to the Lok Sabha, Starred Question No. 18, 30th November, 2015.
[112] Dolby International AB & Anr. v. GDN Enterprises Pvt. Ltd; Dolby International v. Das Telecom Pvt. Ltd., CS(COMM) 1425/2016. Dt. of Order. 27-October 2016.
[113] ISID (2016). Who will Gain from the National IPRs Policy? Policy Brief No. 1, June 2016. Institute for Studies in Industrial Development, New Delhi.

Our analysis of domestic mobile manufacturers shows that they have not reported any recognisable R&D expenditure in their annual reports. Lack of R&D expenditure in the Indian and telecommunications sector, where innovation is the most important, is the critical element which is missing in the mobile ecosystem in India.[114]

In the absence of an innovation ecosystem in the country, we relied upon on the global mobile standards in early 2000 that permitted the extraordinary expansion of mobile phones by allowing mobile phones to be produced at sufficiently low cost. Indian mobile telecom standards have, till date, adopted global mobile telecommunications standards that are developed and promulgated by international standard setting bodies, such as IEEE, ITU and ETSI. The global standard essential patents (SEP) of the mobile telephony adopted by the country led to the proliferative growth of the telecommunication sector in India. This in turn has acted as a catalyst for the country's economic growth.[115]

By investing in research and development, India can increase innovations and contribute to global standards in mobile telephony. The Government of India after intensive stakeholder consultation on 12 May 2016 has adopted the National IPR Policy 2016.

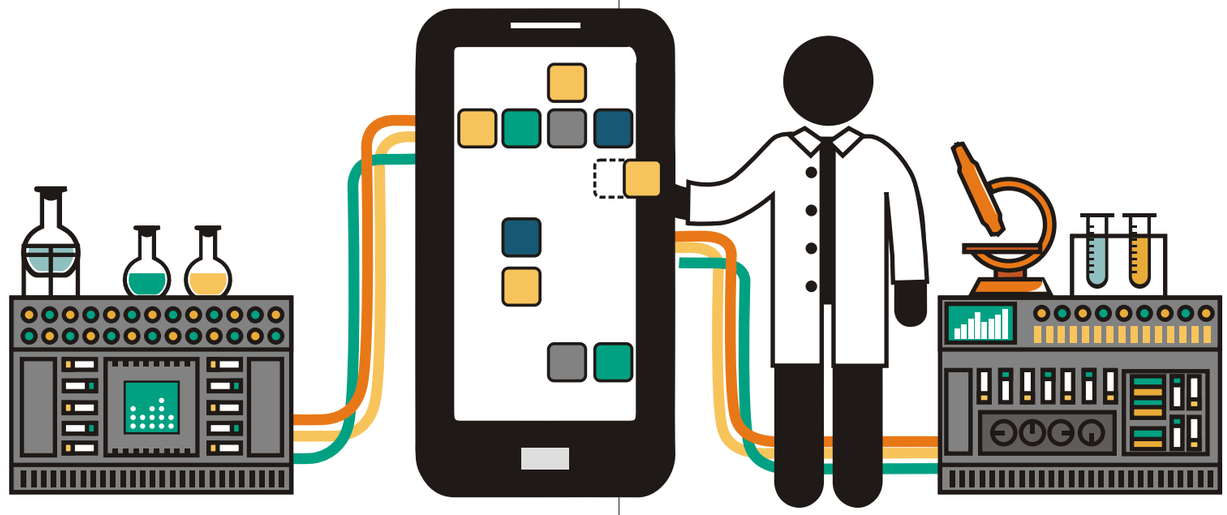
The aim of the policy is to make Indians recognize their own IPs, as also respect others' IPs.

The Vision Statement envisages an India where creativity and innovation are stimulated by Intellectual Property for the benefit of all; an India where intellectual property promotes advancement in science and technology, arts and culture, traditional knowledge and biodiversity resources; an India where knowledge is the main driver of development, and knowledge owned is transformed into knowledge shared.

The clarion call of the Vision Statement is *'Creative India; Innovative India'*.[116]

The Indian mobile phone industry has a long way to go in establishing the innovation framework and in contributing to the global standardisation process. But before that we need to have a business-friendly ecosystem and grow larger.[117]

The incentives and polices of the Government under the Make in India initiative will enable establishing such an eco-system in the country. However, before India has its own Intellectual Property Rights (IPRs) for mobile telephony, we should respect the IPs of others as envisaged under the National IPR policy. This will allow us to reap the benefits of standards and at the same time help the country in reducing cash outflow because of large imports.



The Telecommunications Standards Development Society, India (TSDSI) - an Indian telecom standard setting organisation established in 2014 - comprises local mobile manufacturers, holders of patents on mobile technologies, academic institutions, network providers and the Department of Telecom (DoT) and Centre for Development of Telematics (C-DoT) of the Government of India. TSDSI is an organisational partner of the 3GPP consortium, and emulates the IP policies of ETSI (European organisational partner).

For a standard to be beneficial, it is necessary to ensure that all patents essential to that standard are accessible so that the standard can be implemented.

TSDSI, in line with ETSI, requires all members to declare their willingness, or lack thereof, to license their SEPs on terms that are fair, reasonable, and non-discriminatory (FRAND). In 2016, the Department of Industrial Policy and Promotion (DIPP) released a discussion paper on Standard Essential Patents,[118] where it amongst other issues raised the question of reasonable royalty an innovator is eligible to receive in the context of the development of telecommunication standards.[119]

TSDSI as a representative body can take a lead to strike a balance between adequately rewarding the patent holders who have helped create the standard and the adopters who have implemented these standards in mobiles, keeping in mind the interest of all stakeholders.

The Reasonable Cost of Innovation

There is no unanimity in views expressed by agencies and courts over what is reasonable, when it comes to determining royalty rates on Standard Essential Patents (SEPs). In India, differing views have been expressed by the Delhi High Court and the Competition Commission of India on matters, pending final decision. We will not delve into the merits of these opinions.

Public policy debates on the subject, however, raise two essential aspects of royalty on SEPs: first, what is an appropriate royalty base; two, what is a fair royalty rate.

The concept of royalty payment as part of foreign technology

[114]ISID (2016). Who will Gain from the National IPRs Policy? Policy Brief No. 1, June 2016. Institute for Studies in Industrial Development, New Delhi.
[115]NITI Aayog (2016). Make in India Strategy for Electronic Products. Niti Aayog, Government of India, May 2016
[116]National IPR Policy 2016, http://www.makeinindia.com/policy/intellectual-property-facts
[117]NITI Aayog (2016). Make in India Strategy for Electronic Products. Niti Aayog, Government of India, May 2016

[118]"Discussion Paper on Standard Essential Patents and their Availability on FRAND terms", Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, March 1, 2016.
[119]Discussion Paper on Standard Essential Patents and Their Availability on FRAND Terms, DIPP Ministry of Commerce and Trade. 1st March 2016

agreements came in 1991, when the Government of India *vide* Press Note No. 10 (1991 series)[120] allowed automatic permission to foreign technology agreements in high priority industries, up to a lump sum payment of ₹ 1 crore, and allowed 5% royalty for domestic sales and 8% for exports. The prescribed royalty rates would be paid net of taxes and would be calculated according to standard procedures.[121]

Later, through changes brought in 2009, the royalty cap requirement was removed. Under the existing rules, royalty will be calculated on the basis of the net ex-factory sale price of the product, exclusive of excise duties, minus the cost of the standard bought-out components and the landed cost of imported components, irrespective of the source of procurement, including ocean freight, insurance, custom duties, etc.[122]

While the aforesaid treatment of royalty is not applicable on royalty paid for SEPs, public policy imperatives demand that royalty paid should be based on standard procedures, as recognised through existing procedures or comparable examples. Royalty paid on technology transfer for high priority industries, which at the time of the notifications did not include mobiles, but would naturally include it if its scope were to be revisited, provides a reasonable comparison to follow.

We find a case in the telecommunications domain, albeit under the transfer of technology agreement, where a similar approach was adopted. We consider the case is comparable to the mobile industry, which today has gained much importance in terms of its value and economic potential.

Indian Telephone Industries (ITI) Limited manufactures products in advanced broadband and optical network infrastructure technologies through transfer of technologies from indigenous and global vendors. For its Gigabit Passive Optical Network (GPON) technology, ITI had a Transfer of Technology Agreement with C-DOT), which is the Telecom Technology Development Centre of the Government of India. Under the agreement, ITI paid a technology transfer fee to C-DOT (about ₹60 lakhs) and paid royalty at 4 percent of net sale value during supply. [123]

For the purposes of understanding the basis on which royalty is determined, we draw reference to ITI's commercial terms, under which royalty was paid on net sales value. Similar basis is also followed among other agencies, for instance, DRDO's Guidelines for Transfer of Technology [document dated September 2, 2015][124] state that the royalty will be charged on net sales value.

The Department of Industrial Policy and Promotion (DIPP) in its Discussion Paper on Standard Essential Patents,[125] raised the question of the basis on which royalty rates should be based. The views of courts and/or regulatory agencies, in India, are not final on the subject.

There has been a tendency among courts to fall back on comparable rates to determine what would be a "reasonable rate". There is limited guidance on how a free market determines licensing rates on Standard Essential Patents (SEPs). Gregory Sidak in his paper, *The Proper Royalty Base for Patent Damages*,[126] cited examples of licensor-licensee negotiations worldwide to assert that real-world patent licensing negotiations see firms often calculate royalties with reference to the retail price of the downstream product.[127] The United States International Trade Commission,[128] in the Samsung v Apple patent dispute noted, based on records that the common industry practice is to use the end-used device as a royalty base.

A decision on what is a "reasonable royalty" should be market determined and in case of a dispute, judicially considered.

With an increasing dominance of Chinese mobile manufacturers, it is incumbent upon local manufacturers to innovate. Indian companies are not investing in research and development. There is market evidence to suggest that Indian mobile manufacturers have lost significant market share in recent years, one of the reasons for which is attributed to a lack of innovation, particularly in the smartphone category. Innovation gains from standardisation are well documented. Gains from innovation require paying a reasonable cost towards it, one which is likely to keep the industry competitive.

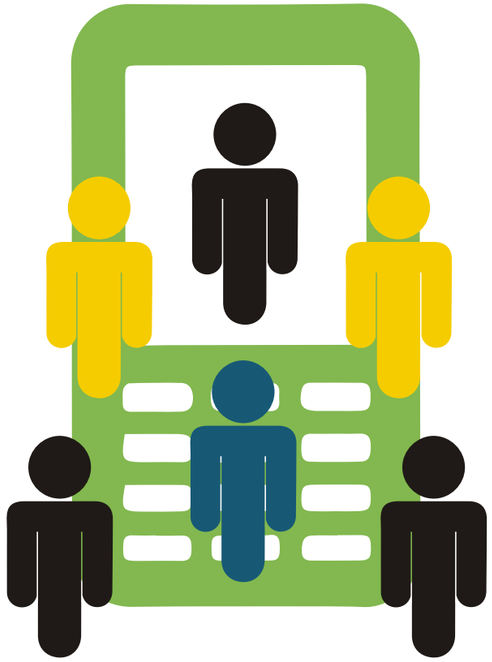
[120]Press Note No. 10 (1991 Series), dt. 14th August 1991.
[121]PN 10 (1991 Series).
[122]Standard Conditions Attached to Approvals for Foreign Investment & Technology Agreement, FT (RBI): Application for Approval of Foreign Technology Transfer.
[123]Lok Sabha Reply to Starred Question No. 324, "Advanced Telecom Technologies": Reply by Shri Ravi Shankar Prasad, Minister of Communications and Information Technology, Date. 12-August-2015.
[124]DRDO Guidelines for Transfer of Technology (September 2, 2015). Available at https://www.drdo.gov.in/drdo/English/DRDO-guidelines-for-ToT.pdf
[125]Discussion Paper on Standard Essential Patents and Their Availability on FRAND Terms: Department of Industrial Policy and Promotion (DIPP): March 1, 2016.
[126]Sidak, Gregory, "The Proper Royalty Base for Patent Damages", Journal of Competition Law & Economics, 10(4), 989-1037. Doi:10.1093/Joclec/Nhu030. Advance Access Publication 26 November 2014
[127]Sidak, Gregory, "The Proper Royalty Base for Patent Damages", Journal of Competition Law & Economics, 10(4), 989-1037. Doi:10.1093/Joclec/Nhu030. Advance Access Publication 26 November 2014
[128]In the matter of, Certain Electronic Devices, including Wireless Communication Devices, Portable Music and Data Processing Devices, and Tablet Computers: Inv. No. 337-TA-794, United States International Trade Commission, Washington, D.C. Available at http://www.groklaw.net/pdf4/SamsungvApple-ITC-Opinion.pdf

Key Highlights

- The growth drivers for mobile phones in India are the scope for increase in mobile penetration, rising income and changing consumer preferences.
- Exponential penetration of 4G services from 3 million in 2015 to 280 million by 2020 will drive demand for smartphones in India.
- The share of mobile and other telecommunications equipment in the country's total import basket currently stands at 26.4%. The share of China in imports in this segment is 69.4% in 2016-17.
- Domestic mobile companies have a median import dependency of 85% of their total purchases. The median of fixed assets to total assets is also 3.1% suggesting local value addition by companies is low.
- Mobile and telecommunications equipment is crucial under the Government of India's Make in India initiative to reduce import dependency.
- Fast Track Task Force (FTTF) aims to 'catalyse and re-establish' significant growth in mobile handsets and component manufacturing ecosystem and achieve production of 500 million mobile handsets by 2019.
- Lack of R&D expenditure in the Indian and telecommunications sector where innovation is most important is the critical element that is missing in the mobile ecosystem in India.
- National IPR Policy 2016 aims to promote innovation in the country and to make Indians recognize their own IPs, as also respect others' IPs.
- TSDSI as a regulatory body should strike a balance between adequately rewarding the patent holders who have helped create the standard, and the adopters who have implemented these standards in mobiles, keeping in mind the interest of all stakeholders.
- TSDSI, in line with ETSI, requires all members to declare their willingness, or lack thereof, to license their SEPs on terms that are fair, reasonable and non-discriminatory (FRAND).

Annexures

Annexure I – Methodology of Multiplier Estimation & Data Sources



For the purpose of calculating the multiplier effect, a scientific and widely used method involving the "Input-Output Table" established by Leontief has been used. The input-output table shows the transactions taking place between consumers and producers. It is prepared in a manner so as to give a user an idea of:

- The demand for inputs from a particular sector; and
- The demand of the sector for immediate and final consumption simultaneously.

In simpler words, the Input-Output (I-O) table helps to analyse the demand of any product for intermediate consumption & final use, thus, allowing for the study of inter-sector linkages. As the I-O table is in matrix form, the entries in the rows and columns of the matrix have different interpretations. Matrix column entries represent inputs requirement, gross value added and net indirect tax. Hence, the sum of the columns represents the total output of the sector. In order to obtain I-O coefficient matrix, each entry in a column of the matrix is divided by the sum total of that column, i.e. the total output of the sector/industry.

For e.g. consider aij denotes the I-O coefficient which represents how much input sector j is taking from sector i per unit output of sector j. This relationship is presented below:

$$Xi = ai1\ xi1 + ai2\ xi2 \ldots\ldots + ain\ xin + yi,\ i=1, 2\ldots.n,\ xij = aij\ Xj$$

In the matrix notation, this can be represented as

$$X = AX + Y$$

$$Y = (I-A)^{-1} X$$

Where:
-A is the input-output coefficient matrix;
-(I-A) is the Leontief Matrix;
-$(I-A)^{-1}$ is the inverse of the Leontief Matrix;
-X is the total/gross output; and
-Y is the final demand of X.

The diagonal of the Leontief Matrix (I-A) gives the net output for each sector with positive coefficients while the rest of the matrix gives the input requirements with negative coefficients. The inverted Leontief matrix $(I-A)^{-1}$ shows how direct and indirect requirements change with a change in final demand by one unit.

Once the inverted Leontief matrix is estimated, it is easier to calculate multipliers, which is explained in detail in the next section.

Multiplier estimation is based on the estimation of the inverted Leontief Matrix, which is derived using the I-O coefficient matrix.

An I-O coefficient matrix is estimated using the I-O table, which summarises the demand and the supply side transactions that are taking place in the economy. The input-output coefficient can be interpreted as the input requirement of a particular sector from other sectors, to produce one unit of output of that

sector. Such a matrix can be obtained by dividing column entries by total output of the sector, where column entries show the input requirement of a sector.

Total output is the sum total of total input, gross value added and net indirect taxes. Hence, the sum of input coefficient, indirect tax coefficient and income coefficient should be one. Once the I-O coefficient matrix is obtained, the Leontief Matrix is obtained by subtracting the I-O coefficient matrix from an identity matrix of the same order.

The diagonal of the Leontief Matrix gives the net output for each sector with positive coefficients, while the rest of the matrix gives the input requirements with negative coefficients. The matrix thus obtained, the 'Leontief Matrix', is then inverted to estimate the multipliers.

Data Sources

In India, the Central Statistics Office (CSO), of the Ministry of Statistics & Programme Implementation prepares the input-output table which is updated every five years. NSSO's report on employment and unemployment for the year 2007-08[129] has been used for obtaining employment data.[130]

The latest available input-output table is for the year 2007-08. Considering the structure of the economy does not change significantly in a span of 5-7 years, we can safely use the estimates derived from the latest available table.

The CSO matrix, however, is a "commodity X commodity" matrix for 130 commodities. To simplify the analysis, for this study, eight broad sectors were identified based on economic activity. The entries in the I-O table were then aggregated on the basis of the economic activities so identified and NIC-2008 codes, to convert the 130 X 130 commodity X commodity matrix into a 9 X 9 sector X sector matrix.

Aggregation of 130 Commodities into Eight Sectors

Sectors	Commodities in I-O Table-2007-08 matrix
Agriculture & Allied Activities	1-26
Mining	27-25
Mobile and Other Communication Equipment	92
Other Manufacturing	38 to 105 except 92
Construction	106
Electricity, Water Supply	107-108
Mobile (Communication) Services	115
Other Services	109-129 except 115
Public Administration	130

Source: TARI Research Team, based on NIC 2008

[129]In order to make the data comparable across the factors, employment data for the year 2007-08 has been used despite the fact that it was thin round of the NSSO survey.
[130]Report titled "Employment and Unemployment Situation in India,2007-08"