AN INQUIRY INTO THE IMPACT OF INDIA'S **APP ECONOMY**

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Executive Summary

In India mobile communications have been the most visible manifestation of the extraordinary digital accomplishments seen in the past decade. One positive fallout of the success of mobile communications has been the rapid development of highly innovative bite sized software programmes called mobile software applications (or simply 'apps') resident on smart hand held devices. Apps differ from traditional mobile value added services (MVAS) since they are palpably richer in content, typically operate on smart devices and mostly depend on the internet to function.

The growing importance of smartphones in Indian society presents an opportunity for apps to deliver transformational changes in economic and social development, including employment creation. India's app economy complements its already well-established IT software services industry, with the same pool of software engineers, user interface developers, designers and other IT professionals directly engaged in app development. With adequate training and orientation, India's software talent, which has a significant global footprint, can clearly replicate earlier successes in this steadily expanding sector

Apps offer unique benefits for a diverse set of stakeholders. Take for instance the restaurant search app Zomato, which apart from directly serving consumers also benefits restaurateurs by functioning as an international marketing platform for their establishments. Behind the scenes, it also employs experts in design, content development, sales, client relationship management, operations, and other business functions. This is increasingly typical of many businesses that are based on or aided by apps

In our report, we explore this potential of apps to create jobs. We use an input-output model to estimate multipliers, i.e. how many potential jobs can be created directly and indirectly (Type I) and how many can be induced by their growing incomes (Type II). Apps currently account for 75,000 jobs in India. Using our estimates for increase in employment (between 2014 and 2016) the multiplier effects have been estimated under different business and regulatory scenarios. The first scenario is business as usual (BAU) with no regulatory intervention. The second scenario assumes a mature industry (IM) with high smartphone penetration and data usage. The third scenario models for government intervention (GI) providing digital infrastructure and enabling demand. The fourth scenario is a combination of the second and third – aggressive government intervention in a mature industry (AGI). The multiplier values increase progressively across the four scenarios. The minimum estimated increase in direct and indirect employment for the app economy is 91476, while the maximum is 159618. If we include changes in induced employment, these numbers rise up to 221,067 and 604867 respectively. Thus the aggregate number of jobs that apps could create in India during the period 2014-16 lies between 91476 and 604867, the upper limit being close to eight times the current levels of employment. If direct employment increases at a faster rate, the multiplier effects will result in massive benefits to overall employment in the economy.

Apps are a part of a highly networked and interdependent ecosystem. Unlike mobile, the app economy cannot thrive in the absence of network infrastructure, devices, content and users. Policy levers must facilitate each part of the ecosystem, jointly and severally, to enable app development, distribution and demand. The supply side bottlenecks that constrain distribution include inadequate backbone networks and distribution platforms. App revenue models have so far seen little success. Poor levels of commercialization impede entrepreneurial aspirations and employability in the industry, increasing the perceived risk around app development. On the demand side the main constraints are lack of affordable mobile devices and broadband services, poor digital literacy as well as limited local applications and content. Policy intervention simultaneously supporting improved infrastructure, more liberal payment regimes and ubiquitous internet access at affordable prices could go a long way in exploiting the potential gains of the app economy. Responses to our survey of 450 app developers and in-depth case studies underline the challenges facing this nascent yet growing industry.

Another aspect of the report focuses on the app value chain. Our research highlights the need for skilled app developers to go beyond trouble-shooting and focus on developing improvements in user interfaces/user experiences (UI/UX) through enhanced design that also serves local needs. There is also a demonstrated need for seed funding for entrepreneurs who are trying to break into the local market.

With India's characteristics of huge service deficits as well as underserved populations and regions, rapid growth of apps presents a rare opportunity to address some of these challenges and increase participation in the digital economy. A few key enabling policy interventions can help drive apps and augment the 'value' of mobile access in a manner that was almost unthinkable only a few years ago.

It is encouraging that the Prime Minister acknowledges the role of technology and apps in his recent policy initiatives, including the 1000 crore Self Employment and Talent Utilisation (SETU) incubation program that will support start ups in the technology area.

1. Introduction

With close to a billion mobile subscribers in India, around three-quarters of the population have access to a mobile phone. Mobiles are arguably the most ubiquitous modern technology in some developing countries, more people have access to a mobile phone than to a bank account, electricity or even clean water. In India mobile communications have been the most visible manifestation of the extraordinary digital accomplishments seen in the past decade—from providing basic access to education and health related information to making cash payments to crowd sourcing- the growing list firmly establishes us as a 'mobile first' economy. Legacy communications systems i.e. fixed line access have been virtually supplanted by mobile systems in India and in the rest of the developing world, as opposed to being supplemented by them in richer countries. Not surprisingly therefore many mobile innovations—such as multi-SIM card phones, low-value recharges and mobile payments—have acquired the soubriquet of 'reverse innovation', having taken root in developing economies and spreading from there. Our work shows that new mobile applications that are embedded in local realities have a much better chance of success in addressing development challenges compared to applications transplanted from elsewhere. In particular, locally developed applications are much more likely to address existential concerns such as digital literacy and affordability, among others.

One positive fallout of the success of mobile communications has been the rapid development of highly innovative bite sized software programmes called mobile software applications or simply 'apps' resident on smart hand held devices. These apps use data-stream either continuously or on a one-off basis to deliver information and perform specific functions.[1] These functions enable gaming, social networking, navigation, utilities, health, and education, among others, and are revolutionising the way phones are used. Apps differ from traditional mobile value added services (MVAS) since they are palpably richer in content, typically operate on smart devices and mostly depend on the internet to function[2]. It is now convention to group SMS, MMS, call related services and data access as standard services that lie outside the domain of what is classified as mobile application software or apps.[3]

That the rapid growth of apps can have a transformative impact on livelihoods and businesses is supported by empirical evidence that is being carefully collected across the world.[4] By making phones more powerful, apps, aided by high-speed networks and innovation can have important productivity enhancing impacts throughout the economy. This new evidence on the 'app' economy comes close on the heels of similar evidence for mobiles and internet that is now firmly established as part of telecom folklore[5].

[1] Kathuria, R. & Srivastav S. (2014) The Indian App Ecosystem. Lirne Asia. The Ford Foundation.
Retrievedfromhttp://broadbandasia.info/wp-content/uploads/2013/03/The-Indian-App-Ecosystem-Final- Report_afterEF2014.pdf

[2] In connectivity constrained environments, developers are working on applications that are saved on a phone's secure digital card/ memory card with occasional need for internet based updates. For example, the Pink Army Application developed by Mobile Harvest

[3] TRAI (2012), Recommendations on Application Services.
Retrieved from http://www.trai.gov.in/WriteReadData/Recommendation/Documents/AS140512.pdf

[4] For example, Qiang, Yamamichi, Hausman, and Altman, 2011, " Mobile Applications for the Health Sector", ICT Sector Unit, World Bank and Qiang Kuek, Dymond, and Esselaar, 2011, "Mobile Applications for Agriculture and Rural Development", ICT Sector Unit, World Bank among several other.

[5] For India, every 10% increase in mobile penetration rate leads to 1.5% increase in GDP with evidence of network effects which magnify the economic impact when the level of mobile penetration exceeds a critical mass of around 25%. On the other hand, the corresponding growth impact of internet has been lower; for every 10% increase in the number of internet subscribers, there is an estimated 1.08% point increase in GDP for India. Globally, the relative magnitudes of growth dividends of different communication technologies establish a sort of hierarchy of impacts, with fixed being the lowest and broadband being the highest. See Kathuria and Kedia, 2012, "India: Impact of Internet", ICRIER

It is useful to understand the value of a sound and competitive telecommunications system to fully appreciate the route through which app impacts are created and transmitted. It has been repeatedly shown that access to telecommunications improves productivity by, inter alia, reducing information asymmetries and containing transactions costs. Because mobiles substitute for fixed lines in developing economies, the growth impact of mobile phones is higher than that for developed economies.[6] Evidence of the impacts of apps could be expected to be along similar lines for developing economies. Unlike simple mobile telephony, the app economy prospers only in the presence of an ecosystem rather than in isolation.

The app economy shares complementarities with India's well established IT software services industry. The economic crisis of 2008 brought the industry under pressure and companies resorted to layoffs and/or a slowdown in fresh recruitment. The challenge from Chinese and Russian firms exacerbated the situation[7]. The upcoming app economy can become a ready solution for graduating computer engineers/ experienced IT professionals in India. With adequate training and orientation, India's talented software engineers can be absorbed in this steadily expanding sector. For the United States, apps are credited to have created 519,000 jobs as of April 2012[8]. The purpose of this study is to estimate the direct, indirect and induced employment multipliers for India's app economy and to identify constraints in the development, distribution and usage of apps. No other study has so far attempted to capture the economic and social impacts of apps in India.

1.1 The App Revolution – An Opportunity for India

Origins of the 'app economy' can be traced back to the launch of the iPhone in 2007 followed by the App Store in 2008. Since then, the global market for apps has been growing at unprecedented rates. Analysts estimate app downloads have increased from $ 24.9 billion in 2011 to $ 81.4 billion in 2013. This number is expected to rise up to $ 310 billion by 2016[9]. The App Store was one of the first commercially successful digital distribution platforms because it challenged the monopoly of the 'walled garden' through which mobile operators controlled content. Mobile operators forced users to interface withtheir network for access to apps and other value added services that were delivered on the operator's network. Thus operators were the gatekeepers, and content providers paiddisproportionate amounts to operators to feature their applications.

Competition triggered by technological advancements such as the development of Wi-FI enabled smartphones and the emergence of special online stores allowed bypass of an operators' network. This weakened their grip on the app ecosystem. These developments encouraged the shift from a telecom-operator controlled network to Wi-Fi as a means of content delivery. This marked the inflexion point for the app revolution. On its part, Apple permitted any developer from the public domain to design apps for the App Store and offered a flat 70 percent of the total revenue to developers. By contrast, telecom operators had adopted a 30:70 revenue share model in their favour. In 2011, Vodafone offered higher revenue shares to developers to popularise apps. Content thus became more easily discoverable and the App Store represented a one-stop-shop which interfaced between many developers and buyers

The model of having a single platform to disseminate and facilitate the payment of apps has been so successful that Apple's competitors which include Google, Nokia[10], Research in Motion and Microsoft launched their own app stores.[11] Other aggregators[12] such as Vserv provide app developers with fresh avenues for monetization. .

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[6] Qiang and Rossotto, 'Economic Impacts of Broadband, Information and Communications for Development 2009: Extending Reach and increasing impact' World Bank 2009

[7] http://www.thenavigatorsindia.com/Docs/Software%20Industry%20Trends%20in%20India.pdf

[8] Mandel and Scherer, 2012, "The Geography of the App Economy", CTIA The Wireless Association

[9] Gartner and Mobi Thinking retrieved from http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/e#lotsofapps

[10] Nokia, now acquired by Microsoft encourages software development on Windows as compared to Symbian. However, some app developers continue to work on Symbian. Please refer to Section 4 on survey data analysis.

[11] Kathuria, R. & Srivastav S. (2014). The Indian App Ecosystem. LirneAsia.The Ford Foundation. Retrieved fromhttp://broadbandasia.info/wp-content/uploads/2013/03/The-Indian-App-Ecosystem-Final-Report_afterEF2014.pdf

[12] Aggregators consolidate ad inventory - various apps and space therein as well as the mobile websites 13Pappas A. (2013). App Economy Forecasts 2013-2016, Vision Mobile. Retrieved from http://www.visionmobile.com/product/app-economy-forecasts-2013-2016/

Apple helped advance a paradigm in which mobile devices evolved from being simply tools for text and voice communication to pocket personal computers. As users wished to do more with their mobile devices, the supply of apps kept pace with the increasing and diverse demand. There are apps now that help users learn new languages, read, music, navigate cities, share files, read the news, learn recipes, and record important health-related information among many other things. The proliferation of apps across many verticals and functions underlines why this sector is regarded as an 'economy' in itself. It is also indicative of the high degree of competition that exists amongst developers. It also demonstrates the shift in value from handsets to apps, as users place more value on mobile software than hardware.[13]

India is a source of enormous demand for apps. Even though smartphone penetration is estimated at just 10 percent of total mobile users,[14] India experiences 100 million downloads per month[15] placing it amongst the top five regions for Google Play, the official Android app store.[16] The number of 3G SIMS in India is also expected to increase from 35 million in 2012 to an impressive 272 million by 2017.[17] India also significantly contributes to app development as roughly ten percent of apps worldwide are developed by Indians either based abroad or at home.[18] In 2010, Indian service providers debuted in app distribution when Bharti launched the Airtel App Central online store. The success however was limited due to the uncompetitive revenue sharing contracts mentioned above. App distribution in India is therefore, dominated by international app stores such as Android's Google Play, Nokia's Ovi Store and Apple's App Store. This is in sharp contrast to other Asian economies such as South Korea and China where local app stores play an equal, if not greater role, in the dissemination and payment of apps than their international counterparts.[19]

India's rapidly expanding middle class will inevitably make the switch from feature phones to smartphones creating vast opportunities for new entrants[20]. Today, over half of Indian smartphone users access the internet daily through their device and nearly all never leave their homes without it[21]. This shows the growing importance of smartphones to Indian society. Affordability of mobile data is anotherkey factor driving this trend. According to the International Telecommunication Union (ITU) India is one the cheapest countries for a phone plan with data[22].

India also represents an opportunity at the 'Bottom of the Pyramid' users due to the huge potential demand for affordable smartphones and apps from this segment. Unlike developed markets where the Android/Apple duopoly on the OS level is firmly established due to the high penetration of Apple iPhones and Samsung smartphones, India offers space for other operating systems, particularly those that are designed to operate on lower-end devices (OS platforms such as Symbian still enjoy significant market share in India and the Firefox OS is expected to gain traction).[23]

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[14] Avendus Estimates

[15] Law, Abhishek. "Developing India's app market." The Hindu [New Delhi] 1 Aug. 2012: The Hindu Business Line. Web. 20 Jan. 2014.

[16] App Annie Data

[17] According to Analysys Mason 3G users in India will touch 272 million by 2017 from 35 million in 2012 Refer to http://www.telecomlead.com/3g/3g-users-in-india-to-touch -272 -million -by-2017-from-35-million-in-2012-analysys-mason-38292/ Web.Jan 20, 2014.

[18] VisionMobile 19Salz P. (2014) Apponomics. InMobi

[20] As of 2013, there were 51 million smartphone users in India but this number is likely to mushroom to 104 million by the end of 2014. The shipment of smartphones increased by 166 percent (in quarter 2, 2013) making India the fastest growing smartphone market in the world. Figures are from IDC.

[21] Google Our Mobile Planet

[22] The average phone plan with 500MB of data costs 85 USD in the United States whereas the same plan costs, on average, only 10 USD in terms of US dollar Purchasing-power Parity (PPP) in a country like India

[23] Saxena, Anupam. "Mozilla partners Spice and Intex to launch $25 Firefox phones in India." The Times of India [New Delhi] 11 June. 2014: Web. 12 June. 2014.

Other platforms such as Android One are also targeted at smartphone first timers, but yet to take off in India. There is a corresponding opportunity for handset manufacturers to design and manufacture devices that can support apps at suitable price-points for this segment. India has been acknowledged as a highly price sensitive market that explains in part the dominance of the Android OS[24]. As stated above, India features among the top five download regions for Google Play by number[25] However, by revenue it is not among the top ten[26] thereby demonstrating the challenge of monetizing its large base of downloads. Challenge, as the cliché suggests is another course to opportunity that in this case can be exploited by handset manufacturers, OS companies and app developers alike, given the sheer scale of the local Indian market.

That data will be the centrepiece of India's second telecommunication revolution is a widely held and an eminently justifiable view the promise of the app economy within this paradigm needs therefore to be better understood. For example, how apps will contribute to India's employment, especially of its youth, is an important issue worthy of rigorous investigation. The presence of a large, skilled pool of young software developers coupled with high growth rates in the smartphone and data markets suggests that the Indian app economy has reached the point of inflexion. According to experts familiar with apps, the next break-through innovation in apps will be Indian.[27]

[24] According to IDC, Google's mobile operating system has a 91% market share in the country, giving it an overwhelming lead over its competitors.Android totally dominates the market because it is used by all major smartphone players in India. Local vendors like Micromax and Karbonn have adopted it. Android powers phones costing Rs 3,000 to Rs 45,000 and that helps it attract a lot of consumers

[25] App Annie Data

[26] Ibid.

[27] "Next Breakthrough App Will Come from India: Microsoft." The Economic Times [New Delhi] 3 April. 2014: Web. 12 June. 2014.

2. The App Ecosystem

The app economy is part of the internet ecosystem which consists of network infrastructure, devices, content and users. Apps are a subset of content and can add to the attractiveness of the broadband network by providing services that are of considerable practical use. Since it is part of a highly networked and interdependent ecosystem, the app economy cannot be viewed in isolation. Its functioning depends on the existence of a robust network infrastructure, appropriate devices and a supportive OS landscape. Its general purpose nature makes it ubiquitous across several verticals of which healthcare, education, business and governance, among others, generate considerable interest due to their ability to address pervasive supply side bottlenecks.

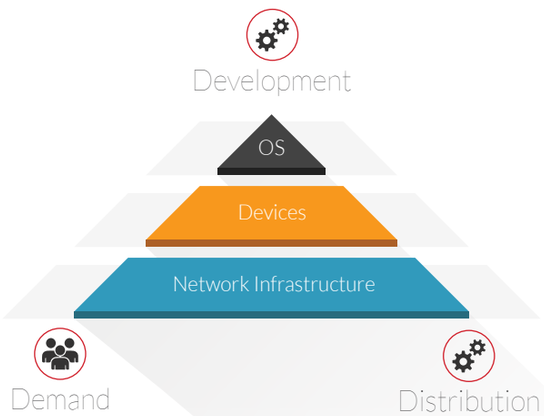

Figure 1: The App Ecosystem

Source: Adapted from Kathuria and Srivastav

Figure 1 captures the different dimensions of an app ecosystem. The app economy consists of three principal activities which are app development, distribution and demand represented by the nodes of the pyramid. The three main factors that influence the core activities of the app economy are network infrastructure, devices and the OS represented as different layers of the pyramid. Each of these dimensions is discussed below.

2.1 Core Activities of the App Ecosystem

2.1.1 Development

Most app stores allow almost anyone to submit an app for consideration. While development of an app could be inexpensive, the challenge lies in overcoming the last mile constraint to reach the final user. App developers design apps either on a contractual basis (i.e. for specific clients) or independently - either as free-lance developers or as start ups. According to Vision Mobile's Developer Segmentation model,[28] app developers are a heterogeneous lot-they can be classified in terms of their main objectives. The first category of developers makes apps in the pursuit of creativity. This category often includes the youth, free-lance developers and hobbyists. The second category of app developers is motivated by revenue generation. This category includes large gaming companies such as Rovio and Zynga as well as companies such as Zomato which design apps keeping in mind a strategic business model. Such profit-maximising developers engage in contractual app development which may be commissioned by business enterprises. They typically comprise 42 percent of the developer population and 48 percent of the app economy revenues globally.[29] This group also represents the "mobile internet only" or "mobile first" businesses. The final category of developers make, or get made, apps for the purpose of extending a business.

[28] voskoglou c. (2013). Developer segmentation 2013. Visionmobile. Retreived from http://www.Visionmobile.Com/product/developer-segmentation-2013/

[29] voskoglou c. (2013). Developer segmentation 2013. Visionmobile. Retreived from http://www.Visionmobile.Com/product/developer-segmentation-2013/ibid.

This category includes known names such as Microsoft, Adobe, MakeMyTrip and The Economist among others who wish to establish presence on mobile. There is an emerging overlap between the second and third category of app developers. The activities of these different developers are supported by a host of secondary services that include app analytics, mobile advertising, testing, API and cloud computing services.

India has a vibrant developer community and locally hosts an estimated 75,000 developers.[30] Vision Mobile, which conducts the most extensive quarterly app developer survey in the world, found that after the US, the largest nationality of developers is Indian,[31] although roughly half of them are based outside India.[32] Of those who operate within India, it is unclear how many create apps that are 'local' in nature (in terms of language and catering to local needs and tastes). The local market for apps is constrained by a restraining cycle in which inadequate local content leads domestic users to consume international apps, which in turn further discourages Indian developers to create and market local content.

Appendix 1 lists the ten most popular Facebook linked[33] app developers headquartered in India by monthly average usage (MAU), as reported byMetrics Monk - an app analytics firm.[34] Most of these apps are an extension of existing services to a mobile platform or gaming apps. Also, the majority user base for these apps developed in India comes from within India with one exception being Hashcube, for which users are primarily from the US.

2.1.2 Distribution

The second element of the app economy's core activities is app distribution. Due to the vast numbers of independent app developers, a platform that aggregates apps and facilitates payment will enhance efficiency in distribution. It would also help in new app discovery. Currently, Android and iOS control over ninety percent of the smartphone market share globally.[35] Google Play hosts about 1300000 apps globally. The corresponding number for Apple App Store is 1200000[36]. While Apple only allows the official App Store to function on its devices, Google operates on an open source ecosystem that allows access to any app store. In several Asian economies, particularly those where local content is in high demand, telecom operator managed app stores running on Google's Android OS play a big role in facilitating dissemination and payment for apps. For example in South Korea, T-store, "the home-grown Android app store run by the local mobile operator, SK telecom"[37] has a bigger share than Google Play with 19 million registered users as of January 2013.[38] Another appealing example of app distribution is the world's first app store for government services. Smart Apps Shop is an Emirati app store that runs on both the Android and iOS platforms. It features over 100 apps that have been developed by UAE government agencies.[39] "MyGov"[40] is India's initiative in this space.

International app stores continue to dominate the distribution of apps in India. An innovative offline app distribution platform called Apps Daily addresses the current impediments of inadequate connectivity and burdensome payments systems in the ecosystem. However, it is unlikely to become the principal platform. Local app distribution platforms must attain critical scale to incentivise app developers to create relevant content. The government has taken a right step in this direction by launching its Mobile Seva Appstore[41] which has won the UN Public Service Award 2014 under category 3 for "Promoting Whole of Government Approaches in the Information Age"

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[30] Industry estimates

[31] VisionMobile: State of Developer the Nation Series.

[32] Ibid.

[33] Facebook-linked apps are those which are accessed or advertised via Facebook.

[34] These statistics cover software developers who use the Facebook Platform (Facebook APIs) to design apps that interact with Facebook features such as data storage and log in. To obtain demographic and geographical data on Facebook-linked apps, Metricsmonk collects three data sets. The first data set consists of publicly available data, such as app and publisher names, rankings, Facebook tiers and ratings. The second data set consists of more specific user data which is obtained from multiple sources and verified using an algorithmic approach. The third data set consists of historical data (Facebook historical real numbers) that provides information on the conformation of the application ranking curve. Active users are then calculated based on algorithms that regularly sample the data sets. The results are continuously verified against "real numbers" of Metricmonk's partners.

[35] Gartner (Q2, 2013).

[36] Statista, The Statistics Portal

[37] Salz P. (2014) Apponomics. InMobi 38Ibid.

[39] Basu, Medha. "UAE launches world's first smart government app store" Asia Pacific FutureGov. 31 March 2014: Web. 12 June. 2014. http://www.futuregov.asia/arti cles/2014 /mar/31/uae-launches-worlds-first-smart-government-app-sto/

[40] http://mygov.in/

[41] https://apps.mgov.gov.in/index.jsp

2.1.3 Demand

The consumers of apps include enterprises, government agencies and individual users. Users in India, like those globally show preference for communication, gaming and social networking apps.[42] The average smartphone user in India has 17 apps on her device[43] compared to the average Android smartphone user in the OECD who has 26 apps and the average Japanese user who has 41.[44] Although low, app usage in India is set to grow as digital technology becomes pervasive and acceptable. .

The most popular age group for app users in India is 18-25.[45] Besides, there is a perceptible gender skew since roughly 80 percent of the smartphone users are male, although it is likely to become more equitable in the future.[46] Appendix 2A and 2B list the most popular Facebook linked apps in the general and gaming categories respectively.[47] WhatsApp Messenger and Facebook are the top free apps in India for Google Play while Teen Patti and Candy Crush Saga are the top grossing.[48] Social Networking and Entertainment are the popular genres. Indians also have a unique appetite for astrology/devotional apps. Among popular apps in India, some are completely focused towards the Indian market (e.g. Truecaller).The popularity of Opera Mini, a browsing app which compresses websites to save users' data costs, illustrates the price sensitivity of the Indian consumer.

The potential for India to leverage the app ecosystem to achieve certain developmental goals is still under utilised as app usage is skewed towards entertainment, gaming and social networking. Apps that focus on initiatives such as agriculture, health, and education have not scaled adequately because the ecosystem is itself under developed.

2.2 Drivers of the App Ecosystem

2.2.1 Network Infrastructure

A robust network infrastructure in terms of both coverage and capability is necessary (although not sufficient) to support growth of the app based economy. Internet penetration in India is 17.4 percent,[49] lowest among the BRICS (Brazil 50%, Russia 53%, China 42%, South Africa 41%).[50] In particular, mobile broadband, at only 5 percent penetration[51] limits scale. 92 percent of India's subscribers access internet on wireless devices, the quality of which is constrained by chronic spectrum shortage and deployment of dated wireless technologies.[52] 2G and 3G wireless services have shown deterioration in recent times,[53] and 4G is yet to mature. While there are apps that function offline, connectivity is vital for initial downloads and for a significant number of apps that continuously depend on real time data (e.g. WhatsApp, Skype, Facebook, Google Maps, Find my Friends etc.). The demand for high bandwidth and therefore spectrum will increase as apps inevitably diversify to education, healthcare and e-commerce. More over, with the introduction of HTML5, more apps will be hosted on the cloud thereby necessitating a rise in mobile broadband coverage and capability.

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[42] Metrics Monk
[43] Google, Our Mobile Planet, India
[44] OECD (2013), "The App Economy", OECD Digital Economy Papers, No. 230, OECD Publishing.http://dx.doi.org/10.1787/5k3ttftlv95k-en
[45] Ibid.
[46] Google, Our Mobile Planet, India
[47] The data presented in these tables are limited to being Facebook linked, however they do capture the major trend in India. Similar data from Google Playstore or the Apple App Store can further build on some of these findings.
[48] Metrics Monk
[49] EMarketer Report, May 2014. Retrieved from http://www.emarketer.com/Article.aspx?R=1010893
[50] ITU 2013
[51] Ibid.
[52] TRAI Performance Indicators Report, December 2013
[53] TRAI Performance Indicators Report, December 2013

The government recognises the need to improve internet connectivity through deployment of the National Optical Fibre Network (NOFN) that seeks to provide high speed internet to over 238,000 gram panchayats.[54] A high speed fibre link to villages will help spur uptake of 3G and newer generation technologies since back haulvastly benefits from the existence of a fibre based network. Meanwhile the market has stepped in to overcome the weak network infrastructure through innovations such as dongles, community internet and public hot spots etc. But ultimately connectivity on fibre is essential.

2.2.2 Devices

In India the penetration of smartphones currently stands at a negligible ten percent but it is increasing rapidly.[55] The penetration of smartphones facilitates the growth of the app economy since apps require devices with advanced computing capabilities and features such as Wifi connectivity, touch screens, GPS, web browsing, graphic displays etc.

Given technological advances,mobile devices can now function as a wallet, camera, television,alarm clock, calculator, address book, calendar, newspaper, gyroscope, and navigational device combined[56]. Price of smartphones is critical for greater penetration and there is no doubt that deviceprices are declining while becoming more powerful at the same time. Penetration is thus set to grow but the app economy also requires scale to become viable. Thus demand-side policies ought to also take into account growth of broadband-enabled services to be effective.

Devices play a major role in influencing app development since the latter have to conform to the characteristics of the mobile device. In India, the device ecosystem is rather fragmented as companies cater to a market of multiple price points and several different types of mobile devices. The high degree of fragmentation can potentially create interoperability issues for app developers as they must ensure that their app functions optimally across different screen sizes and hardware characteristics. Local content development requires app developers to collaborate with handset manufacturers and ensure that Indic scripts can be supported. Smartphone manufacturers have responded to the local challenge and some progress is visible towards leveraging the vast promise of local content and apps, although the full scope and scale of these opportunities is yet to emerge[57].

2.2.3 Operating Systems (OS)

The OS of mobile devices constitutes the software platform atop which apps operate.[58] A developer has to ensure that appsare compatible with the targeted OS platforms. Since Android has the widest reach it is a popular choice for developers although Apple is a good choice for revenue generation.[59] However, an app developer typically targets several OS platforms. App distribution is closely linked to the OS landscape since OS managed app stores are amongst the most popular. For users there is a potential lock-in due to the switching costs associated with purchasing apps and learning to use them on a particular OS. The incidence of lock-in is relatively more severe for Apple which operates a closed, propriety system as opposed to Android which is open source.

The life cycle of an app is shaped by its lure at each stage, namely development, distribution and consumption(demand). Each stage is inextricably linked to the supporting ecosystem which consists of network infrastructure, mobile devices and OS platforms. Competition at each node influences the life cycle of an app while policies provide the supportive framework. This analytic structure allows us to explore the various levers of the app ecosystem and how they interact with each other to deliver growth. The fragmentation that arises from multiple operating systems and platforms continue to challenge India's app ecosystem.

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[54] DoT, National Broadband Policy, 2012. Delay in deployment of NOFN is well recognized

[55] According to IDC, smartphone shipments to India grew by 186% in Q1, 2014.

[56] Maximisng Mobile World Bank 2012

[57] Micromax, an Indian device manufacturer has launched Micromax Unite 2 which supports 21 vernacular languages

[58] Kathuria, R. & Srivastav S. (2014) The Indian App Ecosystem. LirneAsia.The Ford Foundation. Retrieved from http://broadbandasia.info/wp-content/uploads/2013/03/The-Indian-App-Ecosystem-Final-Report_afterEF2014.pdf

[59] Pappas A. (2014) Developer Economics Q1 2014: State of the Developer Nation, VisionMobile. Retrieved from http://www.visionmobile.com/product/developer-economics-q1-2014-state-developer-nation/

3. Impact Analysis

3.1 Literature Review on employment and growth multipliers of the App Economy

Early studies estimated employment and growth effects of apps by primarily focusing on app store sales and mobile advertising. With the app economy becoming more pervasive, a realistic estimate of the impact must include spillover effects i.e. the jobs (and revenue) that gets created outside app stores.[60] When this factor is included, the estimates show that with in the app ecosystem contractual development generates the most revenue, followed by app stores. In 2013, Vision Mobile estimated that contract development was responsible for 56% of the app economy revenue. Besides, 26% of app developers are engaged in developing apps on commission[61]. Other revenue generating activities include in-app advertising, e-commerce and other activities that support app development such as app analytics which are a small but rapidly growing segment of the app economy.[62]

Given the newness of the app economy and its linkages with several other industries, estimating its employment impact using standard econometric approaches is difficult. The app economy's networked nature makes it clear that employment generated in this sunrise sector is not limited to developers but more significantly spills over upstream and downstream to telecom, internet service providers, mobile device manufacturers, etc. which comprise the app ecosystem. CTIA – The Wireless Association and the Application Developers Alliance published a report in 2012 estimating that the app economy in the US has created 519,000 jobs as of April 2012.[63] CTIA used online want ads that were looking for app economy skills. A list of key words [64] and phrases were put together to identify ads related to app economy jobs. A sample based validation was carried out for the selected ads to ensure that they truly represented app economy jobs. The study found that each ad corresponded to roughly 7.2 core app economy jobs.[65] In addition, non-tech jobs were estimated to be almost equal in number.[66] Replicating this methodology for India would be impractical since there isn't any comparable sophisticated source of information for employment opportunities that could help isolate demand for app related jobs. Web based companies like Naukri and Monster at best provide trends in the job market. Arriving at results using data from these sources will result in a specious estimate.

The other estimate of employment attributable to apps is the ACT4 Apps studyfor Europe[67] It shows that the app economy created 794,000 jobs in 28 EU countries, of which 529,000 or two-thirds are direct jobs. The remainder includes a host of non-technology jobs such as management, sales, customer service, accounts, finance, etc. This is in contrast to the US where half the jobs are direct[68].

[60] According to Vision Mobile, revenue sources for the global App Economy in 2013 was majorly contributed by contract development (Euro 27.8 bn), followed by non-app store subscriptions, licensing fees (Euro 10.5 bn), then app store sales (Euro 9.1 bn), in-app advertising (Euro 3.7 bn), and finally e-commerce sales (Euro 1 bn)

[61] Vision Mobile, Developer Economics Q1 2014, State of the Developer Nation, Retrieved from http://www.visionmobile.com/product/developer-economics-q1-2014-state-developer-nation/

[62] Ibid.

[63] Mandel, M. and Schere J. (2012), "The Geography of the App Economy", CTIA – The Wireless Association and Application Developers Alliance

[64] Some of these words included Android, Blackberry API, iOS, IpAd, IPhone, etc.

[65] Core App Economy jobs correspond to Direct Employment in the App economy. It refers to job profiles related to developing, maintaining, and supporting applications for different platforms.

[66] Several limitations to this study have been identified, including sample size, time of survey, etc.

[67] The European App Economy: Creating Jobs and Driving Growth, September 2013 by Vision Mobile and Plum Consulting. Study sponsored by ACT4Apps

[68] The findings of the ACT 4 Apps report is based on Vision Mobile's Q3 2013 Developer Economics global survey which consists of more than 6000 responses

In the US study a multiplier of 1.5 was assumed to quantify the spill over into other sectors. For the EU, the assumed multiplier is 0.66 and both these might be under estimates as higher employment impacts have been estimated in other studies. In particular, a survey based analysis by Mulligan and Card[69] finds that the EU app-developer workforce stands at 1 million and the total app market employment is 1.8 million as per 2013 data reflecting a multiplier of 1.8.

While estimating a multiplier based on a deep understanding of the sector is helpful, it still is not compelling enough for policy action. The approach to quantifying the relationship between ICT indicators such as broadband (Internet) and macro variables such as employment (GDP) that are popular rely on eitherthe input-output method or the multivariate regression technique or both. Raul Katz,[70] for example uses both multi variate regression modelling and input-output analysisto estimate employment multipliers for broadband. International cross sectional studies usually deploy regression models,[71] but those for regional economies use both input-output analysis and multi-variate regression[72]. ICRIER'sstudies on the growth dividend of increasing mobile and internet penetration for India used the simultaneous equation regression technique to arrive at the growth multipliers[73].

In this study we use the Social Accounting Matrix (SAM), an extension of the input-output model to estimate the direct, indirect and induced employment multipliers of the app economy in India. The methodology follows closely the methodology of Katz and Crandall.[74] Please refer to Appendix 3 for details on methodology. Box 1 below explains how this study is a departure from the existing literature on estimation of employment potential.

Box 1: Studies estimating employment potential of the app economy

The Geography of the App Economy by CTIA (2012): This study estimated that the app economy in the US had created 519,000 jobs as of April 2012. Estimation of employment was based on existing research on job multipliers. The ratio between core app economy jobs and indirect app economy jobs was also estimated using anecdotal data. The assumed multiplier in this study from core app economy jobs to core plus indirect jobs was 2. The new studies on the US App economy use multipliers that range between 2.4 and 3.4.

Creating Jobs and Driving Growth by Vision Mobile and Plum Consulting (2013): This study estimated that the app economy created 794,000 jobs in EU (28 countries), of which two-thirds were direct jobs. This study also assumes a multiplier of 1.5 to estimate spill over into other sectors. The authors acknowledge that as the app economy becomes more entrenched in everyday businesses, spill over effects will increase, and the multiplier should accordingly be revised upwards.

Our study on estimating the employment potential of app economy in India is a departure from the studies mentioned above that estimate total employment in the app economy by assuming multipliers. The focus of this study is to use an input output model to estimate the multipliers for India's app economy. The estimated Type I and Type II multipliers range between 1.2 to 7.2, given different business and policy environments.

3.2 Estimating the employment multiplier for India's App Economy

For the app economy the total employment can be viewed as the sum of three parts- direct jobs, indirect jobs and jobs on the demand side. Direct employment arises due to making of apps, indirect employment due to supply of associated inputs/services and induced employment(due to increase in household incomes). In other words, the app economy can be viewed as a source of employment opportunities on both the supply and demand sides.

[69] Mark Mulligan and David Card (2014), "Sizing the EU App Economy" Gigaom Research

[70] Katz, Raul, and Stephan Suter. "Estimating the economic impact of the broadband stimulus plan." Columbia institute for tele-information working paper (2009).

[71] Gentzoglanis, A. (2007). International Competitiveness in the Telecommunications and ICT Sectors: A Cross-Country Comparison. Centre interuniversitaire de recherche sur la science et la technologie and Koutroumpis, P. (2009). The economic impact of broadband on growth: A simultaneous approach. Telecommunications Policy, 33(9), 471-485.

[72] See: Kim, Y., Kelly, T., & Raja, S. (2010). Building broadband: Strategies and policies for the developing world. World Bank Publications and Ford, G. S., & Koutsky, T. M. (2005). Broadband and economic development: A municipal case study from Florida. Review of urban & regional development studies, 17(3), 216-229.

[73] Kathuria et al. (2009) "Impact of Mobile" ICRIER and Kathuria and Kedia-Jaju, (2012) "India: Impact of Internet" ICRIER

[74] See: Katz, Raul, and Stephan Suter. "Estimating the economic impact of the broadband stimulus plan." Columbia institute for tele-information working paper (2009).

The contribution to employment and entrepreneurship is important to assess because the app economy is likely to drive India's imminent data revolution and also a play a vital role in creating efficiencies and lowering transaction and information costs. Direct Employment gets created due to the development and maintenance of apps. Thus software engineers, user interface developers, designers and any other IT professionals who aredirectly involved in creating the app would qualify for this cohort. Indirect Employment is related to non-IT jobs involving sales and marketing, customer relationship management and finance and accounts. Moreover, specific apps such as those that offer location based services engage geo-information engineers with specific expertise. Our survey however reveals that such content is either available for free or for a nominal license fee. Induced Employment is a demand spill over outside the industry driven by increased income of those engaged in the app economy.

Mathematically the employment multipliers can be represented as follows:

$$\text{Type I} \quad \frac{\text{direct} + \text{indirect}}{\text{direct}} \qquad \text{Type II} \quad \frac{\text{direct} + \text{indirect} + \text{induced}}{\text{direct}}$$

The estimates enable measurement ofemployment by reflecting the important cascading effects that apps create by stimulating growth, entrepreneurship and productivity throughout the economy as a whole.

The best way to understand the employment multipliers is to interpret them as the total change in direct and indirect or direct, indirect and induced employment due to a unit change in employment of the target industry, in this case the app economy. Since the evolution of the app economy depends on several factors we construct four different scenarios to tease out the employmentnumbers. These are – Business as Usual (BAU), Industry Matures (IM), Government Intervention (GI) and Aggressive Government Intervention in a Mature Market (AGI). These assumptions and results are shown in Table 1 and Table 2 respectively.

Katz, Raul L. "Estimating broadband demand and its economic impact in Latin America." Proceedings of the 3rd ACORN-REDECOM Conference Mexico City May. Vol. 22. No. 23rd. 2009.

Katz, Raúl L. "II. The contribution of broadband to economic development."Fast-tracking the digital revolution: Broadband for Latin America and the Caribbean: 49,.. pdf (2003).

Crandall, Robert, Charles Jackson, and Hal Singer. "The effect of ubiquitous broadband adoption on investment, jobs, and the US economy." Criterion Economics, LLC Released by New Millennium Research Council. Available at http://newmillenniumresearch. org/archive/bbstudyreport_091703. pdf (2003).

Table 1: Assumptions for different scenarios of the App Industry in the future

SCENARIO	ASSUMPTIONS
Business as Usual (BAU)	• 50% of the expenditure on Electrical Machinery including PC/Laptops and other peripherals including software and mobile handsets[75] can be attributed to apps based on the expected domestic revenue share of IT services and software in the industry in 2014[76] • 10% of expenditure on communication including mobile and fixed line[77]can be attributed to apps.This is based on the data revenue currently accruing to mobile service providers as reported by TRAI
Industry Matures (IM)	• 70% of the expenditure on Electrical Machinery including PC/Laptops and other peripherals including software and mobile handsets can be attributed to apps under this scenario. This is assuming increased smart phone penetration will drive at least 50% of the hardware revenue in the industry to depend on apps, in addition to IT services and software as assumed in the BAU scenario • Improved revenue sharing between service providers, content aggregators, app developers and cheaper data packages can drive the adoption of data services. Share of data in revenue from expenditure on communication has therefore been assumed to increase up to 30% under this scenario
Government Intervention (GI)	• The expenditure on Electrical Machinery including PC/Laptops and other peripherals including software and mobile handsets is unlikely to cross 70% of the total and is hence kept unaltered from the IM scenario • Active government intervention in developing infrastructure, focusing on e-government services, liberalizing m payment regimes can further increase data revenue from mobile services. It has been assumed at 50%, given the prevailing share in some developed markets. However, in mobile first developing countries this share could rise much more in the future.
Aggressive Government Intervention in a mature industry (AGI)	• The expenditure share on software, IT services and hardware is kept unchanged (similar to the IM and GI scenario) • The share of expenditure on data services in total communication revenue is increased to 90%. This is an aggressive estimate.

The Type I and Type II estimates for the app economy under the Business as Usual (BAU) and Industry Matures (IM) scenarios are lower than the multiplier estimated by NASSCOM for IT-ITESfor 2014. In the Strategic Review for 2104, NASSCOM estimates a multiplier of 4. In our model, 4 is roughly the median estimate. Government intervention in the form of favourable IT policies could be expected to push impacts toward the upper limit of 7.2 as estimated in our aggressive scenario. Rapid innovations in the mobile space have been disruptive resulting in lower entry barriers and generating new opportunities for small firms and entrepreneurs. This suggests that bigger impacts are possible under favourable conditions in the future,

[75] Categorised under S56 of the Consumer Expenditure Survey SAM (2007-08) and NSSO (2009-10)
[76] Reported by NASSCOM in its Strategic Review Report 2014
[77] Categorised under S68 of the Consumer Expenditure Survey SAM (2007-08) and NSSO (2009-10)

Our Type I estimates also inspire confidence since these are similar in orders of magnitude to the multipliers estimated in the vast literature on the impact of internet broadband.[78]

Table 2: Multiplier Estimates under different scenarios

MULTIPLIER	BUSINESS AS USUAL (BAU)	INDUSTRY MATURES (IM)	GOVERNMENT INTERVENTION (GI)	AGGRESSIVE GOVERNMENT INTERVENTION IN A MATURE INDUSTRY (AGI)
Type I multiplier (direct + indirect)	1.2	1.4	1.6	1.9
Type II multiplier (direct + indirect + induced)	2.9	4.4	5.3	7.2

The CTIA estimates the number of app developers at about 500,000 in the US and over 700,000 for the EU. Given its well known prowess in the IT space, India is slowly catching up with the developed world.[79] In order to interpret our multiplier estimates and understand their practical implications, we determine multiplier benefits using our current estimates of employment within the app industry (75,000). In the absence of a readily available forecast on employment in the app industry, we project increases in the estimated workforce using revenue estimates for the industry. According to Gartner, the size of India's app economy is estimated to increase from 974 crore in 2014 to Rs 2,065 crore in 2016. Gartner has also forecasted the growth smartphone/ mobile device penetration in India to increase at a compounded annual growth rate of 42 percent for the period 2012 to 2016. Using the latter, we independently extrapolate the size of India's app economy at Rs 1,964 crores for 2016. Based on this narrow range of estimates for the size of India's app economy, we project employment in this industry to range between 1,51,230 and 1,59,010 by 2016. Therefore, the direct increase in employment attributable to India's app economy is expected to range between 76,230 and 84,010 jobs from 2014 to 2016. The multiplier effects for increase in employment for all business and regulatory scenarios are tabulated below (these are likely over estimates[80]). The multiplier effects could result in an increase in employment within the industry by up to 8 times during the period from 2014 to 16.

[78] According to studies by Katz et al. (2008, 2009a, 2009b), Liebenau et al. (2009), the Type I multiplier range between 1.38-1.83, and Type II multipliers from 1.93 to 3.42 See: Liebenau, J., Atkinson, R., Kärrberg, P., Castro, D., & Ezell, S. (2009). The UK's digital road to recovery

[79] Computer World July 2013 India to overtake US on number of software developers by 2017 http://www.computerworld.com/s/article/9240676/India_to_over take_U.S._on_number_of_developers_by_2017

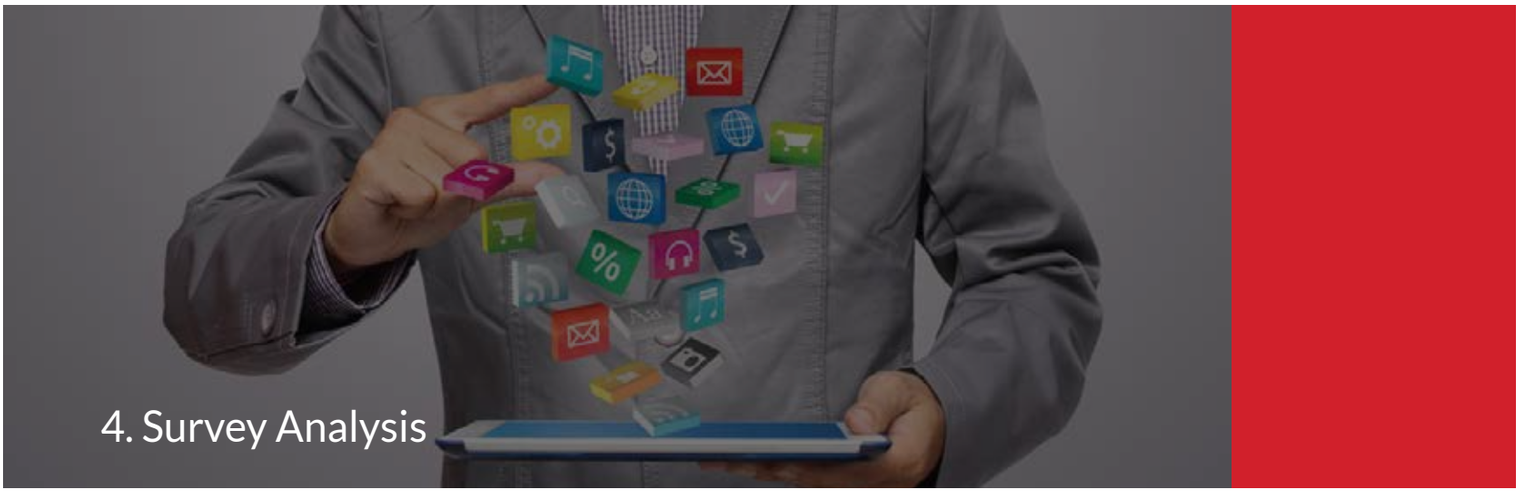
[80] Technological advancements, productivity increases and firm constraints on expenditure may limit the rise in employment even when revenue rises. Accordingly, the growth rate in revenue is likely to be higher than that for employment

Table 3: Estimates for increase in employment between 2014 and 2016

The numbers outside(in) parentheses reflect the multiplier benefits if direct employment increases by151230 (159010)

	BUSINESS AS USUAL (BAU)	INDUSTRY MATURES (IM)	GOVERNMENT INTERVENTION (GI)	AGGRESSIVE GOVERNMENT INTERVENTION IN A MATURE INDUSTRY (AGI)
Increase in employment using Type I multiplier	91476 (100811)	106722 (117613)	121968 (134415)	144837 (159618)
Increase in employment using Type II multiplier	221067 (243627)	335412 (369641)	404019 (445249)	548856 (604867)

Admittedly it is difficult to say which of the scenarios will be realised or how much the app economy will exactly contribute to employment. It seems clear however that the sector is and will continue to be a net generator of jobs. It could, for example, in our most optimistic scenario generate close to 604867 jobs in India, almost eight times the current level of employment. The rate of growth in this industry suggests that these numbers may not be unachievable. For example in the United States alone, the mobile app industry provided an estimated 752,000 jobs in 2013 and in the EU it accounted for 1 million jobs in 2014. As adoption of mobile technology increases and apps become pervasive, new jobs to support sales will also grow. The labor market can also benefit from the ability of mobile apps to improve efficiency and lower costs in matching job candidates and employers. As direct employment in the industry increases, the multiplier effects will benefit overall employment in the economy.



4. Survey Analysis

4.1 Introduction

In addition to estimating multipliers using secondary datawe also collected and analysed primary data on app developers in India. The principal objective of the surveywas to supplement findings from secondary research and to analyse emerging trends in India's app economy based on the app economy frame work discussed above. Data from developers was collected using an online survey, a method ideally suited for the target population[81]. The scope of bias in our survey is thus limited, since the cohort of app developers has native access to the online platform. We reached out purposively to 2000 individuals[82] through email and social media sites. The respondents included a mix of individual app developers and both small and big companies engaged in app development. Our survey differs in objective from other existing surveys in this field that have essentially focused on nature of smartphone usage, popularity of different app categories etc. For India this is the first organized survey that attempts to profile app developers and their artefacts while also trying to understand the constraints in the working of the app eco system.

The app developer survey was conducted over two months in 2013, with a response rate of over 25 percent. We received 515 responses of which 61 had to be omitted due to incomplete, erroneous and/or irrelevant information. The analysis is reported in four sections as below:

a) Who? The App Developer in India

b) What? The Preference of Users and Developers in India

c) Why? The Business of Apps in India

d) How? The Future of Apps in India

The first category highlights the demographics of app developers in India, including the organizational set up. The second category identifies preferences for apps, platforms and devices. The third category brings out popular business/revenue models and associated marketing initiatives. The final category lists the perceived challenges and feeds into our policy recommendations.

4.2 Who? The App Developer in India

App development is a relatively new phenomenon in India and has seen rapid rise since it inception. India's app developers run into hundreds of thousands and are overwhelmingly young - 75 percent of the respondents are below 35 years of age. 'App whiz-kids' - teenagers involved in the development of gaming, entertainment and utility apps - are becoming prime property in India. This has encouraged a trend wherein students and independent professionals engage in app development on a part-time basis. While some of these app developers progress to establish organised businesses with the aim of generating profit, others continue to operate as independent developers or hobbyists.

[81] We are grateful to the Internet and Mobile Association of India (IAMAI) for facilitating the online survey under this project

[82] These 2000 respondents were from IAMAI's database of app developers

The vast majority of app developers in India are male. In our survey of 454 developers, only 35 respondents were female reflecting the gender bias.[83] On the demand side 80 percent of smartphone users in India are male reinforcing the male dominance.[84] Geographically the respondents were all based in India except one developer of Indian origin residing in Malaysia. The well known and established IT cities in India are attractive for app developers because they provide with easy access to infrastructure, skill and a ready market for products. Table 4 shows the concentration of app developers in the cities of Bangalore, Mumbai, Delhi NCR, Hyderabad and Ahmedabad. A larger percentage of developers in such IT cities make apps on a full-time basis as compared to developers in other cities. From the survey data presented below in Table 5 we find that Bangalore, Mumbai and NCR have the maximum number of companies (organized business operations) engaged in app development. Cities like Ahmedabad, Hyderabad and Chennai host many small teams of app developersas well as self-employed app professionals. In most of the other cities such as Bhubaneshwar, Cochin, Coimbatore, Gandhinagar and Kota, app development is done primarily on a part-time basis and is not the primary source of income. This could be the result of limited monetization options that make app development an unsustainable livelihood for many. Monetisation will be discussed in greater detail in Section 4.5

Table 4: No of app developers in cities

CITY	NO. OF DEVELOPERS	PRIMARY OCCUPATION
Ahmedabad	49	38
Bangalore	77	56
Mumbai	78	56
Delhi NCR	98	70
Hyderabad	40	28
Chennai	37	26
Pune	15	7
Indore	16	13
Kolkata	6	4
Others	38	29

[83] Shyamsunder, A. Carter, N. (2014). High Potentials Under High Pressure in India's Technology Sector. Catalyst Research Centers.
[84] Ibid

Table 5: Distribution of app developers in cities based on organization type

CITY	SELF EMPLOYED	SMALL TEAM	COMPANY
Ahmedabad	21	4	24
Bangalore	11	15	51
Mumbai	11	12	55
Delhi NCR	18	17	63
Hyderabad	17	3	20
Chennai	11	7	19
Pune	4	4	7
Indore	4	3	9
Kolkata	2	1	3
Others	8	8	22

4.3 What? The Preference of Users and Developers in India

The demand for apps in India is varied. This heterogeneity is driven by the differences in income, education and infrastructure facilities available in different parts of the country. The advance of high-end feature phones, smartphones and low cost tablets represents the beginning of an indisputable shift towards greater data consumption. For example between 2012 and 2013, the number of smartphones in urban India increased by 89 percent to reach 51 million.[85] This is especially important in light of the fact that globally the growth rate of smartphones is projected to decelerate from 2013 onwards through to 2017 (while India should see the reverse).[86]

Much of the increase in smartphone consumption is driven by consumers aged 16-18 [87]. Pew Research results for the United States show that youth are heavy consumers of data.[88] Userpreference for gaming, entertainment and social networking is reflected in the types of apps being developed. The popularity of international apps is evident in the survey data. The average download of 'Indian' apps is very low. Only 14 of the 454 developers has crossed the hundred thousand download mark, of which only 5 surpassed the one million milestone. These numbers do not pertain to a single app, but to the cumulative number of downloads across all the apps createdby each developer, supporting the thesis of low visibility of apps developed domestically.

In our sample of 454 developers, entertainmentapps including gaming and social networking are the dominant categories reflecting demand side preference. Utilities, health and education are the other important categories. Table 6 below provides the number of apps developed under each category. The list does not include lifestyle and enterprise apps which are exceptions. Oneforceful result of our survey is the focus of app developers on foreign app demand in preference to producing locally-relevant content - as the latter is less profitable.[89] Each respondent in our sample has developed an average of 38 apps.[90] Of these 13 have developed 100 or more apps and these are the larger professional app companies. After excluding extreme values, the average number of apps developed by each respondent falls to 17.

[85] Nerurkar, Sonal . "Teens drive Indian smartphone sales, study finds." The Times of India. 8 Sept. 2013. Web. 20 Jan. 2014. <http://timesofindia.indiatimes.com/business/india-business/Teens-drive-Indian-smartphone-sales-study-finds/articleshow/22406572.cms>. 86 International Data Corporation projections

[87] Nerurkar, Sonal . "Teens drive Indian smartphone sales, study finds." The Times of India. 8 Sept. 2013. Web. 20 Jan. 2014. 88Smith, Aaron. "Smartphone Ownership — 2013 Update." Pew Research Center (2013): http://pewinternet.org/. Web. 20 Jan. 2014.

[89] For example, the Indian app development firm Sourcebits, despite having been founded in India is now headquartered in San Francisco.

[90] This is based on the response of 84 developers, other respondents chose not to provide information on the number of apps developed.

Table 6: Number of Apps developed under each category

	E- Commerce	Agriculture	Health	Education	Social Networking	Entertainment	Productivity	E-governance	Navigation	Utilities	References
Total number of developers	69	23	46	72	77	75	67	22	35	87	30

Skewed revenue sharing models biased against content providers is one of the main reasons why Indian app developers focus on international app stores such as Apple App Store or Google PlayStore that offer a flat 70 percent of the total revenue to developers. This adversely affected development of India-specific apps and even popular apps such as Saavn and Zomato have expanded abroad.

Saavn's musical lexicon includes both Indian sub-continental and Western music and Zomato is spreading to list restaurants in Turkey, UAE, UK and Brazil. There are signs though that the Indian market is adapting to these developments. Apps Daily is an innovative distribution channel for uniquely Indian apps(discussed above). Further more, Vodafone has recently released its beta app store with an internationally competitive 70-30 revenue sharing model. If other players follow suit, it could ensure development of localised content.

The other dimension essential to diffusion of apps among Indian users is the choice of platform/ operating systems and devices that support it. Survey results confirm the dominance of Android followed by iOS. Windows OS is a close third. The others categories include Samsung's Bada and Tizen OS, Web OS and Mac OS. Table 7 below provides the data on number of app developers by platform.[91] The choice of operating systems is closely tied to devices. India's smartphone penetration though low at present, is rising rapidly as manufacturers are introducing new models at lower prices. Moreover, local manufacturers such as Micromax, Karbonn, and Lava are competing with global leaders such as Samsung, by launching smartphones and tablets at affordable prices. Accordingly, most developers are targeting apps that can be supported on smartphones and tablets. A small group of Java developers is focusing on the market for feature phones. Table 8 below provides data on choice of devices that support apps. The 'others' category includes smart watches, smart TVs and desktop apps which are rare.

Survey results indicate an Android dominated future for the app economy in India for two apparent reasons. One, Android devices are more affordable and two, the Android ecosystem is open allowing OEMs such as Samsung and HTC to manufacture mobile devices that use the Android OS. The drawback is the resulting fragmentation in screen sizes, resolution limits and hardware traits. Because of this, "developing apps that work across the whole range of Android devices can be extremely challenging and time-consuming."[92] Moreover, Indian app developers need to recognise the existence of an active market for used phones and thus the appeal of 'backward compatibility' i.e. an app that can work across old devices as well as new ones and also function across both old and new versions of operating systems will stabd a better chance of success.

Table 7: Number of developers by choice of operating system

OS Type	Android	iOS	Blackberry	Windows	Java	Others
Number of developers	84	69	12	62	20	22

[91] Only 232 developers responded to this question.

[92] "Android Fragmentation Visualized (July 2013)." Android Fragmentation Report July 2013. Web. 20 Jan. 2014.

Table 8: Number of developers by choice of device

Device Type	Smartphones	Feature phones	Tablets	Others
Total No. of developers	195	30	128	27

4.4 Why? The Business of Apps in India

Apps need an ecosystem to thrive. One major challenge for app developers in India is to transform a good idea into commercial success. The present rate is not encouraging. Most developers try to optimize their odds of becoming profitable for example by choosing the platform with the highest installed user base. Other factors driving the OS choice are familiarity with the development environment and the cost of development. On the whole, app development is not considered to be a remunerative business opportunity. 17 percent of respondents who answered the question on choice of revenue model indicated that they did not have a specific revenue generation plan. While some developers are engaged in contractual development, there are few developers who self finance their project and do not actively market or promote their app. The business of app development in India seems to be at a stage in which it could be characterised as one based on a 'hit and trial' philosophy.

Self financing is common in the industry. Only 7 and 13 developers approached banks or venture capitalists for financing. Funding an app developer is not an investor's primary choice. Recognising the market failure and the utility of apps, the Department of Electronics and IT and Department of Telecommunication have both instituted funds to encourage mobile technology ventures and app development in India[93]. One can argue on the efficacy of the use of limited public resources for app development, but not the fact that app development in India needs a boost. The industry is still very young and 'unorganized' and is largely dependent on own and informal sources for financing. Table 9 below presents the source of financing for app developers.

Table 9: Source of Financing for Application Developers

	Self	Bank Loan	Informal Sources	Venture Capital	Others
Number of app developers	84	7	20	13	6

Most apps in India are distributed either by app stores or on the developer's websites. Almost 70 percent of the respondents use app stores. In rare cases developers email their app to a target group of users. Developers spend up to 85 percent of their development cost on marketing. Other avenues for marketing include social networking websites, promotions in magazines and cross promoting new apps on an existing app. Popular revenue generation models include advertising, in-app purchasing, freemium and pay per download. Table 10 provides the choice of revenue models for app developers in India.

The vast majority of apps in India are 'free' for the consumer. This means that revenue generation for the developer is either through advertisements or through royalty. In cases where the consumer pays for the app, the modal price range is between Rs 50 – 100. Interestingly, Apple and Google Playstore initially priced most of their apps at $1, which translates to roughly Rs 60 at the prevailing exchange rate. Although the rupee depreciated to almost 69 in 2013, the price for paid apps remains within the Rs 50 -100 range. As stated earlier, a large number of Indian app developers sidestep the unfavourable local conditions by catering to the international market -localised content suffers as a result. For the few local app stores that exist, revenue sharing does not favour local app development. Another outcome of the circumstances for developers has led to their focus on specific clients thereby reducing their search for profitability.

[93] DoT has set up a 1000 crore app development centre called Application Development Infrastructure and 700 crores under the National E-Governance Plan have been allocated for mobile technology ventures

Table 10: Choice of revenue models

	Pay per download	In-app purchasing	Freemium	Subscription	Royalty	Advertising
Number of app developers	52	73	61	42	20	77

The potential for apps is well established, but its business case is still quite weak. In our survey only 82 developers have successfully recovered their investments. Of these, 24 were profitable within a year, 15 between 1-2 years, while the others took much longer.[94] It is worrying that most developers treat app development as a sunk cost. For apps to become a business opportunity for the wider developer community, a mature and localised ecosystem is necessary that is sympathetic to the needs of the developer community.

4.5 How? The Future of Apps in India

India's app ecosystem functions in an environment that is inimical to growth. Our survey respondents highlighted several constraints- absence of skilled manpower, high cost of development, limited or no access to finance- as major impediments to growth. Table 11 below provides survey responses on the barriers. A few other challenges include high cost of user acquisition, hyper competition driven by independent and freelance developers and the high cost of marketing. Industry stakeholders are concerned by the clutter in the developer market, although this could sort itself as the industry evolves and underperforming and uncompetitive developers gradually weed out. In terms of monetization, the challenge is related to the preference for free apps and a user base that is limited in terms of their familiarity with the mobile and internet ecosystem. More than 50 percent of the respondents feel that the preference for free apps damages the revenue potential of this industry. Moreover, given users' price sensitivity, developers have to offer much more to the Indian consumer to drive willingness to pay. This reinforces the case for developing content in Indian languages and localizing the ecosystem as a whole.

Table 11: Barriers facing India's app economy

	Skilled Manpower	Access to Financing	High Cost of Development	Others
Number of developers	77	14	28	7

Since the industry thrives on innovation, protection of intellectual property is important to developers. The balance between protection and sharing of innovation is part of a larger and often tendentious debate on open source versus proprietary software development.[95] We do not attempt to deconstruct that debate here; merely report that 70 percent of respondents are of the view that intellectual property protection is a concern for app developers. However, not all have taken steps to protect intellectual property. The lack of seriousness could be associated with poor revenue potential from apps. Among those who have, some obtained copyrights/patents, while others worked with individual checks on in-app piracy using code morphing, copy protection, server–based checks, or both etc. Table 12 below provides the number of app developers who have adopted different IP protection measures.

[94] Most respondents did not answer this question

[95] Hippel, Eric von, and Georg von Krogh. "Open source software and the "private-collective" innovation model: Issues for organization science." Organization science 14.2 (2003): 209-223.

Table 12: Intellectual Property Right (IPR) Protection in the App Industry

Measures for IPR	Number of developers
Have obtained Copyright/ Patents	58
Have provided for In-app checks	60
Have not taken any steps	23

Although our survey comprised a small sample, the findings complement the secondary data analysis and are a useful supplement to the case studies. Developers highlighted the well known challenges with a view to help unlock the potential in India's appmarket. These include a focus on local content, an improved landscape for local developers, increased smartphone and broadband penetration, a concerted effort to boost digital literacy, awareness and an environment that supports innovation. The focus on the easy to tap urban market which typically demands popular international content must inevitably segue to semi-urban and rural areas for the app economy to prosper riding primarily on local content.

5. Case Studies

Case studies supplemented the analysis and findings of the primarysurvey and in particular sought to identify the micro-channels through which larger macroeconomic impacts (direct, indirect and induced) get created. Referring once again to the frame work developed in section 2, representative stakeholders were selected from each constituent of the app ecosystem. Figure 2 reproduced for convenience buckets stakeholders across the ecosystem, although some operate across multiple segments. Refer Appendix 4 for a list of all stakeholders consulted for this project and Appendix 5 for details of each case study.

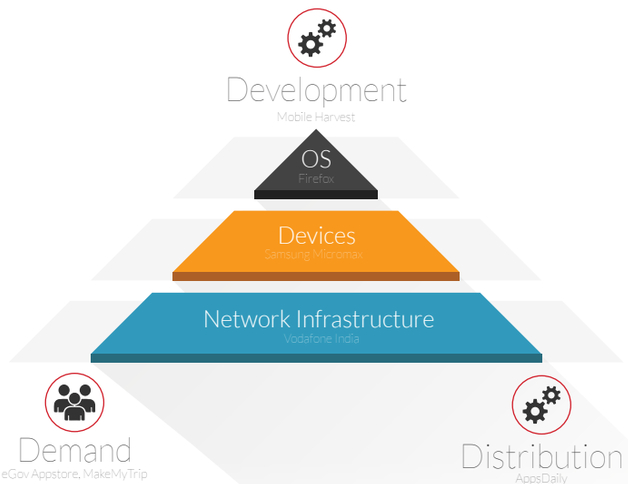


Figure 2: Selected Stakeholders across the Indian App Ecosystem

Source: Author

A strong verdict of the extensive consultations with app developers including Times internet, Get It Info Media, Bellurbis and Mobile Harvest is that Indian app developers typically concentrate on coding. The emphasis on aesthetics, user-interface and interaction design is lacking. The normative view is that this needs to change if Indian apps aim to become internationally competitive.

The need to create locally relevant content was also a recurrent theme in our interactions. Not only can we unlock latent demand as a result, but also expand employment opportunities beyond English language content. A bigger market for local content could create good externalities even larger than those estimated in this report.[96] Mobile Harvest for example faces challenges of a young and relatively fragmented local market. While the market potential is massive, achieving scale, a crucial attribute for success in networked sectors, is a primary challenge.[97]Although preliminary, our case studies also indicate that other benefits of apps in general and local content in particular can provide socialcohesion and extension of communications to low income users which have large multiplier effects throughout the economy.

Distribution is dominated by international app stores in India. With a nascent e-commerce industry and poor credit/debit card penetration, telecom operators tend to play a larger role in the distribution of apps. For example, Samsung Apps has partnered with local telecom operators (Vodafone India) to enable carrier-billing. A unique physical app distribution platform that has emerged in India and spread to other countries is Apps Daily, a local innovation whose success is built on existing gaps in the local operating environment. While the physical channel will continue to exist, stakeholders such as Vodafone, Samsung and Blackberry are of the justified view that scaling up needs regulatory intervention to ease digital payment mechanisms that enables wide spread digital distribution of apps.

96 IAMAI, Local Language Report, 2013.
97 Ibid.

The pattern of app downloads and user profiles have been discussed extensively in section 2. While the largest proportion of demand comes from gamers a growing proportion is now coming from enterprises and government agencies who wish touse technology and mobility solutions for greater transparency and efficiency. Accordingly, eGov app store that we analysed is home to some apps that are becoming popular among users, such as e-procurement, e-heatlh, etc.

The use cases suggest how these apps have streamlined processes and increased efficiency manifold. Details on demand and efficiency gains are available in Appendix 5.3. On the other hand MakeMyTrip presents a case of service extension. It is especially of value to last minute travellers, who find such applications convenient.

Devices form a fundamental component of the app ecosystem. In the first quarter of 2014, India witnessed 186 percent increase in the shipment of smartphones.[98] With smartphones entering the market at price points that are disruptive (e.g. Micromax covered in the list of case studies), there is an upsurge in app demand. Our survey highlights the lack adequate network infrastructure -telecom operators and infrastructure providers have a fundamental role to play in this regard as does the role of a predictable and strong regulatory environment. Operators in India and elsewhere view apps as a threat to their existing business model. However, with the inevitable technological advancement operators will have to adapt to the new reality of greater data use. In case of conflict between regulation and technology, the balance of convenience is to favour innovation in public interest. A perspective of Indian telecom operators towards the app economy was presented by Vodafone India (Refer Appendix 5.7)

Telecom infrastructure is necessary for the app economy to take off but at the same time our consultations suggest that access to infrastructure is certainly not the only thing that matters. On the contrary, research highlights the vital importance of complementary skills and other infrastructure-literacy, competitive distribution platforms, congenial environment for development, among others as being important enablers. Unless these are in place, the potential benefits of apps will be suffocated. There is no benefit in developing a superb app unless it can reach the final consumer at an affordable price in a language that he understands.

Cost and connectivity are barriers but interesting innovations by local entrepreneurs using offline technology such as USB (universal serial bus) to deliver content to users who can afford smartphones helps overcome the initial connectivity issues. Eventually however connectivity will be crucial.

Operating systems (OS) in the final piece in the app economy puzzle. As reflected in the survey, Google's Android followed by Symbian and Microsoft are the popular OS in India. The choice of OS is linked to the device. Samsung, Micromax and Karbonn, three very popular handset companies in India, all use the Android OS (although Karbonn is about to release a dual-OS phone that also runs Windows). Symbian which primarily runs on Nokia devices also enjoys sizable market share although it is decreasing. Since there will be large numbers of first time smartphone users entering the Indian market, there is huge potential for new entrants to capture market share in India. Firefox, a web-based OS, is one such example, struggling with finding its place in the Indian app market. (Refer Appendix 5.8 for details on Friefox OS in India)

[98] IDC

6. Conclusions and Policy Recommendations

The emergence of apps embedded in mobile devices that go beyond providing basic access leads us to hypothesize that apps could potentially have a large impact on the economy and on livelihoods. Emerging markets such as India are the driving force behind rising trends in app downloads. India is among the top three countries for Google Play downloads in the world. Apps provide opportunities for software developers, information aggregators and users. By becoming content providers, users have an opportunity to participate in and even shape the social and economic transformation

In the recent Indian elections for the 16th Lok Sabha social networks became a vibrant platform for user generated content especially the young Indian voters. Some State governments in India have embraced the potential for mobile phones to improve public services for citizens and promote accountable and transparent governance. Apps will further enhance the delivery model. For other verticals such as agriculture, health and financial inclusion, apps need to be designed locally and this offers exciting opportunities for developers. For a dynamic sector that apps is today, it is imperative to customize to local circumstances and to assess impacts regularly. This study breaks new ground in this respect and hopes that estimating growth and employment effects of apps becomes custom in the future.

Previous research in this genre has unambiguously established productivity impacts of greater mobile and internet penetration due to the accompanying reductions in information asymmetries and declining transactions costs. Evidence of the impacts of apps could be expected to be along similar lines especially since India suffers huge service deficits in several areas including education and healthcare. 'Apps for development' could be an attractive and practical option for India to embrace, besides apps for e-commerce, gaming and entertainment that will in any case be driven by the market.

The app economy is credited to have generated half a million jobs in the USA in 2013 and another 700,000 in the EU. According to 2013 data, the EU app economy accounts for 22 percent of the global production of app related services and products. Indians constitute the second largest nationality for app developers (the first is Americans), and hence it is worth documenting the direct, indirect and induced employment effects of the app economy in India. This study uses scenario based analysis to estimate the potential for employment in the app economy under different business and policy environments..

Apps currently account for 75,000 jobs in India. Using our estimates for increase in employment (between 2014 and 2016) the multiplier effects have been estimated under different business and regulatory scenarios. The minimum estimated increase in direct and indirect employment for the app economy is 91476, while the maximum is 159618. If we include changes in induced employment, these numbers rise up to 221,067 and 604867 respectively. Thus the aggregate number of jobs that apps could create in India during the period 2014-16 lies between 91476 and 604867, the upper limit being close to eight times the current levels of employment. If direct employment increases at a faster rate, the multiplier effects will result in massive benefits to overall employment in the economy.

India needs technology to overcome everyday problems. The economic benefits can be huge. And apps can be an important cog in that wheel. Connectivity to the internet holds enormous promise with smart cities, agriculture, health and education, to name a few applications, seeking to democratize the benefits of technology.

While estimating employment potential of apps is the central piece of this study, the primary survey and case study analysis have supplemented these findings to package the trends, patterns and challenges of this industry. The case studies present underlying benefits of apps, although it would need another study to robustly estimate their productivity impacts throughout the economy.

It is a fact that India's market is split by many factors including language, income, access, awareness and digital literacy among others and therefore we need to address both the supply and demand side challenges of the ecosystem. Supply side bottlenecks include deficiency of spectrumand inadequate backbone networks and distribution platforms; on the demand side themain constraints are lack of affordable mobile devices andbroadband services, digital literacy as well as limited local applications and content. As an illustration the success of mobile payments worldwide would not have been possible without the easing of entry barriers such as the falling cost of smartphones and affordable and adequate access to the internet.

Telecom operators and infrastructure providers have a fundamental role to play in harnessing the potential of India's app economy by providing adequate infrastructure. Telecom infrastructure is necessary for the app economy to take off but at the same time our research suggests that access to infrastructure is certainly not the only thing that matters. Even though the bond between mobile operatorsand users is loosening due to the fact that mobile devices can now directly connect to the internet, operators in India will still remain important if not key to unlocking the potential of the app economy. Their vast reach makes them ideal as distribution networks and payment channels for apps-for this they need to constructively work with app developers. This is now fortunately beginning to happen.

The absence of successful revenue models and poor levels of commercialization still stand in the way of entrepreneurial aspirations and employability in the industry. The employment potential of this industry can be realized with revenue sharing increased in favour of the developer and regulatory costs of carrier billing lowered. If policy intervention allows for liberal payment regimes, affordable and ubiquitous access to internet, the gains from this industry can be maximized.

Our research also highlights the need for skilled app developers that focus beyond trouble shooting to produce aesthetically designed apps. The quality of developers must be improved along with increase in quantity. Training in product development and creative designing will enhance the growth of this industry in India. There is also a demonstrated need for seed funding for entrepreneurs who are trying to break into the local market. While, the government has already launched a Rs 1000 crore application development fund, the market itself needs to find ways to support the development of apps, including those meant for improving access to services, such as health and education.

The rapid growth of apps worldwide presents a rare opportunity for India with its unique characteristics and huge service deficits. We know that access to mobile and internet networks can have a transformative impact on livelihoods and businesses. By making phones more powerful, smartphone applications or apps, aided by high-speed networks and innovation can create jobs and also have important productivity enhancing impacts throughout the economy as a whole. This new evidence on the 'app' economy comes close on the heels of similar evidence for mobiles and internet that is now firmly established as part of telecom folklore. With a few enabling policy interventions, apps can further enhance the 'value' of mobile access in a manner that was almost unthinkable only a few years ago. It is encouraging that the Prime Minister acknowledges the role of technology and apps in his recent policy initiatives, including the 1000 crore Self Employment and Talent Utilisation (SETU) incubation program that will support start ups in the technology area.

Appendix

1:Ten most popular Facebook linked App Developers headquartered in India (by Monthly Average Users)

Rank	Developer	Most Popular App of the Developer	Monthly Avg. Users (MAU)	Headquarter City	App Category	Country with Maximum Users	% of Users in the most popular Country
1.	India times	India times	723385	Gurgaon, NCR	Infotainment & Ecommerce (extension of online service)	India	83.2
2.	Myntra	Myntra	558338	Bangalore	Ecommerce (extension of online service)	India	96
3.	HashCube	Sudoku Quest	85253	Bangalore	Gaming	United States	28.0
4.	NDTV Convergence	NDTV	84625	Delhi	Local News & Infotainment	India	86.5
5.	author STREAM	authorGEN Technologies	75398	Chandigarh (Another office in United States)	Productivity	India	55.6
6.	ChaYoWo Games	Cricket Master Blaster	56689	Kochi	Gaming	India	49.5
7.	RJ Softwares	Wordosaur Crossword Game	9827	Kolkata	Gaming	India	83.2
8.	Oneindia.in	Oneindia	13052	Bangalore	Local News & Infotainment	India	83.2
9.	ibibo web (p) Ltd	Games365.in	2838	Gurgaon, NCR	E-Commerce, Travel (Lifestyle)Entertainment & Gaming	India	83.2
10.	Shufflr	Shufflr	23	Bangalore	Infotainment (Video Sharing)	India	83.2

Source: Metrics Monk, Last Accessed on March 23rd, 2015

2A:Top Facebook linked apps consumed by Indians (by Monthly Average Users)

Rank	Application	Monthly Average Users	App Category	Developer	Headquarters	Country with Maximum Users	% of Users in the most popular Country
1.	Facebook	2552261	Social Networking	Facebook	California	India (via Samsung Mobile)	16.3
						United States (via Microsoft)	13.6
2.	Truecaller	2005332	Utilities, Communication (Phone Directory)	True Software Scandinavia AB	Stockholm	India	55.1

Rank	Application	Monthly Average Users	App Category	Developer	Headquarters	Country with Maximum Users	% of Users in the most popular Country
3.	Gaana	1145464	Entertainment, Music	Times Internet	Gurgaon, NCR	India	87.4
4.	YouTube	1089921	Communication (Utilities)	Youtube (Google)	California	United States	20.9
5.	Astrology	714537	Lifestyle, Others (Astrology)	Kudos Media	London	United States	52.7
6.	Trip Advisor	667479	Lifestyle, Travel	TripAdvisor, LLC	Massachusetts	United States	34.0
7.	Skype	644091	Utilities, Other Chat	Skype Communications	Luxembourg	United States	11.3
8.	Saavn	637645	Entertainment, Music	Saavn, LLC	New York, United States	India	70.6
9.	Opera Mini	612524	Entertainment, Other	Opera Software ASA	Oslo, Norway	India	27.8

Source: Metrics MonkLast Accessed on March 23rd, 2015

2B:Top Facebook linked gaming apps consumed by Indians (by Monthly Average Users)

Rank	Application	Monthly Average Users	App Developer	Headquarters	Country with Maximum Users	% of Users in the most popular Country
1.	Candy Crush Saga	8513804	King.com.	London, Delhi	United States	16.8
2.	Teen Patti	3978832	Octro, Inc	Delhi, India	India	97.7
3.	Subway Surfers	2245046	Kiloo Games	Aarhus, Denmark	United States	12.0
4.	Indian Rummy	1009151	Octro, Inc	Delhi, India	India	97.4
5.	Criminal Case	998852	Pretty Simple	Paris	Brazil	16.7
6.	8 Ball Pool	946425	Miniclip.com	Neuchatel, Switzerland	Indonesia	15.6

Rank	Application	Monthly Average Users	App Developer	Headquarters	Country with Maximum Users	% of Users in the most popular Country
7.	Farm Heroes Saga	725652	King.com	London	United States	14.1
8.	Pet Rescue Saga	542854	King.com	London	United States	16.5
9.	Clash of Clans	483153	Supercell	Finland	United States	20.1
10.	Bubble Witch	336148	King.com	London	United States	16.6

Source: Metrics Monk,Last Accessed on March 23rd, 2015

3: Social Accounting Matrix and the Mathematical formulation of the Leontief Inverse Matrices and Type I and II multipliers

The Social Accounting Matrix (SAM) is a square matrix, where each row and column represents receipt and expenditure respectively [99]. It has an endogenised household sector that illustrates the flow from production to income, which then leads back to demand. The SAM framework extends the input-output (I-O) model by including information on income distribution and final demand.

SAM models are typically used to estimate the impact of a policy for an effective change in demand/output/employment in any sector,capturing the feedback effect of consumption. Unlike the input-output model, SAM is used to estimate the induced demand effect (or the Keynesian multiplier) of developmental policies.[100]

The SAM used in this report comprises of seventy eight sectors and has been adopted from Pradhan et al. (2013).[101] In order to isolate the employment multiplier for India's app economy we consider the rise in the demand for two sectors - Electrical Machinery and Communication. Among others constituents, the former includes PC/Laptop, and other peripherals including software and mobile handsets while the latter includes consumer expenditure on mobile and fixed lines charges.[102]

The employment per unit output for each sector has been taken from the NSS 2009-10 data on industrial employment which corresponds with SAM 2007-08. The output data is converted into employment figures using this vector of employment levels.

The mathematical formulation of the Leontief inverse matrices and Type I and II multiplier, are provided below

Since demand from electronics and expenditure on communication cannot entirely be attributed to the app ecosystem, we estimate the employment multipliers using a fraction of the total demand in the two sectors.

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[99] Refer World Bank Social Accounting Matrices and SAM–Based Multiplier Analysis, "Tool Kit for Evaluating the Poverty and Distributional Impact of Economic Policies, Round (2003). Retrieved from http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPSIA/0,,contentMDK: 20481426~menuPK:1108016~pagePK:148956~piPK:216618~theSitePK:490130~isCURL:Y,00.html

[100] See: Pyatt, Graham, and Jeffery I. Round. "Accounting and fixed price multipliers in a social accounting matrix framework." The Economic Journal (1979): 850-873. Buvinich, Manuel J. Rojas. "The evaluation of rural development projects using the social accounting matrix approach." Revista Brasileira de Economia 46.4 (1992): 555-594. Auerbach, Alan J., and Yuriy Gorodnichenko. Fiscal multipliers in recession and expansion. No. w17447. National Bureau of Economic Research, 2011.
Khan, Haider A., and Erik Thorbecke. "Macroeconomic effects of technology choice: Multiplier and structural path analysis within a SAM framework." Journal of Policy Modeling 11.1 (1989): 131-156.

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The employment per unit output for each sector has been taken from the NSS 2009-10 data on industrial employment which corresponds with SAM 2007-08. The output data is converted into employment figures using this vector of employment levels. The mathematical formulation of the Leontief inverse matrices and Type I and II multiplier, are provided below

Since demand from electronics and expenditure on communication cannot entirely be attributed to the app ecosystem, we estimate the employment multipliers using a fraction of the total demand in the two sectors.

$$dX = (I-A)^{-1}dY = B' dY \qquad (2')$$

where B' now measures the total output of sector i that is required as input to produce one unit of output of sector j, accounting for the aggregate chain effects of the direct, indirect and induced output requirements.

To convert output into employment estimates, a vector of employment levels per unit output is required, say W. The direct employment effect of a unit rise in demand for sector i's produce would be denoted by W_i. One unit increase in the final demand of sector j's produce generates the N sectoral aggregative effect of *direct and indirect* employment as:

$$E_j = \sum_{i=1}^{N} W_i B_{ij} \qquad (3)$$

And for the aggregative effect of direct, indirect and induced employment:

$$E'_j = \sum_{i=1}^{N} W_i B_{ij} \qquad (3')$$

Thus, Type-I employment multiplier for a unit rise in sector j's final demand is given by:

$$\sum_{i=1}^{N} W_i B_{ij} / W_i \qquad (4)$$

And Type-II multiplier, where we use coefficients of matrix B' instead of B:

$$\sum_{i=1}^{N} W_i B'_{ij} / W_i \qquad (4')$$

Changes in aggregate employment driven by changes in demand for the app ecosystem can be determined by multiplying the multiplier estimates to the fraction attributed to apps.

4: List of Stakeholder Consultations

1. AppsDaily
2. Qualcomm Ventures
3. Qualcomm
4. ShepHertz
5. MakeMyTrip
6. Times Internet
7. Get It Info Media
8. MCarbon
9. Spice Global
10. Mobile Harvest
11. Unicel Tech
12. Amazon
13. Samsung
14. Bellurbis
15. Blackberry

[101] Pradhan, B. K, M.R. Saluja and A. K. Sharma (2013), A Social Accounting Matrix for India 2007-08, IEG Working Paper No. 326

[102] Refer to the concordance between SAM 2007-08 sectors and NSSO 2009-10 given in Pradhan, Basanta K., M. R. Saluja, and Yashobanta Parida. "A Social Accounting Matrix for India, 2005-06." Research in Applied Economics 6.1 (2014): p176-p201.

5: Case Studies

5.1 Mobile Harvest Solutions[103]

Introduction

Mobile Harvest Solutions is an app development company that designs literacy neutral apps to bring benefits of social networking and connectivity to those who are not proficient with reading and writing. Having a development agenda, Mobile Harvest tailors its literacy neutral apps to meet the needs of specific groups such as farmers, healthcare workers especially women in rural India. Dubbed as an oral Wikipedia (where information is provided in vernacular languages), one of Mobile Harvest's more recent projects has been in collaboration with UN Women, the Ministry of Science and Technology and Tekes, a Finnish Funding Agency for Technology Innovation, to design apps that, inter alia, inform women of government programmes and disseminate information related to family planning.

The Mobile Harvest interface is intuitive and minimalistic in nature. Launched as a pilot project for farmers in Andhra Pradesh in 2012, the flagship Mobile Harvest app saw 1300+ media files uploaded within a month where farmers shared best practices on farming. Information uploaded/accessed through this app was organized pictorially into groupings such as irrigation, weather, pests, prices etc. to facilitate easy use.

Challenges

A challenge for the company is in exploiting domestic demand to the fullest. Low digital literacy and awareness constrains the potential demand base of the Indian app economy. The test for Mobile Harvest has been in scaling up and getting adequate funding for its ventures. The UN Women venture lasted one year and saw a revenue of 12,60,000 INR. However, it only managed to capture 30 monthly average users. The Indian app market, from the user-side, is still young and highly fragmented. Venture capital firms in India seem to be targeting the low-hanging fruit (low-risk infotainment/social networking apps for urban customers). This makes Mobile Harvest's novel endeavour all the more tricky.

To reach out to rural customers the requisite network infrastructure needs to be in place and app companies like Mobile Harvest will need support of telecom operators, who have the widest access to India's rural prepaid segment, and OEMs who can pre-install certain apps on their devices. The support of telecom operators will be particularly useful in facilitating the billing of app services to those who do not have formal bank accounts/credit or debit cards.

Opportunity and Impact

The opportunity lies in the large untapped market. A study revealed that in rural India 43 percent of non-users of the internet said they would adopt the medium if it were provided in the local language.[104] In urban India, 13.5 percent of non-users said that local language content would inspire use of the internet.[105] Given that most of this access would be through mobile devices, the potential of apps like Mobile Harvest which operate in the vernacular becomes evident. The impact of such apps could be significant but currently private funding for such projects is conspicuous by its absence-these are driven mainly by NGOs, governmental organisations and development finance agencies which while good for individual efforts are not quite effective in establishing scale.

5.2 AppsDaily[106]

Introduction

AppsDaily is India's home-grown app distribution platform which accounts the unique challenges of the Indian app ecosystem. To circumvent the unfavourable mobile payment regulation and cater to India's digitally lay segment, AppsDaily established physical retail outlets from where apps can be purchased using cash.

[103] This case study is based on a consultation the authors had with the founder of Mobile Harvest Solutions.
[104] IAMAI, Local Language Report, 2013.
[105] Ibid.

The physical payments method has gained toehold in India due to low debit/credit card penetration. Flipkart, a leading e-commerce firm in India introduced cash on delivery for customers not owning credit cards or those who were reluctant to use them. Like AppsDaily, Flipkart has been palpably successful. In addition, AppsDaily with its physical attendant takes 'pressure' out of the process of downloading apps and provides a comfortable alternative to the do-it-yourself model, which is ill-suited to countries where large segments of the population are unfamiliar with digital payments. AppsDaily has gained immense popularity as it addresses and exploits the current gap in the market- low credit card penetration and low digital consciousness. Moreover, by having stores with a physical attendant, AppsDaily has made the process of obtaining apps easier. Such indigenous business model innovation is needed in the Indian app market, which has its unique set of constraints, to increase creation and distribution of localised apps.

Challenges

Due to the envisaged risks, the RBI has taken a cautious approach towards enabling mobile payments. There is a limit on the transaction amount and number of transactions a user can make per day. Due to security concerns, password copying is not allowed and generally, the failure rate of e-transactions is high due to weak network structure and the design of payment gateways. This constrains the revenue generation potential of India's app economy.

Opportunity and Impact

AppsDaily addresses these issues by enabling cash payments for apps. Its model has met with success in India as over 1 million apps have been sold, over 10,000 outlets have been established and its reach extends across 140 cities.[107] AppsDaily can install apps on a variety of devices including Micromax, Samsung, Nokia, HTC etc. It has launched pilot programmes in Australia, Bangladesh and Saudi Arabia.

5.3 eGov AppStore[108]

Introduction

As a part of the government's vision to enhance efficiency, transparency and effectiveness of public services using digital technology, DeitY and NIC launched the eGov AppStore in May 2013. eGov AppStore aims to propel the National e-Governance plan by providing a common platform, where all apps are certified and from where government-to-government services can be distributed across India. The apps are hosted on the National Cloud and are customised such that they can be used by government agencies/departments at the Centre and State level. The government believes that this will help in the deployment of e-governance services across the nation and save different agencies the time and cost associated with developing similar apps from scratch. While the eGov AppStore is in its preliminary stage, where most apps are awaiting productization, DeitY has already released information on which apps have been rated highly as per initial reviews (see table below).[109]

Top Apps on India's e-Governance AppStore

App Name	Purpose	State
Government eProcurement System of NIC	Generic	Delhi
e-Hospital	Health	Tripura
Xtended Licensing and Laboratory Node	Food & Drugs	Gujarat

[106] This case study comes from Kathuria, R. & Srivastav S. (2014) The Indian App Ecosystem. LirneAsia.The Ford Foundation. Retrieved from http://broadbandasia.info/wp-content/uploads/2013/03/The-Indian-App-Ecosystem-Final-Report_afterEF2014.pdf and is based on a consultation the authors had with the CEO of AppsDaily

[107] See Official AppsDaily website: www.onwardmobility.com

[108] Statistics and information obtained from the official website: http://apps.nic.in/about-us

[109] Official website: http://apps.nic.in/about-us

App Name	Purpose	State
eOffice Digital Signing Tool (PDF Files)	Generic	Delhi
Public Distribution System Common Application Platform	Food & Consumer Affairs	Delhi
eMunicipalities Suite for Urban Local Bodies	Urbanisation	Maharashtra
eGranthayala: A Digital Agenda For Library	Library and Informatics Services	Delhi
Cooperative Core Banking Solution	Banking	Delhi
District and Subordinate Courts Software	Legal	Maharashtra

Opportunity and Impact

As table 15 shows, the Government eProcurement System of NIC (GePNIC) is the top rated app. It aims to bring greater transparency and simplicity to the process of government procurement. The app seeks to establish a one stop shop for all services related to government procurement and help both the bidders and organizers of tenders. In the state of Jammu and Kashmir, GePNIC is widely used across major departments under the Mission Mode Project.
This includes the Departments of Policy, Housing and Urban Development and Health and Medical Education.

Second on the list of rated apps, is e-Hospital, an integrated Hospital Management Information System, which has been adopted in Tripura. E-Hospital helps to digitalise hopsital processes such as patient registration and is a store-house of information on patients, past records, diseases, prescriptions etc. For example, e-Hospital provides doctors with statistics on common diseases in the catchment area of the hospital in question.[110] Impact analysis of e-Hospital has shown tht the app has streamlined hopsital processes and increased efficiency manifold (see table below).

Efficiency Gains due to e-Governance Healthcare App

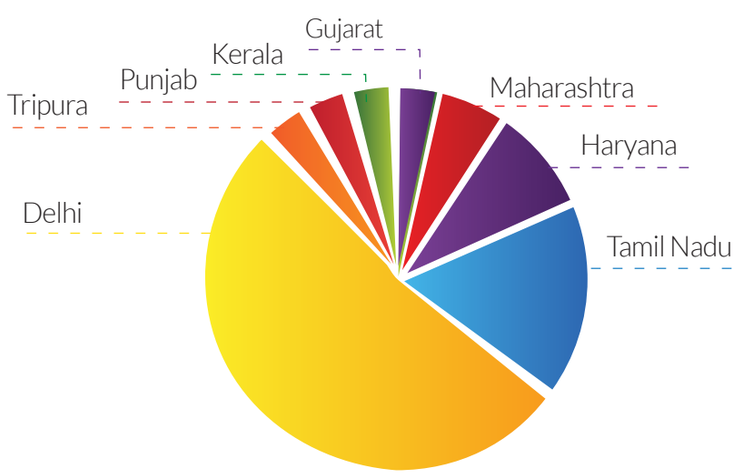
Service/Facilities	In Manual System	Using e-Hospital@NIC
Patient Registration	1 minute 15 seconds per new patient	35 seconds per new patient
Follow-Up Re-Registration with UHID)	15-30 minutes per patient	15 seconds per patient
Billing & Cash Collection	2 - 4 hours per patient	30 seconds
Laboratory Investigation report for OPD patient	1 to 2 days	Same day in most cases
Radiology Investigation Report for OPD Patient	1 to 2 days	Same day in most cases

[110] http://tsu.trp.nic.in/ehospital/benefit.html

Service/Facilities	In Manual System	Using e-Hospital@NIC
Emergency Services such as Ambulance, Blood Bank, OT etc	Unmanaged and available only at specific service delivery counters.	Managed and available at all care points
Dietary Service	Unmanaged diet distribution among patient as per diet scale	Managed diet distribution among patient as per diet scale & linked with inventory system of raw materials
Inventory Service	Unmanaged with wastage of valuable stocks	Reduced waste - no stockpiling or expired products
Blood Bank	Manual- inefficient	Increase in blood utilization
		*Donor's information shared and disseminated helping donor deferral process and avoiding repeat of expensive tests.
		*Centralize Blood inventory information - saves time, cost and makes blood banking productive.
Care Planning by Physicians	Care planning is event based and time consuming	EMR of a patient helps physician in better care planning and monitoring

Data shows that in terms of uptake, Delhi and Tamil Nadu have, thus far, adopted the greatest number of e-governance apps (figure below). Since this initiative is in its initial stages, these figures must be interpreted with caution.

Apps by State-Number of Apps



Source: eGov AppStore Official Website

Once the eGov AppStore gains maturity and scale, it will be augmented to include apps developed not only by the Centre and States but also private players. It will consist of a complete ecosystem replete with funding, charge back, formal contract formation, SLAs etc.

5.4 MakeMyTrip[111]

Introduction

MakeMyTrip has launched two apps named 'MakeMyTrip' which facilitates hotel and transportation bookings and 'Route Planner' which calculates the best method of getting from one Indian city to another. MakeMyTrip views apps as an extended method of service delivery. Its apps are free to download and are primarily centred on delivering information. MakeMyTrip believes that since India is a 'mobile first' economy, mobile apps will enable MakeMyTrip to expand its base of consumers by reaching out to more people. This strategy is reflected in the platforms which MakeMyTrip targets – the MakeMyTrip app can be downloaded on all major platforms (of which Android is most used) and the Route Planner is designed specifically for the low-cost Nokia Asha. The MakeMyTrip app does not have an overt monetization model but is viewed by the company as a long-term investment that will expand the reach of MakeMyTrip services. The flagship app relies on bookings made by consumers

Challenges

MakeMyTrip's development team consists of around 100 employees of which 25 are devoted to mobile phone services. While aspects of the apps are developed in-house, other elements such as, making the app functional across multiple platforms, are outsourced to companies. In MakeMyTrip's experience, it was difficult to access personnel who specialize in interaction design. The process of finding a suitable company to whom parts of the app development process could be outsourced was not easy (a total of 42 companies had to be consulted before reaching a decision). While a paucity of skilled IT professionals in India is unlikely, their accessibility may be limited due to the high price of their services. Companies such as Source bits have experienced IT professionals but charge around 50 lakh rupees for their services. This is out of reach for many parties.

A challenge at the user-end is that the growth of mobile transactions is constrained because of certain mobile payment regulations. Due to the requirement of the One Time Password (OTP) delivered by SMS, users have to exit the MakeMyTrip app, view their OTP and re-enter in order to complete a transaction.

This process is lengthy and increases the rate of failed transactions. A parallel ecosystem constraint is the low penetration of credit and debit cards in India which prohibits a large proportion of users from engaging in online shopping. When asked if MakeMyTrip could consider routing payments through telecom operators, it was found that due to the high price of trips, telecom operators would be wary of facilitating the payment and taking on the associated risk.

Simplification of the mobile payment while maintaining its integrity is a challenge that needs to be addressed while simultaneously improving credit card penetration and financial inclusion, both long term goals in the field of vision of the policy maker.

When asked if language is an issue which may prohibit app adoption, MakeMyTrip highlighted that there are people who, although not formally literate, are English aware. MakeMyTrip has ensured that it can cater to this segment of the population by using a Natural Language Processing program which interprets informal interjections, wrong spellings, and phonetic typing to decipher what English-aware people are trying to convey. However, from a long-term perspective, MakeMyTrip acknowledged that local language content is needed to increase the penetration of mobile apps throughout India.

Parallel ecosystem adjustments, such as increasing wireless broadband penetration, are equally important to ensure that apps can deliver rich content, perform optimally and that users have a positive experience.

Opportunity and Impact

Despite the challenges, the MakeMyTrip app has experienced two million downloads and 20 percent of total hotel bookings are done via mobile devices. It has been found that a large proportion of bookings made via the mobile app are same day/next day bookings reflecting that the app has managed to tap into a new group of last-minute customers who would have previously been unable to make such bookings if it were not for the mobile app.

[111] This case study is taken from 111Kathuria, R. & Srivastav S. (2014) The Indian App Ecosystem. LirneAsia.The Ford Foundation. Retrieved from http://broadbandasia.info/wp-content/uploads/2013/03/The-Indian-App-Ecosystem-Final-Report_afterEF2014.pdf and is based on a consultation the authors had with Make My Trip.

5.5 Micromax[112]

Introduction

Micromax the second largest smartphone company in India and the tenth largest mobile phone manufacturer in the world has disturbed the handset market and challenged incumbents such as Samsung and Nokia, by offering affordable variants. Micromax aims to democratise technology by providing smartphones that are at par with high-end handsets but offered at a fraction of the price. This low margin and high volume strategy has helped Micromax consolidate its presence in most South Asian countries, home to extremely price sensitive consumers.

Challenges

A particular challenge for Micromax is to market itself as an 'aspirational' brand rather than simply an affordable one. Currently, Micromax appeals to low- and middle-income groups but wishes to expand its presence across higher-income segments as well. To this end, Micromax has engaged in a number of first time innovations such as the thirty day battery back-up, dual sim dual standby phones, and universal remote control mobile phones etc. which make it a serious competitor to incumbent OEMs.

Opportunity and Impact

Being an Indian company, Micromax is contributing to the development of the Indian mobile manufacturing ecosystem. While it is well known that Micromax's R&D and design occurs in India, it is less known that 100 percent of Micromax's LEDs and tabs are also manufactured locally. The company has also started making phones in India at a new facility in Rudrapur. Therefore, Micromax represents an innovative Indian OEM which makes mobile devices with many first time innovations at highly competitive prices. Micromax aims to expand its services across the globe to become an international player

5.6 Samsung[113]

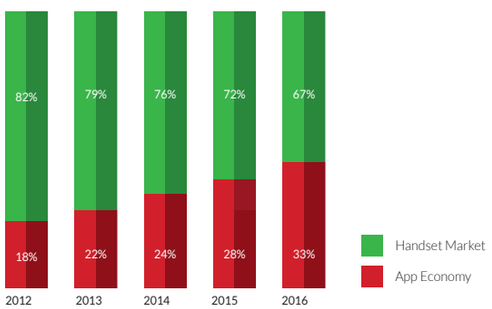
Introduction

Samsung, India's most popular handset vendor illustrates the case of how shifting value distribution is forcing OEMs to reorient their strategies towards content as value migrates from mobile hardware to software. While Samsung enjoys 32 percent market share in terms of value in the Indian mobile market,[114] it is acutely aware of the global trend of the commoditization of smartphones.[115]

Challenges

Fierce competition from start up brands means that smartphones are becoming increasingly homogeneous. This poses a serious challenge for brands like Samsung. Evidence shows that the distribution of value between smartphones and apps is shifting in favour of the latter, albeit from low starting levels. Apps are envisaged to contribute 33 percent by 2016 as shown by figure below.[116] Therefore, a part of Samsung's long-term strategy to diversify into apps and other value added services.

Global Share of Combined App Economy and Handset Revenue[117]



Source: VisionMobile and Portio Research

[112] Information obtained from official website http://www.micromaxinfo.com/ and stakeholder interactions
[114] IDC Data
[115] Pappas A. (2013). App Economy Forecasts 2013-2016, Vision Mobile. Retrieved from http://www.visionmobile.com/product/app-economy-forecasts-2013-2016/
[116] Ibid.

Opportunity and Impact

Samsung's venture in the app space has been helped by its strength in the device segment. Samsung's official app store, Samsung Apps, comes pre-installed on every Samsung device. To ensure that its app store is competitive against the app stores of competitors Google and Apple, Samsung has partnered with Vodafone India and Aircel to enable carrier billing for purchases made on its app store. In India, where mobile payments are cumbersome and credit/debit card penetration meagre, this move will be act to galvanise purchase of apps. It will also differentiate Samsung's app store from Google Play and Apple's App Store which currently do not host this feature.

importance of the Indian market to Samsung's strategy. Further initiatives such as Club Samsung, an entertainment store selling Indian music, movies, songs etc., attest to the fact that Samsung sees good prospects in the Indian smartphone market for content and apps. It is interesting to note that Samsung is bundling hardware and content as a means to keep its hardware competitive. For example, users of the smartphone, Grand 2, get discounts for Club Samsung.

5.7 Vodafone India[118]

Introduction

Vodafone India, one of India's largest telecom operators is engaging with the new reality of increased data consumption and app usage. With its 52 million data customers, Vodafone India is poised to become the Group's top contributors in the next few years. Accelerated data performance is one of the top reasons for its 13 percent year-on-year growth reported in early 2014.

Challenges

Chat and voice over internet protocol (VoIP) apps such as WhatsApp and Skype have the potential to eat into operator revenue by diverting customers away from SMS and calling. On the other hand, they can also increase revenue by augmenting data consumption. With the shift towards chat and VoIP apps appearing inevitable, several telecom operators have recognised the need to ride the wave and capitalise on the opportunity presented by the app economy rather than pushback. Moreover with average revenue per user (ARPU) reaching a plateau, data presents potential to bolster revenue. To be sure, operator revenue from data services has remained constant at ten percent for the last decade.[119] This represents an untapped segment of the market which can be exploited to the advantage of telecom operators with the help of useful and easily accessible apps.

Opportunity and Impact

Vodafone India, itself a beneficiary of increased data consumption, has decided to ride the app economy wave by launching its own app store, VStore. VStore is internationally competitive as it offers app developers 70 percent of the total revenue generated by the app. This is an important development in the Indian app market as hitherto, telecom operators offered as little as 30 percent to the developer. This was at odds with the international revenue sharing norm of 70-30 (where 70 percent went to the developer) and made Indian app distribution platforms uncompetitive. VStore seems to be amongst the first telecom-operator managed app distribution platforms that, thanks to international competition, has corrected for this earlier failing.

VStore currently hosts 10,000 apps and games of which some are free and others are priced between Rs. 5 – 150. The store's most salient feature is that it has the option of carrier billing where app purchases are either deducted from the prepaid balance or charged to the postpaid bill. This feature is likely to gain traction in the Indian market as credit/debit card penetration is only 21 percent.[120] As mentioned earlier Vodafone India has also extended its carrier billing services to other app distribution platforms such as Samsung Apps. These arrangements show Vodafone India's growing interest in the app economy. With 125 percent year-on-year increase in data traffic, it is in Vodafone India's strategic interest to promote apps that will be an important feature of India's second data-centric telecom revolution.

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[117] Ibid.

[118] Statistics and information collected from the official website: https://www.vodafone.in/pages/index.aspx

[119] TRAI Data

[120] RBI Data, 2011

5.8 Firefox OS

Introduction

Firefox OS - Mozilla has entered the mobile space by launching the Firefox OS for smartphones. Mozilla's strategic interest lies in emerging markets where there are many first-time smartphone users. It is believed that there is potential for the Firefox OS to gain market share since only one in four individuals around the world has a smartphone. While the upper segments of the market are saturated by sophisticated smartphones, there is potential at the bottom of the pyramid. This is why Mozilla will launch a 25 USD (1500 INR) smartphone, running the Firefox OS in India and Indonesia.

Low price points have the potential to trigger mass adoption. By bundling the Firefox OS with affordable handsets, Mozilla has the capability to break into price sensitive markets such as India. Mozilla has partnered with Intex and Spice to ensure that the smartphone attains scale. The company is also using chips made by the Chinese manufacturer, Spreadtrum. Given that the Firefox OS smartphone would be competitively priced one expects it to expose the world of apps to more people in India.

The Firefox OS is different from other platforms in the sense that it is purely web-based. Apps are not native to the device. This helps the Firefox OS have adaptive search and real-time content display (which makes downloads a thing of the past). It also means that the OS and its apps can adapt fairly easily to any device, regardless of screen size or other hardware specifications. However, the challenge with a web-based OS is that connectivity to the internet is crucial. Unlike other platforms, the Firefox OS loses much of its capabilities if the smartphone is 'offline.' This could be problematic in countries with weak network infrastructure.

Challenges

Nevertheless, if the requisite network coverage and capability are in place, the Firefox OS and its ultra-cheap handset could have a transformative impact. The Firefox Marketplace (Mozilla's app store), is actively seeking to develop engaging content to further incentivize users to buy its device. Attracting developers to make apps for a new OS is hard when large incumbents such as Google and Apple have app stores that enjoy massive scale and a high installed base. However, through partnerships with local companies in developing markets, Mozilla seems to be catching the attention of those who see enormous potential in the low-end segment. Like other app stores, the Firefox Marketplace abides by global revenue sharing norms and gives 70 percent of all app purchases and in-app purchases to developers.

Opportunity and Impact

For India, the introduction of the Firefox OS smartphone could help spread app usage at the lower end of the distribution. As stated above, connectivity to the internet is essential for the OS to function normally. If the Mozilla smartphone is successful, one could expect large groups of new smartphone users in the market, creating new demand and increasing impacts.

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